

The Effect of Metronome Use on Heart Rates in Top 10 Drum Corps Percussionists

by
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A thesis presented to the Honors College of Middle Tennessee State University in
partial fulfillment of the requirements for graduation from the University Honors
College

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Abstract

PURPOSE: To evaluate if playing a musical selection without a metronome would affect the heart rates of drum corps percussionists. **METHODS:** Heart rate and Rate of Perceived Exertion (RPE) values were collected from eleven battery and twelve front ensemble members from one drum corps. The music consisted of two portions of the show at two different tempos (i.e. 96 beats per minute (bpm) and 176 bpm). The music was performed at "standstill" with the battery members lined up behind the front ensemble marching in time, but not moving around or carrying their instruments. The participants performed each show tempo, with and without a metronome, three times with a one-minute rest period between each repetition. Participants recorded RPE values for the two show selections, with and without a metronome. **RESULTS:** There was no significant difference between heart rates for both tempos with and without a metronome. When playing without a metronome, RPE values were higher for the slower musical selection (11.83 ± 1.61 vs. 12.65 ± 1.72 , $p < 0.05$), as well as the faster selection (13.87 ± 2.34 vs. 14.48 ± 2.33 , $p < 0.05$). The front ensemble heart rates were higher than the battery during the faster selection with (104.39 ± 6.93 vs. 129.19 ± 17.40 bpm, $p < 0.05$) and without a metronome (105.03 ± 8.03 vs. 128.58 ± 18.84 bpm, $p < 0.05$). **CONCLUSION:** Playing without a metronome requires more effort from drum corps percussionists, psychologically, but does not affect heart rate. The physical demands of the faster selection are most likely the cause of such a drastic difference in heart rate between the battery and front ensemble.

Acknowledgements

I would like to acknowledge and thank everyone who supported me during this process. Thank you to my family for helping me financially and providing housing while I collected data in Illinois. Thank you to Dr. Barry for guiding me so patiently through the entire design and writing process. Finally, thank you to the 2014 Phantom Regiment and 2014 Cavaliers Drum and Bugle Corps staff and participants. Without your cooperation and participation, data collection could not have been accomplished as smoothly and successfully. Your willingness to help me and work my study design into your schedule does not go unnoticed.

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Terms and Definitions

Supine position: lying on the back; this position for a period of time is recommended in order to obtain a measurement closest to the heart rate while sleeping. (Swain, 250)

DCI: acronym for Drum Corps International; Drum Corps International is an internationally known, nonprofit organization for elite marching activity. This league encompasses World and Open class drum corps that train and tour across North America each summer. (Introduction)

Battery: another name for marching percussionists; the battery consists of snare, quad, and bass drums that are worn and carried by the players as they march across the field.

Front Ensemble: another name for non-marching percussionists; the front ensemble can consist of marimbas, vibraphones, xylophone, glockenspiel, synthesizer, timpani, gong, concert bass drum, and other miscellaneous instruments for effect. The players do not wear these instruments and do not march while playing.

Dut: this word is spoken at a certain speed to maintain tempo over periods where instruments are not played. The short vowel sound helps with pronunciation and space distinction during fast tempi.

Introduction

Studies have measured the effects of music on heart rates, but the results remain inconclusive. Many of the studies showing non-significant results involve participants at rest and their physiological reactions (i.e. heart beat and respiration rate) just from listening to music (Battacharya, 2013; Ellis, 1952). Some studies conclude that music does not significantly affect heart rate and could be more relaxing than arousing (Battacharya, 2013; Dainow, 1977; Ellis, 1952). The difference may be in performing an action to the rhythm of the music. In a study by Barbosa (2010), participants performed certain aquatic aerobic exercises to music with varying tempos. A significant change in heart rate probably occurred because participants performed aquatic exercise in time with the tempo, causing an increase in heart rate with an increase in exercise intensity. A study by Bernardi (2006) resulted in heart rates lower than the resting baseline when silence was intermittently placed within musical tracks. This study suggests that music and sound could have an arousing effect on heart rate. ESPN recorded an experiment with a Drum Corps percussionist in 2005 conducted by an exercise physiology professor, Dr. Edwards. Dr. Edwards measured the member's heart rate and energy expenditure during rehearsal. Data from Edwards' measurements showed that the member's heart rate jumped to 180 beats per minute (bpm) when the corps started playing—while the member wasn't actually on the field playing (Allen, 2007). This testimony relates the effects of music and sound to the marching population and questions how much of a physiological response occurs during rehearsal.

