AN EXPLORATORY STUDY EXAMINING IF AND HOW MUSIC IS PERCEIVED TO EFFECT SELF-EFFICACY AND PRE-PERFORMANCE EMOTIONS IN TENNIS PLAYERS

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ABSTRACT

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The aim of the present study was to understand if listening to music is a common part of tennis players' pre-performance routines, and how this relates to emotion, memory, self-efficacy, and auditory imagery. Participants were recruited by contacting mid-Michigan college coaches and college club team coaches. After explaining the study to the coaches, a survey was sent to each participant online, requesting permission to take part in the study. Overall, 52 participants' data were analyzed (n=52). Results showed that 58% of players typically listen to music before playing, either always or most often. Most players (90%) reported music leads to a positive mood state after listening. Although there was no relationship found between music which elicits memories of past successful events and perceived self-efficacy ($p>.05$), there was a statistically significant relationship found between music which elicits a positive mood and self-efficacy ($p< .05$). Also, over half of players used auditory imagery during match play, but less than half of participants perceived this had a positive effect on them. In conclusion, the present study showed music is an integral part of tennis player's pre-performance routines, music which leads to an overall positive mood state is related to self-efficacy, and that players commonly engage in auditory imagery during match play. Limitations include the use of an unvalidated survey, survey length, and the effects of the COVID 19 pandemic on survey response rate and specific questions such as amount of time players spent on court. Further research is required to continue to explore the relationship between music, emotion, memory, and self-efficacy in tennis players, as well as athletes of other sports.

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KEY TO ABBREVIATIONS

MEAMS	Music-Evoked Autobiographical Memories
COVID	Corona Virus Disease
MEMOS	Music Evoked Memory Orientation Scale
USTA	United States Tennis Association
IZOF	Individual Zones of Optimal Functioning
BMRI	Brunel Music Rating Inventory
NCAA	National Collegiate Athletic Association
fMRI	Functional Magnetic Resonance Imaging
bpm	Beats per minute
dBA	A-weighted decibels
CRT	Choice Reaction Time
TMS	Transcranial Magnetic Stimulation
MEP	Motor Evoked Potential
EMG	Electromyography
hr	Hour
UK	United Kingdom
km	Kilometers

CHAPTER ONE

INTRODUCTION

Tennis is a highly popular sport in the United States, reaching a total of 17.9 million players as reported by the Tennis Industry Association (Gilbert, 2019). Although many players play recreationally, a growing percentage of players compete at higher levels, such as in high school tennis, collegiate tennis, or within the United States Tennis Association (USTA) competitive structure. The USTA has worked diligently in the last few years to increase the number of youths playing tennis. Rates of 6 to 12-year olds playing tennis increased 4%, up to 2.14 million, while 13 to17 year olds grew 9%, up to 2.23 million (Gilbert, 2019). It is clear that a number of young people are playing the game competitively with the goal of maximizing their performance and reaching their full potential as players.

Mental preparation is seen as an important component in helping players successfully compete. To play at their best, competitive tennis players must find the right combination of motivation and emotions needed to unleash peak performance (Laurer et al., 2009). It is not surprising, then, that a substantial amount of literature focuses on psychological issues in tennis whether it be on player self-talk (Raalte, Brewer, Rivera, & Petitpas, 1994), mental toughness (Weinberg, Butt, Harmsion, & Mellano, 2017) or performance routines (Cohn, 1990). Little attention, however, has been paid to the role of music in helping players mentally prepare for competition – despite the fact that many players listen to music prior to performing.

Although research on music in sport and especially the tennis context is limited, the popularity of music in tennis as a pre-performance routine tool is already evident in all levels of play, amateur to professional. Many world-class tennis players such as Serena Williams, Nick

Krygios, and Naomi Osaka are consistently seen with headphones on, listening to music as they enter stadiums around the world to perform at the highest levels. Sixteen-time grand slam champion Novak Djokovic once stated in a CBS News 60 minutes interview that he would "listen to the classical music because it calms me down, calms my nerves down" in his developing years as a competitor. When asked if he enjoys classical music, he replied by saying "I did. And I still do," implying it's still a crucial part of his game (Cook, 2012).

While attending the 2019 International Counsel for Coaching Excellence conference in Japan, this investigator had the pleasure of meeting Phia Sundhage, Head Coach of the Brazilian Women's National Soccer Team. We discussed how her team uses music before soccer games. She stated the Brazilian team sings and dances together on the bus on the way to games. During her time with the Sweden National Women's Soccer team, her team would listen to "Laleh," a national hit which discussed overcoming struggle. Coach Sundhage explained that listening to music and singing before games helps the team reduce their stress, increase motivation, and results in the team feeling more united.

Many world class athletes are open about their use of music to prepare for competition. Olympic champion Michael Phelps said in a *Guardian* interview, "I have walked out to race with my headphones on throughout my whole career and listen to music until the last possible moment. It helps me to relax and get into my own little world" (Honeyball, 2005). Twenty-three time grand slam champion Serena Williams stated in the well-known "73 Questions with Serena Williams" *Vogue* interview in 2016 that she listens to "Flashdance What a Feeling" by Irene Cara before every match, as part of her pre-performance routine. She also listens to "Work" by Rihanna to celebrate after a match (Editors, 2017). Although it's evident that athletes of all sports, including tennis players, use music to prepare for performance, it's surprising to see that there are a very limited number of studies that examine and seek to understand the role of music in tennis players' mental and emotional preparation and effects on performance.

Although not found in tennis specifically, there have been a few studies that investigated the use of music in coping with stress, both in life and in sport. One survey study examining ways in which people in everyday life deal with stress found that over 50% of respondents listen to music to deal with anxiety (Thayer, Newman, & McClain, 1994). In sport, athletes have also been found to most often listen to music during pre-event preparations, warm-up, and training to increase levels of activation, motivation, performance and positive affect (Laukka & Quick, 2011).

Music listening as a pre-performance strategy in tennis remains largely under researched. Although it seems like a popular way athletes prepare mentally for competition, research has yet to determine the rate at which music is used as a pre-performance routine in tennis players. Researchers have only scratched the surface of what we know regarding the emotional state that tennis players seek to achieve via music, the emotional effects of music on tennis players, the factors that lead to song selection, the use of auditory imagery, and the relationship between self-efficacy and music. To date, there is only one study that has examined the process in which pre-performance music is selected and the emotional states tennis players seek to obtain via music listening. Fourteen tennis players, with a mean age of 18.4 years (SD =1.97) took part in qualitative interviews designed to understand how tennis players use music to manipulate their emotional states, and to gain a better grasp of the factors that mediate their emotional response to music. Ten of the fourteen participants also kept a diary for two weeks, which allowed them to keep track of the songs they would listen to in their everyday life, and how it made them feel. This study noted that extra-music association, which is when music is associated with key events in one’s life, other people, films, etc., acoustical properties, and inspirational lyrics were reasons for selecting music. Also, it found that tennis players used music to psych-up, relax, and/or promote attentional focus (Bishop, D. T., Karageorghis, C. I., & Loizou, 2007). However, although understandable since this study was qualitative in nature, this study only had 14 participants, of which only two were noted as “having sufficient knowledge of musical structure to articulate some of the properties of the music they had selected” (Bishop, D. T., Karageorghis, C. I., & Loizou, 2007).

These initial findings provide a start in bridging the gap in tennis and use of music literature, but more research is needed to fully understand the music selection in tennis players and the emotional states players seek by listening to music, especially since The Bishop et al. (2007) study was performed in the United Kingdom (UK), without any American participants, and since cultural differences in music may impact the generalizability of this study to American tennis players. Although the previous study touched on imagery being provoked due to listening to music, the dynamic relationship between music, emotional states, memories, and self-efficacy in tennis players are not fully understood. When considering that music has been shown by numerous studies to assist in the recall of past memories, influence mood, and influence the recall of positive memories when in a positive mood, and since two major sources of self-efficacy are past success and emotional state, logically one may assume that music can influence self-efficacy in athletes, but this assumption has not been supported by any literature to date (Blaney, 1986; Chase, Feltz, & Lirgg 2003; Eschrich, Münte, & Altenmüller 2008; Scherer, Zentner, & Schacht 2001; Warner, et al. 2014). Also, we do not understand if players engage in auditory imagery while playing and how this may influence their emotional state during a tennis match.

Given the above, this study seeks to bridge the gap between our understanding of music in the realm of tennis. The investigator seeks to understand if listening to music is in fact a common and integral part of tennis players' pre-performance routines and acquire statistical data to support this claim. The study is also designed seek to understand if and how music is associated with a player's emotional states, how a change in a player's emotional state may influence the recall memories of past, successful events, and how one's emotional state and memories of successful performances may be perceived to influence self-efficacy. Other questions of interest focus on what emotional state players seek to achieve by listening to music and how tennis players use auditory imagery during match play.

