Strategies for Increased Efficiency: Altering Pre-Existing Percussion Notation to Meet Personal Performance and Practice Needs

By

Joseph R. Murfin

A doctoral project submitted in partial fulfillment of

the requirements for the degree of

Doctorate of Musical Arts

(Percussion Performance)

at the

UNIVERSITY OF WISCONSIN-MADISON

2015

Date of final oral examination: 5/8/15

The doctoral project is approved by the following members of the Final Oral Committee:

Anthony Di Sanza, Professor, Percussion
Mark Hetzler, Associate Professor, Trombone
Ronald Radano, Professor, Musicology and Ethnomusicology
Jessica Johnson, Professor, Piano and Piano Pedagogy
Todd Welbourne, Professor Emeritus, Piano

ABSTRACT

This paper analyzes the link between music notational practices and learner efficiency with regard to modern percussion repertoire. In particular, it explores how physically altering pre-existing percussion notation can make music easier to read, learn, or memorize. Alteration methods discussed include the color-coding of note heads, the compression of dense musical information into compact diagrams, and the creation of road maps, which aid in the process of memorization of complex solo or chamber works. The goal of the alteration techniques is to reduce the amount of mental strain that the performer must exert in order to learn or perform music from a written manuscript, thus increasing productivity in the learning process and proficiency in performance situations.

In order to assess the effectiveness of one of the notation alteration techniques (color-coding) on multiple-percussion notation, eight undergraduate students were asked to learn two multiple-percussion etudes. The notation in one etude was color-coded by instrument, while the notation in the other etude was uncolored. A survey of the students indicated that the color-coded notation had a positive effect on the musical learning process. In particular, color-coding improved the students' ability to sight-read, reduced the amount of mistakes made while practicing, and made the music easier to learn overall when compared to the uncolored multiple-percussion notation. These findings suggest that modifications to pre-existing percussion notation have the potential to lead to improvements in learner efficiency and therefore may increase productivity in general musical learning and performance processes.

ACKNOWLEDGEMENTS

I would like to thank everyone who supported me in the completion of my degree and the completion of this project. Thank you to Zen-On Music Company, Ltd.,A-R Editions, Inc., Universal Edition (London) Ltd., C.F. Peters Corporation, Colla Voce Music, LLC., and Boosey and Hawkes. Thank you to my primary advisor, Anthony Di Sanza, for being a terrific mentor and an outstanding teacher to me throughout my graduate school career. Your impact on my musical career is immeasurable. Thank you to the University of Wisconsin-Madison Mathematics Department for funding the entirety of my doctoral degree. Thank you to John Stevenson for his help with editing the survey used in the project. And of course, thank you to my wonderful wife Kristen, who has loved and supported me throughout this entire process. I could not have done this without you beside me.

TABLE OF CONTENTS

INTRODUCTION

When presented with new repertoire, modern percussionists are faced with a unique set of challenges that can often encumber the musical learning process. Such issues include inconsistent notation systems throughout the standard repertoire, physical difficulties involved with navigating large instrument setups, and the necessity to learn and adapt to a wide variety of instruments and playing techniques. All of these factors can contribute significantly to the amount of time that it takes for percussionists to learn new music. While there have been some studies that focus on ways to improve efficiency in the percussion learning process, much of the literature on this topic is very composer-centric. That is, the writings focus on ways in which composers can effectively notate their music so that it is more intuitive for the percussionist, thus enhancing practice productivity and improving performer preparedness. Though it is certainly helpful for percussionists when composers take steps to create efficient and logical notation systems, there is another question that has not been formally addressed: Is there a way in which percussionists themselves can make alterations to pre-existing notation in a manner that will further decrease learning time and increase proficiency in performance?

This paper will address that exact question. In particular, it will explore how physically altering or rewriting pre-existing percussion notation can expedite learning and memorization processes and help improve note precision in performance situations. It will include in-depth analyses of several techniques and notation schemes that I have discovered or developed in an attempt to alleviate many of the problems associated with reading, learning, and memorizing percussion music. These problems include the absence of a standardized multiple-percussion notation system, difficulties involved with memorization of complicated solo and chamber repertoire, struggles reading densely-notated or heavily-polyrhythmic music, and general issues that arise when dealing with non-intuitive notation schemes.

The goal of the paper is not necessarily to dictate processes that one *must* follow in order to achieve greater efficiency in the practice room and greater confidence on the performance stage. Nor is it the goal of this document to demean or berate particular notation practices. It is instead my hope that more percussionists will become aware of ways to increase efficiency in the music learning process and that a greater conversation concerning percussion notational practices and alteration techniques will take place in the music community.

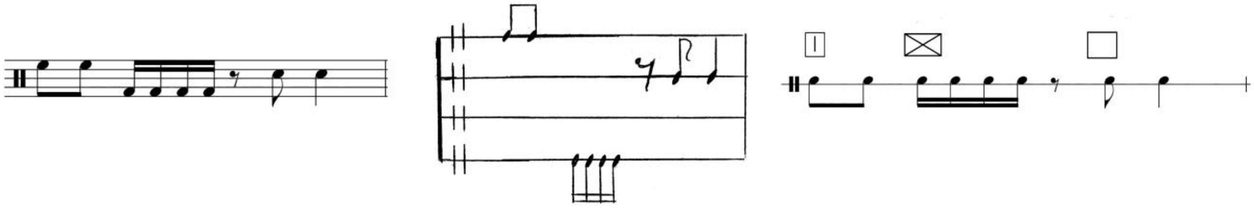
This paper will discuss several topics relevant to the issue of percussion notation alteration techniques. It is outlined in the following manner: Chapter 1 addresses some general issues unique to percussion notation and explains how certain notational practices can cause problems in the process of learning and performance. The second chapter presents an overview of literature that discusses the link between learning processes and music notational practices. Chapter 3 explores significant innovations to percussion notation by four major composers, while Chapter 4 discusses historical attempts to facilitate the process of learning percussion repertoire via specific notational practices. The fifth chapter provides a brief overview of cognitive load theory and discusses how the theory relates to musical learning. Chapter 6 introduces practical techniques that can be used to alter pre-existing percussion notation in a way that will increase learning efficiency and performer confidence. The paper closes with a survey that analyzes the effects of using a particular notation alteration technique (color-coding) on the abilities of university percussion students to quickly learn new multiple-percussion works.

CHAPTER 1

GENERAL NOTATION-RELATED PERCUSSION ISSUES

In general, the music learning process is affected by a wide variety of factors. For percussionists, many of these factors are related to notational issues found throughout the modern repertoire. In particular, specific notational techniques found in manuscripts, as well as organizational layouts of scores, can have a profound effect on percussionists' ability to both learn music quickly and perform proficiently.

One of the most prominent difficulties in this area stems from the lack of a universal percussion notation system, an issue that is most apparent in scoring for multiple-percussion works. Because individual multiple-percussion pieces require distinct instrument configurations, the physical orderings of instruments on the staff are unique from piece to piece. Therefore, each time a performer studies a new multiple-percussion work, he or she must learn how to read a new staff. Depending on the number of instruments in the setup, this can take large amounts of time and mental processing power. Furthermore, there are a variety of staff systems that composers might use to organize multiple-percussion works. For example, a composer might write all of the instruments on a standard five-line staff, a multiple-system line score, or a single line that indicates instrument changes via a pictogram system.

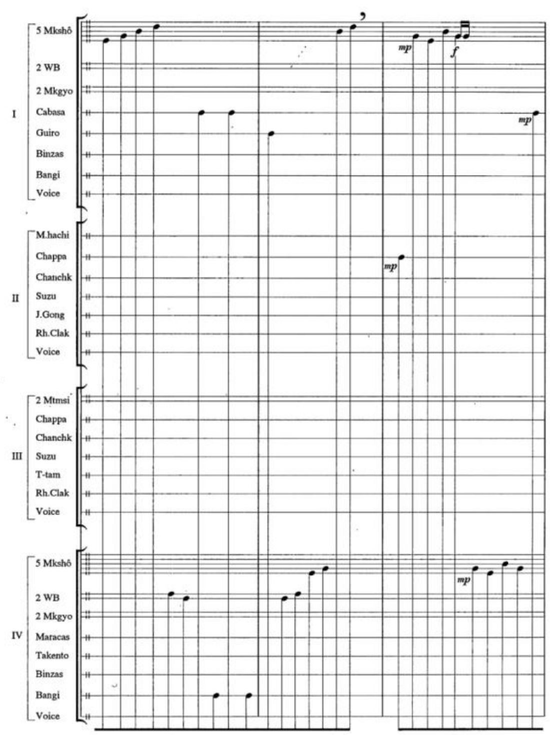


(a) (b) (c)

Example 1.1 The same musical example depicted on a five-line staff (a), multiple line score (b), and a single line with pictograms (c)

Though these are three very common notation methods, they are by no means exhaustive, as there are many works that utilize systems that are distinct from these.

Another issue that can cause potential problems in percussion repertoire is the use of overly-complicated notation practices, which can make relatively simple passages incredibly difficult to read and learn. Consider the following excerpt from Shin-Ichiro Ikebe's *On the other side of Rain* (1995) for percussion quartet.



Example 1.2 Shin-Ichiro Ikebe, *ON THE OTHER SIDE OF RAIN* page 11

Not only is each instrument written on a separate staff, but the musical line is beamed across the entire score, making each player's part nearly impossible to sight-read (the piece is not published with individual parts). In this situation, each player must either create his or her own individual part, memorize the passage, or spend a significant amount of time and energy studying and learning how to read the score. Therefore, the learning process is hampered not necessarily by the difficulty of the music, but by the complexity of the notation.

To be clear, the purpose of this paper is not to demean the practice of using a variety of notational techniques when writing unique percussion works. On the contrary, complete standardization of percussion notation would surely stifle the creativity of composers in both their musical decisions and instrument choices. In fact, the ability of percussionists to adapt to new notational situations is one of the catalysts that has led to a vibrant and diverse canon of percussion repertoire. However, it is important to note that each time a composer introduces a new or unique staff system, part of the mental processing power that the performer will use to learn the music will be devoted to learning the new notation scheme. In addition, if the system is particularly complicated, then sight-reading ability can be severely stifled.

Another major challenge for performers of multiple-percussion music in particular is the relationship between the physical organization of instruments in a percussion setup and the instruments' spatial representation on the staff. For example, it is very intuitive to order instruments on a staff so that higher lines and spaces correspond to higher pitched instruments in the setup. However, it is possible that by using such a system, the visual hierarchy of the staff will not correspond in an intuitive manner to the most optimal instrument layout. On keyboard instruments such as the marimba and the xylophone, moving from the bottom to the top of the staff corresponds to moving from left to right on the keyboard, respectively. However, in a setup consisting of multiple-percussion instruments, it is quite possible for such a configuration (lower pitched instruments on the left, higher pitched instruments on the right) to be physically impractical in regard to the passages that must be executed.

When notation systems do not relate idiomatically to their corresponding instrument setups, there can be a disconnect between the brain's visual processing of a note head on the staff and the body's physical reaction of where in space the hands should move to strike the note. Thus, the reaction time between when the note is seen and when it is struck is lengthened, decreasing the "efficiency" of the notation system (O'Neill, 1980, p. 25). John C. O'Neill articulates this idea in his article "Recent Trends in Percussion Notation" (1980):

> If the efficiency of a notation is regarded as proportional to the speed at which it can be learned (and thus implemented), then efficiency is dependent on the reaction-time created by that notation. An improvement in notation is then measurable in terms of reaction-time. Reaction-time is the delay between the occurrence of a stimulus and its response…the more direct the relationship between the visual stimulus and the desired response, the shorter the reaction-time will be. (O'Neill, 1980, p. 25)

Michael Udow also discusses this topic at length in his article "Visual Correspondence between Notation Systems and Instrument Configurations" (1981). Not only does Udow address the relationships between notation systems and their corresponding instrument setups, but he uses the discussion to introduce and advocate for the innovative timbre-staff notation.[1]

[1] Timbre-staff notation is discussed at length in Chapter 2

Learning or performing music on large instruments or within large instrument setups also creates difficulties in terms of reading notation. For example, with the length of the modern five octave marimba being over five feet, it is often difficult to place music in a particular location so that it can be seen from every playing position. A similar issue is common in works for which performers have setups that consist of various instrument “stations.” For example, in a single piece, a percussionist might play a vibraphone passage, then quickly dart two or three feet to play a setup consisting of five tom-toms before having to then move to a third station in order to play two timpani. In situations such as these, it is necessary to have music set up in several locations, as it can be physically impossible to place all of the instruments within eyesight of a single music stand.

Consider the picture below of the setup for *Threads* (2005), a percussion quartet by Paul Lansky. Within each multiple-percussion setup, each performer must play at a variety of stations (often switching incredibly quickly), meaning that the music must be distributed strategically among several music stands in different locations. If a manuscript is not constructed in a way where this is feasibly possible, then it is not uncommon for percussionists to physically cut up the score and paste sections of it on poster boards in various locations around the setup, a procedure that can require quite a bit of experimentation and take time away from the actual process of learning the piece.

Example 1.3 Percussion setup for *Threads*, by Paul Lansky
Performers: Clocks in Motion

For modern percussionists, many of the issues laid out in this chapter are unavoidable. The percussion world continues to see an expansion in both innovative music and thus innovative notation systems and score layouts. It is therefore beneficial for percussionists to find ways to increase their ability to quickly process information that is presented via manuscript so that the learning process can be as efficient as possible. In Chapter 6 of this paper, I discuss individual techniques that I have used and/or developed that, when applied to existing scores, can reduce mental strain on the performer and therefore increase learning efficiency, thus facilitating the transition from the practice room to the concert hall.

CHAPTER 2

REVIEW OF LITERATURE RELATING MUSIC NOTATIONAL PRACTICES TO LEARNER EFFICIENCY

Though there are many variables that can affect the learning processes associated with modern music repertoire, the focus of this paper is to discuss specifically the relationship between notational practices and their effects on learning and performance efficiency. Though such research in the specific area of percussion is still quite sparse, there exists a larger body of literature that addresses this topic in other musical settings. This chapter represents an overview of the literature that relates the areas of music notational practices and the processing of musical information.

In several publications, the process of transforming written notation into complex musical ideas (and vice-versa) is discussed as a coding procedure. For the composer, the goal is to encode abstract musical information through the use of modern notation practices. For the performer, the goal is to take the written notation and encode it in his or her mind in a way that will allow for the proper execution of intended musical concepts.

In his book *Mind Models* (2005), Reynolds discusses how effective notation can allow a musician to mentally encode pertinent musical information for efficient use in practice or performance. Particularly, Reynolds recognizes that only a limited amount of musical information can be expressed using modern notation systems and suggests that when possible, performance notation "should be no more than a reference" to the information that the composer is trying to transmit to the musician (Reynolds, 2005, p. 134). Likewise, Reynolds recognizes that due to limitations on mental “channel capacity,” only a limited quantity of written information can be encoded and stored by the brain at any given time, meaning that effective, economical notation must be “compact and accurate” (Reynolds, 2005, p. 139,140).

Similarly, Fletcher (1957) explores the differences that occur when music is encoded in singers’ minds versus when it is encoded onto a written document. Fletcher notes that a musician, upon hearing a melody, can encode the tune internally, and (despite the absence of absolute pitch) can reproduce the tune at a later time so that it is still recognizable to another listener. However, for the tune to be encoded into written notation, a sung interval, described as the “phoneme,” must be recoded as a written interval, called the “grapheme” (Fletcher, 1957, p. 81). Fletcher argues that intervals, though easily distinguished when sung, become ambiguous and unnecessarily complicated when encoded into our written notation system. For example, two tones placed on adjacent lines may be interpreted as either a major or minor third (Fletcher, 1957). However, the interval remains ambiguous until the singer can reference the tonic or the key, both pieces of information that are outside of the “staff-code” (Fletcher, 1957, p. 82). Fletcher states that the way we deal with such ambiguities is by introducing more codes into the system, such as tone letter names, sharps, flats, and numeral systems, all in an effort to allow the singer to understand a written code that is intuitively understood when sung:

> They fail nevertheless in large numbers to find in all this an evident and readable encodification of the musical patterns the audial reality of which they may all the time be vividly aware. (Fletcher, 1957, p. 84)

Fletcher suggests that we should explore pedagogical methods that would make the transition from singing to reading written notation more intuitive. Specifically, he explores how curriculum that is used to teach children to read text in English can be applied to teaching singers written music notation.

In addition to the issue of encoding musical language, several publications have explored the interpretation of musical notation in terms of its cognitive load. Specifically, these publications approach music notation and instruction from the point of view of cognitive load theory, a psychological theory developed by John Sweller that studies the process of individual learning by investigating the limitations of human cognition (Owens, 2005). The goal of cognitive load theory is to create effective learning curricula by identifying factors that attribute to mental strain, known as *cognitive load*, in the mind of the learner (Owens, 2005). Excessive cognitive load can hinder the ability of the working memory (also known as short-term memory) and therefore make it difficult to learn new skills or concepts (Kerr, 2014). Though short-term memory is limited in its capacity to hold information, long-term memory is very efficient at holding large amounts of data that can be readily accessed (Owens, 2005). These pieces of information, which Keller refers to as *schemas*, are theorized to constitute the makeup of one's knowledge, and the distinction between an individual being an expert or a novice in a particular field is precisely the difference in the quantity of schemas that he or she has acquired in his or her long-term memory (Owens, 2005).

Owens (2005) is considered to be the first to apply the concepts of cognitive load theory to music (Kerr, 2014). Among the findings of his experiments were that written music instruction was more effective when delivered in a "spatially-integrated" manner (Owens & Sweller, 2007, p. 41). That is, students performed better when instructional prompts were physically located near musical examples for which the students were answering questions. An abbreviated version of this study was published by Owens and Sweller in 2007.

Kerr's (2014) research consists of interviews with seven "proficient" musicians who had difficulties learning the traditional western music notation system. Throughout the paper, Kerr discusses ideas related to cognitive load theory and reviews the previous findings of Owens and Sweller. Kerr further suggests that cognitive load can be reduced by using alternate notation systems. The paper discusses the possible use of solfege, shape notes, the Nashville Number System[2], and base-12 tonal numbering systems.

Though not presented as a paper on cognitive load theory, Wolf (1976) explored the act of sight-reading as a cognitive issue. Wolf suggests that the act of sight-reading should be viewed as a cognitive model that addresses the psychological mechanisms that allow a musician to receive, store, and process information from a musical manuscript. Furthermore, Wolf suggests that differences in individual skills in information-processing and pattern recognition account for the differences in skilled and unskilled sight-readers (Wolf, 1976). In the study, Wolf references the earlier experiments of Kenneth Bean (1938), who also studied music reading as a function of pattern recognition (Wolf, 1976). In particular, Bean set out to determine the amount of complexity that a musician can perceive within "one fixation of the eyes" (Bean, 1938, p. 10).

Kerr (2014) interestingly points out that Velizar Godjevatz addressed many of the issues associated with cognitive load theory well before the official theory was founded (Kerr, 2014). In *The New Musical Notation: Without Clefs, without sharps, without flats, without naturals* (1948),

[2] The Nashville Number System uses a combination of numbers and symbols to represent chords relative to a tonic note or key. For example in the key of C, the numbers 1, 4, and 6m would represent the chords C-major, F-major, and A-minor, respectively.

Godjevatz suggests that many of the difficulties associated with reading music arise from unnecessary complications in the Western notation system. Godjevatz argues that the interval naming system, which he finds antiquated, makes even simple arithmetic illogical. For example, simple intervallic addition, such as a major second plus a major second leading to a major third, suggests that in terms of musical arithmetic, 2 + 2 = 3 (Godjevatz, 1948). Also troubling to Godjevatz is the ambiguity in the physical distance of tones on the staff in relationship to their “tonal distance.” For example, the vertical distances of major and minor sixths on the staff are the same. Therefore, it is impossible to know what specific interval is being represented without knowing another piece of information, namely the tonic or key (Godjevatz, 1948). Godjevatz states:

> Another illogical stock-in-trade a musician has to deal with, is the inexact graphical representation of intervals on the stave. The graphical distances do not correspond to the intervals, hence the need for using clefs, in order to determine the position of the so-called diatonic half-tones (semitones). Our intuition is constantly challenged by the inexact graphical representation, and the number of unnecessary mental operations in order to determine the exact position of a tone is so great, that it takes years for even intelligent persons to master this kind of cryptography (Godjevatz, 1948).

Godjevatz argues that a base-twelve numbering system for the twelve chromatic tones, combined with a seven line staff, would make the system much more intuitive and would negate the necessity for clefs, sharps, flats, and naturals (Kerr, 2014).