Fewer studies have distinguished the effects of certain sounds or tempi without music. A study by Yanagihashi, et al. (1997) concluded that a mechanical sound in comparison to a synthesizer and birds tweeting induced alertness and sympathetic

nervous dominance in the participants. These results suggest that a mechanical sound, such as a metronome, creates alertness and could increase heart rate. A study by Repp et al. (2001) assessed finger tapping synchronized with repetitive sound. The response to tempo change was used as a means to quantify internal neural processes. Repp concluded that detection of change caused a quicker correction response in finger tapping than undetected change (2001). Drum corps percussionists consciously make tempo adjustments in response to the metronome and to each other during rehearsal. However, no studies have assessed whether the use of a mechanical sound, a metronome, affects their heart rates. In order to practice maintaining time, practices consist of using and removing a metronome from the listening environment while playing. Internalizing tempo without a metronomic correction may or may not affect heart rate.

The Borg RPE scale is a numerical and descriptive scale ranging from 6 to 20 and "no exertion at all" to "maximal exertion," respectively. This scale was created to predict heart rate with the equation, $HR = RPE \times 10$ bpm and can be used to predict intensity for dynamic exercise (Swain, 2014). In a study by Chen (2013), dynamic, partially dynamic, and static exercises (i.e. running, dumbbell curls, and an isometric hold in the curled position while holding a dumbbell, respectively) were performed to validate the relationship between RPE and heart rate. Chen (2013) validated the modified regression equation for an RPE range of 11-16 ($HR = RPE \times 10 + 20 \sim 30$ bpm) and concluded that RPE cannot accurately predict heart rate for partially dynamic and static exercise. Therefore, the relationship between heart rate and RPE is dependent on full-body, aerobically demanding work. Because standing and playing would be considered a partially dynamic exercise, RPE cannot accurately predict the heart rate response for this study.

Thesis

The percussion section, especially the marching percussion, provide tempo for a drum corps because a metronome cannot be used during a performance. Directors and instructors must consider changes that occur between rehearsal and performances once the metronome is used from the listening environment. The purpose of this study is to evaluate if playing a musical selection without a metronome would affect the heart rates and RPE values of drum corps percussionists. It is hypothesized that heart rate and RPE will not vary when playing musical phrases without a metronome as these are highly trained individuals and playing without a metronome should not be more difficult.

Methods

Participants

Data was collected from twenty-four percussionists from one drum corps; 17 males and seven females with a mean age of 19.96 ± 1.07 years old participated. The drum corps director was emailed for approval before recruiting the percussionist members. Marching (i.e. seven snare drums, three bass drums, two quad drums) and nonmarching (i.e. five marimbas, one xylophone and glockenspiel, four vibraphones, one synthesizer, one timpani) percussionists were evaluated. Based on the AHA/ACSM Health/Fitness Facility Preparticipation Screening Questionnaire (ACSM, San Diego, California), all participants were able to participate in physical activity, and were free of heart problems. After explaining the protocol and purpose, consent was attained. The University Institutional Review Board approved this study.

Members from a second Drum Corps participated in this study. This data was not combined with the first Drum Corps data because this group had different music,

environmental setup (outside vs. inside), and participant profile (all-male vs. co-gender). Furthermore, only 12 percussionists from the drum corps participated in the study (i.e. five battery and seven front ensemble).

Procedure

Roughly 26 hours before data collection day, participants were emailed and/or texted a reminder of the study, which included the meeting location for monitor assignment, a list of foods and supplements containing caffeine that should be avoided, and contact information regarding withdrawal. On the morning of data collection, participants were assigned monitors, ate breakfast, and stretched quadriceps, hamstrings, calves, hips, forearms, upper arms, necks, and backs. Following stretch, all 24 participants assumed supine positions for roughly 15 minutes. Following the 15 minutes, resting heart rates were recorded for five minutes. Participants followed a regular morning rehearsal schedule once the resting heart rate measurement was complete. The front ensemble members played musical warm-ups outside, focusing on physical coordination for moving around the instrument as well as mental integration amongst the members. Battery members performed marching warm-ups consisting of marching forward, backward, and horizontally while playing and not playing. They also learned drill, which consisted of marching for a certain number of counts, pausing to receive correction, and moving back to the original position. After an hour lunch, the percussion sections lined up in standstill in an air-conditioned gym to complete the heart rate assessment with and without the metronome.

The metronome setup consisted of a Boss DB-90 Dr. Beat (Roland, Los Angeles, California) digital metronome on the quarter note, non-accented setting and connected to a Long Ranger (Lectrosonics, Rio Rancho, New Mexico) portable speaker. Heart rate

was measured using Polar RS800 heart rate monitors. Each monitor was lubricated with water and placed on the skin over the sternum and below the chest muscles. The members were allowed to wear the sensor watches or keep them in mallet bags while playing.