Five research questions will be investigated in this study: The research questions are:

(1) Do tennis players typically listen to music before performing;

(2) What emotional states do collegiate tennis players attempt to reach by listening to music before performance;

(3) For athletes who report listening to music that is associated with and or facilitates recall of past successful events, do they perceive that this impacts their self-efficacy?;

(4) Does listening to music that affects a player's emotional state before performance effect self-efficacy; and,

(5) Do athletes engage in auditory imagery during tennis matches and how does it affect their emotional state?

To investigate these research questions a survey will be administered to a sample of collegiate club and intercollegiate tennis players. Based on the previous literature, it is hypothesized that: (1) more than half of tennis players listen to music before performing and practicing; (2) tennis players will attempt to experience a more positive mood state using music than the mood they were experiencing before listening to music; (3) athletes who report listening to music that is associated with past, successful events will perceive that is this enhances self-efficacy; (4) music that improves one's emotional state will be related to increased self-efficacy; and, (5) that more than half of tennis players use auditory imagery and that it will be perceived to have positive effect on emotional states.

CHAPTER TWO

LITERATURE REVIEW

This thesis is focused on understanding if and how music can be used to influence player's emotional states, how a perceived change in a player's emotional state may influence the recall memories of past, successful events, and how one's emotional state and memories of successful performances may be perceived to influence self-efficacy. While only scant research has examined the role of music relative to the mental states of players, the psychology of music has been studied. The review will begin by first examining the motivational components of music, which are rhythm response, musicality, cultural impact, and association. Next, the literature examining how listening to music effects physical performance will be reviewed followed the psychological effects of music. Next, studies examining the link between music, emotion, memory and self-efficacy will then be presented as well as the studies that have looked at music in the sport of tennis. The review will conclude with discussing how the literature reviewed informs the purpose and rationale for the present study.

Motivational Components of Music

Karageorghis defined motivational music as it pertains to sport as "that which stimulates or inspires physical activity" (Karageorghis, Priest, Terry, Chatzisarantis, & Lane, 2006). The four factors that determine the motivational qualities of music are rhythm response, musicality, cultural impact, and association. Rhythm response refers to the rhythmic elements of a piece of music, which includes tempo, defined as the beats per minute of a song. Musicality refers to the pitch-related elements of a piece of music, such as harmony and melody. Harmony is defined as how the notes of a song are combined, while melody refers to the tune of a song. Cultural impact refers to the prevalence, effect, and popularity of a song in a particular culture. Association refers to the extra-musical images, feelings, and thoughts that the music may evoke.

The survey instrument used to examine the motivational qualities of music in exercise and sport settings is known as the Brunel Music Rating Inventory, or BMRI (Karageorghis, Priest, Terry, Chatzisarantis, & Lane, 2006). The BMRI was originally was intended to become the standardized way in which athletes, coaches, and researchers can select motivational music. However, the BMRI has limitations. These include, the instability in the rhythm response factor across the two samples used in their multi-sample confirmatory factor analysis, items in the cultural impact factor having low internal consistency, and the variance of the melody item was solely accounted for by the musicality factor in which it sat. This led to the creation of the BMRI-2, which had some notable changes. For example, the BMRI-2 is less than half the length of the BMRI, making it easier to administer to a larger number of participants because it takes less time to complete. Also, the original BMRI contained subjective bias, because experts in music selection, rather than participants, designed the instrument and inferred what they subjectively thought would classify as motivating music for participants, which may or may not be motivating due to the subjectivity of the nature of music. The single factor BMRI-2 includes items related to the musical stimulus itself, instead of one's own personal and subjective interpretation of the music, as seen in the original measurement, to avoid bias. Also, since rhythm, tempo, and beat items were more strongly correlated with the single factor of the BMRI-2 than the melody item, the importance of rhythmic and tempo qualities of music over melodic qualities in the BMRI-2 have been underlined (Karageorghis, Priest, Terry, Chatzisarantis, & Lane, 2006). The changes in instrumentation have reduced subjective bias and have led to more accurate and objective data collection, which is a paramount achievement due to the complexity of studying music and its subjective nature.

Most of the literature conducted on the motivational components of music have examined the effects of tempo on performance and perceived rate of exertion. Although the importance of rhythm and tempo cannot be ignored, there is evidence that other motivational components of music may influence athletes in different ways. In one qualitative interview study, 97% of participants in a college aerobic dance class stated that music evoked imagery, extramusical associations such as music associated with culturally significant films, and memories of past, pleasant events. Also, 93% of participants rated that the ability of music to evoke extramusical associations assisted aerobic exercise and performance (Gfeller 1988). Terry, Karageorghis, Saha, and D'Auria did in fact show that mainly tempo led to increased endurance in a treadmill study. However, other findings in the study showed that motivational components of music led to more positive mood responses and feeling states, as well as greater reductions in tension. Also, although the general trend for all participants was that as the study progressed and participants became more tired, negative emotions such as depressed mood, anger, and confusion increased, the trend was weakest with the motivational music condition (Terry, Karageorghis, Saha, & D'Auria 2012). This shows that motivational music elements such as association or cultural impact benefited the participants from a psychological standpoint.

Another study, which demonstrated the impact of association and cultural aspects of music, found that participants could endure an isometric-endurance task for 11% longer when listening to a motivational music condition and a rhythm condition than with no music (Crust & Clough, 2006). Since the task had no movement synchronization element whatsoever, it implied that characteristics such as lyrics, harmony, melody, cultural factors, and extra-musical associations may have been responsible for the findings. The song that was used was "Beautiful Day" by U2, which was a number one song on the Official UK Singles Chart and had strong cultural significance. It also had strong associations with sport and exercise. These extra-musical associations led the researchers to believe that the rhythm condition caused a shift to an external focus that made it psychologically easier to hold on longer (Crust & Clough, 2006).

During a study testing the effect of motivational music, oudeterous music (neither motivating or demotivation), and silence on endurance, perceived rate of exhaustion, in-task affect, and exercise-induced feeling states of participants walking on a treadmill from 75% maximal heart rate until exhaustion, it was found that motivational music had a significant effect on endurance and in-task affect. All songs in the study were standardized at 125 beats per minute, in order to allow movement synchronization to take place. The results showed that oudeterous music had a six percent increase on endurance, while motivational music had a 15% increase on endurance. Since both motivational and oudeterous music had the same tempo, the nine percent difference in effect between motivational music and oudeterous can attributed to motivational qualities other than tempo, such as association, musicality, or cultural impact (Karageorghis, et al., 2009).

Another study highlighting the importance of motivational factors other than tempo in music is a study conducted by Tenenbaum and colleagues (Tenenbaum, R. Lidor, N. Lavyan, K. Morrow, S. Tonnel, A. Gershgoren, J. Meis, M. Johnson, 2004), which tested the effect of rock, dance, inspirational, and no music on high intensity running. Music did not affect perceived rate exertion. However, participants stated that music from the inspirational music category, which included songs high in association, such as "Eye of the Tiger" in the film "Rocky" and a song from the film "Chariots of Fire," were rated as likeable and may have helped tolerate exertion level at moderate amounts. Their follow-up study (Tenenbaum, et al. 2004), which was the same study but with an added interview element, also had similar findings. Although the music conditions did not affect perceived rate of exertion according to the measures, the interview data showed that only six percent of those who listened to inspirational music focused on the pain and discomfort they felt. Many of them stated that the images they had when listening to music were related to films they have seen, and some even associated the music with personal memories, which again shows the importance of music that evokes extra-musical associations (Tenenbaum, et al. 2004). These studies highlight the importance of musicality, culture, and association as three of the four motivational components proposed by Karageorghis that are supported by several studies as valuable, important, and significant in the literature.

Performance Effects of Music

As mentioned, most of the literature conducted on the four motivational components of music has examined the effects of tempo on performance, highlight the importance of rhythm response in sport and exercise. Although one study found no effect of music tempo on anaerobic exercise, (Atan, 2013) the majority of research supports the argument that music tempo has an effect on sport and exercise performance in a significant way (Karageorghis, et al., 2011).

Rhythm response, which refers to our natural tendency to synchronize our movements with the tempo of musical stimuli, can help us understand if and how tempo can increase performance. Music that is associated with consciously matching one’s repetitive movements with the beat or tempo is known as synchronous music. Asynchronous music, or oudeterous music, on the other hand, is referred to as background noise, or music that is not consciously synchronized with movement. In the qualitative interview investigation mentioned earlier which studied college students participating in an aerobic dance class, 79% of the college student respondents used music to “help them to move more accurately in a coordinated fashion,” while 54% of respondents cited that the music’s tempo or rhythm provided “a temporal cue indicating when to move” (Gfeller 1988). Karageorghis has noted that there are neurophysiological explanations for rhythm response and music synchronization. Specifically, Schneider, Askew, Abel, and Struder found patterns between exercise and music tempo that corresponded to electroencephalographic delta activity in the brain, acting as a “pattern generator” (Karageorghis & Priest, 2012). This is important because Frank Wilson, an early biologist in the early twentieth century, stated that an internal clock in the brain that regulates temporal functioning, which may coordinate the afferent and efferent nerve signals (Karageorghis & Priest, 2012).