Godjevatz’ proposal for a new notation system is by no means novel. In fact, Gardner Read collected and analyzed three hundred ninety-one other proposed changes to the Western music notation system in the *Source Book of Proposed Notation Reforms* (1987). Such proposed reforms include new staff systems, new varieties of note heads, and new types of clefs, as well as completely new systems of musical organization. Though many of the notation schemes in the collection were developed by non-musicians (for example, some of the practices were developed by acousticians or scientists studying pulses) and are not aimed toward practicing musicians, it is interesting to note that a few systems attempt (like Godjevatz) to address the issue of extraneous cognitive load (Stone, 1987). For example, Cornellis Pot's invention of *Klarvarskribo* was an attempt to create a keyboard notation that was more intuitive than the traditional staff system. In the *Klarvasrskribo* system, pitches are read left to right (in a manner that mimics the layout of keys on a piano) while temporal events occur vertically. The staff system makes flats, sharps, and clefs unnecessary in any tonality (Read, 1987). Also, the exact temporal appearance of notes within their respective measures serves as an attempt to make rhythms more intuitive than traditional symbols, whose durations must be memorized (Read, 1987).

Pot was not the only person to recommend that reforms to rhythmic notation could make reading more intuitive for musicians. In fact, Osborn (1966) suggests that when rhythms are not proportionally spaced throughout a measure, it can place unnecessary mental strain on the learner. Osborn proposes that notation should be spatially representational and recommends that notes should be placed in their exact temporal position within the staff in order to maximize the efficiency of the learning process. Osborn also advocates for a system of metric notation (i.e. representing duration with lengths of bars instead of traditional note beaming). The paper suggests that such an intuitive scheme would increase the efficiency of the learning process in young learners (Osborn, 1966).

Mortenson (1970) studied the effectiveness of such a system on high school band students and found that training with metric-representational notation showed an overall increase in students' rhythmic skills. Furthermore, the study showed that seventy-five percent of the students "liked" or "strongly liked" the training that incorporated the metric-representational notation (Mortenson, 1970).

Many studies on the effects of music notation systems have involved simplifying the traditional staff system. For example, Rivera-Diaz (1992) introduced a new system of notation to beginning Puerto Rican band students by removing the five-line staff and replacing individual note heads with numbers one through eight, each number corresponding to the note's scale degree in the key. Exercises were taken from a pre-existing beginning band book and transcribed into the new notation scheme (Rivera-Diaz, 1992). Though there was no evidence of the superiority of this system to that of the original notation, Rivera-Diaz did conclude that the method worked as a possible approach for teaching students who lacked experience with music due to inadequate or non-existent general music education programs (Rivera-Diaz, 1992).

Bukspan (1979) conducted a similar study with beginning music students by converting traditional music notation into a symbolic notation scheme, which made use of numbers and symbols to represent tone and rhythm, respectively. Each pitch was assigned a binary number (e.g. 001 was assigned to A#, while 000 was assigned to B), while duration was assigned a symbol (e.g. " = " represented a half note, while " — " represented a quarter note) (Bukspan, 1979). When combined, each number-symbol combination would inform the student of both the pitch and duration of the note without the need for a staff (Bukspan, 1979). Bukspan converted traditional written notation into this binary system and tested its effectiveness on learning efficiency with beginning music students. He concluded that the binary system was adapted by the beginners at a much faster rate than the standard notation. However, due to the small sample size of the study, it was recommended that further research be performed (Bukspan, 1979).

In a similar study, Walker (1981) found success in prepping young music learners with cross-modal symbols before introducing them to standard notation. The study consisted of two phases. In the first phase, students were taught musical concepts away from the staff and traditional notation system. The control group was introduced to pitch using solfege and rhythm using French time names (e.g "ta ta ta-aa"), while the experimental group was introduced to pitch and rhythm via cross-modal matching symbols. Both groups were then introduced to traditional staff notation. Walker concluded that the experimental group performed better when switched to traditional notation than the control group and that the experimental group had developed a better understanding of musical concepts.

Though there seems to be some general agreement that the addition of color stimuli can be beneficial in general learning processes, there has been little research published that addresses how the addition of colors affects musical learning specifically. Within the studies that do exist, the majority focus on younger children and the learning processes associated with early stages of learning music notation.

George L. Rogers conducted two studies in the 1990s exploring the effects of color-coding on the musical learning processes of young children. In his first study in 1991, Rogers tested ninety-two fifth and sixth grade beginning band students by highlighting the note heads on the students' music with specific colors. In Rogers' system, each pitch from the western chromatic scale was highlighted with a particular color. Ultimately, the study showed that the color-coding did not give an advantage to students overall in regard to memorization, sight-reading, or note name recognition when compared to the control group. However, Rogers found that sixty-five percent of the students stated that they found color-coded notation to be easier to play (Rogers, 1991). In addition, Rogers suggested that the color-coding process was beneficial to students who were considered learning-disabled or mentally handicapped (Rogers, 1996).

In 1996, Rogers published a second study in which he tested the effect of color-coding on the ability of first and second grade students to read and clap rhythms. The experimental group read rhythms in which each note duration was coded with a specific color. For example, in one lesson, all of the quarter notes might be written in red, while all of the half notes might be written in blue. The aim of the study was not to have the students associate each note duration with a specific color. In fact, the color schemes were changed from week to week. Instead, color-coding served as a way for students to easily distinguish between different note durations while reading the rhythms (Rogers, 1996). In this study, Rogers claims that the color-coding had a statistically positive effect on the students' abilities to clap and vocalize the written rhythms. In fact, both the experimental and control groups saw increased abilities to clap and vocalize the rhythms when presented with rhythmic notation that was color-coded (Rogers, 1996). As with the previous study, students also tended to prefer reading the notation that was color-coded versus the notation that was monochrome (Rogers, 1996).

In a similar study, Banister (1994) observed the effects of using colored highlighting on key signatures, dynamics, and style markings in middle school band music. The study showed that highlighting these markings led to a positive effect on the band's musicality compared to when the markings were not highlighted. In addition, Banister found that seventy-two percent of the students preferred playing from the highlighted parts (Banister, 1994).

Falter (2011) showed that using colors could help middle school students visualize and understand rhythms through the use of rhythm worksheets. His system consisted of creating a grid of squares and writing the notated rhythms above the grid. In the system, each square stood for one “macro beat” (Falter, 2011, p. 29). Students then subdivided the macro beat into proportions associated with the notated rhythms and used colors to differentiate spatially where the subdivisions occurred (Falter, 2011). This allowed the students to create a visual representation of each note duration in relationship to other notes in the rhythm (Falter, 2011). Falter then led students through a series of rhythmic counting exercises using the rhythm grids as a visual reference.

McVay (2005) found that the use of color-coding could also aid in the process of learning piano in elderly adults. In the study, McVay color-coded the pitches of beginning piano manuscripts and then used the same color scheme to create physical color cues on the piano keyboard. The color cues were presented in two formats: a large piece of cardboard that sat behind the keys of the piano (which lined up each physical piano key with its note name and its corresponding color) and colored stickers that were placed directly on the piano keys. The study also included two other groups: one that received instruction with color-coded notation but without physical keyboard color cues and a control group (McVay, 2005). McVay concluded that color-coded notation and color-coded keyboards had a positive effective on older adults’ ability to learn keyboard skills, music theory rudiments, and aural skills.

Chuang and Kuo (2013) developed a music notation system that used color-coding as a way of completely eliminating the five-line music staff when using monophonic musical lines. In the system, each of the twelve chromatic pitches is assigned a particular color as well as one of two shapes. Pitches corresponding to the white keys on a piano are assigned a circular shape, whereas pitches corresponding to black keys are assigned a triangular shape. Dots above or below a color/shape indicate that the pitch is a specified number of octaves above or below (respectively) the middle range. The intensity of each note is indicated by the size of the shape, whereas duration is determined by the subdivision of a square lattice. These characteristics, along with a few other symbols for sustain, rests, and repeats, allowed the author to create a notation system that is void of accidentals, clefs, staffs, and key signatures (Chuang & Kuo, 2013). Though the effectiveness of the new notation system was not empirically studied in this paper, Chuang and Kuo suggest that further research should be done to address the effectiveness of such a system, the ability to expand the system to include polyphonic structures and information about other musical elements, as well as ways in which this system can be connected to more traditional staff notation structures (Chuang & Kuo, 2013).

Studies in the effects of shape notes on learning have led to mixed results. O’Brein (1969) determined that the introduction of shape notes on intermediate level elementary school students had no effect on their sight-singing ability compared to a control group, which used traditional round notes. However, Kyme (1960) had much success with shape notes in an experiment performed with fourth and fifth grade music students. Kyme found that shape notes increased students’ ability to sight-sing compared to the control. In fact, an increase in ability was also seen in those students who already had experience playing an instrument (Kyme, 1960). Interestingly, Kyme states that the students in the experimental group were also the only students in the study to "develop skill in notating their own created melodies," and it is suggested in the study that music educators should reappraise the use of shape notes when teaching sight-singing (Kyme, 1960, p. 8).

There is very little literature that relates notational practices and learner efficiency specifically to percussion. However, a recent study by Kamstra (2006) measured the effects of various notation systems on percussionists' ability to sight-read on multiple-percussion setups. The research studied the effects of the five-line staff, the composite staff system, and the timbre-staff notation system on students' sight-reading abilities and found that varying notational systems led to varying degrees of sight-reading ability, particularly on large setups (Kamstra, 2006). Kamstra suggests that future research could lead to more effective multiple-percussion notation systems.

Parts of Kamstra's paper focus on timbre-staff notation, which was proposed by Michael Udow in his article "Visual Correspondence between Notation Systems and Instrument Configurations" (1981). Udow discusses how notational systems that correspond idiomatically to multiple-percussion instrument configurations can create more intuitive musical learning processes. He therefore makes an argument for the use of timbre-staff notation, which uses the already familiar layout of the keyboard to create a staff system that relates percussion instruments' positions in space to the lines and spaces of the treble clef.[3]

Applebaum (1978) took an innovative approach to improving the multiple-percussion learning process for a few select contemporary percussion works by constructing twelve etudes that contain notational structures and performance issues that are similar to the works

[3] The timbre-staff notation system is discussed in detail in Chapter 4

themselves. The twelve etudes attempt to solve interpretation and performance problems found in Feldman's *The King of Denmark* (1964), Berio's *Cirlces* (1960), Haubenstock-Ramati's *Liasons* (1958), Maderna's *Quadrivium* (1969), and Stockhausen's *Zyklus* (1959) (Applebaum, 1978). Applebaum constructed the short etudes in a manner that introduces the performer to the notational systems used in the larger works. For example, one of the etudes is a miniature version of *The King of Denmark* and consists of a grid and symbols that are very similar to those used by Feldman in the actual piece (Applebaum, 1978). Applebaum's hope is that by working on the etudes, one will more easily be able to accurately and easily interpret the notation in the larger works.

One of the most commonly-referenced papers on percussion notation systems and their effect on learning abilities is John C. O'Neill's "Recent Trends in Percussion Notation" (1980). O'Neill discusses how different notation systems can affect the way in which percussionists process written musical information and transform it into musical sound. The paper references the performer's information intake abilities in terms of "channel capacity," meaning that only a limited amount of written information can be observed, processed, and interpreted simultaneously in any given moment (O'Neill, 1980, p. 30). O'Neill claims that when the brain must process an over-abundance of information, reaction time (that is, the amount of time between the interpretation of the visual stimulus [notation] and the act of sounding a note) is slowed. He therefore defines "efficiency" in notation based on the performer's reaction time, indicating that a shorter reaction time corresponds to a more efficient notation system, while longer reaction times indicate a less efficient notation system.

The amount of literature that focuses on notation systems and their relationships to musical learning is growing. However, for such an important topic, the amount of research done in this area is still relatively limited. It is my hope that musicians, musicologists, and psychologists continue to pursue, research, and discuss this issue so that the musical learning process can be further understood, leading to an increase in the effectiveness of musical training and the efficiency of personal learning. Furthermore, specific research into learning processes related to percussion notation could be very beneficial to a wide variety of subjects, including professional percussionists, educators, and composers. For those wishing to begin an examination of the relationship between notation and learning, this chapter will hopefully serve as a valuable resource and a starting point from which further topics can be explored.

CHAPTER 3

A BRIEF ANALYSIS OF SELECT INNOVATIONS IN PERCUSSION NOTATION

Because of the varied nature of modern percussion music, there have been numerous attempts to create notation systems that accurately convey composer intent to the performer. Percussion notation continues to evolve, and it is therefore important to understand some of the historical practices that have been used by major composers writing for modern percussionists. The following section is a brief overview of four select works that incorporate historically innovative percussion notational practices.

***Histoire du soldat* (1918), by Igor Stravinksy**

The percussion part for Igor Stravinsky's *Histoire du soldat* (1918) requires a single percussionist to play a large instrument setup that includes three snare drums, triangle, tambourine, bass drum, and cymbals. *Histoire du soldat* is of particular historical importance to percussionists as it is considered to be the first multiple-percussion part ever written. Also of significance are the detailed instructions that Stravinsky includes in the score for the performer. Not only does Stravinsky indicate the types of implements and percussion instruments to be used throughout the piece, but he also gives specific directions concerning playing techniques, implement angles, and body placement (Early, 1993). In fact, in the movement "Ragtime," Stravinsky gives the following notes:

> *Exécuter avec la bag. a tête d'éponge don't l'exécutant prendra soin de tenir la tête tournée en bas et de la manier rien qu' avec le doigts (le bras restant*

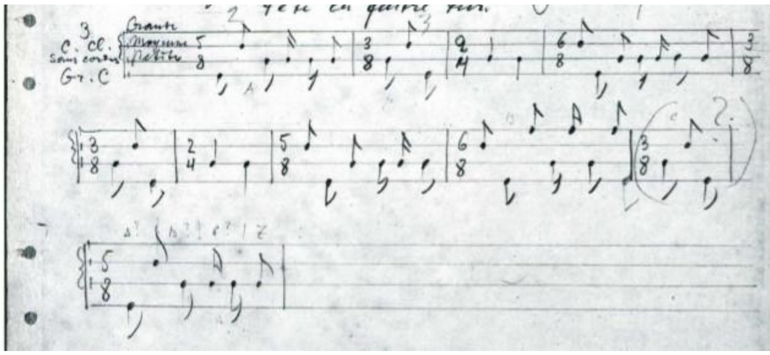
> *parfaitemente immobile) de facon à donner au rythme une allure mécanique et précise* [To be played with the sponge stick, which the performer must take care to hold with the head downwards and to wield with the fingers only (the arm remaining perfectly rigid), in order to give the rhythm a mechanical and precise character.] [4]

Stravinsky also includes a diagram of a suggested setup to be used by the performer. In fact, Stravinsky later verified that while writing the part, he gathered the appropriate percussion instruments himself and experimented with playing the part as he composed it (Kraft, 1992).

Because of the novel nature of this multiple-percussion setup, Stravinsky implemented some innovative notation ideas in order to precisely convey his intent to the performer. As can be seen from his early sketches, Stravinsky often made use non-traditional staff systems in place of the standard five-line staff to notate the individual drum pitches. In the example below, while notating the three snare drums and bass drum, Stravinsky uses a four-line staff (however, it should be noted that there are other places in the sketches that make use of multiple five-line staves).

---

[4] Translation by David Early; Early, D. (1993) Percussion performance issues in Stravinsky's Histoire du soldat. *Percussive Notes, 31*, 69–75.



Example 3.1 Sketch by Igor Stravinsky, *Histoire du soldat*
"The Triumphant March of the Devil"

Considering how new of an endeavor it was to write for multiple-percussion, Stravinsky's notation is surprisingly clear. In fact, Morris Lang, who has studied Stravinsky's original percussion manuscript in detail, praises its organization, stating "I was immediately impressed with the simplicity and clarity of the percussion writing" (Lang, 1975, p. 51).

A particularly interesting aspect of the original *Histoire du soldat* manuscript is that Stravinsky developed an innovative system for indicating percussion sticking (i.e. right-hand versus left-hand). Notes that are to be played with the right hand are notated with their stems up, while notes that are to be struck with the left hand are written with stems down. Again, this detail can be attributed to the fact that Stravinsky learned the part himself as he wrote it, therefore attempting to pass on the intended performance practices as they related to his particular instrument setup (Kraft, 1992).

A noteworthy characteristic about the notation for *Histoire du soldat* is that there has been a long history of confusion concerning the pitch ordering of the drums in relationship to their location on the staff. In the 1924 edition of the work (published by Chester Music, Ltd.), the drum on the top line is simply notated *tambour* (Early, 1993). Many percussionists have assumed that the top line would intuitively indicate the higher-pitched drum (Early, 1993). However, it was Stravinsky's original intent that the top line indicate the field drum, which is the lowest pitch of the three graduated drums (Early, 1993). When William Kraft asked Stravinsky about this apparent notational oddity, Stravinsky indicated that he had notated the low drum on the top line because the drum was on the far right side of the setup, as indicated in his original diagram (Early, 1993). This disconnect between what notation seemed intuitive for the composer versus what seemed intuitive for certain performers shows how easy it can be to misinterpret a seemingly basic notational idea.

Unfortunately, the different editions of *Histoire du soldat* have suffered from a history of discrepancies and inconsistencies (Early, 1993). Much of the criticism seems to be aimed at the original 1924 Chester publication, which Kraft calls "highly inaccurate and occasionally unplayable" (Kraft, 1992 pg 47). In addition to the many mistakes that the edition includes, it also contains parts that are very difficult to read. For example, in "The Triumphant March of the Devil," each instrument (bass drum, three graduated drums, and cymbals) is placed on five individual staves. When combined with Stravinsky's up and down stems to indicate left and right sticking, the part can become very confusing for the performer.

Example 3.2 *Histoire du soldat*, by Igor Stravinsky,
"The Triumphant March of the Devil" (ending)

Chester Music later released an edition of *Histoire du soldat* with percussion parts edited by percussionist James Blades. In this edition, all of the instruments are consolidated into a single five-line staff system, and the drums are written in order of ascending pitch. Indeed, the notation is much more compact and easier to read than the earlier Chester edition, and it eliminates some of the ambiguities associated with instrument ordering in relationship to the staff (Early, 1993). An example of the same excerpt from above can be seen below with Blades' notation.

Example 3.3 *Histoire du soldat*, by Igor Stravinsky,
"The Triumphant March of the Devil" (ending)
© Copyright 1987 J. & W. Chester/Edition Wilhelm Hanson London Ltd

The 1924 version of the work is not the only edition that suffers from mistakes and inconsistencies. In fact, in his article "A Journey to the Source" (1975), Morris Lang attempts to identify and rectify many of the errors and inconsistencies that have been found in the various editions over the years by examining Stravinsky's original 1918 manuscript. Lang addresses many of the most common questions associated with the score, and his paper serves as an excellent reference for those wishing to study the piece.

Zyklus (1959), by Karlheinz Stockhausen

Zyklus for One Percussionist (1959), by Karlheinz Stockhausen, is one of the first published multiple-percussion solos and represents a significant event in the history of modern percussion repertoire. Translating literally as "cycle," *Zyklus* serves as a unique example of the juxtaposition of complete serial control and performer freedom (Williams, 2001). Though every sonic aspect of the work was composed using strict serialist techniques,[5] Stockhausen also allows for a significant amount of choice on behalf of the performer, creating a blend of strict serialism and indeterminacy (Williams, 2001). Of particular importance in terms of performer freedom is the fact that the performer may begin the piece at the beginning of any one of seventeen "periods"[6] and proceed to play the piece forwards or backwards (Williams, 2001). Period seventeen always leads directly back into period one (or vice-versa), creating a cycle (*zyklus)* that ends when the performer re-strikes the first note with which he or she began the piece (Williams, 2001). In addition, the performer is surrounded by an enclosed multiple-percussion setup within which he or she turns either clockwise or counterclockwise continuously throughout the performance, depending on the decided order of the periods (DePonte, 1975). An interesting note is that as the piece is played forward (clockwise), the performer experiences greater freedom in choice, while as the piece is played backwards (counter-clockwise) the performer experiences less freedom and more determinate notational structures (DePonte, 1975; Maconie, 2005).