The music consisted of two portions of the 2014 Phantom Regiment Drum and Bugle Corps production, *Swan Lake* (TheMrDavidLangley, 2014). The first selection was picked from the first movement of the show—arrangement of *Swan Lake* by Peter Illyich Tchaikovsky, and was played at 96 bpm. The second selection was the percussion feature in the third movement of the show—arrangement of *Dracula* by Philip Feeny, and was played at 176 bpm. The show selections were chosen based on moments that both percussion sections played and that both sections were comfortable with, while providing a tempo variety. The time elapsed for each repetition included the first tap or beep of the metronome to the last not played; the metronome was stopped with the last note played. The slower, majestic selection lasted approximately 50 seconds, while the faster, aggressive selection lasted approximately one minute and 13 seconds. The participants played each portion with and without a metronome for a total of four different data sets. The music was performed at "standstill" where the battery members were lined up behind the front ensemble; the battery was marching in time but not moving around and not carrying their instruments. The repetitions with a metronome included four, quarter-note beeps before the cues and continuous beeping until the last note played. The center snare player tapped two half-note cues followed by four, quarter note vocal "duts" from the entire battery for all repetitions. Participants performed each show section, with and without a metronome, three times with a one-minute rest period between each repetition. Once they finished playing completely, participants recorded RPE values for the two show tempos, with and without a metronome.

Data Analysis

After data collection, the resting heart rates for the second through fourth minutes of rest were averaged. The fifth minute was not included as many participants moved during this minute. Analysis involved downloading the heart rate information through Polar ProTrainer 5 (Polar Electro, Kempele, Finland). This software stored the heart rate data and allowed the information to be viewed in visual and list formats with corresponding time measurements at which the heart rates occurred each second. Lap markers were manually placed at the recorded start and stop times for each repetition to average the heart rates for the metronome and non-metronome musical selection. Statistical analysis was completed using SPSS software (IBM, Armonk, New York), to compare metronome vs. non-metronome heart rates and RPE values for the entire group and between the battery and front ensemble. Paired-sample and independent T-test analysis measured significance at a p value of ≤ 0.05 .

Results

A total of 23 male and female members participated in the study (See Table 1). Participants performed two selections of a show at different tempos three times with and without a metronome for a total of six performances per selection. The average heart rate and RPE values for the 11 battery and 12 front ensemble members were analyzed using paired-sample and independent T-tests. Analysis compared metronome vs. non-metronome values for the entire group, as well as the battery vs. front ensemble.

There was no significant difference between heart rates with and without a metronome for each tempo. RPE values were significantly higher for the first musical selection at 96 bpm ($p < 0.05$), as well as the second selection at 176 bpm ($p < 0.05$)

without a metronome compared to with a metronome (See Table 2). The front ensemble heart rates were higher than the battery during the faster selection with ($p < 0.05$) and without a metronome ($p < 0.05$) (See Table 3 and Table 4).

Table 1: Characteristics of Participating Drum Corps Members (mean \pm SD)

	Battery ($n = 11$)	Front Ensemble ($n = 12$)	Total ($n = 23$)
Age (y)	19.91 \pm .90	20 \pm 1.15	19.96 \pm 1.07
Male	10	6	16
Female	1	6	7
Resting Heart Rate (bpm)	63.27 \pm 7.01	70.03 \pm 6.05	66.80 \pm 7.51

Table 2: Total Heart Rate and RPE* Values When Playing With and Without a Metronome at Different Tempos (mean \pm SD)

	96 M	96 NM	176 M	176 NM
Heart Rate (bpm)	105.49 \pm 9.00	104.96 \pm 9.43	117.33 \pm 18.27	117.32 \pm 18.75
RPE	11.83 \pm 1.61	12.65 \pm 1.72†	13.87 \pm 2.34	14.48 \pm 2.33‡

*RPE = Rate of Perceived Exertion; M = with a metronome; NM = without a metronome; $n = 23$

† $p = .000$ 96 NM vs 96 M for RPE; ‡ $p = .003$ 176 NM vs 176 M for RPE

Table 3: Heart Rate and RPE* Values by Section When Playing With and Without a Metronome at 96 bpm (mean \pm SD)

	M BA	M FE	NM BA	NM FE
Heart Rate (bpm)	102.72 \pm 7.55	108.03 \pm 9.77	101.64 \pm 7.13	108.00 \pm 10.52
RPE	11.55 \pm 1.86	12.08 \pm 1.38	12.73 \pm 1.90	12.58 \pm 1.62

*RPE = Rate of Perceived Exertion; M = with a metronome; NM = without a metronome; BA = Battery ($n = 11$); FE = Front Ensemble ($n = 12$)

Table 4: Heart Rate and RPE* Values by Section When Playing With and Without a Metronome at 176 bpm (mean \pm SD)

	M BA	M FE	NM BA	NM FE
Heart Rate (bpm)	104.39 \pm 6.93	129.19 \pm 17.40 [†]	105.03 \pm 8.03	128.58 \pm 18.84 [‡]
RPE	12.82 \pm 2.27	14.83 \pm 2.04	13.82 \pm 2.52	15.08 \pm 2.07

*RPE = Rate of Perceived Exertion; M = with a metronome; NM = without a metronome; BA = Battery ($n = 11$); FE = Front Ensemble ($n = 12$)