There are several treadmill studies involving walking as well as running that show correlations between music tempo and enhanced performance in athletes and exercisers. One study conducted to determine the link between exercise intensity, heart rate and music tempo found that fast tempo music, music at 140 beats per minute, was preferred over slow and moderate tempo music by treadmill walkers who exercised at high intensities, or 75% max heart rate. Moderate tempo music, at 120 beats per minute was also preferred over slow tempo music, which was at 80 beats per minute, for all intensities, including moderate level intensity at 60% maximum heart rate and low-level intensity at 40% maximum heart rate. This showed that slow tempo music was least preferred for all conditions, and that fast tempo music was the most preferred (Karageorghis, Jones, & Low, 2006).

Another study conducted by Karageorghis examined flow state, intrinsic motivation, preference, and tempo as participants walked on a treadmill at 70% maximum heart rate. They listened to medium, fast, and mixed tempo music, along with a no-music control. Results showed that medium tempi music was preferred over fast music and mixed tempi music, which shocked researchers, since they suspected that faster tempi would be preferred. Moderate tempi music was also rated higher in flow, intrinsic motivation, and interest-enjoyment as well. This may be due to the fact that this study identified “high intensity exercise” as 70% maximum heart rate, while the previous study (Karageorghis, Jones, & Low, 2006) defined it as 75% maximum heart rate. It had been suggested that at 75% max heart rate, there was a strong prevalence for faster tempi music rather than moderate tempi music, and that there may be a step change from 70% max heart rate to 75% max heart rate (Karageorghis, Jones, & Low, 2006). A key difference between the 2 studies was that participants in this study were expected to endure the task, rather than reach a predetermined workload, which was the case in the study with Karageorghis and Low, 2006. (Karageorghis, Jones, & Stuart, 2008)

A running experiment conducted on 16 recreational runners tested the effects of music tempo on running. A music database containing 117 songs that had a tempo range of 130-200 beats per minute (bpm) were initially included. However, after participants completed the BMRI-2 test, and the top 20 songs with the highest scores were calculated, those 20 were the only ones used. Participants ran a 200 meters running track for four laps continuously for 12 trials, at their own pace, while various music of different tempos was played, to determine if changes in music tempo would affect running cadence. Results showed that faster music was associated with faster running, and slower music was associated with slower running. Although in this particular study no significant relationship between perceived exertion and tempo, another interesting finding emerged; females experienced more change in running tempo than men, suggesting they are more responsive to musical stimuli (Dyck, et al., 2015).

Gender differences contradicted this finding in another study conducted to test the effect of music tempo on exercise performance and heart rate in young athletes running on a treadmill.

Men achieved higher maximum heart rate while listening to fast music than women. However, they also did so without music, suggesting that music was not the factor that led to higher heart rate. Heart rate was significantly higher when performing with fast music than maximum heart rate achieved without the fast music condition for both men and women, suggesting music, and particularly fast music, improves the exercise duration of athletes. Although one limitation found was that the researchers did not have strict standards for fast tempo, they stated that "self-selected music was played, which was fast and loud for all" showing that indeed fast tempo music was being used in this study (Thakare, Mehrotra, & Singh, 2016).

Simpson and Karageorghis also tested the effects of synchronous music, on a 400-meter sprint. They selected tracks all within a tempo range of 135-140 beats per minute and used the BMRI-2 to assess the motivational qualities of the tracks. After dividing the participants into three groups, one group with the highest scoring track as the motivational music group, one group with the lowest scoring track as the oudeterous music group, and one last group acting as a no-music condition control group, the participants performed the sprint test. The results showed that the running times of both music conditions were shorter than those of the control group. This shows that music, especially when synchronized with running patterns, can improve performance. Both conditions were similar in tempo, suggesting that the tempo may have played a big role in influencing performance. However, contrary to the second hypothesis, there was no difference between the motivational synchronous music group and the oudeterous synchronous music group. This again showed that tempo and synchronization was the main reason why both music conditions performed better than the control. Other motivational factors such as musicality, association, or cultural factors did not influence performance, since there would have been a difference between these two groups if that had been the case (Simpson & Karageorghis, 2006). This is very understandable since the tracks were selected by the researchers, not self-selected by the participants, because songs related to association and cultural factors tend to be personal and self-selected, varying from individual to individual.

Again, another study by Karageorghis showed that tempo is the most important quality of a song that influences performance and synchronization between movement and music. Eleven elite triathletes completed three different running tests, one with motivational music, one with neutral music, and one with no music. The tempo for both the motivational music condition, and the neutral music condition was the same, which ranged from 80-97 beats per minute. Although this may seem slow, the songs were selected so that the athletes could synchronize their stride to the half beat, rather than the full beat. The main difference between both music conditions was that the neutral music condition did not possess strong motivational qualities such as association or cultural impact, while the motivational music condition did. Participants ran significantly longer when listening to motivational music and neutral music, rather than no music, showing that motivational qualities were not the cause of prolonging endurance, but rather the tempo that both music conditions possessed (Terry, Karageorghis, Saha, & D'Auria 2012).

Several cycling studies that show similar effects to music, tempo, and performance. One cycling study conducted by Karageorghis found that slow music was given low prevalence scores for all intensities. Also, although there were no differences between preferring moderate and fast music for moderate intensity exercise, which was around 50-60% maximum heart rate, participants cycling at high intensities of 70% maximum heart rate preferred faster music over moderate or slow music. Again, it was found that once high exercise intensity is reached, defined as more than 80% maximum heart rate, an increase in music tempo is not necessarily preferred.

It was also found that both males and females respond to musical tempo similarly, consistent with their previous study (Karageorghis, et al., 2011).

Work by Anshel and Marisi (1978) on the effect of music and rhythm on performance in a bicycle ergometer task evaluated synchronized music, background music, and a control with no music. The results showed that those who performed the task with synchronized music, which was at 100 beats per minute, performed better than the control group and the background music group, in which the songs varied between 125 and 135 beats per minute. Indeed, music which is synchronized to a movement or set of movements in spirt or exercise has been found to be beneficial to performance (Anshel & Marisi, 1978).

These findings were further supported by a ten kilometers (km) cycling study, testing the effect of motivational music played at 142 beats per minute in comparison to a no-music control on performance. The results showed that speed, heart rate, and power were higher in the music condition. The speed condition was especially faster in the first three km of the trial, although it decreased throughout the trial. Perceived exertion was higher in the music condition, showing that participants may have worked harder in order to achieve the faster cycling time. Although speed decreased throughout the trial, the perceived exertion scores remained high, which was confusing for researchers. The participants rated the rhythm response of the music as the most important element of the music, followed by musicality. Cultural impact and association were not recognized as important by the participants, which again puts forth the argument that rhythm response is more important than the remaining motivational qualities of music (Atkinson, Wilson, & Eubank 2004).

These findings are supported by a cycling performance study which tested variations in tempo of music on heart rate, perceived rate of exhaustion, and performance, along with the original track. Three versions of the same song were created, one being the original track, another being the same song but with a 10 percent increase in tempo, and the last being the same song but with a 10 percent decrease in tempo from the original track. When listening to the faster tempo version of the song, the rates at which participants pedaled, covered distance, and performed work increased, along with heart rate. They also reported a higher rate of exhaustion than the slower versions of the song, most likely because their work rate increased and because they reported that they felt their body temperature increased (Waterhouse, Hudson, & Edwards, 2010). These findings, which show fast tempo music can increase work output in cycling, are consistent with literature that examines the relationship between music and swimming.

Although tempo was not specifically controlled, one study showed that swimmers who listened to music performed significantly better in 50-meter sprints as well as 800-meter-long distance swimming than those who did not listen to music. Although this study showed that music (listened to while performing) impacted performance, it was uncertain of which specific elements of music did so (Tate, Gennings, Hoffman, Strittmatter, & Retchin 2012).

Luckily, Karageorghis conducted a study testing the effects of asynchronous motivational music as well as oudeterous music on swimming performance. Unlike the previous study mentioned, all songs in this study were standardized to 130 beats per minute, meaning the main difference between both music groups were there motivational qualities. The swimmers completed three trials while being exposed to the two music conditions, as well as a no-music control. The participants swam faster under the two music conditions than the control. The motivational music group had a statistically significant 2.1 percent faster time than the control, while the oudeterous group had a 1.8 percent faster time than the control which, in swimming terms, can be the difference between first and fourth or even last place at times (Karageorghis, et al., 2013).