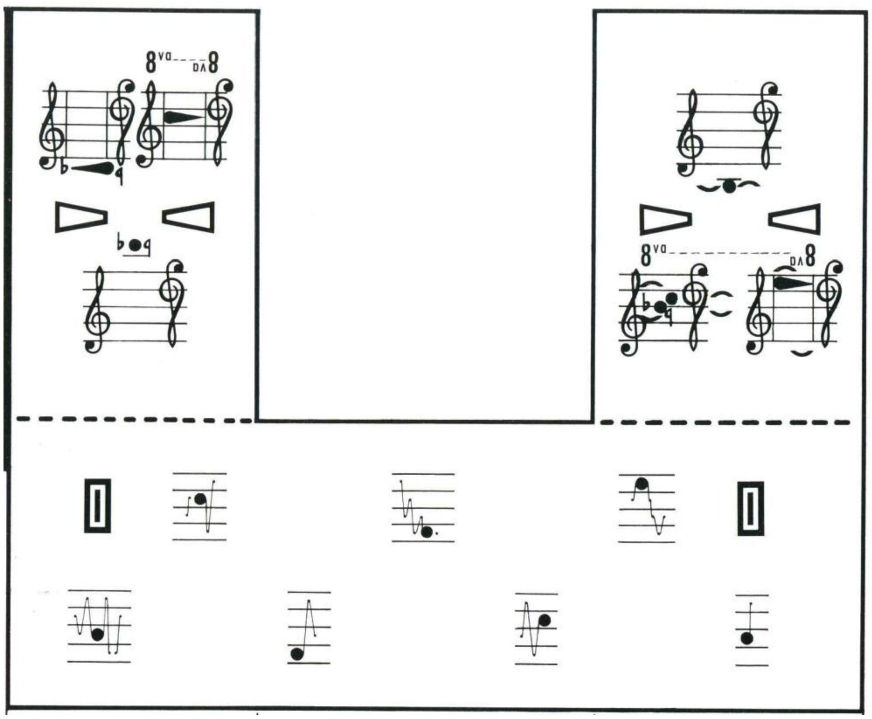
In terms of notation, *Zyklus* is revolutionary for many reasons. First, since the piece may be performed as a cycle going either forward or backward, Stockhausen notates the music in a

---

[5] An analysis of serialism in *Zyklus* can be found in Neil DePonte's paper *Zyklus: How and Why?* (1975)

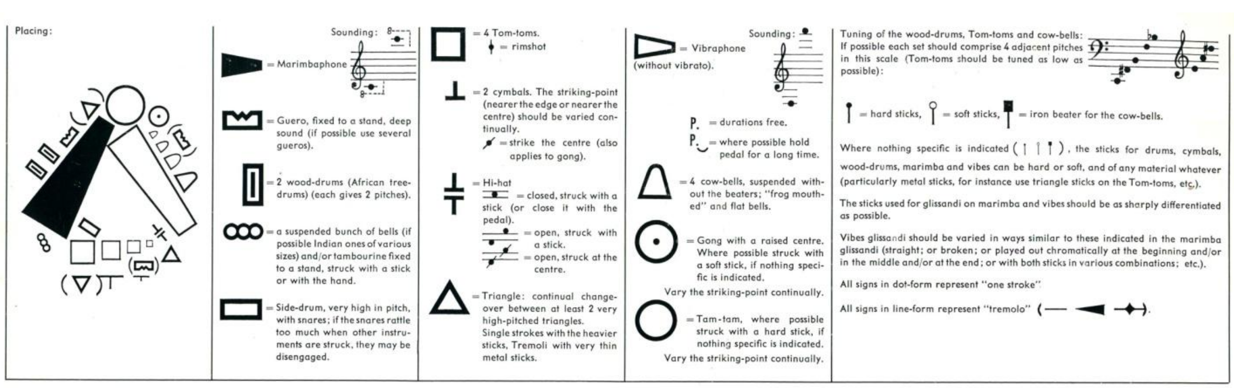
[6] Each period consists of its own page, except for period one and seventeen, which both exist on the opening page of the bound edition.

way so that each page can be read either right-side up or up-side down, depending on the direction that the performer is moving.



Example 3.4
Karlheinz Stockhausen, Zyklus|für einen Schlagzeuger|Nr. 9

Likewise, the piece contains very little text, but instead conveys musical information to the performer via a series of well-defined pictograms in the instructions.



Example 3.5
Karlheinz Stockhausen, Zyklus|für einen Schlagzeuger|Nr. 9

Within each period are a mixture of nine[7] notated "structures," each containing sets of "points" (attacks) or "shapes" (glissandi) (DePonte, 1975). Each structure imposes various levels of choice on the performer, ranging from very aleotoric to very deterministic (Williams, 2001). The most deterministic structure is the first structure, which appears on each page. It consists of a horizontal grid that acts as a time-scale for the performer. The time-scale is a constant throughout the work and is divided into thirty equal time units on each page of the piece (DePonte, 1975). The corresponding temporal length of each time unit may be decided upon by the performer but must remain constant throughout the performance (Williams, 2001). Within the time-scale, Stockhausen places various types of attack symbols (all defined in the score), and all other structures occur in relation to the time-scale (DePonte, 1975).

To indicate instrument changes, Stockhausen makes use of pictograms instead of text. Each pictogram represents a particular instrument, and Stockhausen uses them throughout the score. According to percussionist Cristoph Caskel, who premiered the work in 1959, *Zyklus* is the piece responsible for making pictograms well-known to the percussion community (Caskel, 1971).

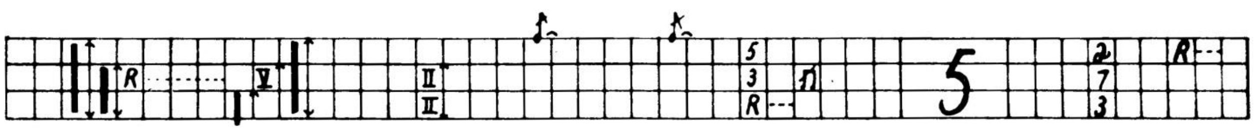
***The King of Denmark* (1965), by Morton Feldman**

Morton Feldman's *The King of Denmark* (1965) is a multiple-percussion work that incorporates a unique grid notation system. Feldman viewed all previous methods of musical composition as a form of musical "construction" and was consequentially looking for a way to divorce the sounds in music from their respective symbols, therefore allowing the sounds

[7] Stockhausen actually indicates only eight structures in the score, but the leading literature on the subject divides the fourth structure into two distinct structures, one concerning groups of strokes, and the other concerning single strokes. Williams (2001) divides structure four into structure four and structure five, and thus each of the latter structures is one cardinal number higher than previously stated.

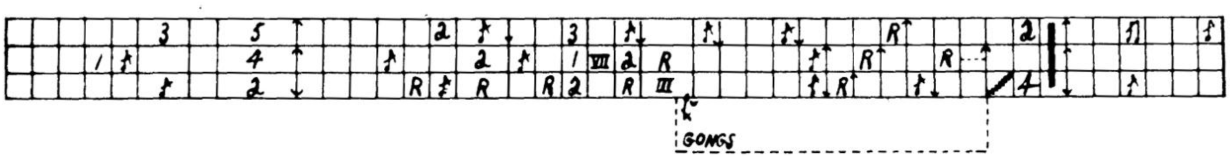
themselves to exist as individual entities, without ties to particular notation or abstract ideas (Smith, 2005). Using the grid gave Feldman a way of achieving such freedom while at the same time mandating a certain amount of musical order (Smith, 2005).

The horizontal axis on Feldman's grid represents time and is divided into equal units, each representing a metronome marking between sixty-six and ninety-two. Though Feldman does not designate whether the tempo should remain constant throughout the piece, Daryl Pratt suggests that based on previous writings by Feldman, a "fairly stable" tempo should be observed throughout (Pratt, 1977, p. 72). The vertical element of the grid represents pitch and is divided into five pitch classifications: very low, low, middle, high, and very high.



Example 3.6 *The King of Denmark*, by Morton Feldman, Page 2-System 1

In lieu of using traditional notation, Feldman uses a series of symbols that occur within the time-scale of the grid. Arabic numerals assign a particular amount of sound attacks to be played within a certain time unit (box), while roman numerals designate that a particular number of sounds should be sounded simultaneously. The numbers are placed at different vertical levels, designating the pitch class in which they are to be performed. Large numbers, which span the entire grid vertically, represent "single sounds to be played in all registers in any time sequence." Thick horizontal lines indicate that a cluster of sounds should be played on various instruments. Though all of the sounds must occur within certain time parameters (i.e. within their respective position on the grid), the performer is free to choose the rhythm in which they are played.



Example 3.7 *The King of Denmark*, by Morton Feldman, Page 1-System 2

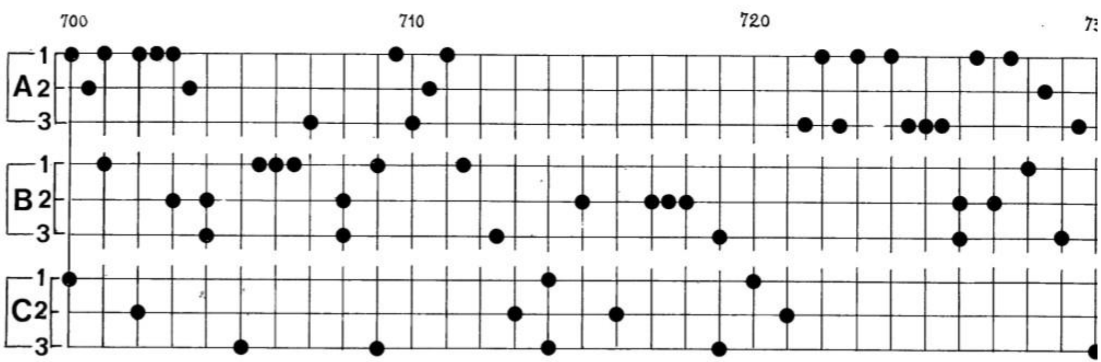
Feldman indicates that the dynamics should be "extremely low" and that all notes should be played in as equal dynamics as possible. In addition, he requires that all sounds must be produced with the "fingers, hand, or any part of [the] arm." No sticks or mallets are allowed. Pratt (1977) argues that the dynamics therefore act as one of the elements of control, while other elements, such as rhythm and pitch, represent "de-control," creating a juxtaposition of performer freedom and compositional constraints (Pratt, 1977 pg 74).

Other symbols used by Feldman in the score include a broken line (indicating sustain), grace notes, jagged diagonal lines, and *laissez vibrer* (⌒) symbols. With the exception of the broken line, none of these symbols are referred to in the key. However, Pratt (1977) indicates that the *laissez vibrer* symbols should be treated as if they were found in any standard musical notation system, while the diagonal lines should be interpreted as "upward slides" and "downward slides," depending on their direction (Pratt, 1977, p. 71). Furthermore, Pratt deduces that the grace notes should not necessarily be seen as "subservient" and that they may be interpreted as equally important to the other sounds (Pratt, 1977, p. 71). He states:

> The result is a lack of rootedness that could not have been accomplished by placing the sounds "inside of" the metric structure, on the beat or a subdivision of it. The grace note, therefore, becomes a vehicle for uprooting sounds, allowing them to float freely. (Pratt, 1977 pg 71)

Psappha (1976), by Iannis Xenakis

In his multiple-percussion work *Psappha* (1976), Iannis Xenakis also employs the use of a grid structure to represent the passage of time. However, unlike Feldman, Xenakis dictates exact rhythms that are to be observed by the performer. Within the grid, vertical lines represent individual uniform units of time, which should pass at a tempo of one hundred fifty-two beats per minute or greater. Instead of traditional notes, Xenakis indicates attacks via dots, which represent rhythms based on their spatial relationship to the vertical lines. For example, a dot occurring on a vertical line indicates that an attack should occur "on the beat," while a dot halfway between two vertical lines would indicate an attack exactly halfway between two beats.



Example 3.8 *Psappha*, by Iannis Xenakis, measures 700-730
© Copyright 1976 Editions Salabert

Vertically, the graph is divided into six systems, each of which represents three instruments from different timbral groups. Systems A, B, and C represent high, medium and low drums and wood instruments, which may be mixed within each group. Systems D and F represent medium and "very high" metallic sounds, respectively, while system E represents one "neutral" metallic instrument. Each staff system (except for E) contains three horizontal lines, which designate the register graduation of the three instruments being used in that system from low to high. Because of the ordering of the systems, higher-pitched instruments will often be written physically below lower-pitched instruments, which is of course non-intuitive for the performer (Smith, 2005).

Within the instrument timbre groups of wood, metal, and skin (drums), the performer chooses the specific instruments that he or she would like to use (Smith, 2005). In a 1976 interview with Xenakis, it was revealed that Xenakis was not so concerned with the specific sounds that were chosen, but rather with the timbral quality of the group (i.e. A, B, C, etc.) as a whole (Emmerson & Xenakis, 1976; Rosen, 1996; Smith, 2005). However, Xenakis does state in the score that he does not wish the sounds to be "banal and ordinary."[8]

Xenakis uses accents throughout the piece. However, these markings do not simply mean to strike the note louder. Xenakis gives this description in the score:

An accent within a given sequence can signify one of the following[9]

1. Play louder.
2. Suddenly change the timbre.
3. Suddenly change the weight given the stroke.
4. Suddenly add another sound and play them simultaneously on each of the beats that are not accentuated.
5. Play any combination of the following indications.

---

[8] Translated by Mike Rosen; Rosen, M. (1996). Terms Used in Percussion: Russian Percussion. *Percussive Notes*, 64.

[9] Ibid

Xenakis also uses two lines above an attack to indicate that it should be rolled. Because many of the rolls must be performed with one hand, some performers place two identical instruments parallel to each other so that one implement can be moved rapidly back and forth to create the effect of a roll (Smith, 2005).

Though it is not totally clear why Xenakis wrote his composition using dots on a grid instead of traditional notation, Xenakis himself thought of the piece as “purely rhythmic” and intended that the different timbres used in the piece should be specifically chosen to “render more clearly the polyrythmic construction.” (Emmerson & Xenakis, 1976, p. 24; Smith, 2005). It therefore could be concluded that the grid provided a more precise way of visually representing the aural polyrhythmic nature of the piece (Smith, 2005). Smith also suggests that the reasoning behind the notational system might have some relationship with Xenakis’ work on Sieve Theory, a mathematical sorting process that Xenakis claimed could help with the “organization of points on a line” (Smith, 2005, p. 75; Zaplitny & Xenakis, 1975). Regardless, the fact that Xenakis uses the grid for rhythmic values instead of standard rhythmic notation practices means that the performer must become very familiar with the new system, which is simultaneously very intuitive, yet somewhat laborious.

These four works represent a small fraction of the innovative notation techniques that have been implemented by composers writing for modern percussion. The diversity of instruments associated with percussion music makes percussion a perfect medium through which composers can experiment with new ideas and new notational practices. The following chapter continues to address this idea of notation experimentation in percussion, though in a slightly different light. In particular, it will discuss several percussion notation innovations specifically designed to increase learner efficiency and productivity.

CHAPTER 4

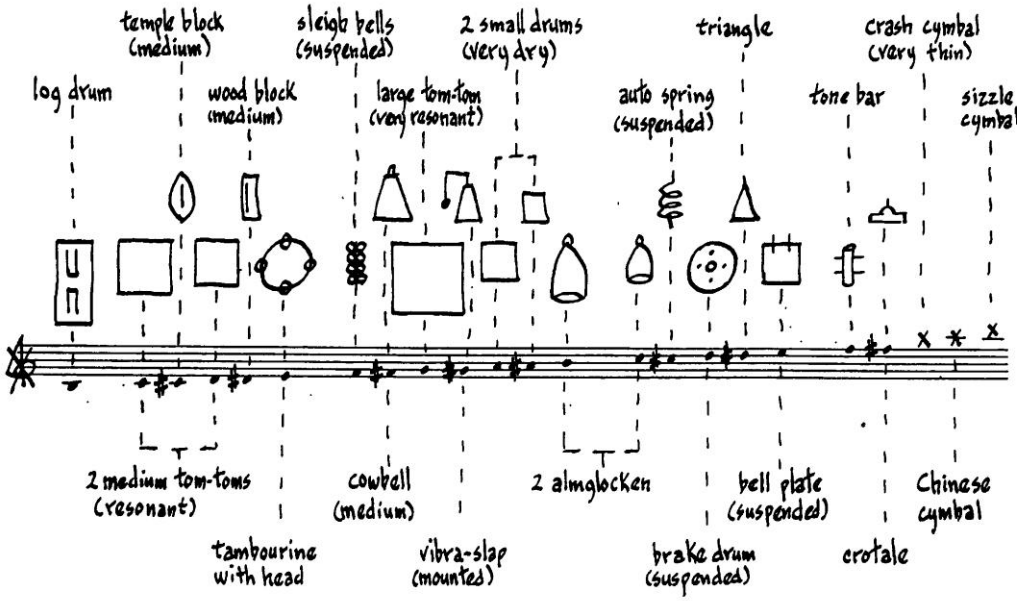
SOME HISTORIC ATTEMPTS TO INCREASE PERCUSSION LEARNER EFFICIENCY VIA NOTATION SYSTEMS

While the notation systems outlined in Chapter 3 are certainly innovative, they are not necessarily designed specifically to create optimal learning efficiency for the performer. However, there are a number of percussive notation innovations that were designed with the specific purpose of making music both easier to read and faster to learn. Select historical innovations in the field of percussion notation learner efficiency are discussed below.

Timbre-staff Notation

In his 1981 article "Visual Correspondence between Notation Systems and Instrument Configurations," Michael Udow discusses the relationship between notation systems for multiple-percussion and the spatial orientation of instruments within multiple-percussion setups. Udow suggests that when possible, it can be beneficial to the composer and the performer alike to arrange multiple-percussion instruments into a configuration that resembles that of a keyboard. The advantage of such an arrangement is that the composer can use traditional keyboard notation to create a one-to-one correspondence between the lines and spaces of the staff and the physical location of the instruments within the multiple-percussion setup (Udow, 1981). Assuming that the performer already has experience reading and performing on keyboard percussion instruments, the layout of the multiple-percussion configuration represents a direct physical-notational relationship with which the percussionist is already familiar (Udow, 1981).

Julian-Jones (2005) also suggests that if the composer is methodical when composing while using this method, composer intent can be more easily transmitted to the performer.



Example 4.1 *Dusting the Connecting Link*, by Dave Hollinden
Timbre-staff Configuration
© Copyright 1995

It is important to note that this notation, which Udow refers to as *timbre-staff notation*, does not create a correspondence between the tonal representations on the staff and the relative pitch of the instrument to be struck, but instead indicates only the physical location of the instruments within the configuration (Udow, 1981).

The instrumental setup associated with timbre-staff notation is referred to as *timbrack*, and is utilized in Herbert Brün's *In and…and Out* (1974), a chamber work for ten performers, including one percussionist. Brün gives the percussionist the following instructions:

> *Timbrack* refers to an instrument configuration and corresponding notation system wherein a number of percussion instruments of disparate timbral qualities are arranged in

> a physical approximation of a mallet keyboard. The notation for this set-up uses what looks like pitch notation to indicate which instrument to strike, not the resulting sound. For sections 4, 6, 7, and 10 of *In and…and Out,* a timbrack consisting of twelve instruments is indicated, with a staff notation ranging from first space F natural to fourth space E natural (as in treble clef). The percussionist is asked to select the instruments, decide the arrangement, and construct the set-up. (Brün, 1974, introduction to score)

In order to perform Brün's *Stalks and Trees and Drops and Clouds*, Udow constructed a new instrument that he called the Timbrack (Julian-Jones, 2005). Udow's Timbrack consisted of a variety of small percussion instruments and keyboard bars laid out on top of a four-octave keyboard frame (Udow, 1981). Julian-Jones (2005) suggests that this setup provided Udow with more control over the musical qualities of the piece during performance.

Michael Udow utilizes timbre-staff notation in *Timbrack Quartet* (1978) for four percussionists as well in his book *The Contemporary Percussionist*[10] (1986), which contains twenty progressively-difficult multiple-percussion recital solos. After meeting with Udow at the University of Michigan, composer Dave Hollinden also developed an interest in timbre-staff notation and composed several pieces using the system (Julian-Jones, 2005). Included in these works is *Cold Pressed* (1990) for solo percussion, *Release* (1995) for percussion ensemble, and *what clarity?* (2000-01), a concerto for percussion solo and orchestra.

Similar notation ideas were also used earlier by Ross Lee Finney in *2 Acts for 3 Players* (1975) for clarinet, piano, and percussion. In fact, Udow mentions this piece in "Visual Correspondence." In *2 Acts*, Finney calls for thirteen individually tuned roto-toms and notates

[10] Written by Michael Udow and Chris Watts

them using their designated pitches on a bass staff. Though Finney does not suggest a setup for the drums, Udow proposes that since the thirteen pitches span one octave (from C3 to C4) and include all chromatic tones in between, the performer could benefit from setting the drums up in a keyboard configuration in order to facilitate the learning and performing process (Udow, 1981).

Michael Colgrass also writes for chromatically tuned roto-toms in *Fantasy Variations* for eight chromatic drums and percussion sextet. Like Finney, Colgrass notates the drums by placing them on a staff that corresponds to their exact pitch (though Colgrass uses a C-clef instead of an F-clef). Though *Fantasy Variations* only includes eight pitches, it would still theoretically be possible to set the drums in their corresponding keyboard positions. Of course in such a situation, there would be holes in the setup where the pitches are not included.