[†] $p = .000$ M Front Ensemble vs Battery for Heart Rate; [‡] $p = .001$ NM Front Ensemble vs Battery for Heart Rate

Discussion

The primary purpose of this study was to evaluate if playing a musical selection without a metronome would affect the heart rate of drum corps percussionists. The secondary purposes were to compare the heart rates between sections, and to evaluate the psychological effort using RPE during the same scenario. Results showed no significant difference in heart rate between playing with and without a metronome at the slower tempo (105.49 \pm 9.00 vs. 104.96 \pm

9.43) and faster tempo (117.33 ± 18.27 vs. 117.32 ± 18.75), respectively. However, RPE was significantly different when playing with and without a metronome at the slower tempo (11.83 ± 1.61 vs. 12.65 ± 1.72 , $p < .05$) and faster tempo (13.87 ± 2.34 vs. 14.48 ± 2.33 , $p < .05$). In addition, the front ensemble had significantly higher heart rates than the battery while playing with (104.39 ± 6.93 vs. 129.19 ± 17.40 , $p < .05$) and without a metronome (105.03 ± 8.03 vs. 128.58 ± 18.84 , $p < .05$) at a tempo of 176 bpm.

No effect from playing without a metronome on heart rate most likely occurs as the percussionists perform the same motions regardless of a metronome. Percussionists are trained to perform the same motions at a consistent speed without a metronome, so the heart rate remains consistent in order to maintain consistent actions. Furthermore, the significant difference in heart rate between the battery and front ensemble seems contradictory. Studies by Barbosa (2010) on aquatic aerobic participants and Bernardi (2006) on musicians and nonmusicians show a linear relationship between tempo and heart rate. Therefore, as percussionists move at a faster speed, heart rate should increase. One would think the battery would have similar heart rates to the front ensemble as the battery members are not marching and wearing their instruments, yet battery member heart rates were lower at the faster tempo. One reason could be that battery members are more fit, indicated by a lower average resting heart rate and greater stroke volume, causing a less dramatic rise in heart rate with intensity. The study was completed a week after the beginning of full-day rehearsals requiring the battery to march and carry their drums. Some physiological adaptations to training could have occurred. Although

the AHA-ACSM questionnaire contains a question regarding physical inactivity, activity levels before the study were not assessed. The most probable cause is the musical demands particular to the front ensemble compared to the battery. Even though both sections may be playing at the same tempo and using mainly upper body motion to play, the differences in playing motion, (e.g. pronating, supinating and flexing the wrist once vs. twice within the same amount of time for an extended amount of time, and playing in one area of the drum vs. reaching for notes) supports the significant heart rate differences between the battery and front ensemble.

The significant change in RPE when playing without a metronome suggests that more psychological effort is needed to play without a metronome. The goal of maintaining tempo is to maintain the space between each beat, not necessarily maintaining a beat. In order for the entire percussion section to play together and sound like one person, personal adjustments must be made in order to play each beat of music with the correct space corresponding to tempo. A metronome provides a constant and consistent checkpoint that can be heard by all percussionists. Playing without a metronome removes this checkpoint causing members to adapt to the tempo and tempo changes. Repp (2001) recreated previous finger tapping experiments to validate awareness of tempo change. The study concluded that a conscious effort is required to detect tempo change quickly. An internal timekeeper controls motor activity. The difference in space between the audible tones and the pace controlled by the timekeeper must be acknowledged and diminished for synchronization. This involves a higher-level cognitive response, which could correlate to the change in perceived exertion when playing without a

metronome, as the internal timekeeper required when not using a metronome relates to period correction. The participants may have recorded higher RPE scores, yet heart rate did not increase with the rate of perceived exertion.

In order for heart rate to increase, catecholamines must be released from the adrenal glands and travel through the bloodstream to the heart. These hormones affect the heart's sensitivity to ions that cause contraction, increasing the heart rate (Swain 2014). Even though the participants experienced psychological stress related to playing without a metronome, the stress may not have been enough to 1) release catecholamines or 2) release enough catecholamines to create a response from the heart.

Several limitations accompany this study. Although the battery playing in standstill and not carrying their drums allows a comparison to the front ensemble, this formation is not indicative of typical performance setup. Normally, the battery is marching and carrying drums around a field while the front ensemble stays in the same area the entire performance. The difference in energy demand would be interesting to compare. A potential bias in the study includes participants not understanding how to correctly rate perceived exertion, which was minimized with verbal instructions and stress on individual perception. Another potential bias could be practicing outside before the study, which could elevate heart rates prematurely. Performing the study inside after an hour-long lunch break helped minimize this by allowing the body to rest before the assessment. One of the biggest limitations would be relating the battery and front ensemble comparison to other marching groups. Drum corps shows are constantly evolving and none are completely alike.