Taken together, the studies assessing the effects of music on physical performance have shown that out of all of the four motivational qualities of music, tempo has the most impact on performance. The process in which one times the rhythm of our movement to the tempo and rhythm of music is known as synchronization. Studies assessing running, cycling, and swimming all conclude that listening to high tempo music will most likely increase work output in exercise and sport, while listening to slow tempo music during these tasks will most likely decrease speed of movement (Karageorghis & Priest, 2012).

Psychological Effects of Music

Music has been shown to affect one's perceived rate of exertion during low to moderate physical activity by numerous studies (Karageorghis & Priest, 2012). The relationship between exercise, music, and perceived rate of exertion is best explained by the work of Rajeski (Rejeski 1985) and the parallel processing model. This model suggests that bodily sensations become registered in the sensory cortex in three ways, two of which are on a single path, which are afferent stimulation and innervation from the central motor cortex. The third way is peripheral muscular stimulation to central motor outflow. With this, there are two main ways to understand the role of emotion and cognition on the perception of exertion. The sequential model describes that when people experience a physical sensation, they react based of the strength of the stimulus and their own personal, past experiences to form an emotion. Although there have been some studies that use the sequential model, it is too simplistic because it states that perception is a passive process.

In contrast, the parallel-processing model states that sensory cues can be psychologically manipulated before they reach the cortex, which implies that perception is an active process

(Rejeski 1985). For example, it has been shown that one's expectation of the duration and intensity of a running task can affect perceived rate of exertion. One group of runners ran for 20 minutes at 85% maximum heart rate, while another group, the experimental group, ran for 20 minutes at 85% maximum heart rate but were told they were going to run 30 minutes before the task began. Their expectation of a longer task affected their perceived rate of exertion, even though they ran the same as the other group. The experimental group had lower rates of perceived exertion than the control group and "paced themselves" during the task, as they expected the task to be much more demanding than it was (Rejeski & Ribisl 1980).

Another study by Rajeski showed that females who were shown a video of a woman reacting negatively to riding bicycle before themselves performing a 20 minutes bicycle task had higher rates of perceived exertion than those who performed the same 20 minutes task after being exposed to a video of women reacting positively to the task. Rajeski concluded that the women's negative expectations of the task due to the intolerant model video influenced their perceived rate of exertion in a negative way, even though they performed the exact same task as those who saw a positive video. This shows that perception is an active process we can manipulate, influenced by the expectations we have of exercise (Rejeski & Sanford 1984).

Another study showed that the mere suggestion of a heavier workload to participants biking resulted in much higher perceived rate of exertion compared to participants who did the exact same task but did not receive the heavier workload suggestions. The fact they thought they were completed a vigorous task led to more perceived rate of exertion, even though in reality those who performed the task without the stimulus had moderate levels of perceived rate of exertion. Again, this shows that perception of pain is an active process (Morgan, Hirta, Weitz, & Balke 1976). The parallel processing model highlights the difference between perception and focal awareness, stating that perception is all of the stimuli that an organism can attend to in its potential, while focal awareness is all of the stimuli that an organism actually does attend to in its reality. From this perspective, external stimuli such as music can provide a relief from fatigue, by occupying the limited channel capacity that is responsible for bringing the feelings of pain from exercise into focal awareness, at low to moderate levels of intensity (Rejeski 1985). However, at high intensities, physiological cues can overwhelm processing capacity for music stimuli, which is why athletes may feel fatigue even when listening to music. Listening to music while exercising at high intensities can change how one interprets how one experiences fatigue, but not fatigue itself. (Karageorghis & Priest, 2012).

Evidence for these claims are apparent in one study which examined the effects of music on perceived exertion in high intensity running. Specifically, Tenenbaum and his colleagues (Tenenbaum, et al., 2004) tested the effect of rock music, inspirational music, dance music, and no music on the perceived rate of exertion in runners. There was no significant effect of any of the music groups on rate of exertion, which is likely due to the fact that the runners performed at a high intensity, up to 90% of their maximum heart rate. Although there were no significant findings, participants stated that they paid more attention to rhythm and tempo rather than lyrics during the final phase of the study, which was more intense. They also stated they paid more attention to associational elements of music during initial phases of the task, which was less intense.

These findings were supported by the second study conducted by the researchers (Tenenbaum, et al., 2004) which had the same procedures as the first study, but with an interview after the task was complete. Again, there were no significant effects of music on perceived rate of exertion or running, likely due to the nature of the high intensity of the task. About half of the runners claimed that they focused on running-related sensations, and five to 22% claimed that inspirational music was attended to.

The third and final follow-up study consisted of eight sets of 2.2 km runs, four where the participants ran against another person and four when running alone. The same four music conditions and measures were used as the previous two studies mentioned, along with the interview in Study 2. The results were similar to previous studies, in that no effect on perceived rate of exertion was evident. These studies confirm the work of Rejeski's Parallel Processing Model, because associative and dissociative coping strategies, which in this case were the music conditions during high exertion exercise, did not extend the period of time they coped with the pain of exercise (Tenenbaum, et al. 2004).

These findings, which show that music does not increase endurance in high exertion exercise, are further supported by another study completed on 22 regularly trained rowers who completed a 500 meters row under a no-music control condition, a slow tempo music condition, and a fast music condition. The music was extracted from Beethoven's Symphony No. 7 in A major op.92. The slow version was 76 beats per minute, while the fast version, which was an exposition of the last movement, was 152 beats per minute. People were randomly assigned to one of the three groups and reported their rate of exertion using the Borg rating of Perceived Exertion (Borg, 1998). The results showed that participants in the slow music category performed better than the control group with no music, contrary to the hypothesis. The findings also showed that participants in the fast music condition had shorter completion times and more strokes per minute than the participants in the slow music group, supporting the hypothesis that fast music increases performance. Lastly, the results showed that there was no significant difference of perceived rate of exertion for any of the conditions, which supports the previous research of Yamashita (2006) who found that music can effects perceived rate of exertion for low intensity, but not at moderate or high exercise intensities (Rendi, Szabo, & Szabó, 2008)

It has been shown that visual stimuli alone, without auditory stimuli such as music, is not enough to interfere with physiological feedback signals and lower perceived rate of exertion. Twenty-four athletes performed four separate 20 minutes cycling tasks, once with no music, once with only auditory stimuli, once with visual stimuli, and once with both auditory and visual stimuli. The auditory stimuli consisted of fast music, which had a tempo of 140-145 beats per minute. The visual stimuli consisted of high action video footage of human stunts. The athletes reported lower ratings of perceived exertion when exercising and listening to the fast tempo music and when watching videos with music when compared to their perceived rate of exertion with only the videos. This shows that fast, high tempo music was enough to interfere with physiological feedback signals associated with exertion, while the visual stimuli alone was not (White & Potteiger 1996).

One cycling study tested the effect of music, no music, and sensory deprivation on perceived rate of exhaustion. The researchers hypothesized that the sensory deprived condition would experience the most perceived exertion, since they would not have other stimuli such as music to use as a distraction from the pain of exercise. They found that those who listened to music while exercising at low intensities reported less perceived exertion than those in the sensory deprivation condition. They also found that those in the control condition reported less perceived exertion than those in the deprivation condition for moderate intensities (Boutcher & Trenske 1990). Again, this confirms the work of Rajeski and supports the parallel processing model.

The perceived rate of exertion was also found to have no difference in a basketball player study testing the effect of motivational music on sprints. The 12 participants completed 12 trials of 20 meters sprints at maximal effort both with music, and then without music four to five days later. They reported no differences in sprint time, perceived rate of exertion, or heart rate, with or without music, likely due to the fact that this exercise was of high intensity (Eliakim, Meckel, Gotlieb, Nemet, & Eliakim, 2012).

Another study showed that 91% of participants use music to distract themselves from discomfort and take their minds off physical work (Gfeller 1988). Music also produced significantly lower rates of perceived exertion and allowed athletes to exercise longer in a treadmill study when compared to the no-music control (Bharani, Sahu, & Mathew 2004). This finding is important because treadmill walking is a highly popular way people exercise at local gyms and at home. Although many people may view treadmill walking as a dull task, knowing the positive effects of music, especially during treadmill walking, can make the task more enjoyable, by reducing perceived exertion.

One of the older and more significant studies conducted on music and tempo synchronization was by Hayakawa, Takada, Miki, and Tanaka (2000). They studied the effect of synchronous aerobic music, asynchronous Japanese folk music, and a no-music control on mood during a bench-stepping exercise. The tempo was set at 120 beats per minute, but the Japanese folk music was not synchronous with the movements. The exercise session took 60 minutes, which included a warm-up, a bench stepping exercise, a floor exercise, and a cool-down period. The study showed that both music groups led to more positive mood states such as less fatigue than the no-music condition. The music may have distracted the subjects from feeling fatigue. Participants who listened to asynchronous music reported less vigor and more confusion than those who listened to synchronous music, possibly due to the fact that the tempo of the music they were listening to did not synchronize with the movements of the exercise, which led to confusion. The synchronized music may have led to more active movement, since they reported more perceived exertion than the asynchronous Japanese folk music condition. Not only do the results imply that synchronous leads to more physical activity than asynchronous music, but it also implies that it leads to more positive mood states as well (Hayakawa, Takada, Miki, & Tanaka, 2000).