Pictograms

Pictograms provide a way of representing verbal information in terms of symbolic or pictorial notation. In percussion manuscripts, pictograms are often used to denote a particular instrument or an implement with which an instrument should be struck. The advantages of using pictograms in modern percussion notation are numerous, including the reduction of confusion related to instructions written in foreign languages, as well as the avoidance of ambiguities associated with instrument abbreviations and foreign instrument names (McCarty, 1980; Read, 1998). For example, the word *timbales,* when written by a French composer, should be interpreted as “timpani,” not “Cuban timbales,” a mistake that would create a very embarrassing situation for a percussionist showing up to a rehearsal. Galm (1972) also points out that an abbreviation such as “TB” can be quite ambiguous, as it could mean “timbales, temple block, tambourine, or temple bell” (Galm, 1972, pg 47).

Many claim that pictograms can be helpful in increasing learner efficiency. In fact, McCarty (1980) argues that pictograms can increase sight-reading ability, particularly if the pictogram is well-constructed. He states:

> The percussionist neither has to read and digest lengthy instructions nor learn any new form of notation. The meaning of a well-designed pictographic symbol is instantaneous to any trained percussionist, regardless of his or her nationality. Since, through the use of these signs, the number of words appearing in a score or part may be reduced, other notational elements are clearer. (McCarty, 1980, pg 8)

McCarty also praises the adaptability of pictograms:

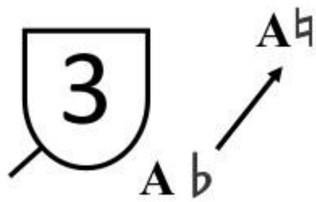
> Finally, these symbols are capable of expansion in detail and use in various combinations. This gives the composer or arranger seemingly limitless means of clearly indicating “nontraditional” performance techniques. Percussion pictograms are thus economical, international and powerfully adaptive to musical circumstance. (McCarty, 1980, pp. 8–9)

In this circumstance, McCarty uses the word “economical” to refer to the idea that a well-drawn pictogram can indicate a large amount of information using a very small symbol (McCarty, 1980). For example, imagine a scenario in which a percussionist is reading a manuscript when he or she comes across three measures of rests and the written instructions “to bongos-left hand hold brush, right hand hold two medium mallets.” Using very simple pictograms, the same information can be implied in a way that does not require the performer to read long texts (or in the case of non-native speakers, translate text).

Example 4.2
Pictogram Example-"to bongos; left hand: brush; right hand: two medium mallets"

Therefore, assuming that it is non-ambiguous, a pictogram can reduce the amount of information the performer must process and perhaps reduce their cognitive load[11] while reading.

Pictograms are particularly useful in notating complicated timpani tuning changes (McCarty, 1980). The diagram below makes it very clear that the performer should change the third drum from an A♭ to an A♮ before striking it again (a change that could be easily missed during sight-reading).



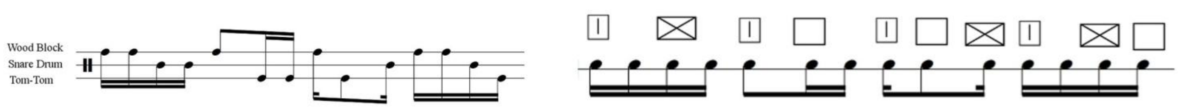
Example 4.3 Pictogram-Timpani Tuning Change

This strategy is especially useful when playing unfamiliar music, as it can help reduce the number of mistakes that occur due to stresses related to sight-reading or performance. Timpani pictograms can also indicate an appropriate time to retune during a piece, a very useful piece of information in a timpani part that is dense or that contains an immense amount of tuning changes.

[11] See Chapter 5

In his book *Contemporary Percussion* (1970), Brindle discusses how the use of pictograms can allow composers to compress line scores and therefore create more efficient manuscripts. For example, scores that make use of four or five lines (one line per instrument) can often be reduced to one or two lines through the use of pictograms (Brindle, 1970). Also, Brindle emphasizes that the use of line scores and pictograms do not have to be mutually exclusive. In fact, the combination of these two compositional practices can create manuscripts that are compact, economical, and easy to read (Brindle, 1970).

One should remember that pictograms do not always serve as the most efficient means of notating instrument changes. The example below (a) would be very confusing if notated using pictograms on a single staff line (b).



(a) (b)

Example 4.4 Line Score versus Single Line with Pictograms

Therefore, the composer should take great care when considering whether or not to use such symbolic notation (Brindle, 1970).

An obvious challenge to using pictograms in notation is the difficulty of creating universal and unambiguous symbols. McCarty (1980) emphasizes that when creating effective pictograms, there are a few key attributes that must be apparent. He states:

> To be effective, these signs must be easily recognized by an international majority of percussionists. They must not be overly abstract; a strong mimetic quality is necessary.

> However, too much detail or decoration should be avoided. These figures must easily be hand-drawn by composers, arrangers or copyists, most of whom are inexperienced in the graphic arts. (McCarty, 1980, pg 9)

Another challenge in regard to pictograms is the lack of standardization from composer to composer. In *Symbols for Percussion Notation* (1980), McCarty presents a rather in-depth classification of what he considers to be the most “standard” percussion pictograms. Standard symbols can also be found in Kurt Stone’s *Music Notation in the Twentieth Century* (1980) and Brindle’s *Contemporary Percussion* (1970), both of which are referenced by McCarty. A more exhaustive listing of possible pictograms (both percussion and non-percussion) can be found in Read’s *Pictographic Score Notation: A Compendium* (1998).

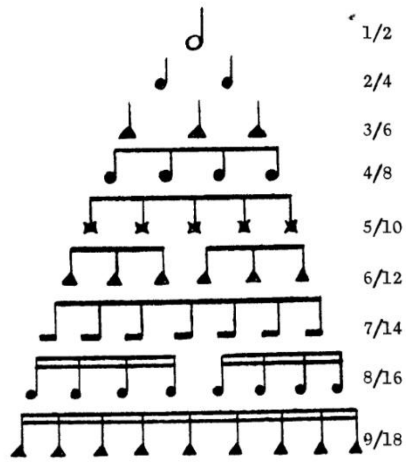
The earliest work for percussion to make use of pictograms was Karlheinz Stockhausen’s *Zyklus for One Percussionist* (1959) (Caskel, 1971). The work includes pictograms that depict instrument and mallet changes as well as the construction of the instrument setup. In fact, throughout the score, nearly every piece of musical instruction is delivered to the performer via pictogram, with written text occurring in only a few instances. Other influential composers to make use of pictograms include Carl Orff, Earl Brown, and Morton Feldman (Galm, 1972).

Keeping in line with the main thesis of this paper, it should be noted that pictograms can serve as a very effective way of altering existing manuscripts in an effort to increase learner efficiency. Adding pictographic representations of instrument and implement changes (as well as timpani tuning changes) to a score can greatly reduce the amount of time that it takes to learn a new piece of music and can expediate the re-learning of music that has been performed in the past.

Microrhythmic Modulation

In an effort to facilitate metric modulations (as well as distinguish it from other types of tempo changes) in his piece *Fantasy Variations for Eight Chromatic Drums and Percussion Sextet* (1961), Michael Colgrass implemented a notation system that made use of shaped note heads. Unlike traditional shape notes, which were designed to indicate relative pitch, Colgrass' note heads indicate a change in the metric base of the notes' durations (O'Connor, 1966). The following description is given by Colgrass in *Fantasy Variations*:

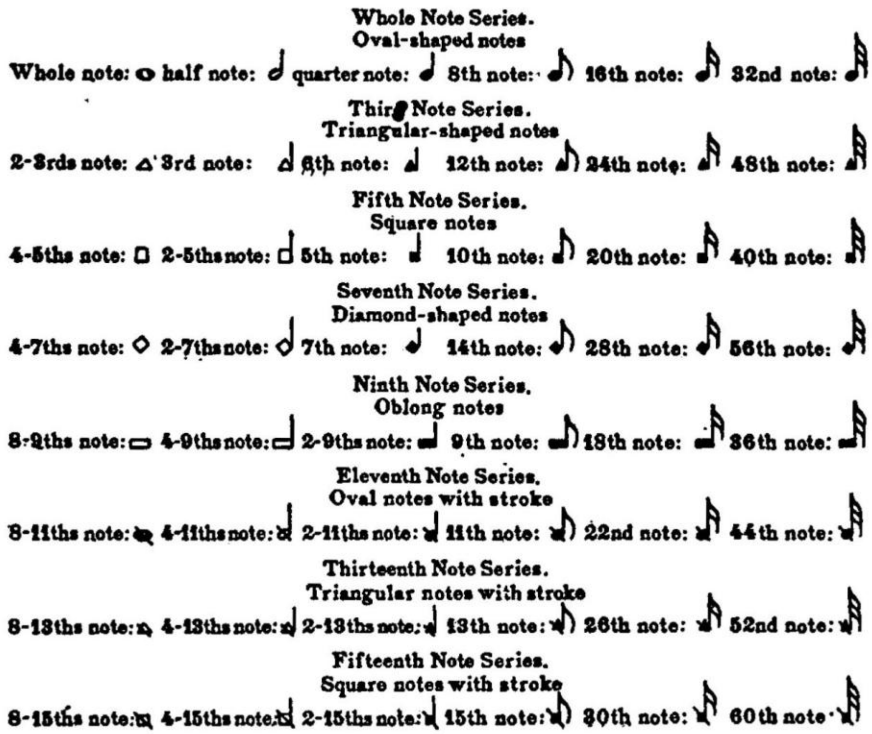
> The notation for rhythmic modulations in this work is based on the assumption that all odd, or bracketed groupings, e.g. ┌ 3 ┐ ┌ 4 ┐ ┌ 5 ┐ etc., are tense by nature because they are against the basic metrical unit of a given bar. When this conducted unit is allowed to "fall away" the odd group can "float out" freely, that is, without tension and one or more of these odd group units can become the new basic metrical unit. To emphasize the difference between this rhythmic feeling and all other changes in time which are similar in feeling but not the same (i.e., accelerando, ritardando, meno and piu mosso, con moto, etc.), dotted bar lines, triangular and star-like note heads and "microrhythmic" meter signatures are employed (see table below).



Example 4.5 "Microrhythmic Table"
Fantasy Variations (55-73075) Music by Michael Colgrass

This metrical notation system was also implemented by John Bergamo in his multiple-percussion solo *Tanka* (1964) (O'Connor, 1966).

It should be noted that Colgrass did not invent the concept of using shaped notes to facilitate metric modulations or new rhythmic subdivisions. In fact, it was first implemented by Henry Cowell, who employed the system nearly fifty years earlier in his piano piece *Fabric* (1917) (O'Connor, 1966). Cowell developed a system of note heads that indicated unusual metric subdivisions without the need for brackets (O'Connor, 1966). Cowell describes the system in *New Musical Resources* (1996), where he displays a chart that includes the traditional "whole note series" alongside his newly-formulated "third-note series," "fifth note series," "seventh note series," etc (Nicholls & Cowell, 1996).



Example 4.6 “Example 9” from *New Musical Resources*, by Henry Cowell, page 58

Part of Cowell’s fascination with the new notation system was that it would allow composers to more easily denote rhythms that were difficult to notate using standard notation (Nicholls & Cowell, 1996). Cowell states:

> Another advantage is that metres formed by the use of odd-note values, such as 2/6 metre, etc., become possible to notate. Such metre and time relationships are a natural development, but have been inhibited by being unnotatable. The practical meaning of 2/6 metre is that notes of triplet time-value are accented in groups of two instead of in groups of three. Still another possibility opened up by the new notation is that of separating notes of triplet or other time-values by placing between them notes of other systems. Thus in old notation three triplet notes or their equivalent must always be used together; in the

new notation perhaps only one triplet note will be used between quarter-notes, as in the following example:

Example 4.7 “Example 10” from *New Musical Resources*, by Henry Cowell, page 59

Certainly this list of notation innovations is not exhaustive. However, the existence of such systems shows that the development of notation techniques designed to facilitate learning and performance is important to the history and future of percussion notation practices. It is my hope that future composers will not only strive to create great music, but will also spend time thinking about the notation systems that they intend to utilize. In the same way that overly complicated notation systems can make music more difficult to learn, well thought-out notation practices can help percussionists access, learn, and interpret composers’ intentions more quickly and intuitively.

CHAPTER 5

COGNITIVE LOAD THEORY AND ITS RELATIONSHIP TO MUSICAL LEARNING

Chapter 6 of this paper presents various notation alteration techniques that can be applied to pre-existing percussion notation systems in order to facilitate learning and/or improve performance. The basic goal of each of these methods is to reduce the amount of mental processing power that must be employed by the performer to interpret written notation, therefore freeing up cognitive processes that can be applied toward performing other complex musical tasks. This concept relates directly with many of the ideas found in cognitive load theory, a psychological theory developed by John Sweller which seeks to develop effective pedagogical practices by studying the mechanics of human cognition. A basic description of cognitive load theory and its relationship to musical learning will be outlined in this chapter.

In the field of cognitive load theory, working memory (sometimes called "short-term memory") refers to memory that is devoted to processing and storing new information (Kerr, 2014). Unlike long-term memory, which is capable of storing large amounts of information, working memory is much more constrained (Owens, 2005). In fact, it is suggested by some studies that working memory might be limited to holding around only seven "chunks" of information at one time (Kerr, 2014). The way that information is chunked has a large effect on how many pieces of individual data our working memory can retain at any given time. For example, it is much easier to remember the phone number 243-830-4291 when it is chunked into three data units—243, 830, and 4291—than it is to recall ten chunks of single digits 2-4-3-8-3-0-4-2-9-1.

According to cognitive load theory, the major factor that affects the efficiency of short-term memory is the cognitive load, the amount of mental strain exerted by the working memory (Owens, 2005). As previously stated, the ability of the working memory to store and process information is finite. Therefore, if the cognitive load is exceeded, the ability for the working memory to properly manage incoming information will be hindered. Cognitive load theory (CLT) suggests that learning occurs when new information from the working memory can be internalized and transformed into chunks of data known as *schemas*, which are stored in long-term memory and are easily accessible when needed to perform a future task (Owens & Sweller, 2007).

According to CLT, there are three types of cognitive loads that impose work on the working memory. The first of these is known as intrinsic cognitive load, and refers to the processing power that must be devoted to interpreting individual elements in a system and how they relate to each other (Owens & Sweller, 2007). Intrinsic cognitive load can vary depending on the task and the level of interactivity among the elements (Kerr, 2014). For example, the process of learning how each of the seven "white" keys on one octave of a piano relate to a corresponding location on staff incorporates a relatively small intrinsic cognitive load, since each note position can be learned individually. However, when presented with music that makes use of all of these notes, the intrinsic cognitive load increases, since one must now manage the relationship of all of the notes to each other and play them in a particular order, in a particular timing, and at a particular tempo.

The overall intrinsic cognitive load of a task (e.g. learning to play an instrument or speak a foreign language) cannot be reduced by altering instructional practices (Owens, 2005). That is, certain tasks have high intrinsic cognitive loads simply by the nature of their inherent complexity. However, intrinsic cognitive load can be managed "by decomposing complex tasks, segmenting and sequencing the content into a series of prerequisites tasks, and distributing the supporting knowledge and skills over a series of lessons, topics, and instructional events" (Kerr, 2014, p. 85).

The second type of cognitive load is known as extraneous cognitive load and refers to excessive strain that is put on the learner due to unnecessarily complicated instructional practices (Kerr, 2014; Owens & Sweller, 2007). Therefore, any pedagogical practices that are not essential to the learning process add to the extraneous cognitive load and limit the cognitive ability of the learner (Owens, 2005). It is important to note that extraneous cognitive load and intrinsic cognitive load are additive (Owens, 2005). Therefore, an activity with a low intrinsic cognitive load but a high extraneous cognitive load may still be cognitively manageable by the learner (Kerr, 2014). However, on the contrary, if an activity with a high intrinsic cognitive load is supplemented by instructional practices that exert a high extraneous load, then the capacity of the working memory might be overloaded and learning a task can become difficult or even impossible (Kerr, 2014).

The problems presented by extraneous cognitive load in relation to instructional practices can be extrapolated to include notational practices that are unnecessarily complicated. In this particular case, the composer represents the "instructor" (i.e the one delivering information) while the musician represents the "learner" (the one who must interpret the information that is supplied to him or her). Therefore, non-intuitive or overly-complicated notational practices can increase the extraneous cognitive load on the musician. If the combination of extraneous cognitive load and intrinsic cognitive load (associated with the inherent difficulty of the music) becomes too large, then learning the music becomes difficult, and the musician might find himself or herself spending an immense amount of time learning a particular piece.

The third type of cognitive load is germane cognitive load. This refers to mental processing power that is devoted to the development of schemas (chunks of information stored in long-term memory for future access), which will ideally become automated over time (Kerr, 2014). Like intrinsic and extraneous cognitive load, germane cognitive load is additive and does take away from the mental processing power of the brain (Owens, 2005). However, the trade off is that the processes that are learned through germane cognitive load will be stored in long-term memory and therefore lead to overall more efficient learning and “deeper understanding” of the material (Owens, 2005, p. 106). Since it is suggested that the difference in novice and expert ability is the number of acquired schemas that a person possesses, CLT proposes that instructional practices devoted to germane cognitive load are beneficial to a learner’s transition from inability to proficiency (Owens, 2005).

Musicians who are efficient in their practice time make very good use of germane cognitive load. That is, they are able to practice in a way that not only involves repetition, but creates a deeper understanding of a style of music, a particular piece, or a particular instrument. In fact, Di Sanza (2007) addresses this very issue in *Improvisational Practice Techniques: A Handbook for Incorporating Improvisation into the Percussionist’s Daily Practice Routine*. In the book, Di Sanza approaches increasing germane cognitive load through the process of improvisation in practice. He describes improvisational methods that can be applied to various percussion practice situations in an effort to increase the performer's understanding of the music and ability to perform it with more confidence (Di Sanza, 2007).

Though Di Sanza's ideas do not specifically relate to notational practices, the major ideas that he suggests (i.e. increasing musical understanding through separate exercises both in front of and away from the musical score) can be applied to notation techniques. In fact, Applebaum (1978) explored this idea by creating short etudes that contained notational materials that were similar to notational practices used in complex multiple-percussion works. The idea was that after the etudes were studied, it would be easier to learn the actual pieces to which they corresponded (Applebaum, 1978).[12] In this case, the germane cognitive load associated with learning the etudes was designed to create schemas in the students' long-term memory that would help them learn the larger works more efficiently.

Though this paper does not specifically focus on instructional music practices, the concepts related to CLT can certainly be applied to learning new music repertoire by both students and professionals alike. In this case, the intrinsic load of learning a piece of complicated music is high, as the act of playing music is a complex process. However, by applying particular notation alteration techniques, as discussed in Chapter 6, one can reduce the extraneous cognitive load associated with interpreting complicated, dense, or non-intuitive notation systems. By doing so, mental processing power can be freed up to work on more complex musical ideas and perhaps focus on processing germane cognitive loads that lead to a deeper understanding of the repertoire.

[12] Applebaum's paper is discussed in more length in Chapter 2

CHAPTER 6

NOTATION ALTERATION METHODS AND THEIR PRACTICAL APPLICATIONS

The following chapter is devoted to discussing manners in which percussionists can physically alter pre-existing notation in a way that makes it both easier to learn and easier to perform. It includes methods that I have developed (as well as methods that I have adapted from other professional percussionists) in an effort to create practical techniques that can be applied to a wide variety of notational styles. There is no doubt that the ability to learn music quickly and accurately is invaluable to performers, who must not only be able to perform difficult music, but who often must learn music within short timeframes or under strict deadlines. Therefore, any methods that can increase efficiency in this process become very useful resources. It is my hope that the following chapter will be informative to both musicians and composers alike and that it will help facilitate the development of efficient, economical, and practical notation practices.

Color-Coding

Color-coding serves as an attempt to minimize the amount of time it takes to learn new or complicated staff systems. In the system, distinct instruments, instrument groups, or timbres are highlighted with different colors, which act as visual cues that connect the notes' locations on a staff to their corresponding sounds or positions within a percussion setup. By defining notes based on a color scheme in addition to their physical position on a staff, one can reduce the cognitive load associated with remembering how the staff system relates to the corresponding pitches, timbres, or instruments. The colors can also help with retention of the rules of the staff system when revisiting pieces in future performances.

Though color-coding can be applied in many situations, it is particularly useful in the process of learning and performing multiple-percussion music. Since there is no standardized system for writing multiple-percussion notation, percussionists often find themselves learning new staff systems each time they learn a new multiple-percussion piece, which can significantly slow the learning process and increase necessary practice time. By color-coding the multiple-percussion staff, one can reduce the amount of time required to learn a new staff system and therefore increase efficiency in the overall musical learning process and increase confidence in the knowledge of the staff system during performance.