Because the difference between the battery and front ensemble heart rates was most likely dependent on the music played from the 2014 production, *Swan Lake*, other corps may have different outcomes (TheMrDavidLangley, 2014). Possible future research includes measuring the heart rates and RPE during a performance day, comparing the effects between different corps, comparing the heart rates of battery members when marching and in standstill, and measuring the metronomic effects on the heart rates of less experienced high school marchers.

In conclusion, playing without a metronome requires more effort psychologically, but may not affect heart rate. Therefore, when learning music, rehearsing with a metronome may reduce psychological effort and allow musicians to focus on other aspects of the music or the show. In addition, more emphasis on rehearsing without a metronome prior to performance may allow percussionists to adjust to the elevated perceived effort associated with playing without a metronome.

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Appendices

Appendix A: Middle Tennessee State University IRB Approval letter

Appendix B: Approval letter from Phantom Regiment Drum and Bugle Corps

Appendix C: Approval letter from The Cavaliers Drum and Bugle Corps

Appendix D: Informed Consent form

Appendix E: Informed Assent form

Appendix F: Informed Parental Consent form

Appendix G: AHA/ACSM Health/Fitness Facility Preparticipation Screening Questionnaire

Appendix H: Borg RPE Scale for First Selection With a Metronome

Appendix I: Borg RPE Scale for First Selection Without a Metronome

Appendix J: Borg RPE Scale for Second Selection With a Metronome

Appendix K: Borg RPE Scale for Second Selection Without a Metronome

Appendix A



5/8/2014

Investigator(s): Danielle Dye, Dr. Vaughn Barry

Department: Health and Human Performance

Investigator(s) Email: dmd3z@mtmail.mtsu.edu, Vaughn.Barry@mtsu.edu

Protocol Title: "The effects of a metronome on the heart rates of DCI percussionists.

Protocol Number: 14-357

Dear Investigator(s),

The MTSU Institutional Review Board, or a representative of the IRB, has reviewed the research proposal identified above. The MTSU IRB or its representative has determined that the study poses minimal risk to participants and qualifies for an expedited review under 45 CFR 46.110 and 21 CFR 56.110, and you have satisfactorily addressed all of the points brought up during the review.

Approval is granted for one (1) year from the date of this letter for 48 participants.

Please note that any unanticipated harms to participants or adverse events must be reported to the Office of Compliance at (615) 494-8918. Any change to the protocol must be submitted to the IRB before implementing this change.

You will need to submit an end-of-project form to the Office of Compliance upon completion of your research located on the IRB website. Complete research means that you have finished collecting and analyzing data. **Should you not finish your research within the one (1) year period, you must submit a Progress Report and request a continuation prior to the expiration date.** Please allow time for review and requested revisions. Failure to submit a Progress Report and request for continuation will automatically result in cancellation of your research study. Therefore, you will not be able to use any data and/or collect any data. Your study expires **5/8/2015**.

According to MTSU Policy, a researcher is defined as anyone who works with data or has contact with participants. Anyone meeting this definition needs to be listed on the protocol and needs to complete the required training. **If you add researchers to an approved project, please forward an updated list of researchers to the Office of Compliance before they begin to work on the project.**

All research materials must be retained by the PI or faculty advisor (if the PI is a student) for at least three (3) years after study completion and then destroyed in a manner that maintains confidentiality and anonymity.

Sincerely,

Kellie Hilker,

Compliance Officer/ MTSU Institutional Review Board Member

Appendix B



www.regiment.org

April 30, 2014

Danielle Dye
Middle Tennessee State University

Danielle,

We are pleased to grant your request to visit our Spring Training Camp for your research study. We are happy to allow all reasonable access to our students for your work.

We will be on the campus of Rockford University in Rockford, Illinois from May 16 through June 11. Some days will be less conducive than others, so please confirm your schedule with me in advance.

We look forward to having you on campus.

Sincerely,

A handwritten signature in black ink that reads 'Dan Farrell'.

Dan Farrell
Program Director

420 N. Main Street Rockford, Illinois 61103- 6819 Phone 815/261-195

Appendix C



The Cavaliers

Drum & Bugle Corps
P.O. Box 501, Rosemont, IL 60018

E-mail: info@cavaliers.org
www.cavaliers.org

224-567-8171
fax: 224-567-8169

May 20, 2014

Danielle Dye
MTSU Undergraduate Student
Exercise Science
Pre-Physical Therapy

To Whom It May Concern:

Danielle Dye has requested and been granted permission to collect data from the front ensemble and battery during rehearsal prior to the Murfreesboro, TN show on Friday, July 25, 2014.

Adolph DeGrauwe
President & Corps Director

Sponsored by The Village of Rosemont – Rosemont, Illinois

Appendix D

**Middle Tennessee Institutional Review Board
Proposal for Research Study Using Human Participants
Consent Document for Research Study**

Principal Investigator: Danielle Dye

**Study Title: The effects of a metronome on heart rate for DCI World Class percussionists.
Institution: Middle Tennessee State University**

Name of participant: _____ Age: ____

The following information is provided to inform you about the research project and your participation in it. Please read this form carefully and feel free to ask any questions you may have about this study and the information given below. You will be given an opportunity to ask questions, and your questions will be answered. Also, you will be given a copy of this consent form.