Music with a faster tempo has also been shown to exhibit a distracting factor for volleyball players in training, leading to lower perceived rate of exhaustion than when training with no music. Training with high tempo music was also linked to stable scores of positive engagement and revitalization, unlike training with slow tempo music, which was linked to lower scores of positive engagement and revitalization. The slower music also led to the lowest perceived effort reports, likely because it may have slowed the athletes down physically (Szabo & Hoban, 2004). Overall, many studies show that music can decrease perceived rate of exertion in low to moderate intensity exercise, but not in high intensity exercise (Rejeski 1985).

Looking across all the studies examining how music influences physical performance, several conclusions can be reached. First, at low to moderate exercise intensities, music can occupy the limited channel capacity that is responsible for bringing the feelings of pain from exercise into focal awareness, resulting in feeling less fatigue (Rejeski 1985). Second, at high exercise intensities, physiological cues can overwhelm processing capacity for music stimuli, making music ineffective in reducing fatigue (Karageorghis & Priest, 2012). Third, music at a high tempo can increase the speed of one’s movements, which results in greater work output and greater fatigue (Hayakawa, Takada, Miki, & Tanaka, 2000), but high tempo music can also reduce fatigue in volleyball players (Szabo & Hoban, 2004).

Music, Emotion, Memory, and Self-Efficacy

There are different types of music-related emotional symptoms, which include physiological, motor-expression, subjective feeling, behavioral, and cognitive-related. Listening to music can cause physiological changes, such as trembling, constriction of internal organs, temperature sensations, and respiratory and cardiovascular accelerations and decelerations (Scherer 2004). Chills, thrills, and frissons can also be experienced when experiencing emotions caused by music. Chills are often accompanied by gooseflesh, and can be experienced down the spine, in one's arms, and in other parts of the body. Thrills are tingling sensations throughout the body that occur with emotional intensity. Frissons are associated with pleasant, tingling feelings such as excitement and surprise, raised body hairs, and gooseflesh. One study found that listening to music that induces frissons can activate areas in the brain associated with food, sex, and drug abuse. It is possible to develop a dopaminergic anticipation for the return of this type of music in its absence, implying that one can become addicted to frisson-inducing music (Harrison & Loui 2014).

Listening to music can also cause motor expression symptoms, such as facial changes, vocal expression changes, posture changes, and gesture changes. Emotions also cause behavioral changes, such as interrupting goal-directed behavior to deal with the stimulus or stimuli which has caused an emotion. Emotional responses can affect one's mood, arousal, and psychological state. Finally, cognitive symptoms of listening to emotional music include effects on attention, judgement, and memory (Scherer 2004).

In one study respondents were asked the types of music they listen to and the different emotional reactions they experienced to determine the feelings, symptoms, and behaviors associated with recalling such past events using music (Scherer, Zentner, & Schacht 2001). The study concluded that although some participants listened to a concert the day prior to the study, in most cases memory retrieval played a big role in recalling emotional events. Based on the findings, most emotional states generated from music were not "basic" emotions such as fear, joy, or anger. The most frequent reaction was eye symptoms, such as moisture in the eyes. Subjective arousal, positive valence, and unspecific feelings were reported more commonly than basic emotions, but shivers, motor movements, cardiovascular symptoms, proactive motivation, cognitions, feeling calm, and other symptoms were less common (Scherer, Zentner, & Schacht 2001). This suggests that the emotions that are exhibited due to music can result in physical effects in one's body, such as moist eyes. The process in which music produces emotions, which ultimately may have physical effects on the body, is best understood by the four emotional routes of music highlighted by Scherer and Zentner (Peynírcíğlu, Tekcan, Wagner, Baxter, & Shaffer 1998).

There are several ways in which music can elicit various emotions in listeners. Major pathways in the brain, or routes, contain a large number of neural and somatic structures via which emotions are elicited. These four routes are appraisal, music-related memory associations, contagion and empathy, entrainment, and disinhibition. For the scope of this study, the investigator is particularly interested in music-related memory associations. Music titles and melodies have been shown to effective in assisting recall of names of songs and song melodies, showing how music is a trigger and cue to assist memory (Peynírcíğlu, Tekcan, Wagner, Baxter, & Shaffer 1998).

There are two memory mechanisms that are relevant to music-related memory associations, which are episodic and associative memory. Episodic memory is when a specific cue triggers a strong emotion that one has experienced in the past, along with a memory of that event. Events may be strongly experienced once again in one's mind, as they vividly imagine what took place, which can even cause physiological reactions. One reason why music can cue memories of past events is because it is commonly associated with highlighting moments in one's life, such as weddings or religious ceremonies. As we begin to associate music with events, associative memory occurs, when we create scenarios, visual images, and auditory images using our imagination after a signal or cue (Scherer & Coutinho 2013). For example, a song played during one's own wedding may remind that person of their wedding when listening to the song years later. In sport, listening to a song right before a career defining performance may lead to one remembering that specific performance years later, due to listening to that same song again.

Since music can influence one's mood in a variety of ways, it can indirectly influence the type of memories one recalls music. Mood dependent memory is a term to describe how what one remembers while they are in a particular mood is determined by what one learned when they were in that same mood in the past (Blaney, 1986). In one study, participants learned a list of words while they were either happy or sad. Then, they learned another list in either the same mood they were in, or a different one. The ones who recalled the word list while in the same mood as the mood they were in when learning the word list recalled many more words than the group who were in a different mood during recall than the one they were in originally when learning the word list. Mood congruent memory assumes that mood state during learning is not important. Rather, mood congruency highlights the importance of the match between the affective characteristics of the event that is being recalled and the mood one is in during retrieval

(Buchanan 2007). For example, many studies show that depressed individuals are more likely to recall negative events, and less likely to recall positive events. Also, individuals who are not depressed and report positive mood states recall positive memories more easily than depressed individuals (Blaney, 1986). One study showed that music high in positive valence was more accurately and consistently recalled than neutral music. The study also found that music high in negative valence was more accurately and consistently recalled than neutral music, suggesting that music that contains high emotional qualities, whether they are positive or negative emotions, are more memorable and better recalled than neutral music (Eschrich, Münte, & Altenmüller 2008). These findings are important because knowing this can guide athletes to select and listen to music high in emotion prior to performance, which may increase the likelihood of that song in helping to recall positive past experiences, thereby improving one's emotional state.

The affect theory helps to explain this phenomenon. Mood is stored in a network of associations in the brain. When one's affective state is activated, it also activates other components of the network, such as memories of past events associated with that state. The affect theory was eventually modified with the affect infusion model, which states that the infusion of affect may influence decision making and social processing, and other cognitive functions, which is important because one's mood has been shown to impact cognitive functions such as memory (Buchanan 2007; Eschrich, Münte, & Altenmüller 2008). Music has been shown to activate the entire limbic system, which is involved in not only the processing of emotions but also in memory (Jäncke 2008). From a biopsychological perspective, memories are a network of neurons which represent a code for past events and experiences. When a cue, such as music, activates this neural network, we relive and re-experience the past event. Past events are remembered more easily and with greater accuracy, detail, and vividness when those memories are emotional and relevant to one's life due to the amygdala, which is involved and active during emotional events. Damage to the amygdala and the hippocampus has been shown to decrease the degree and accuracy to which individuals can retrieve unpleasant events.

Patients with medial temporal lobe amnesia, who typically show impaired learning of new memories but unimpaired memory of past events, were tested to determine the role of emotion in memory retrieval. People with medial temporal lobe amnesia limited to the hippocampus retrieved emotional memories very similarly to regular people, showing that the recollection of emotional autobiographical memories is not dependent on the hippocampus alone. However, people with damage to the hippocampus and the amygdala had difficulty retrieving unpleasant events. In conclusion, the hippocampus, along with the amygdala, has been shown to assist retrieval of emotional information, showing their functional connectivity in the memory process (Buchanan 2007).

One functional magnetic resonance imaging (fMRI) study looked at differences in brain activity between one group who were shown emotional pictures and another group who were shown emotional pictures and emotional music as well. The results showed that the emotional experiences during the combined conditions were increased greatly compared to the group who only saw the pictures. The limbic system was activated in both groups, but the group with both stimuli had more evenly distributed and bilateral activation compared to the other group. The combined condition experienced more activation in the automatic ventral system of emotion perception, the bilateral amygdala, ventral frontal cortex, left striatum, left insula, and brainstem nuclei, memory systems such as the hippocampus and parahippocampus, visual processing areas such as the fusiform gyrus, and visual-auditory integration areas such as the bilateral temporal pole and bilateral medial temporal gyrus. The amygdala was activated only in the combined condition, but not in the visual condition alone (Baumgartner, Lutz, Schmidt, & Jäncke 2006).