An example of the color-coding process can be seen in the excerpt below, taken from Iannis Xenakis' multiple-percussion solo *Rebonds* (1987-9). Xenakis uses a standard five-line staff to notate the instruments that are used in the piece, which include bongos, tom-toms, bass drums, a tumba[13], and woodblocks. To facilitate the learning process of this piece, I decided to color-code the staff according to each instrument group. That is, both bongos are yellow, all of the tom-toms are green, both bass drums are blue, the tumba is pink, and the woodblocks are uncolored.

Example 6.1 *Rebonds A*, by Iannis Xenakis, measures 9-10 (color-coded)

It is important to note that in this instance, I did not make each instrument its own color. Instead, colors represent groups of like instruments. The reasoning behind this is that I did not want to overload the brain with too many stimuli. For example, if all of the drums were distinct

[13] A large conga drum

colors, then there would be eight colors on the page. If we were to add the five individual woodblocks into the scheme, there would be thirteen colors to retain in the memory. Since the sizes of the instrument groups in *Rebonds* are small, it suffices simply to make each group a distinct color. That way, it is easy to distinguish which type of instrument should be struck at any point in the music. Then, for example, upon seeing a yellow note head, the brain must only make the distinction between high bongo or low bongo instead of having to consider all of the drums in the setup as a possible instrument to strike.

Color-coding is especially useful for learning and performing the polyrhythms in the first movement of the piece, *Rebonds A.* As can be seen in the example below, Xenakis writes densely-packed polyrhythmic material, making it difficult to distinguish which drum should be struck at which time.

Example 6.2 *Rebonds A*, by Iannis Xenakis, measure 49

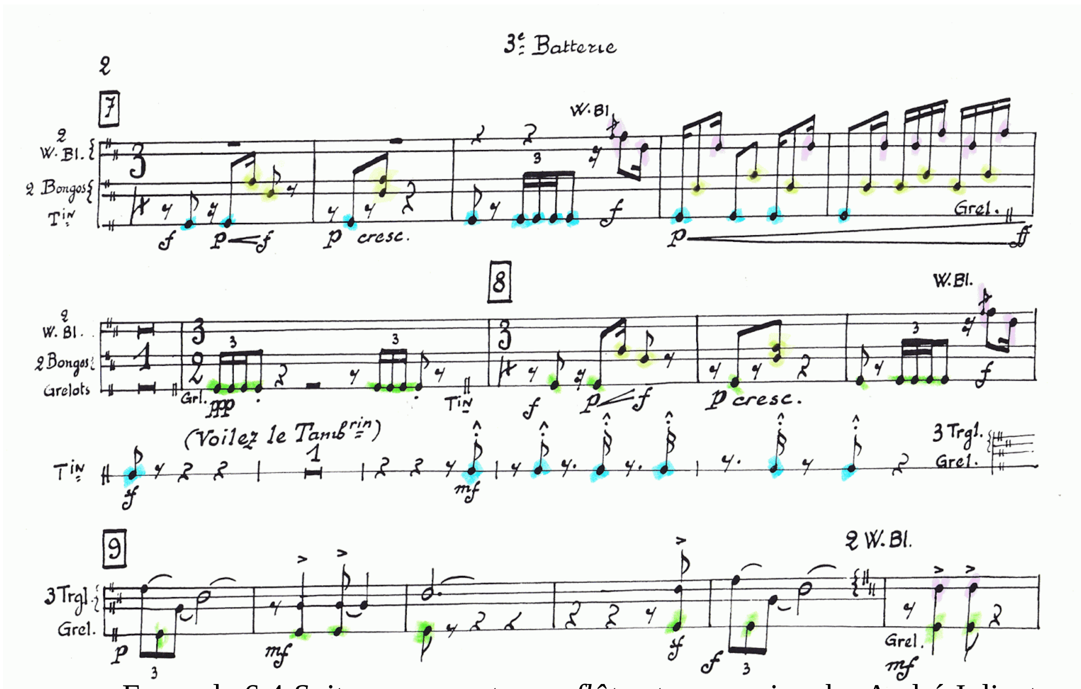
However, with the color-coding in place, it becomes easy to distinguish which instruments should be played within each polyrhythmic grouping.

Example 6.3 *Rebonds A*, by Iannis Xenakis, measure 49 (color-coded)

For example, if within a flurry of notes, the performer sees no blue notes, he or she can safely deduce that there are no bass drums in the particular section of the passage. Thus, brain processing power that would normally be used for deciding which instruments should be struck can be diverted to appropriately executing the figure.

In addition to facilitating the learning process and increasing confidence in a particular staff system, color-coding can also reduce confusion related to an instrument's relative (and often ambiguous) position on a staff or staff system. It can also help make complicated or difficult-to-read staff systems much easier to interpret. For example, let us consider André Jolivet's *Suite en concert pour flûte et percussion* (1966) for four multiple-percussionists and flute. In the multiple-percussion parts, Jolivet places each instrument group on a separate staff, which, due to the physical distance between each line, makes the part fairly difficult to read. In addition, lines in the staff system are constantly added and removed as instruments are introduced and subtracted from the orchestration, meaning that the performer must constantly read cues that indicate which instrument is being designated to each staff.

By applying the color-coding technique, the difficulties associated with the physically large, constantly-changing staff system are practically eliminated, as the performer associates each instrument with its color rather than its physical position on the staff. In the example below, wood blocks (W. Bl.) are colored pink, bongos are colored yellow, the military drum (T-in) is colored blue, and the bells (Grelots) are colored green. The triangles are uncolored.



Example 6.4 *Suite en concert pour flûte et percussion*, by André Jolivet
3e Batterie, Movement I, measures 45-65

Notice that in the top system, the military drum is on the bottom staff, while in the second system, the bells are on the bottom staff. If the performer misses the written cue, then it is very possible that he or she will continue to play the military drum in spaces where there should be bells. However, once the percussionist learns the color-coding system, it becomes unnecessary to read the cue, reducing the amount of time that he or she must remove his or her eyes from the actual notes in the score. If one thinks about the amount of time that it takes to read (and in this case interpret from French) the cue for the instrument change versus the amount of time it takes to recognize the color green, the color-coding has a obvious advantage in terms of reaction time, especially in situations where the performer must change between instruments very quickly.

There is one other advantage to color-coding in *Suite en concert*, and it is related to the inconsistency of the notation system implemented by Jolivet. In addition to constantly adding and removing staves from the staff system, there are a few instances in which Jolivet actually changes the hierarchy of the staff system. That is, the vertical ordering of the instruments on the page is not consistent. The three examples below are from three different sections of the Percussion III part. In the first example, the bongos (yellow) are notated physically above the bells (green) and below the wood blocks (pink).

Example 6.5 *Suite en concert pour flûte et percussion*, by André Jolivet
3e Batterie, Movement I, measures 75-77

However, Jolivet does not keep this ordering consistent. At rehearsal 7 in Movement III, the ordering of the bells and bongos is reversed as Jolivet writes the bells above the bongos.

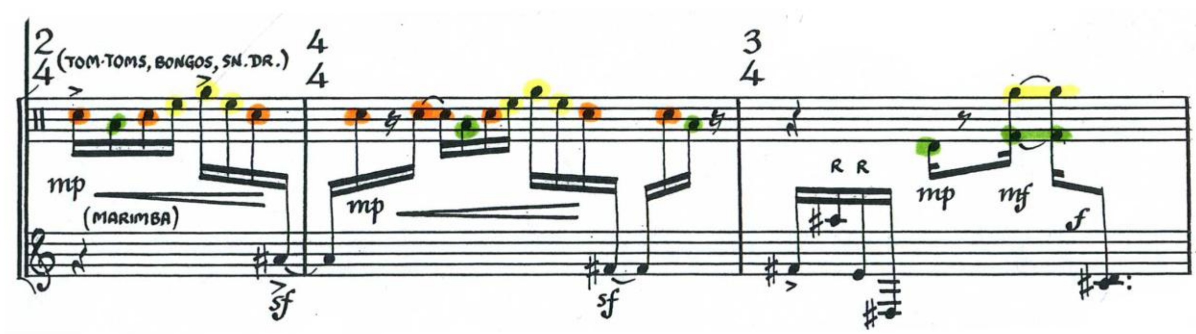
Example 6.6 *Suite en concert pour flûte et percussion*, by André Jolivet
3e Batterie, Movement III, mm 50-52

A similar issue occurs in Movement III, rehearsal 24, where the bells are written above the woodblocks, which is again counter to the initial hierarchy of instruments from the first example.

Example 6.7 *Suite en concert pour flûte et percussion*, by André Jolivet
3e Batterie, Movement III, measures 155-158

This simple act of re-ordering the instruments within a staff system increases the mental workload that the performer must exert to practice and perform the piece. However, the color-coding makes it easy for the performer to know exactly which instrument is represented on each line, regardless of the hierarchy of the staff system, reducing the extraneous cognitive load and increasing the confidence that he or she is playing the correct instruments in a performance or practice situation.

In the example below, I apply the color-coding technique to Tania León's *A la par*, a duo for percussion and piano. In the piece, the percussionist must often play a wide variety of multiple-percussion instruments while simultaneously playing a marimba. In this example, it is easy to see the distinction between the marimba (pitched) staff and the percussion (non-pitched) staff, as well as which multiple-percussion instruments should be struck. It should also be noted that to perform this piece, the performer must often take his or her eyes off of the music in order to accurately strike the correct pitches on the marimba. As the eyes return to the manuscript, the addition of the colors can make it easier for the performer to keep track of where he or she is on the page, as the page is no longer a large mixture of black and white, but instead contains distinct patterns of colors, each of which correspond to the instrument that the performer was previously playing.



Example 6.8 *A la Par*, by Tania León, Movement I, mm 39-41
© Copyright 1986 Southern Music Publishing Co, Inc.

Color-coding is not only useful for multiple-percussion pieces, but can be applied to many situations where there are changes in tone or timbre on a single instrument. For example, in Iannis Xenakis' *Okho* (1989) for three djembes, each drummer is responsible for producing a myriad of both traditional and non-traditional tones, timbres, and sound effects on a single djembe. Since there are no formal notations for all of these sounds (at least in the context of Western music), Xenakis denotes the distinct types of slaps, bass tones, and muffled tones on a system of two staves of three lines each. Sounds that are produced in the center of the drum head are notated on the bottom staff while sounds produced at the edge of the drum head are represented on the top staff.

Example 6.9 *Okho*, by Iannis Xenakis
Player C, measures 10-12
© Copyright 1989 Editions Salabert

Though the piece is by no means easy to play, I found that perhaps the most difficult aspect of learning the work was simply trying to read the staff and play the corresponding sounds. Upon color-coding the particular tones, I found myself learning passages much more quickly and performing them with much greater consistency. In fact, the several times that I have revisited the piece, I have found that the color-coding greatly helped my retention of the notation system.

Example 6.10 *Okho*, by Iannis Xenakis
Player C, measures 58-59
© Copyright 1989 Editions Salabert

I am always very conscience of both the number of colors that I use on any given piece and the particular colors that I assign to each instrument and sound. For example, when coloring multiple-percussion works, I often try to make lower-pitched instruments correspond to darker colors. In the *Rebonds* example above, the bass drums were blue, the toms were green, the tumba was pink, and the bongos were yellow. As the pitches of the instruments rise, so does the "brightness" of the colors: blue, green, pink, then yellow. By applying this rule, I find it easier to remember which instrument is related to which color. As I use color-coding more and more, I try to keep this system as consistent as possible. As with any notation system, the more it is used, the easier it becomes to read. Therefore, I believe it is important to pick colors that psychologically make sense to the performer. For example, in *Okho*, I notated all of the slaps with fluorescent pink. In my mind, pink is "loud" and complements the slap sounds quite well. Of course, how individual colors psychologically correspond to distinct sounds will vary from performer to performer. Therefore, I believe that it is important that when applying a color-coding system to pre-existing notation, performers should pick colors in a way that makes logical sense in their minds and in a way that will further increase learning efficiency.

Information Compression

One of the goals of efficient music notation should be to convey complex ideas in a very compact form. That is, the amount of information that *must* be processed by a performer should not exceed the amount of information that *can* be processed by the performer. Essentially, the less visual information that the brain has to interpret, the more processing power can be devoted to other complex tasks. Roger Reynolds discusses this idea in more detail in his book *Mind Models* (2005), in which he suggests that an efficient encoding system can increase the amount of pieces of information that our working memory can manage simultaneously. Reynolds relates this concept to efficient notation and evokes a very profound quote by mathematician and philosopher Alfred North Whitehead: “By relieving the brain of all unnecessary work, a good notation sets it free to concentrate on more advanced problems” (Reynolds, 2005; Whitehead, 1958, p. 39). Though Whitehead was referring to mathematical notation, a similar line of logical thinking can be applied to music notation. By reducing the amount of visual musical information the brain must process, it is possible to allow the brain to concentrate on more advanced problems, such as intonation, sound quality, and dynamic control.

Therefore, when dealing with music notation that contains an overwhelming amount of visual stimuli, it can be useful to rewrite this information in a much more compact form. Similar to information compression in computer science, the main idea of information compression in music is to create a notation that is compact, yet contains enough information to allow the performer to reproduce the composer’s intentions with high fidelity. It is not necessary that the new notation system contain *all* of the information that is contained in the score. However, the compressed notation should contain enough visual clues so that the performer can easily extract the remaining information.

This process is in fact one that we use quite often to aid in memory. For example, if college-level algebra students are asked to multiply two binomials together, it would not be uncommon for them to use the acronym “F.O.I.L.” as a reminder that they should multiply the First, Outer, Inner, and Last terms of the expressions in order to obtain the correct product. The information to perform the algebraic process is not inherently hidden in the word “FOIL,” but it serves as a visual (or audible) clue that allows the students to extrapolate the information that they need to solve the problem. Therefore, the act of information compression in music is not an attempt to create a new score, but rather it allows for the creation of a visual cuing device that can help the performer easily recall complex information that is part of a larger manuscript.

My first experience with using information compression was while learning the second marimba part to Steve Reich's *Mallet Quartet* (2009) for two marimbas and two vibraphones. Particularly, I was having trouble deciding how I would be able to easily learn and perform the third movement of the piece. This movement, which consists of non-stop sixteenth notes played through constantly-shifting meters, presents three main problems for the marimbist. First, the movement is ten pages long with no breaks. The notes are fast and the marimba part requires holding four mallets, which makes turning pages impossible without a page-turner. Secondly, the part is incredibly dense and looks very uniform throughout. In other words, it is quite easy to lose one's place, and since there are so many meter changes, recovery from such a mistake becomes very difficult. Third, while the rhythms stay consistent among similar meters, the metric ordering does not follow any kind of explicit pattern, making memorization very difficult.

Example 6.11 Marimba 2, measures 387-419
Mallet Quartet by Steve Reich

In order to alleviate many of these problems, I decided to make an abbreviated version of the score. However, the original idea to do this was not my own. In fact, I came across the concept while reading a blog by Adam Sliwinski, a member of the very successful professional percussion ensemble So Percussion. In the blog "Read-Memorize-Cheat!" Sliwinski describes his "cheat sheet" for one of the *Mallet Quartet* marimba parts. The main piece of information that the cheat sheet contained was the order of the meters (Sliwinski, 2013). Sliwinski states that he had the harmonic material (as well as the rhythmic material) memorized, but that the cheat sheet gave him more security when it came to accurately performing the piece. I adapted Sliwinski's cheat sheet in order to include more information about the part, particularly the harmonic changes throughout the work.

There are two main properties of *Mallet Quartet* that allow this marimba part to be easily compressed into a compact notation scheme. First, the rhythmic and sticking patterns (i.e. right [R], versus left [L]) are consistent among similar meters. For example, 5/8 time signatures always correspond to five eighth notes in a R-L-L-R-L sticking pattern, while 7/8 time signatures always correspond to seven eighth notes in a R-L-L-R-L-R-L sticking pattern. Therefore, by simply knowing the meter, one already knows the rhythm and sticking pattern that should be played. One can then remove many of the notes and replace them with a shorthand notation that simply indicates how the meters change.

Example 6.12 Re-written Marimba 2 part, measures 387-454
Mallet Quartet by Steve Reich

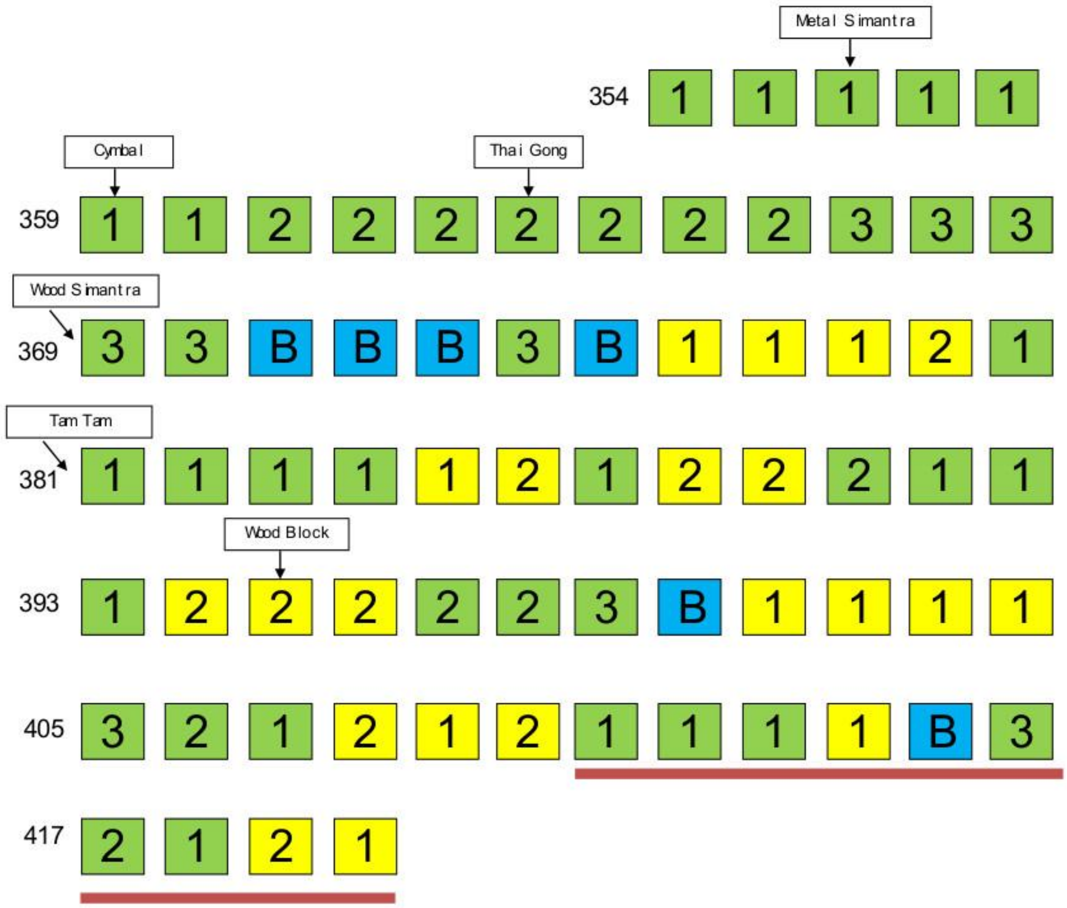
The second property that allows for information compression is the fact that the harmonic changes in *Mallet Quartet* occur very slowly. When the harmonic language does change rapidly, it is usually very brief and follows some kind of repeating pattern. Since most of the pitch material is static (with brief, temporary changes), the performer needs only to see where the changes occur and know to which hand they apply. In the top two systems of the example above, the two left-hand mallets toggle between an interval of G-D and B♭-F, while the right hand remains on E and F. After the alternating pitches are firmly established, the note names are removed and replaced with up and down arrows, again decreasing the amount of visual information the performer must process. The up arrows indicate that the left hand should be at an interval of B♭-F, while the down arrows indicate that the left hand should move “down” to the G-D interval. In this particular system, movements made with the right hand are indicated above the numbers while movements made with the left hand are indicated below the numbers. It is of course necessary for the performer to have an intimate knowledge of this particular system and to be familiar with the changes in the original manuscript. However, once that knowledge is attained, the shortcut notation can lessen the mental burden of trying to read such a dense series of rhythms, meters, and pitches.

In this instance, the process of notation compression allows the performer to focus solely on the *changes* in the music. This aspect is important mainly because of the uniform look of the original score. Not only does the compact notation help ensure that the performer does not miss a harmonic change in the music, but it also makes it easier to see areas where there are no harmonic changes. In other words, unlike when reading the original notation, the brain does not have to constantly scan the grand staff to see if a harmonic change is about to occur, allowing it to focus on other musical processes.