Your participation in this research study is voluntary. You are also free to withdraw from this study at any time. In the event new information becomes available that may affect the risks or benefits associated with this research study or your willingness to participate in it, you will be notified so that you can make an informed decision whether or not to continue your participation in this study.

For additional information about giving consent or your rights as a participant in this study, please feel free to contact the MTSU Office of Compliance at (615) 494-8918.

1. Purpose of the study:

You are being asked to participate in a research study because the effects of a metronome on heart rate while playing music in DCI World Class percussionists are unknown.

2. Description of procedures to be followed and approximate duration of the study:

You will be asked not to ingest caffeine the day before and morning of data collection. The day of the data collection, we will complete a resting heart rate assessment. To do this, you will lie on your back for five minutes while wearing a heart rate monitor. The monitor has a strap that wraps around the chest and will need to be lubricated with conducting gel, placed on the skin, and over the sternum below the breasts. You will choose if you want to place the monitor or have the investigator place the monitor and will be provided a private place to do this (e.g., restroom). Following this assessment, you will stretch, warm up and line up for a percussion ensemble at standstill. At this time the ensemble will be asked to rep two show chunks for a total of six times, three with and three without a metronome. Between each rep there will be a two-minute pause. The playing portion of data collection should take roughly 20-30 minutes. During this session you will be asked to wear a heart rate monitor that will record your heart rate during the performances. After, you will rate the difficulty of playing each show chunk with and without a metronome.

3. Expected costs: N/A

4. Description of the discomforts, inconveniences, and/or risks that can be reasonably expected as a result of participation in this study:

An inconvenience could be the flow of the procedure in comparison to normal practice procedures and some discomfort could occur with a lack of caffeine, especially if you are used to ingesting caffeine on a regular basis. If you rely on caffeine for alertness during practice, you may have to adjust when playing.

5. Compensation in case of study-related injury: N/A

6. Anticipated benefits from this study:

- a) The potential benefits to science and humankind that may result from this study are more knowledge on how the body reacts to tempo, sound, and music, as well as, a connection between physiological and musical fields.
- b) The potential benefits to you from this study are N/A.

7. Alternative treatments available: N/A

8. Compensation for participation: N/A

9. Circumstances under which the Principal Investigator may withdraw you from study participation:

You could be withdrawn if you ingest caffeine, drugs or medication that could affect heart rate the day before or the morning of testing. You could also be withdrawn if you are injured or have a heart problem.

10. What happens if you choose to withdraw from study participation:

You will not be penalized and are free to withdraw at any time.

11. Contact Information. If you should have any questions about this research study or possible injury, please feel free to contact Danielle Dye at (615) 509-4667 and/or dmd3z@mtmail.mtsu.edu, or my Faculty Advisor, Dr. Vaughn Barry at (615) 898-5535 and/or Vaughn.Barry@mtsu.edu.

12. Confidentiality. All efforts, within reason, will be made to keep the personal information in your research record private but total privacy cannot be promised. Your information may be shared with MTSU or the government, such as the Middle Tennessee State University Institutional Review Board, Federal Government Office for Human Research Protections, if you or someone else is in danger or if we are required to do so by law.

13. STATEMENT BY PERSON AGREEING TO PARTICIPATE IN THIS STUDY

I have read this informed consent document and the material contained in it has been explained to me verbally. I understand each part of the document, all my questions have been answered, and I freely and voluntarily choose to participate in this study.

Date

Signature of patient/volunteer

Consent obtained by:

Date

Signature

Printed Name and Title

Appendix E

**Middle Tennessee Institutional Review Board
Proposal for Research Study Using Human Participants
Assent Document for Research Study**

PI: Danielle Dye

**Study Title: The effects of a metronome on heart rate for DCI World Class percussionists.
Institution/Hospital: Middle Tennessee State University**

This assent document applies to: members under the age of 18. _____

Name of participant _____ Age _____

Below are the answers to some of the questions you may have. If you have any questions about what is written below or have any other questions about this research, please ask them. You will be given a copy of this consent form.

1. Why are you doing this research?

You are being asked to participate in a research study because the effects of a metronome on heart rate while playing music in DCI World Class percussionists are unknown.