Just as memories are a network of neurons which code for past experiences, MEAMS, or music-evoked autobiographical memories, are also a network of neurons which code for past events in the brain. MEAMS are self-defining moments in one's life that are triggered to recall due to listening to music (Blais-Rochette & Miranda, 2016). Music is often associated with important events such as marriages, relationships, and religious ceremonies (Scherer & Coutinho, 2013). One study found that adolescents consider a song to be meaningful to them when it is associated with positive memories. Elderly people also report listening to music for the same reasons, to bring back memories (Blais-Rochette & Miranda, 2016).

Memories in general and time have an interesting relationship. There are five dimensions of time perspective, which are past positive, past negative, present-hedonistic, present-fatalistic, and future. Past positive refers to viewing one's past in a positive light, past negative refers to viewing one's past in a negative light, present-hedonistic involves pleasure-seeking in the present, present-hedonistic refers to obtaining hopeless attitudes towards the present, and future refers to one's behavior executed for the purpose of future goals. One study examined the MEAMs of 408 Canadian students and how they may relate to autobiographical memories, personality, self-esteem, emotions, and nostalgic tendencies. The results showed that MEAMs were related to higher self-esteem, possibly because remembering songs that evoke memories may help one to explore a positive self-narrative, looking at what he or she did in the past in accordance with who he or she has become in the present. They also found that people who had a positive view of their past tend to share memories of past events in their everyday more often, which may contribute to their overall happiness and life satisfaction. However, sometimes it is the case that recalling old, pleasant memories of "good old times" hindered happiness as well, causing mixed feelings of emotions if one's present is not as pleasant as those memories. With that in mind, having a positive outlook on one's past generally leads to better mental health and happiness, and having a negative outlook leads to more negative mood states (Blais-Rochette & Miranda, 2016).

Although the research is scarce, it is possible that music-evoked autobiographical memories may be able to influence one's self-efficacy. Self-efficacy is defined at one's belief in their ability to perform a task in a given context or situation (Chase, Feltz, & Lirgg 2003). According to Albert Bandura (Bandura, 1977), a prominent self-efficacy researcher, recalling one's past, successful events is one of the main ways athletes can increase their self-efficacy. Bandura's theory of self-efficacy holds that one's efficacy beliefs have four primary sources. These include: (1), mastery experience; (2) vicarious experience; (3) verbal persuasion; and, (4) physiological and affective states (Bandura, 1977).

Mastery experience represents experiences in which one performed well and successful in the past, which indicates that if one can and has already been successful in the past, they can become successful in the future as well. Vicarious experience increases one's self-efficacy by watching and observing successful people perform, and modelling after them. Verbal persuasion is convincing another of their abilities, often with motivational language. Physiological states are one's levels of autonomic arousal that are associated with fear and doubt, or with being psyched up and ready. Positive affect before a task can help one feel ready and confident in his or her abilities, while negative affect may decrease one's self efficacy by having the opposite effect (Bandura, 1977).

Vealey, Walter, Garner-Holman, and Giacobbi extended Bandura's work by identifying and measuring self-efficacy sources such based off of three broad categories, which are achievement, self-regulation, and climate. While including more social factors which influence self-efficacy such as social support and coach's leadership, they also included mastering sport skills, demonstrating ability, feeling psychologically and physically prepared, self-presentation of the physical self, vicarious experience, managing emotions in a high-stress environment, and situational favorableness. There are parallels between these sources and the sources suggested by Bandura given that mastering sport skills and demonstrating previous ability go hand in hand with Bandura's mastery experience, and managing emotions go hand in hand with the emotional states literature suggested by Bandura as well (Chase, Feltz, & Lirgg 2003).

Mastery experience is considered the strongest source of self-efficacy (Warner, et al. 2014). One literature analysis which examined 27 self-efficacy studies concluded that mastery experience indeed has consistently shown to increase self-efficacy significantly (Ashford, Edmunds, & French, 2010).

One example of how a mastery experience influences self-efficacy examined 34 Women's National Collegiate Athletic Association (NCAA) Division 3 basketball players from three different teams in the Midwest to determine their sources of self-efficacy (Chase, Feltz, & Lirgg 2003). The study found that successful past performances were the most commonly cited source of self-efficacy. Forty one percent of the players in Team 1 stated they used past performances as a source of self-efficacy, along with 61% in Team 2 and 45% in Team 3. Past performance accomplishments were not just in regard to a competition, but in practice as well. In fact, successful practices were more commonly cited than successful performances, which shows the importance of practice for athletes' confidence. The study also concluded that physiological and emotional state was a strong source of self-efficacy. Specifically, 35% of players on Team 1 indicated physiological and emotional state was a source of self-efficacy, along with 23% in Team 2 and 44% in Team 3 (Chase, Feltz, & Lirgg 2003). These results confirmed Bandura's self-efficacy work and show that one's previous, positive experience and performances can be used to improve their self-efficacy.

Also, one's positive emotional state can influence self-efficacy (Chase, Feltz, & Lirgg 2003). More recently, an online questionnaire, which assessed 1,406 individuals' physical activity specific self-efficacy found that mastery experience was the strongest indicator of self-efficacy, along with psychological and affective states. However, evidence for vicarious experience and verbal persuasion in this study was lacking. (Warner, et al. 2014).

While self-efficacy has been found to have a number of sources, the role music plays in enhancing self-efficacy has not been investigated. Yet, music might influence self-efficacy by influencing one's affective state or recalling memories of past performances. The relationship between listening to music and athlete self-efficacy needs to be explored.

In summary, research shows that music can cause emotional responses which may affect one's mood, arousal, and psychological state. Music related memory associations, including episodic memory, which is when music triggers strong emotions that one has experienced in the past along with a memory of that event, may even cause physiological reactions in one's body. Music related memory associations are also dependent on one's overall view of their past. If one has a positive view of their past, they're more likely to recall more positive memories, and vice versa (Blais-Rochette & Miranda, 2016). Also, being in a positive mood increases the likelihood of recalling positive experiences, and vice versa (Blaney, 1986). Since music can assist in the recall of past events, influence emotional state, and influence the recall of positive memories when in a positive mood or the recall of negative memories in a negative mood, it is possible that music can influence self-efficacy in athletes, especially when considering that sources of self-efficacy include past success and emotional state (Blaney, 1986; Chase, Feltz, & Lirgg 2003; Eschrich, Münte, & Altenmüller 2008; Scherer, Zentner, & Schacht 2001; Warner, et al. 2014).

Music and Tennis

There are several studies that have examined the role of music and its use by tennis players. A sequence of studies conducted by Daniel Bishop from Brunel University titled, " A Multicomponential Examination of Tennis Players' Emotional Responses to Music" has greatly contributed to this literature and helped us understand the effects of music on reaction time and emotional states, and in so doing, greatly furthered our knowledge of the neurological effects of listening to music (Bishop, 2007).

The first study, titled, "A Grounded Theory of Young Tennis Players' Use of Music to Manipulate Emotional State" sought to understand tennis players' use of music to manipulate emotional states and gain a more thorough understanding of their emotional responses to listening to music, as well as the variables that affect those responses (Bishop, 2007). Fourteen competitive, junior tennis players from the UK were asked to list five emotional states that were important for success in tennis, and then given a catalog of 2,024 songs. Then, they were asked to select songs that helped them achieve the emotional states listed. Next, interviews were conducted, and participants were asked questions about the tracks they selected. Ten of the 14 participants also completed a diary, in which they would keep track of the songs they would listen to for two weeks, including what they were doing when listening and how it made them feel. The results showed that players listened to music to achieve a desired emotional state they currently were not experiencing. Most players reported a negative mood before listening to music, and improved mood after listening. Common emotional related states that they sought to achieve via music were to feel psyched up, relaxed, and to shift focus and attention. Songs that were played to psych up were noticeably faster in tempo and played at a higher intensity, while songs that were played to relax were slower in tempo. All songs were rated as highly liked, highly arousing, and highly familiar. Players selected songs to listen to based off of extra-musical associations, peer and family influences, film soundtracks and music videos, acoustic properties, and identification with artist or lyrics. They described visual and auditory imagery that was triggered from certain songs, which helped to them remember a past event or listen to the song in their head (Bishop, 2007).