This idea of using information compression to highlight musical changes works especially well in pieces that contain a large amount of repetition or patterns that slowly morph over time. For example, in the closing section of Iannis Xenakis’ *Persephassa* (1969) for percussion sextet, each performer plays a unique repeated pattern that consists of tremolos on metals, woods, and drums. The pattern is built up instrument by instrument until the composite pattern is obtained. Though the general pattern stays virtually the same throughout the finale, each time the sequence of instruments is repeated, the individual drum that is used for that particular pattern toggles among high and low bongos, three graduated tom toms, and a bass drum (though the order in which the drums are played does not follow a particular pattern). As the pattern accelerates, it becomes incredibly fast. This aspect, combined with the double-staff system that Xenakis employs, makes it very difficult to see both which of the six drums should be played on a particular passage of the pattern and when other new instruments (metals and woods) are added to the existing pattern.

Example 6.13 *Persephassa*, by Iannis Xenakis,
Player B, measures 387-392

By compressing the notation into an easy-to-read, color-coded system, we can reduce the amount of visual information that the brain must process in order to play each pattern properly. Sean Kleve, a colleague and member of the chamber music group Clocks in Motion, originally came up with the idea of applying the information compression technique to the finale of *Persephassa* and created an abbreviated notation system to help him learn this part of the music. I modified his notation scheme and added some color-coding, leading to the notation below.



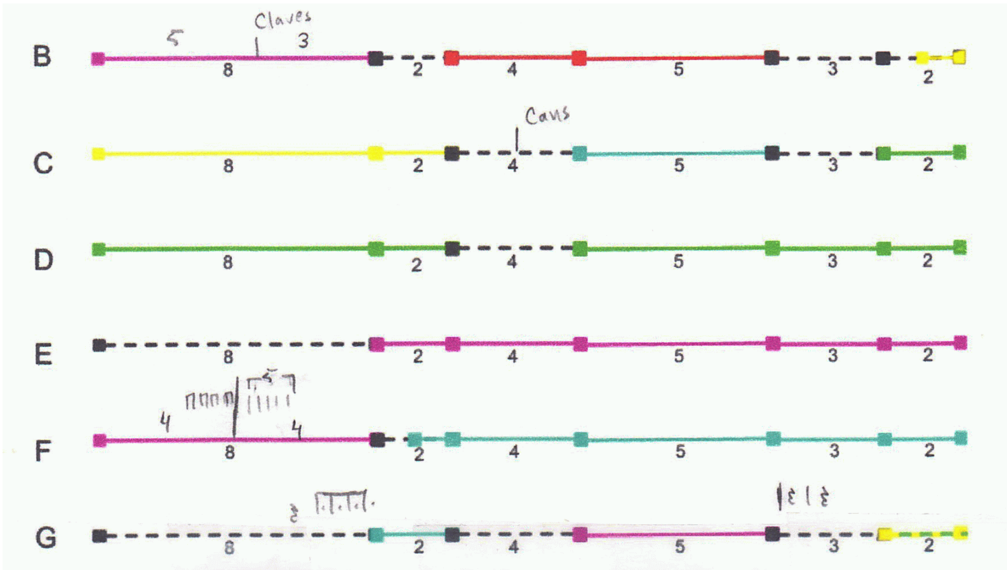
Example 6.14 *Persephassa*, by Iannis Xenakis,
Rewritten Player B part, measures 354-420

In the notation system, each color represents a different drum-type: green represents tom-toms; yellow represents bongos; and blue represents the bass drum. To further distinguish between the different sizes of bongos and tom-toms, I placed a number inside of each color. For example, a "1" inside of a green square means to play the high tom-tom, whereas a "2' inside of a green square would mean to play the second highest tom-tom, etc. The red highlighting represents the siren whistle, a small signaling siren that is held in the performer's mouth and blown. As the pattern builds, new instruments are added, and these entrances are written in amidst the notation for the drums.

Again, as with *Mallet Quartet*, the re-written part is not designed as a replacement for the score. In fact, for someone who had never studied the Player B part for *Persephassa*, the alternate notation would make little to no sense and certainly does not contain all of the information necessary to properly perform the piece. However, for a performer who has taken the time to practice and learn the patterns for this section and has studied the score, the alternate notation can make reading the part much easier. In fact, one might argue that between the removal of the notes and the addition of colors, the alternate notation can actually make it easier not to lose one's place in the repetitive nature of this relatively long finale. In addition, if the part is memorized, the alternate notation can serve as a method of compact visual cues in case of a memory slip. We have also managed to condense three pages of music down to a graphic that will easily fit onto one sheet of paper.

Road Maps

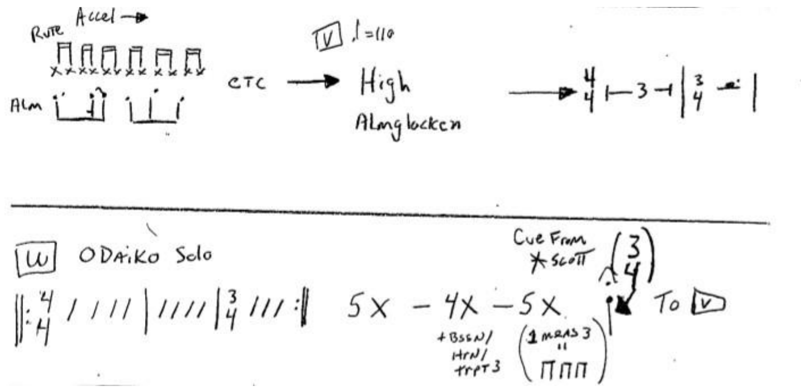
A road map is simply a condensed version of a score that gives the performer visual cues that aid him or her when performing from memory. Specifically, it serves as a way to visually "jog" the performer's memory as he or she moves from section to section. Because road maps need only to contain minimal information, they can be extremely compact and can often be hidden in a performer's setup. My road map for one of the percussion parts to John Cage's *Third Construction* (1949), a quartet for four multiple-percussionists, can be seen below. Within the map, each instrument group (cans, drums, maracas, etc…) is represented by a specific color. Rests are represented by broken lines. The number above each grouping refers to the number of measures within that section. "Claves," "Cans," and other written-in notations are cues related to other players' parts.



Example 6.15 *Third Construction*, by John Cage
Percussion II Road Map, Rehearsal B to Rehearsal H

Though all of the sections of the piece are individually memorized, the road map helps ensure that the performer switches to the correct instrument group at a particular point in the piece or rests for the appropriate number of measures before reentering. Thus, it helps alleviate many of the stresses and mental burdens associated with performing a complex chamber piece from memory: specifically, the fear of skipping a section or entering at the wrong time. From a practical standpoint, many road maps can be physically shrunk down to the size of a note card and easily hidden somewhere within a percussionist's setup.

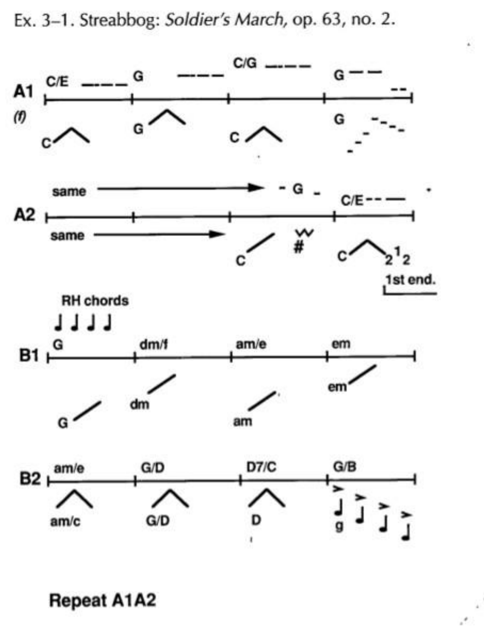
The following figure is an excerpt from percussionist Anthony Di Sanza's road map for *Moon Shadows* (2012), a concerto for percussion and orchestra by Michael Udow.



Example 6.16 *Moon Shadows*, by Michael Udow
Anthony Di Sanza Road Map

Again, like the Cage example above, this section of the road map gives Di Sanza just enough information to jog his memory during performance so that he does not have to read the music off of a large score or rely strictly on memory.

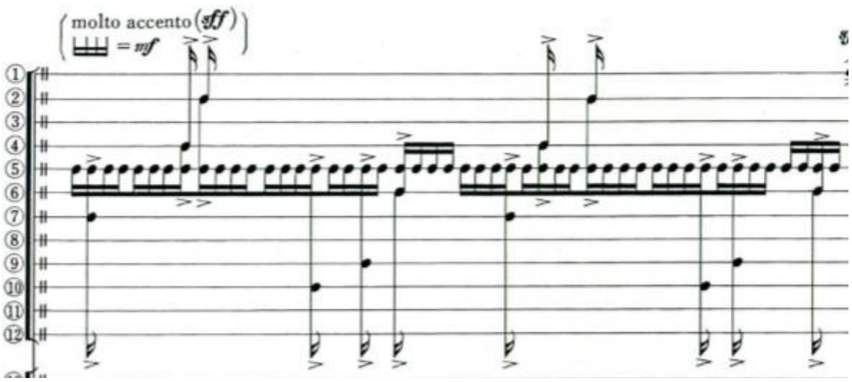
Of course, roadmaps are not only useful in ensemble playing. They can help the learning and memorization process in solo repertoire as well. In fact, Rebecca Shockley explores how the concept of "mapping" can aid in piano performance in the book *Mapping Music: For Faster Learning and Secure Memory* (1997). Shockley suggests that by creating visual mapping systems, performers and students can more efficiently learn and memorize new music without falling into the trap of "mindless repetition" (Shockley, 1997, p. 1). In addition, Shockley suggests that the act of mapping out pieces can decrease the amount of time it takes to relearn music that has been performed in the past. The book is full of practical applications of how to use compact notation to represent ostinato patterns, chord changes, and melodic contour as a learning tool for piano performers. However, Shockley suggests that any musicians can use similar techniques for their own instruments or voices.



Example 6.17
This example is taken from the following publication:
Rebecca Payne Shockley. *Mapping Music: For Faster Learning and Secure Memory*, 2nd ed. Middleton, WI: A-R Editions, Inc., 2001 Used with permission.
www.areditions.com

Note-Numbering

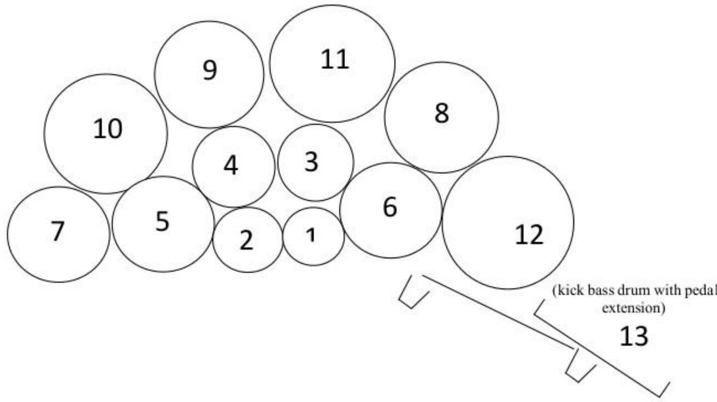
In certain circumstances, the physical layout of a percussion setup can make even a relatively intuitive notation system difficult to read. For example, in Maki Ishii's *Thirteen Drums* (1986), the performer must construct a large setup of twelve skin drums and a pedal bass drum in a manner that will allow him or her to play very fast rhythmic passages full of furious grace note flourishes and fast drum changes. Ishii notates the thirteen drums on thirteen separate single-line staves. Though the notation is intuitive in the fact that the drums are written in descending order of pitch (with the bass drum on the bottom line), the physical size of the staff system makes it very difficult to identify drums that are notated toward the center of the staff. For example, though it is very easy to identify the highest and lowest drums, identifying the eighth highest drum on the staff becomes challenging, as it is quite difficult to tell exactly how many lines are above or below the note head upon first sight.



Example 6.18 excerpt from page 3, *Thirteen Drums Op. 66*, by Maki Ishii
© Copyright 1986 by Moeck Musikinstrumente & Verlag, Germany

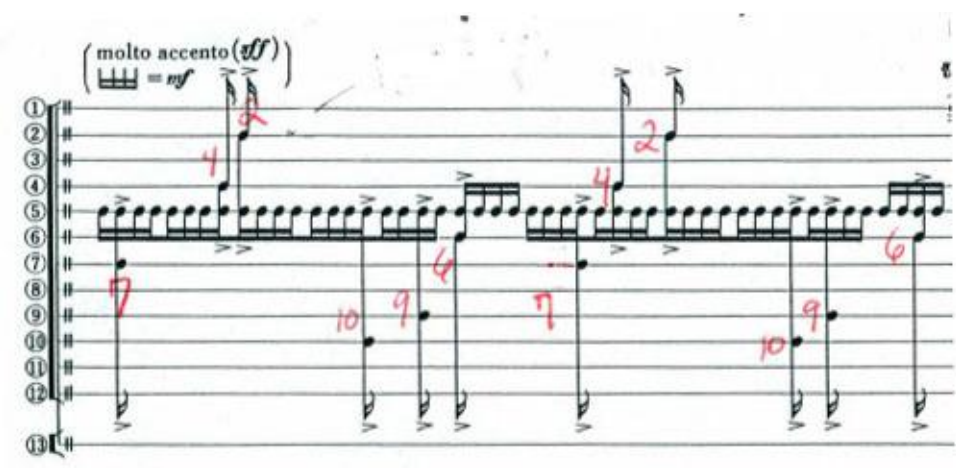
The drum numbers are listed on their relative position to the far left of each page. However, when reading the score, these numbers become difficult to see without taking one's eyes off of the music.

Furthermore, setting up the drums so that they ascend uniformly (for example, left to right as low to high) does not yield a drum configuration on which it is possible to perform the fast, complex figures in the piece. In fact, Mark Berry explores a variety of setups for the piece in his article "Thirteen Drums for Percussion Solo, op. 66: Interpreting in concurrence with Maki Ishii's 'Space-Time' concept" and concludes that the setup which "allows perhaps the greatest potential for realizing the composer's intention that much of the composition be played *as fast as possible*" is in fact not intuitive with regard to the notation (Berry, 2009, p. 58). When learning the piece, I used Berry's suggested setup (seen below).



Example 6.19 Setup diagram for *Thirteen Drums Op. 66* (1986), by Maki Ishii

Obviously, the configuration of the drums is not intuitive with regard to the hierarchy of the notation system as they do not follow a particular ascending or descending pattern. In order to alleviate this problem, I elected to somewhat ignore the location of each drum on the staff and to instead simply internalize each drum's physical location in relationship to its number. To facilitate this internalization, I physically placed numbers on the drum heads using masking tape and then wrote the corresponding numbers on the score.



Example 6.20 excerpt from page 3, *Thirteen Drums Op. 66*, by Maki Ishii

At this point, in a passage where I should move to play the seventh drum, I could focus simply on the number "7" instead of the physical location of the note head on the staff. After a few days of practicing, it was very easy to remember where the corresponding seventh drum was in my setup, and upon seeing the number “7” in the score, my hands would instinctively move to the drum at the front far left of the configuration. Though there is of course somewhat of a learning curve to such a system, I found that the amount of time that it took me to become comfortable with the notation was relatively small, and I was quickly able to perform the piece without having to memorize large sections of the work. In places where the music was memorized, the numbers served as a nice reference in the practice room. That is, the numbers made it quick and easy to ensure that a memorized passage was being played correctly without having to take the time to count staff lines or reference the numbers on the left-hand side of the staff.

These are just a few examples of potential notation-alteration techniques that can be used to increase learning efficiency in the practice room and confidence on the concert stage. It is likely that not all of these techniques will seem practical or intuitive to each individual. However, these suggestions will hopefully inspire percussionists to use and develop their own techniques and share them with the percussion community.

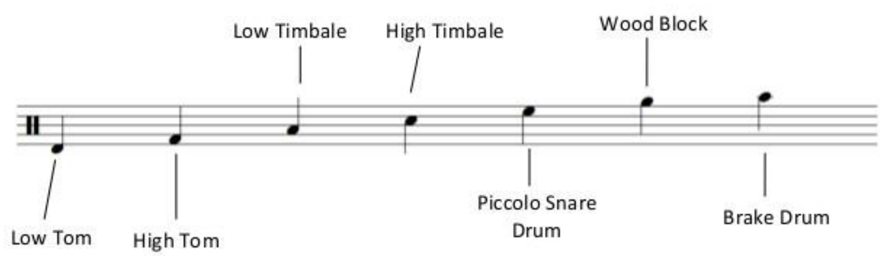
CHAPTER 7

SURVEY OF THE EFFECTIVENESS OF THE COLOR-CODING TECHNIQUE

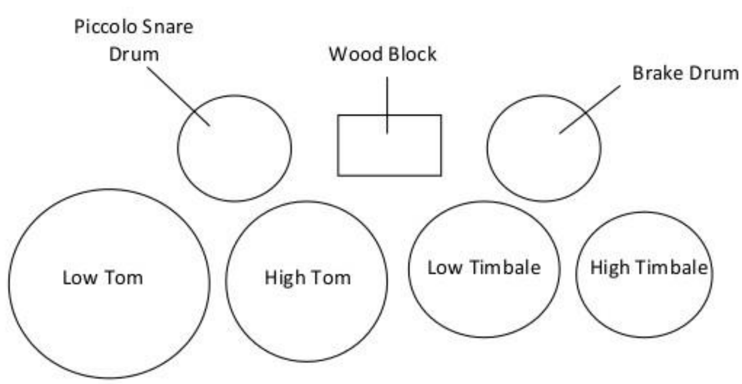
In an effort to evaluate the effectiveness of the color-coding technique on the multiple-percussion learning process, I conducted a survey among percussion students at the University of Wisconsin-Madison. Eight students were asked to practice two pieces of music (one that was color-coded and one that was not) for a period of four days and then take a survey that addressed the effectiveness of the color-coding on their ability to learn the music quickly and effectively. The process and results of this survey are described in this chapter.

In order to appraise the usefulness of the color-coding technique on university percussion students at the University of Wisconsin-Madison, I composed two short multiple-percussion etudes. The instrumentation for each etude consisted of seven instruments, though the setup and instruments used for each etude were unique. The staff keys and instrument configurations for each piece are displayed below.