2. What will I do and how long will it take?

You will be asked not to ingest caffeine the day before and morning of data collection. The day of the data collection, we will complete a resting heart rate assessment. To do this, you will lie on your back for five minutes while wearing a heart rate monitor. The monitor has a strap that wraps around the chest and will need to be lubricated with conducting gel, placed on the skin, and over the sternum below the breasts. You will choose if you want to place the monitor or have the investigator place the monitor and will be provided a private place to do this (e.g., restroom). Following this assessment, you will stretch, warm up and line up for a percussion ensemble at standstill. At this time the ensemble will be asked to rep two show chunks for a total of six times, three with and three without a metronome. Between each rep there will be a two-minute pause. The playing portion of data collection should take roughly 20-30 minutes. During this session you will be asked to wear a heart rate monitor that will record your heart rate during the performances. After, you will rate the difficulty of playing each chunk with and without a metronome.

3. Do I have to be in this research study and can I stop if I want to?

You will not be penalized and are free to withdraw at any time.

4. Will anyone know that I am in this research study?

All efforts, within reason, will be made to keep the data in your research record private but we cannot promise total privacy. The data we collect on you may be shared with others (for example, your parents) if you or someone else is in danger or if we have to do so by law.

5. How will this research help me or other people?

The potential benefits to science and humankind that may result from this study are more knowledge on how the body reacts to tempo, sound, and music, as well as, a connection between physiological and musical fields.

6. Can I do something else instead of this research?

There is no other research option, but you can still march.

7. Who do I talk to if I have questions? If you should have any questions about this research study or possible injury, please feel free to contact Danielle Dye at (615) 509-4667

and/or dmd3z@mtmail.mtsu.edu, or my Faculty Advisor, Dr. Vaughn Barry at (615) 898-5535
and/or Vaughn.Barry@mts.edu.

Date

Signature of patient/volunteer

Consent obtained by:

Signature

Printed Name and Title

Appendix F

**Middle Tennessee Institutional Review Board
Proposal for Research Study Using Human Participants
Parental Consent Document for Research Study**

Principal Investigator: Danielle Dye

**Study Title: The effects of a metronome on heart rate for DCI World Class percussionists.
Institution: Middle Tennessee State University**

Name of participant: _____ Age: _____

The following information is provided to inform you about the research project and your child's participation in it. Please read this form carefully and feel free to ask any questions you may have about this study and the information given below. You will be given an opportunity to ask questions, and your questions will be answered. Also, you will be given a copy of this consent form.

Your child's participation in this research study is voluntary. He or she is also free to withdraw from this study at any time. In the event new information becomes available that may affect the risks or benefits associated with this research study or your willingness to participate in it, you will be notified so that you can make an informed decision whether or not to continue your participation in this study.

For additional information about giving consent or your rights as a participant in this study, please feel free to contact the MTSU Office of Compliance at (615) 494-8918.

1. Purpose of the study:

Your child is being asked to participate in a research study because the effects of using a metronome on heart rate while playing music in DCI World Class percussionists are unknown.

2. Description of procedures to be followed and approximate duration of the study:

He/She will be asked not to ingest caffeine the day before and morning of data collection. The day of the data collection, we will complete a resting heart rate assessment. To do this, he/she will lie on his/her back for five minutes while wearing a heart rate monitor. The monitor has a strap that wraps around the chest and will need to be lubricated with conducting gel, placed on the skin, and over the sternum below the breasts. Participants will choose if they want to place the monitor or have the investigator place the monitor and will be provided a private place to do this (e.g., restroom). Following this assessment, he/she will stretch, warm up and line up for a percussion ensemble at standstill. At this time he/she will be asked to rep two show chunks for a total of six times, three with and three without a metronome. Between each rep there will be a two-minute pause. The playing portion of data collection should take roughly 20-30 minutes. During this session he/she will be asked to wear a heart rate monitor that will record his/her heart rate during the performances. After, he/she will rate the difficulty of playing of each section with and without a metronome.

3. Expected costs: N/A

4. Description of the discomforts, inconveniences, and/or possible risks that can be reasonably expected as a result of participation in this study:

An inconvenience could be the flow of the procedure in comparison to normal practice procedures and some discomfort could occur with a lack of caffeine, especially if he/she is used to ingesting caffeine on a regular basis. If he/she relies on caffeine for alertness during practice, he/she may have to adjust when playing.

5. Compensation in case of study-related injury: N/A

6. Anticipated benefits from this study:

a) The potential benefits to science and humankind that may result from this study are more knowledge on how the body reacts to tempo, sound, and music, as well as, a connection between physiological and musical fields.

7. **Alternative treatments available:** N/A

8. **Compensation for participation:** N/A

9. **Circumstances under which the Principal Investigator may withdraw your child from study participation:**

Your child could be withdrawn if he/she ingests caffeine, drugs or medication that could affect heart rate the day before or the morning of testing. He/She could also be withdrawn if he/she is injured or has a heart problem.

10. **What happens if your child chooses to withdraw from study participation:**

He/She will not be penalized and is free to withdraw at any time.

11. **Contact Information.** If you should have any questions about this research study or possibly injury, please feel free to contact Danielle Dye at (615) 509-4667 and/or dmd3z@mtmail.mtsu.edu, or my Faculty Advisor, Dr. Vaughn Barry at (615) 898-5535 and/or Vaughn.Barry@mtsu.edu.