A follow up study sought to understand the effects of modifying intensity and tempo of researcher selected music on emotional response and choice reaction time performance in tennis players (Bishop, 2007). The song "Deepest Blue" was used for the study, and variations were made by modifying tempo and intensity. Slow tempo was 99 bpm, moderate tempo was 129 bpm, and fast tempo was 161 bpm. Each excerpt was cropped to 90 seconds in length, and each tempo had two intensities, moderate (55 A-weighted decibels or dBA) and loud (75 dBA). Two other conditions, one silence condition and one white noise condition were also used. Participants listened to the excerpts and marked their responses to music by marking a cross in one box of the Affect Grid, and by circling adjectives laid out in a grid formation. There were 28 descriptors in total, ranging from positive to negative emotions. Participants' heart rate was measured via a heart rate monitor strapped on one's chest as well, to monitor changes in heart rate while listening to music at various tempos. Then, reaction time was measured, after 20 seconds of listening to the excerpts, which corresponds to the 20 seconds tennis players are allowed between points. Visual stimuli were presented on a projector, the image being a tennis court, and a ball stimulus moving to the center, right, or left of the court. The participants were given remotes to be held by their dominant hand with three buttons, which corresponded with the three areas the ball could have appeared. They were instructed to respond to the ball stimulus to “return” it as quickly as possible, for each of the 24 trials. Results showed that faster tempi and loud intensity did elicit higher subjective arousal. Fast, loud music elicited higher subjective arousal scores overall, but there was no effect on heart rate. Listening to music played at both a fast tempo and higher intensity yielded shorter reaction times than fast, moderate intensity music, while music played at louder intensities alone also yielded shorter reaction times. Faster music was linked to more valence, or pleasantness, while slower tempi was associated with less valence. Although faster tempi elicited more valence, it did not elicit shorter reaction times, which is especially interesting since its faster tempi was correlated with higher arousal scores, which is negatively correlated with reaction time (Bishop, 2007).

The third study in the series was titled, “Neurophysiological Indices of Emotional Responses to Music Listening and Subsequent Choice Reaction Time Performance” (Bishop, 2007). The purpose was to replicate the previous study, while also adding a neurophysiological component. In other words, the investigator wanted to understand the possible neural mechanisms of not only the emotional responses to music exhibited during listening, but the behavioral responses observed during choice reaction time task performance. Twelve tennis players engaged in very similar procedures as the previous study. The song “Deepest Blue” was modified to yield six excerpts at varying tempos and intensities, with 2 white noise and 2 silence excerpts also included. Participants used the Affect Grid to mark down the affective responses of each excerpt. Most importantly, fMRI scanners were used to produce blood oxygen level-dependent images as they heard each excerpt. Similar procedures used in the previous study to measure reaction time, which included a visual stimuli presentation and remote reaction time task was also conducted. Results showed that listening to music increased activity in the auditory cortex when compared to a period of silence, some of this activity located in the superior temporal gyrus, a brain structure responsible for processing sounds. The cerebellum, which is known as the brain structure involved in regulating motor movements, was involved in the music process. No other brain areas that are involved in improved RT performance were activated while listening to music. Highly arousing music increased activity in the areas of the brain involved in visuomotor functions, sensorimotor integration, motor control, and processing of emotion. High tempo and high valence, or pleasantness did not increase activity in rewarding structures of the brain on a significant level, although pleasant music did elicit higher activity in the right middle frontal gyrus, which is involved in reorienting attention to an external stimulus. Although fast music did not increase activity in rewarding structures, it did increase activity in the cuneus, a structure in the visual cortex (Bishop, 2007). The results of this study, then, show that high tempo music does not trigger reward structures in the brain. Music does in fact trigger visuomotor, sensorimotor and motor areas of the brain, as well as the cerebellum when processing music.

The final study conducted by Bishop in this series was titled, “Corticospinal excitability in emotional responses to pre-performance music” (Bishop, 2007). In the previous study he noted many important activations of neural structures as a result of listening to music, both during music listening and CRT performance. There were not any significant activations in the supplementary motor area, premotor cortex, or primary motor cortex. The purpose of this study was to use transcranial magnetic stimulation (TMS), to understand the extent to which music selected may increase corticomotor excitability. A sample of 73 competitive, junior tennis players from the UK listened to a one-minute excerpt of 20 songs selected by the researcher, some likely to be pleasant and arousing, and some which were likely to be associated with low levels of valence. They all recorded their responses on a customized sheet with 20 small reproductions of the Affect Grid. The song "Pump It" by the Black-eyed peas was rated the most arousing and most pleasant track.

For the next part of the study, participant were 10 full time tennis players, who played over 20 hours a week, but later one dropped from the study, leaving nine participants left. All participants followed the same protocol for all measures, which was baseline, silence, and music. The baseline condition was used to avoid the possibility that the new procedure in of itself would be sufficiently exciting to elicit changes in participant's affective ratings. Then, the participants listened to the conditions and recorded how they felt using the Affect Grid. After five monophasic pulses were delivered at an initial stimulus intensity of 100% maximum, mean values were calculated from the averaged response of five Motor Evoked Potentials (MEPs). Then, the participants had to respond to the dots on the screen using a remote, with three buttons, representing left, center, and right. They were given 30 trials and had to respond as quickly as possible, and Electromyography (EMG) data was recorded automatically. The results provided only partial support for the hypothesis. Despite a small sample size, the results displayed a general trend that music was associated with higher corticospinal excitability than the silence condition. Findings further showed that an "extended emotional response to music" which encompasses increased electrophysiological activation, is apparent. Heightened arousal appears to heighten corticospinal activity, an important finding that requires additional research to be confirmed. No doubt, these studies have helped researchers and practitioners alike understand the effect of pre-task music on emotional states, reaction time, and brain areas involved in these processes (Bishop, 2007). Specifically, they showed that tennis players tend to use music to enhance their overall mood prior to performance to feel psyched up, relaxed, and to shift focus and attention. Tennis players selected songs to listen to before playing based on extra-musical associations, social influences, film soundtracks and music videos, acoustic properties, and identification with the lyrics or artist. Listening to music played at a fast tempo were rated as more pleasant, and yielded shorter reaction times than moderate and slow tempo music, and the same applied to listening to music played at a louder intensity when compared to music at a lower intensity. High tempo and high valence, or pleasantness increased activity in the cuneus, a structure in the visual cortex, and the right middle frontal gyrus. However, it did not increase activity in rewarding structures of the brain on a significant level. Heightened arousal resulted in an increase in corticospinal activity (Bishop, 2007).

A handful of other studies examining music in tennis players also contribute to the literature in a meaningful way. One study called "The Effects of Music and the Time-of-Day on Cognitive Abilities of Tennis Player" sought to determine the effects of music on cognitive abilities of tennis players relevant to success in tennis, such as reaction time, attention, executive functions, and spatial memory skills (Jarraya & Jarraya, 2019). It also sought to determine the effect of the time of day on the same cognitive skills, relating any change to the circadian rhythm in core temperature, since previous literature suggests cognitive performance may be affected by time-of-day. The participants included 14 male Tunisian tennis players who were divided into two groups, a control group with no music, and an experimental group who listened to music for 10 minutes prior to completing the tasks. Tasks included a reaction time test, a barrage test to measure visual-spatial ability, visual discrimination, and recognition, a trail-making test, to measure a wide variety of cognitive processes including attention, visual search, and scanning, and a paper-folding test, to measure spatial memory skills. The results showed that listening to music 10 minutes prior to completion of the various tasks increased cognitive performance skills, such as reaction time, attention, executive functions. Cognitive performances on these tasks were time-of-day dependent, with higher scores during the evening. Listening to music also improved spatial memory skills as well (Jarraya & Jarraya, 2019).

Lastly, one study titled, "The Role of Rhythmic Ability on the Forehand Performance in Tennis" examined the effect of rhythm training with or without an auditory stimulus on the tennis forehand (Zachopoulou & Mantis, 2001). Fifty participants between the ages of eight to 10 years were all first tested on their forehand stroke stability. Then, participants were divided into two groups, one control group who engaged in rhythm training without an auditory stimulus, and one experimental group who engaged in rhythm training with fast tempo and slow tempo auditory stimuli. Results showed that the experimental group, who benefited from listening to the auditory stimuli at both stimuli, improved their rhythmic accuracy, in both tempos (Zachopoulou & Mantis, 2001).

In summary, the findings from this group of studies contribute to the literature by demonstrating the effects of music on a wide variety of areas such as cognitive skills, time-of-day, neuroscience, and much more. These findings are important because they make up most of literature examining the role of music in tennis players. Understanding how high tempo can impact arousal, reacting time, and pleasantness can help tennis players select high tempo music to listen to before performing. Also, understanding the effects of music and time of day on reaction time, which is important in the sport of tennis given that returning a serve depends on it, can help players to train later on in the day while also listening to music prior to practice and matches for best results.