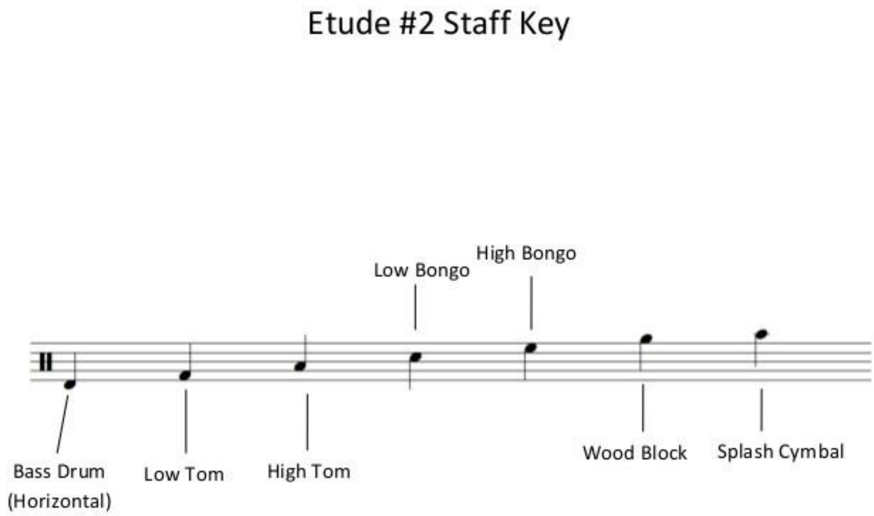
Etude #1 Staff Key

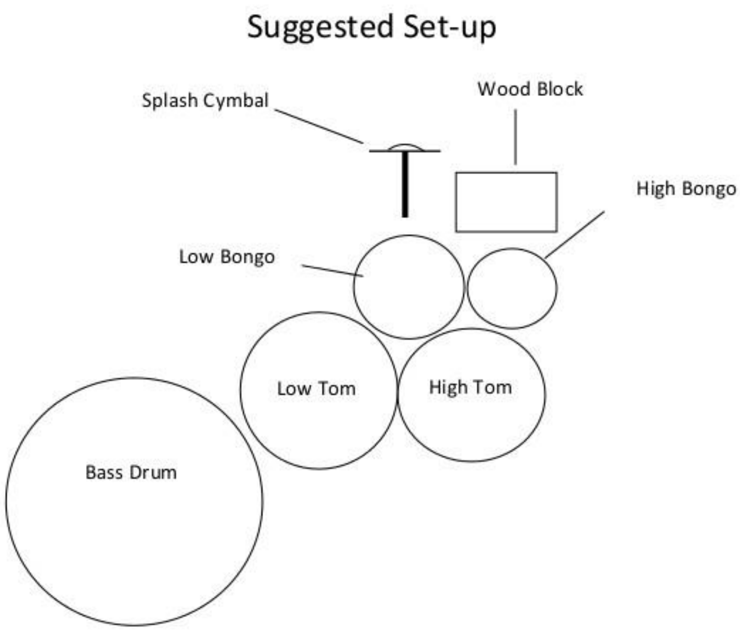


Suggested Set-up



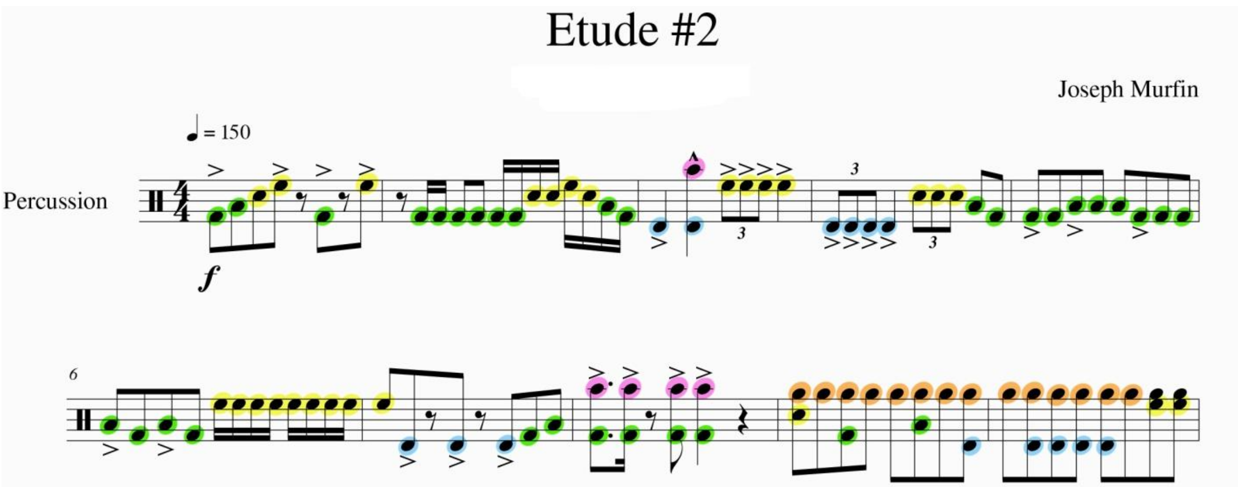
Example 7.1
Etude #1 Staff Key and Instrument Setup





Example 7.2
Etude #2 Staff Key and Instrument Setup

The etudes were composed to be of nearly identical difficulty and were both notated on a standard five-line staff. For each of the etudes, I created two versions: one version that was black and white and one version that was color-coded by instrument group. That is, all instruments of the same type (for example, tom-toms) were colored with the same color. In the example from "Etude #2" below, tom-toms (2) are colored green, bongos (2) are colored yellow, the bass drum is colored blue, the wood block is colored orange, and the splash cymbal is colored purple.



Example 7.3 Etude #2, measures 1-10 (color-coded)

Each student practiced one of the etudes in black and white and the other etude in color. Since I was evaluating the effectiveness of the color-coding on helping the students learn the new notation system, they did not practice the same etude in both formats. That is, I wanted to guarantee that when they began to learn each etude, they had no prior experience with that particular staff system.

I split the students randomly into two groups: Group A and Group B. Group A was asked to practice "Etude #1" in black and white and "Etude #2" color-coded. Group B was asked to practice "Etude #1" color-coded and "Etude #2" in black and white.

Group A	Group B
Etude #1 – Black and White Etude #2—Color-coded	Etude #1 – Color-coded Etude #2—Black and White

Example 7.4 Survey Group Assignments

The purpose of creating two groups was to reduce bias on my own part while composing. That is, I randomized which students received color-coded versions of the particular etude as a way to ensure that the color-coded etude was not purposely easier than the black and white etude. Since both etudes were given in both color-coded and black and white formats, it would be impossible to make the color-coded etude easier than the black and white etude for both groups simultaneously.

Students were instructed to practice each etude for twenty uninterrupted minutes (forty minutes total) each day for four consecutive days. The goal was that at the end of the four days, students would not have mastered the etudes, but would instead still be in the process of learning the music. Therefore, when they filled out the surveys, they could still actively recall the effect of the color-coding on the early learning process.

After four days of consecutive practicing, each student anonymously filled out a fourteen-question survey about their experience with the color-coded notation. The results of the survey were very positive in regard to the use of color-coding. Particularly, the students all agreed that the color-coding was helpful in both distinguishing and remembering which instrument corresponded to which staff line. In addition, the majority of the students indicated that it was easier to learn the color-coded notation, that they made fewer mistakes when reading the color-coded manuscript, and that they felt more proficient playing the color-coded notation than the black and white notation after four days of practicing. One of the most interesting results was that all eight of the students specified that the color-coded notation was easier to sight-read, a very valuable piece of information in regard to multiple-percussion notation practices. Furthermore, every student indicated that the color-coded notation was easier to learn, and a large majority favored reading the color-coded notation over the black and white notation. The detailed results of the survey are listed below.

1. Is this the first time you have played multiple-percussion music that was color-coded by instrument?	Yes	No
Responses-Group A	3	1
Responses-Group B	4	0
Total Responses	7	1

2. When practicing the color-coded piece, did you find the colors distracting?	Extremely distracting	Very distracting	Somewhat distracting	A little distracting	Not at all distracting
Responses-Group A					4
Responses-Group B[14]				2	1
Total Responses				2	5

3. Compared to the uncolored notation, the colored notation made distinguishing between individual instruments on the staff:	Much more difficult.	Somewhat more difficult.	About the same.	Somewhat easier.	Much easier.
Responses-Group A				1	3
Responses-Group B				2	2
Total Responses				3	5

[14] There are only seven responses here because one of the Group B members did not answer this question.

4. How helpful was the color-coding when it came to recalling which instrument related to which staff line?	Not helpful	A little helpful	Somewhat helpful	Very Helpful	Extremely helpful
Responses-Group A				2	2
Responses-Group B		1	1	1	1
Total Responses		1	1	3	3

5. Overall, learning the new staff system with the colored notation was _______ than learning the staff system with the uncolored notation.	Much harder	Somewhat harder	About the same	Somewhat easier	Much easier.
Responses-Group A				3	1
Responses-Group B			2		2
Total Responses			2	3	3

6. Compared to the black and white notation, how did the color-coding affect your note accuracy?	I was much more accurate with the black and white notation.	I was somewhat more accurate with the black and white notation.	There was no difference in accuracy between the colored and non-colored notation.	I was somewhat more accurate with the color-coded notation.	I was much more accurate with the color-coded notation.
Responses-Group A				3	1
Responses-Group B			1	1	2
Total Responses			1	4	3

7. How did the color-coding affect your sight-reading ability?	The color-coding made it much harder to sight-read.	The color-coding made it somewhat harder to sight-read.	The color-coding had no effect on my sight-reading ability.	The color-coding made it somewhat easier to sight-read.	The color-coding made it much easier to sight-read.
Responses-Group A					4
Responses-Group B				1	3
Total Responses				1	7

8. Compared to the uncolored music, the time it took to learn the color-coded music was:	Much longer.	Somewhat longer.	About the same.	Somewhat shorter.	Much shorter.
Responses-Group A		1		1	2
Responses-Group B			2	1	1
Total Responses		1	2	2	3

9. Overall, compared to the uncolored notation, I made:	Significantly more mistakes when practicing the colored notation.	More mistakes when practicing the colored notation.	About the same amount of mistakes when practicing the colored notation.	Fewer mistakes when practicing the colored notation.	Significantly fewer mistakes when practicing the colored notation.
Responses-Group A				3	1
Responses-Group B			1	2	1
Total Responses			1	5	2

10. Which notation did you prefer to practice?	The black and white notation.	No preference.	The color-coded notation.
Responses-Group A			4
Responses-Group B	1	1	2
Total Responses	1	1	6

11. After four days of practicing, how do you feel about your proficiency on the two pieces?	More proficient playing the uncolored music.	About the same level of proficiency playing both pieces of music.	More proficient playing the color-coded music.
Responses-Group A	1	1	2
Responses-Group B		1	3
Total Responses	1	2	5

12. Overall, I think color-coding made the music ________to learn.	Much harder	Harder	About the same	Easier	Much Easier
Responses-Group A				1	3
Responses-Group B				3	1
Total Responses				4	4

13. How do you think color-coding would affect your note accuracy in a performance situation?	It would greatly decrease my note accuracy.	It would somewhat decrease my note accuracy.	It would have no effect on my note accuracy.	It would somewhat improve my note accuracy.	It would greatly improve my note accuracy.
Responses-Group A			1	2	1
Responses-Group B			1	1	2
Total Responses			2	3	3

14. How interested would you be in experimenting with color-coded notation in the future?	Not very interested.	A little interested.	Somewhat interested.	Very interested.	Extremely interested.
Responses-Group A				2	2
Responses-Group B			2		2
Total Responses			2	2	4

The results of this survey indicate overwhelmingly that color-coding by instrument can be a significantly useful tool when learning multiple-percussion music. Not only does it seem to improve sight-reading ability, but it seems to reduce mistakes while practicing and make the music easier to learn overall. In addition, it appears that many percussionists might find color-coded multiple-percussion music preferable to read and that color-coding could improve proficiency in performance situations. My recommendation is that more study is done on this topic and that composers and percussionists alike begin to experiment with other beneficial effects of using color within notation systems. With the advance of technology, using colors in music is cheaper than even twenty years ago, making experimentation with color-coding easier than ever. It is my hope that others perform similar surveys to confirm that this effect is seen in other groups and that the beneficial practices of color-coding will begin to be used in a wide variety of percussion music.

CONCLUSION

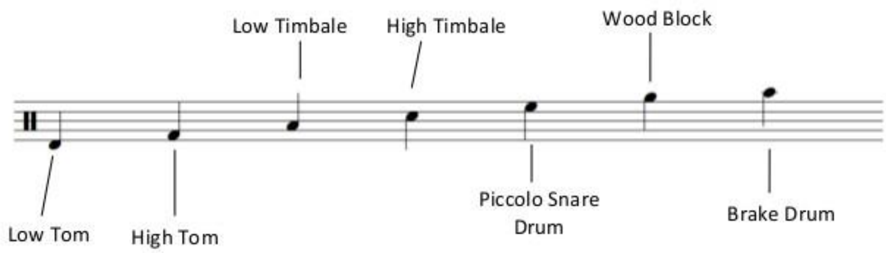
As percussion notation systems continue to evolve and transform, the ability of modern-day percussionists to adapt to new notational structures quickly and efficiently will remain a valuable asset. By using individualized notation alteration techniques, one can develop a personalized system that aides in learning music quickly and performing music with more confidence. Furthermore, the survey conducted in this paper suggests that many percussionists might benefit greatly by implementing such systems. More study should be done on the practical applications of such practices and their effects on percussionists' ability to learn music effectively.

The practices outlined here represent only a small sampling of possible techniques that can be applied to pre-existing percussion notation. However, it is my hope that this document will motivate percussionists to experiment with their own systems and share their ideas with the rest of the percussion community. Likewise, I trust that such a conversation will encourage other musicians and composers alike to think about their own notation systems and how they can be written more efficiently and in a way that facilitates the learning process.

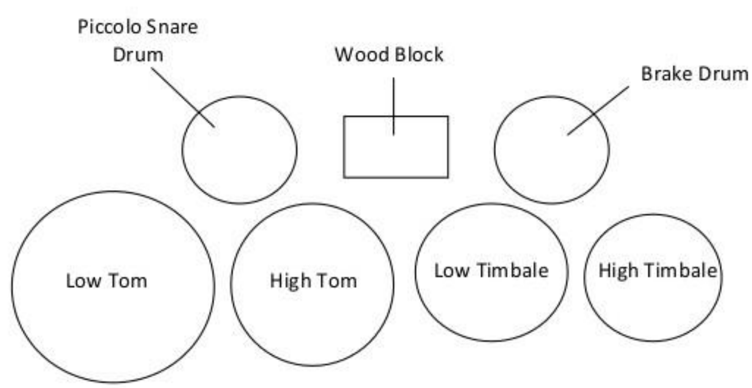
Appendix A

Etude Staff Keys and Instrument Configurations Used in Color-Coding Evaluation

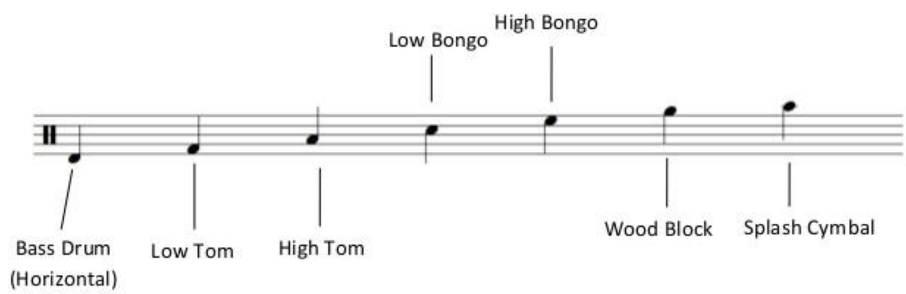
Etude #1 Staff Key



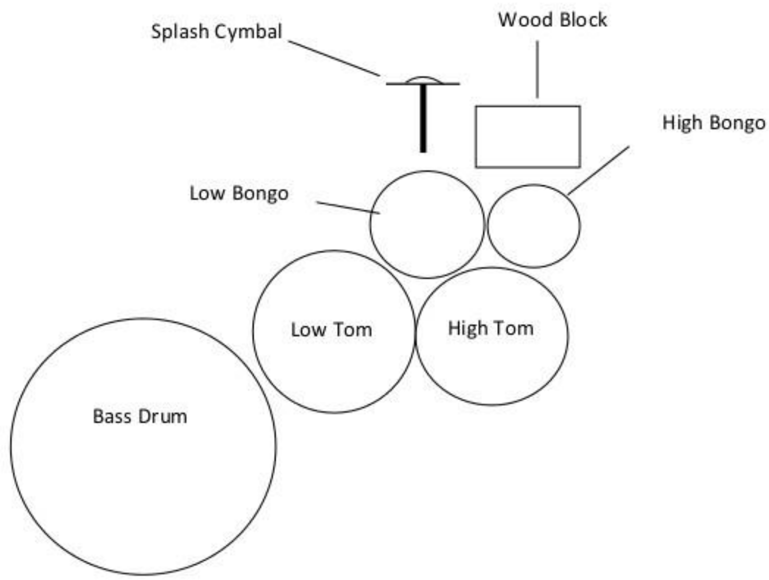
Suggested Set-up



Etude #2 Staff Key



Suggested Set-up



Appendix B

Etude #1 and Etude #2 Used in Color-Coding Evaluation

Black and White

Etude #1

Joseph Murfin


38
42
45
48
ff
51

Etude #2

Joseph Murfin

Etude #2

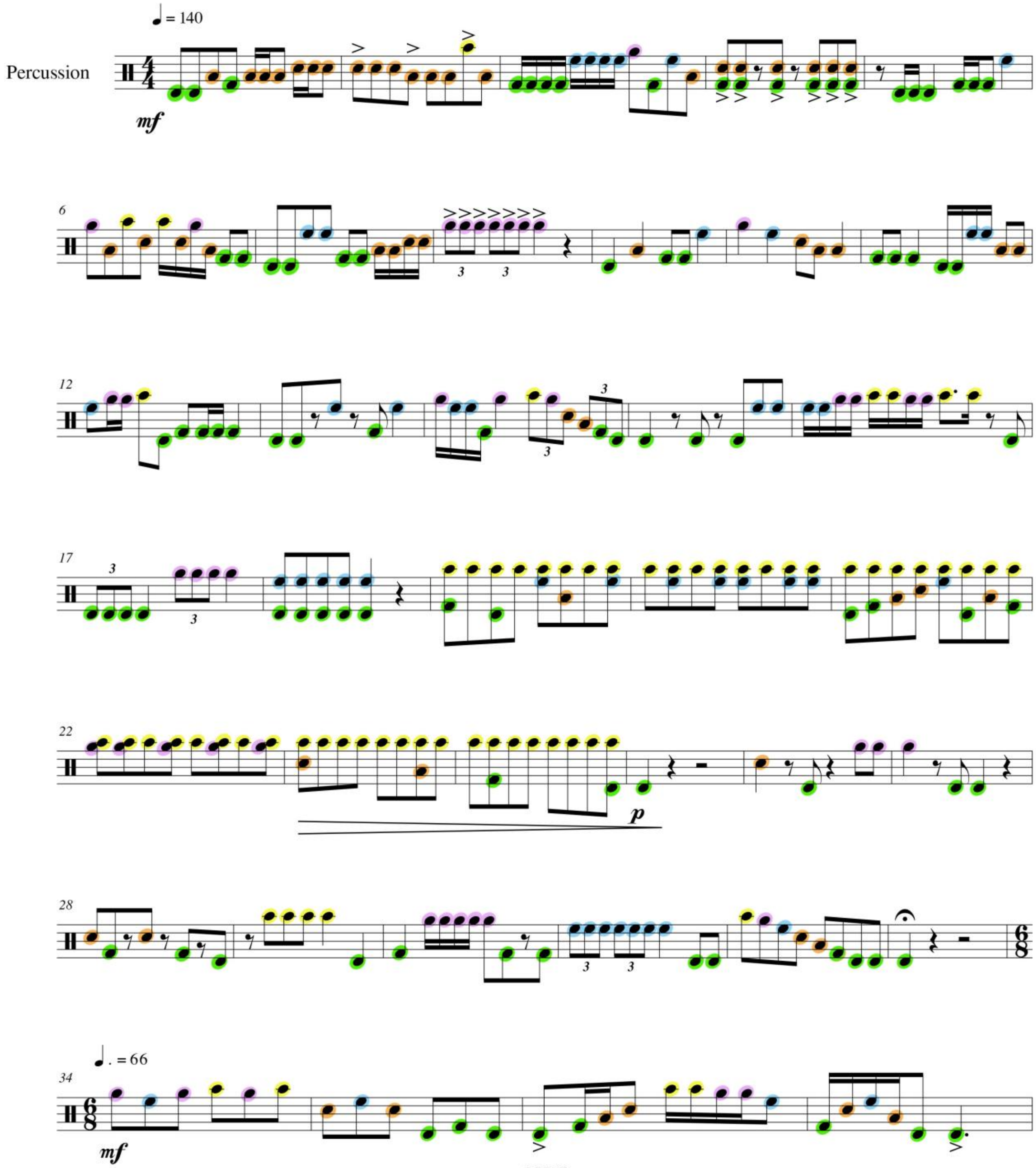
Appendix C

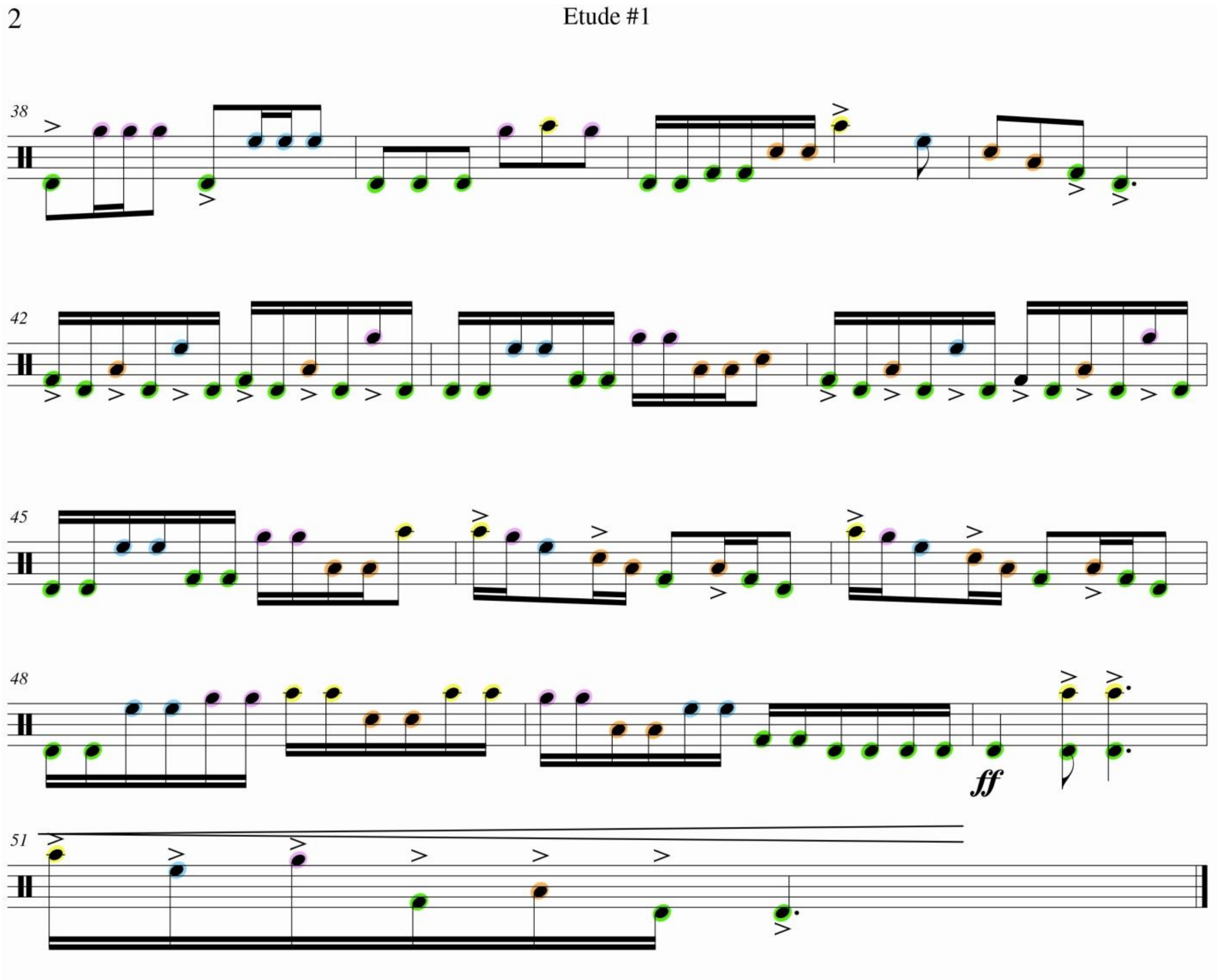
Etude #1 and Etude #2 Used in Color-Coding Evaluation