12. **Confidentiality.** All efforts, within reason, will be made to keep the personal information in your child's research record private but total privacy cannot be promised. Your information may be shared with MTSU or the government, such as the Middle Tennessee State University Institutional Review Board, Federal Government Office for Human Research Protections, *if* you or someone else is in danger or if we are required to do so by law.

14. **STATEMENT BY PERSON AGREEING TO PARTICIPATE IN THIS STUDY**

I have read this informed consent document and the material contained in it has been explained to me verbally. I understand each part of the document, all my questions have been answered, and I give permission for my child to participate in the study.

Date

Signature of patient/volunteer

Consent obtained by:

Date

Signature

Printed Name and Title

Appendix G

AHA/ACSM Health/Fitness Facility Preparticipation Screening Questionnaire

Assess your health needs by marking all *true* statements.

History

You have had:

- A heart attack
- Heart surgery
- Cardiac catheterization
- Coronary angioplasty (PTCA)
- Pacemaker/implantable cardiac defibrillator/rhythm disturbance
- Heart valve disease
- Heart failure
- Heart transplantation
- Congenital heart disease

If you marked any of the statements in this section, consult your physician or other appropriate healthcare provider

Other health issues

- You have diabetes
- You have or asthma other lung disease.
- You have burning or cramping in your lower legs when walking short distances.
- You have musculoskeletal problems that limit your physical activity.
- You have concerns about the safety of exercise.
- You take prescription medication(s).
- You are pregnant.

Symptoms

- You experience chest discomfort with exertion.
- You experience unreasonable breathlessness.
- You experience dizziness, fainting, blackouts.
- You take heart medications.

Cardiovascular risk factors

- You are a man older than 45 years.
- You are a woman older than 55 years, you have had a hysterectomy, or you are postmenopausal.
- You smoke, or quite within the previous 6 mo.
- Your BP is greater than 140/90.
- You don't know your BP.
- You take BP medication.
- Your blood cholesterol level is >200 mg/dL.
- You don't know your cholesterol level.
- You have a close blood relative who had a heart attack before age 55 (father or brother) or age 65 (mother or sister).
- You are physically inactive (i.e., you get less than 30 min. of physical activity on at least 3 days per week).
- You are more than 20 pounds overweight.

*If you marked two or more of the statements in this section, you should consult your physician or other appropriate healthcare provider before engaging in exercise. You might benefit by using a facility with a **professionally** staffed exercise program.*

None of the above is true.

You should be able to exercise safely without consulting your physician or other healthcare provider in a self-guided program or almost any facility that meets your exercise program needs.

Appendix H

Session

Date Completed Staff initials Participant ID

<input type="text"/>	<input type="text"/>	-	<input type="text"/>	<input type="text"/>	-	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
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Please rate your exertion towards playing the 1st musical chunk WITH a metronome. Please circle the corresponding number based on the scale below.

Rating of Perceived Exertion (RPE)	
6	
7	Extremely light
8	
9	Very light
10	
11	Light
12	
13	Somewhat hard
14	
15	Hard
16	
17	Very hard
18	
19	Extremely hard
20	Maximal effort

Appendix I

Session

Date Completed Staff initials Participant ID

<input type="text"/>	<input type="text"/>	-	<input type="text"/>	<input type="text"/>	-	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
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Please rate your exertion towards playing the 1st musical chunk WITHOUT a metronome. Please circle the corresponding number based on the scale below.

Rating of Perceived Exertion (RPE)	
6	
7	Extremely light
8	
9	Very light
10	
11	Light
12	
13	Somewhat hard
14	
15	Hard
16	
17	Very hard
18	
19	Extremely hard
20	Maximal effort

Appendix J

Session

Date Completed Staff initials Participant ID

<input type="text"/>	<input type="text"/>	-	<input type="text"/>	<input type="text"/>	-	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
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Please rate your exertion towards playing the 2nd musical chunk WITH a metronome. Please circle the corresponding number based on the scale below.

Rating of Perceived Exertion (RPE)	
6	
7	Extremely light
8	
9	Very light
10	
11	Light
12	
13	Somewhat hard
14	
15	Hard
16	
17	Very hard
18	
19	Extremely hard
20	Maximal effort

Appendix K

Session

Date Completed Staff initials Participant ID

<input type="text"/>	<input type="text"/>	-	<input type="text"/>	<input type="text"/>	-	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
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Please rate your exertion towards playing the 2nd musical chunk WITHOUT a metronome. Please circle the corresponding number based on the scale below.

Rating of Perceived Exertion (RPE)	
6	
7	Extremely light
8	
9	Very light
10	
11	Light
12	
13	Somewhat hard
14	
15	Hard
16	
17	Very hard
18	
19	Extremely hard
20	Maximal effort