Color-Coded

Etude #1

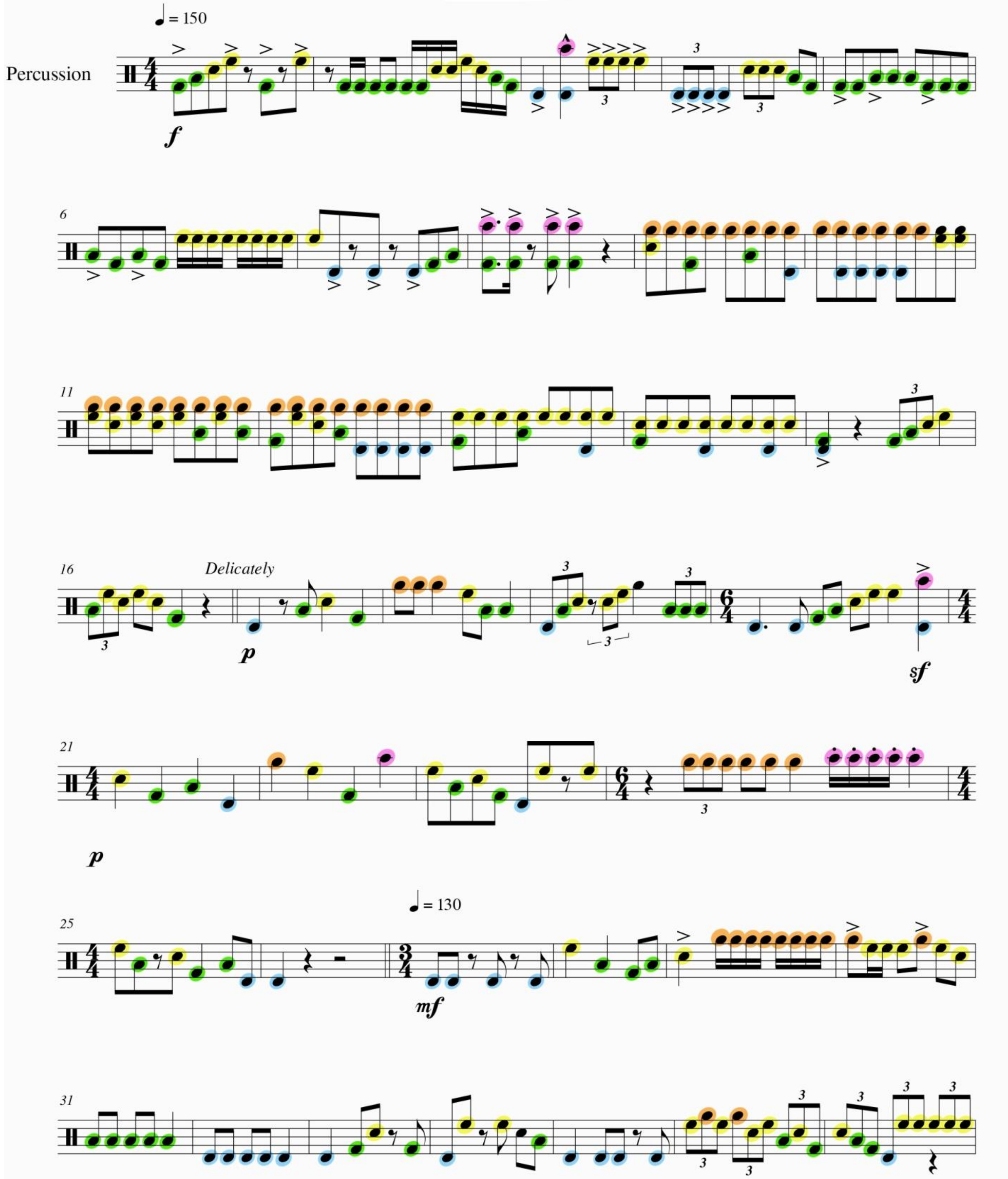
Joseph Murfin

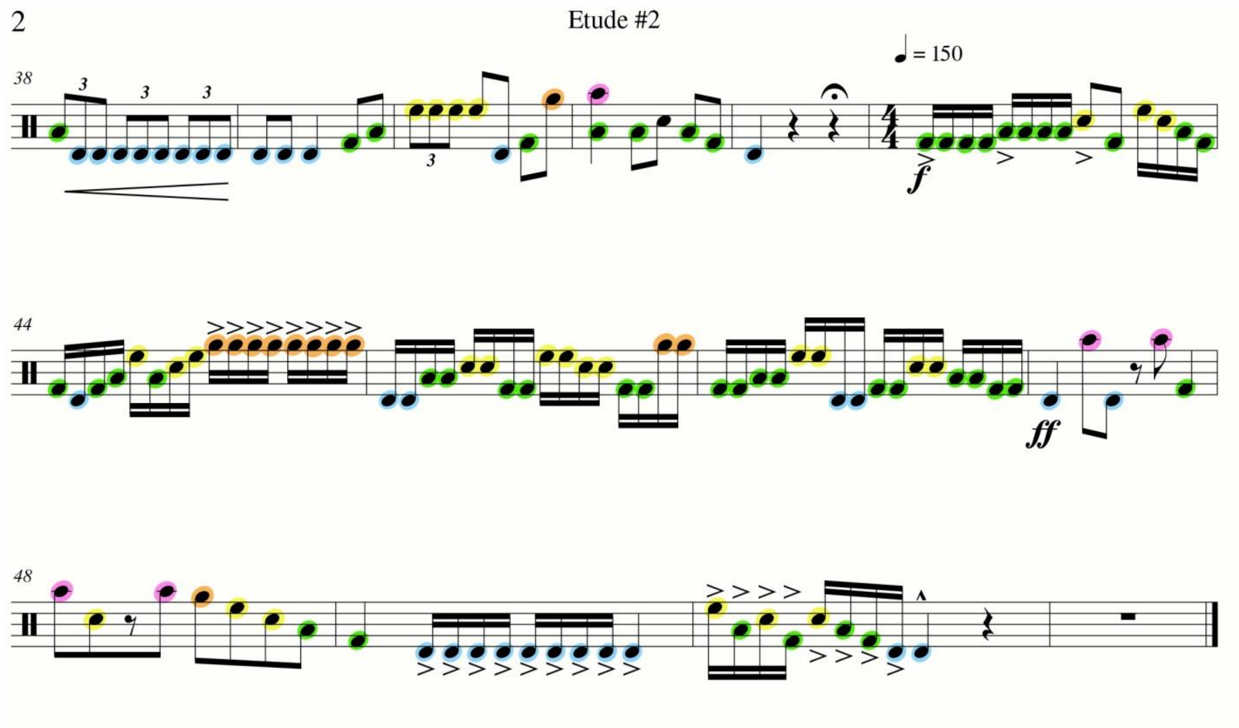



2
Etude #1
38
42
45
48
ff
51

Etude #2

Joseph Murfin




2
Etude #2
38
3
3
3
3
= 150
f
44
ff
48

Appendix D

Survey Used in Color-Coding Evaluation

SURVEY: THE EFFECTS OF COLOR-CODING MULTIPLE PERCUSSION MUSIC

1. Have you ever played multiple-percussion music that has been color-coded by instrument?		Yes		No	
2. When practicing the color-coded piece, did you find the colors distracting?		Yes		No	
3. Compared to the uncolored notation, the colored notation made distinguishing between individual instruments on the staff:	Much more difficult.	Somewhat more difficult.	About the same.	Somewhat easier.	Much easier.
4. The use of color-coding made it easier to remember which staff line corresponded to which instrument:	Strongly disagree	Disagree	No opinion	Agree	Strongly agree
5. Overall, learning the new staff system with the colored notation was _______ than learning the staff system with the uncolored notation.	Much harder.	Somewhat harder	About the same	Somewhat easier.	Much easier.
6. The color-coding technique improved my note accuracy during practice.	Strongly disagree	Disagree	No opinion	Agree	Strongly agree
7. The color-coded music was easier to sight-read than the uncolored music.	Strongly disagree	Disagree	No opinion	Agree	Strongly agree
8. Compared to the uncolored music, the time it took to learn the color-coded music was:	Much longer.	Somewhat longer.	About the same.	Somewhat shorter.	Much shorter.
9. Overall, compared to the uncolored notation, I made:	Significantly **more** mistakes when practicing the **colored** notations.	**More** mistakes when practicing the **colored** notations.	About the **same** amount of mistakes when practicing the **colored** notations.	**Fewer** mistakes when practicing the **colored** notation.	Significantly **fewer** mistakes when practicing the **colored** notation.
10. I preferred practicing the color-coded notation versus the uncolored notation.	Strongly disagree	Disagree	No opinion	Agree	Strongly agree

11. After 4 days of practice, I feel	More proficient playing the uncolored music.		About the same level of proficiency playing both pieces of music.		More proficient playing the color-coded music.
12. Overall, I think color-coding made the music ________to learn.	Much harder	Harder	About the same	Easier	Much Easier
13. I believe using color-coded multiple-percussion music would increase note accuracy during performance.	Strongly disagree	Disagree	No opinion	Agree	Strongly agree
14. I would be interested in experimenting with color-coding on other multiple-percussion pieces in the future.	Strongly disagree	Disagree.	No opinion.	Agree	Strongly agree

Appendix E

Instructions for Color-Coding Evaluation

Instructions:

You will practice the two etudes for four consecutive days. Please pick a time period over the next few weeks that will allow you to do so without missing a day.

Practice each etude for one, uninterrupted 20-minute session each day. You may either practice both etudes in a 40 minute block or you may practice in two 20-minute sessions spread out over the course of the day.

Both etudes consist of 7 instruments, which are represented on a five-line staff. One of the etudes will be black and white, while the other will be color-coded by instrument. For example, in Etude #2, there are two bongos (a high and a low), but both are colored yellow. Meanwhile, the two tom-toms are both colored green. The bass drum is colored purple, etc.

Practice each etude as if you were preparing them for a future performance. Use whatever techniques you would normally use while practicing a piece of multiple-percussion music (slow practice, recovery prep, etc.). You are free to adjust the setups as you practice, but please return them back to the recommended setup after you are finished with each practice session. Also, at the end of each practice session, please return the sheet music back to its appropriate folder, face down.

The goal of the exercise is not for you to be able to play the etudes perfectly by the end of the four days, or even to be able to play them all the way through. There is no particular percentage of the piece that you are expected to complete by the end of the four days. In fact, the hope is that by the end of the four days, you will still be in the process of learning the music.

At the end of the four days, you will be asked to fill out a survey concerning the effect of the color-coding on your ability to learn the music. Please let me know whenever you begin your four day practice routine, so I can be sure you have a survey right after you finish.

Important: On the first day that you begin to learn the music, try to sight-read all the way through each piece at a slow tempo. One of the survey questions will be related to the first sight-reading.

Things to think about as you practice the pieces over the four days:

1. What kind of effect (if any) does the color-coding have on your ability to easily identify individual instruments on the staff?
2. Does the color-coding affect your note accuracy?
3. Does the color-coding affect the speed at which you learn the notation system (i.e. which instrument relates to which staff line) versus the black and white notation?
4. Does the color-coding affect the speed at which you learn the music in general versus the black and white notation?
5. Does the color-coding affect your retention of the previous day's practice session? i.e. When reviewing the material learned on a previous day, does the color-coding help or hinder?

WORKS CITED

Applebaum, T. L. (1978). *A comprehensive performance project in percussion literature with an essay comprised of multi-percussion performance problems as found in selected contemporary works, with original etudes relevant to those problems*.(Doctoral Dissertation). Retrieved from Proquest Dissertations and Theses Global (302885063)

Banister, S. (1994). The effects of highlighting on the musicality of middle school band students' performance. *Contributions to Music Education*, *21*, 64–72.

Bean, K. L. (1938). An experimental approach to the reading of music. *Psychological Monographs*, *50*(6), i–80.

Berry, M. (2009). Thirteen Drums for Percussion Solo, op. 66: Intepreting in concurrence with Maki Ishii's "Space-Time" concept. *Percussive Notes*, *47*(5), 50–59.

Brindle, R. S. (1970). *Contemporary percussion*. London: Oxford University Press.

Brün, H. (1974). In and-- and out : opus 44. Baltimore, Md.: Smith Publications.

Bukspan, Y. (1979). Introduction to musical literacy to children by means of a binary system of music notation: an experimental Study. *Council for Research in Music Education*, *59*(Summer), 13–17.

Caskel, C. (1971). Notation for percussion instruments. *Percussionist*, *8*, 80–84.

Chuang, M.-C., & Kuo, Y.-T. (2013). A proposal of a color music notation system on a single melody for music beginners. *International Journal of Music Education*, *31*(4), 394–412.

DePonte, N. (1975). Zyklus: how and Why? *Percussionist*, *12*(4), 136–149.

Di Sanza, A. (2007). *Improvisational practice techniques: A handbook for incorporating improvisation into the percussionist's daily practice routine*. Eau Claire: RGM Music.

Early, D. (1993). Percussion performance issues in Stravinsky's Histoire du soldat. *Percussive Notes*, *31*, 69–75.

Emmerson, S., & Xenakis, I. (1976). Xenakis talks to Simon Emmerson. *Music and Musicians*, *24*(May), 24–26.

Falter, H. E. (2011). The new beat spectrum: With a rhythm color worksheet, learning to count can take on an extra dimension. *Teaching Music*, *19*(3), 28–31.

Fletcher, S. (1957). Music reading reconsidered as a code-learning problem. *Collected Work: Journal of Music Theory. I/1 (March 1957). (AN: 1957-00828).*, *1*, 76–96.

Galm, J. (1972). The need for using symbols in percussion notation. *NACWPI Journal*, 46–49.

Godjevatz, V. (1948). *The new musical notation : without clefs, without sharps, without flats, without naturals*. New York, N.Y.: Godjevatz.

Julian-Jones, R. C. (2005). *A survey of multiple percussion notation with an emphasis on timbre staff notation and setup*. (Doctoral Dissertation). Retrieved from ProQuest Dissertations and Theses Global. (305390134)

Kamstra, D. J. (2006). *Multiple-percussion notation: The effectiveness of three types of staff notation on sight-reading ability*. (Doctoral Dissertation).Retrieved from ProQuest Dissertations and Theses Global. (305329610)

Kerr, J. M. (2014). *Adults' experiences learning traditional music notation: A phenomenological study*. (Doctoral Dissertation). Retrieved from ProQuest Dissertations and Theses Global. (1611246315)

Kraft, W. (1992). Histoire du Soldat - a music review of Chester's publication. *Percussive Notes, 30*, 47–54.

Kyme, G. H. (1960). An experiment in teaching children to read music with shape notes. *Journal of Research in Music Education*, *8*(1), 3–8.

Lang, M. (1975). "A Journey to the Source" on L'Histoire du Soldat. *Percussionist*, *12,* 50–54.

Maconie, R. (2005). *Other planets: The music of Karlheinz Stockhausen*. Lanham, Md.: Scarecrow Press.

McCarty, F. (1980). Symbols for percussion notation. *Percussive Notes: Research Edition Percussionist*, *18*(1), 8–19.

McVay, V. J. (2005). *The effectiveness of color-coding for learning music theory rudiments, aural skills, and keyboard skills in persons aged 60 and older*. (Doctoral Dissertation). Retrieved from ProQuest Dissertations and Theses Global (304994424)

Mortenson, G. R. (1970). *Development and use of computerized procedures for scores sight reading of rhythms to compare of metric and representational notation with conventional notation*. (Doctoral Dissertation). Retrieved from ProQuest Dissertations & Theses Global. (302441671)

Nicholls, D., & Cowell, H. (1996). *New musical resources*. Cambridge ; New York: Cambridge University Press.

O'Connor, G. A. (1966). Prevailing trends in contemporary percussion notation. *Percussionist*, (n4), 61–74.

O'Neill, J. C. (1980). Recent trends in percussion notation. *Percussive Notes Research Edition Percussionist*, *18*(1), 22.

Osborn, L. A. (1966). Notation should be metric and representational. *Journal of Research in Music Education*, *14*(2), 67–83. doi:10.2307/3343957

Owens, P. (2005). *Cognitive load theory and music instruction*.(Doctoral Dissertation). University of New South Wales, Sydney, Austrailia

Owens, P., & Sweller, J. (2007). Cognitive load theory and music instruction. *Educational Psychology*, *28*(1), 29–45. doi:10.1080/01443410701369146

Pratt, D. (1977). Performance analysis: Morton Feldman,. *Percussive Notes Research Edition*, *25*(3), 70–83.

Read, G. (1987). *Source book of proposed music notation reforms*. Westport: Greenwood.

Read, G. (1998). *Pictographic score notation: A compendium*. Westport: Greenwood.

Reynolds, R. (2005). *Mind models: New forms of musical experience*. New York: Routledge.

Rivera-Diaz, A. (1992). *The development and trial of a beginning band method for teaching wind and percussion instruments based on a notation system different from the traditional notation*. (Doctoral Disseration) Retrieved from ProQuest Dissertations and Theses Global (304000907)

Rogers, G. L. (1991). Effect of color-coded notation on music achievement of elementary instrumental students. *Journal of Research in Music Education*, *39*, 64–73.

Rogers, G. L. (1996). Effect of colored rhythmic notation on music-reading skills of elementary students. *Journal of Research in Music Education*, *44*(1), 15–25. doi:10.2307/3345410

Rosen, M. (1996). Terms used in percussion: russian percussion. *Percussive Notes*, 64.

Shockley, R. P. (1997). *Mapping music : for faster learning and secure memory : a guide for piano teachers and students*. Madison, Wis.: A-R Editions.

Sliwinski, A. (2013). Read-Memorize-Cheat! Retrieved from http://adamsliwinski.blogspot.com/2013/07/read-memorize-cheat.html?q=cheat

Smith, A. G. (2005). *An examination of notation in selected repertoire for multiple percussion*. University Microfilms International (UMI), Ann Arbor.

Stone, K. (1987). Foreward. In *Source book of proposed notation reforms* (pp. ix–x). Westport: Greenwood.

Udow, M. (1981). Visual correspondence between notation systems and instrument configurations. *Percussive Notes Research Edition*, *18*(2), 15–29.

Whitehead, A. N. (1958). *An introduction to mathematics*. New York: Oxford University Press.

Williams, M. (2001). Stockhausen: “Nr. 9 Zyklus.” *Elements*, (9), 60–69.

Wolf, T. (1976). A cognitive model of musical sight-reading. *Journal of Psycholinguistic Research*, *5*, 143–171.

Zaplitny, M., & Xenakis, I. (1975). Conversation with Iannis Xenakis. *Perspectives of New Music*, *14*(1), 86–103. doi:10.2307/832544