For the sake of the present study, findings from the first study mentioned, “A Grounded Theory of Young Tennis Players’ Use of Music to Manipulate Emotional State” conducted by Bishop (2007) are of most relevance. The findings showed that music can be used to trigger memories of past events, specifically successful performances. One participant said, “I’m choosing ‘Another Day’ because it reminds me of this girl called Lauren…I wanted to use a word that means something to me; I couldn’t use ‘Fight’….I wanted something that’s going to be mental arousal on different levels….So that’s why I use John Secada, because it reminds me … of good tennis” (Bishop, 2007). Another participant discussing a different song said, “If I listen to this song before a match, I play really well…if I hear it again, then I’ll think of stuff in the match, how well I did, if I’m just like in my room” (Bishop, 2007). Both of these participants highlight how a song they listen to before they play was mentally associated and related to a specific event that they recall, or a person that the song may be related to, in order to feel emotionally ready to compete and perform. It’s also important to note that, when closely examining the results, 49 out of 70 of the music tracks listed by the participants were chosen partially or solely because those songs carried with them extra-musical associations with significant persons, places, or things (Bishop, 2007).

Although these findings are a great start, more research is needed to fully understand the psychological and emotional effect of listening to these associative songs and how they may influence and impact self-efficacy in tennis players. To date, there are no studies which thoroughly examine the role of music and self-efficacy in tennis players. Regarding the other important and helpful findings in the study, such as the emotional states one wishes to seek by listening to music, reasons for selecting music tracks, and the role of auditory imagery in tennis, only 2 of the 14 participants had the “sufficient knowledge of musical structure to articulate some of the properties of the music they had selected" (Bishop, 2007). This ultimately means that more research in this realm of study is not only optional, but necessary to accurately inform players, coaches, and researchers alike.

Purpose and Rationale for the Present Study

The purpose of this study is to understand the frequency of music as pre-performance routine in tennis players, understand the role of music in emotion, memory, and self-efficacy, and understand the role of auditory imagery in tennis players and its psychological effects. This study is needed because while studies have explored how music influences motivation, emotion and efficacy, few field studies have been conducted with tennis players, despite the fact that many tennis players listen to music prior to competing. Hence, the investigator is interested in determining how many players listen to music prior to competing and what the perceive is the purpose of doing so.

Specifically, since several studies have shown that music has been used as a cue to influence mood, and since mood and positive affect is related to self-efficacy, this study aims to understand if music is perceived to increase self-efficacy by enhancing one's mood (Blais-Rochette & Miranda, 2016). Also, since several studies show that music can be used as a cue to improve one's mood, that positive mood leads to the recollection of positive memories of successful, past events, and since the recollection of positive experiences can lead to increased self-efficacy due to recollection of mastery experience, one would also assume that music can increase perceived self-efficacy this pathway as well (Chase, Feltz, & Lirgg 2003).

The research questions for this study are: (1) Do tennis players typically listen to music before performing; (2) What emotional states do collegiate tennis players attempt to reach by listening to music before performance; (3) For athletes who report listening to listening to music that is associated with and or recalls past, successful events, do they perceive that this impacts their self-efficacy?; (4) Does listening to music that affects a player's emotional state before performance effect self-efficacy; and, (5) Do athletes engage in auditory imagery during tennis matches and how does it affect their emotional state?

The hypotheses are: (1) more than half of tennis players listen to music before performing and practicing; (2) tennis players attempt to experience a more positive mood state using music than the mood they were experiencing before listening to music; (3) athletes who report listening to music that is associated with past, successful events will perceive that is this enhances self-efficacy; (4) music that improves one's emotional state will be related to increased self-efficacy; and, (5) more than half of tennis players use auditory imagery that will be perceived to have positive effect on emotional states.

CHAPTER THREE

METHOD

Study Design

This field study was designed to understand the frequency that music is used as a pre-performance routine in tennis players with the goal of understanding the role that music is perceived as playing in terms of eliciting emotion, memory and self-efficacy. The study was intended to further the understanding of the role auditory imagery plays in tennis. To accomplish this objective, a one-time survey was administered to competitive tennis players, ages 18-24 or older.

Participants

Selection criteria for participants included tennis players 18 years of age and older. The original goal of the study was to recruit a minimum of 100 male and female players from college and university club and collegiate tennis programs. However, due to issues related to contacting participants during the Corona Virus Disease-19 (COVID) pandemic only 52 participants could be secured.

This population of participants was selected for several reasons. First, studies show that adolescence, which is defined as the ages of 10-19 by the World Health Organization (Sacks, 2003) is a time in which autobiographical memories become a part of one's sense of self and identity. Therefore, asking participants who are 18 to 24 years of age or older about music and how it relates to memories they have made in the past was appropriate because they most likely have a vast amount of memories to reflect on at this point in their lives. Also, adolescence and young adulthood is a time in which young people typically immerse and interest themselves in music, which has a big part in setting the tone for what they will listen to as they age (Blais-

Rochette & Miranda, 2016). Collegiate athletes and club team players were included because they represent many players and to understand how music affects their emotional states.

Procedure

Participants were recruited and selected by first contacting mid-Michigan college coaches and college club team coaches. 29 coaches were contacted with five coaches agreeing to allow their athletes to take part. After explaining the study to the coaches, a survey was sent to each participant online, requesting permission to take part in the study. Each survey took around 15 minutes to complete. An online survey was sent to 148 players with 62 players returning completing ones.

Instrument

An electronic survey was used for this study and was comprised of 39 questions (See Appendix A). Some questions in the survey stem were based upon the several existing surveys and studies. The Music Evoked Memory Orientation Scale (MEMOS), which assessed the qualities and characteristics of music evoked memories, was used to formulate some of the questions related to the relationship between music and memory in tennis players. Specifically, the MEMOS scale tested the vividness, coherence, accessibility, time perspective, sensory detail, emotional intensity, visual perspective, sharing, distancing, and valence of memories associated with music (Blais-Rochette & Miranda, 2016). However, the entire scale was not used because in its entirety it did not address the research questions posed in this study and also included a number of questions that go beyond the scope of the study (e.g., accessibility, time perspective, visual perspective, sharing, and distancing). Although the entire scale was not used, questions regarding emotional intensity, which refers to the degree to which one experiences emotions during the process of recalling a memory, and vividness, which is one’s ability to remember and picture the details of a memory, are two of the 10 phenomenological characteristics developed by Sutin and Robbins in 2007 which were used in this survey (Blais-Rochette & Miranda, 2016). Questions based on the findings of (Bishop, 2007) were also explored, which examined the music selection process in tennis players and the effects of music on emotional state.

Self-efficacy was also assessed in the survey. To measure self-efficacy, a non-hierarchical self-efficacy measure was designed to measure the participants' beliefs they could execute tennis specific skills under pressure. Non-hierarchical self-efficacy measures list questions which assess the certainty in which participants believe they can execute fundamental tasks and skills that vary in complexity, difficulty, and stressfulness, without ordering them from least difficult to most difficult. A non-hierarchical scale does not list skills in any particular order, as hierarchical self-efficacy measures do. Since it is difficult to rank and order skills in tennis based solely on difficulty, given that different players have unique strengths and weaknesses, a non-hierarchical self-efficacy measure was used to calculate a total self-efficacy score. Participants rated their degree of certainty, which measures efficacy strength, that they can perform each skill listed, on a near-continuous scale. The scale ranged from zero to 10, with zero representing total uncertainty and 10 being total certainty (Garza & Feltz, 1998). Several skills related to tennis performance were listed in this survey, such as, "successfully execute a forehand to win a point under pressure, successfully execute a backhand to win a point under pressure, successfully execute a volley to win a point under pressure, successfully execute an overhead to win a point under pressure, successfully execute a serve to win a point under pressure, successfully hold your serve under pressure, and successfully break your opponent's serve under pressure." Efficacy scores were analyzed by summing every item listed. Nonhierarchical self-efficacy measures have been used in tennis before and has been validated by research in other sports such as figure skating (Hatzigeorgiadis, Zourbanos, Goltsios, & Theodorakis, 2008) ; Garza & Feltz, 1998).

Although commonly confused with self-efficacy, the investigator did not include questions regarding outcome expectations, or beliefs about how one's actions lead to outcomes like winning or losing. Past studies which have examined outcome expectations, often tested using a one-item question to measure how certain participants are that the can beat an opponent, have had issues with reliability and validity due to competitive situations consisting of several factors and extraneous variables that influence the outcome (Feltz & Lirgg, 2001). Due to these reliability and validity outcome efficacy was not used in this study.

Table 1 contains a three-column table which includes the questions used in the left column and the reason for its inclusion in the survey in the middle column. The far-right column includes the answer or response choices.

Table 1: Survey Questions and Rationale for Question Inclusion

Survey Question	Rationale	Answer Choices
Q1 Please indicate your age range	This demographic question will ensure only participants 18 years or older participate and may give more insight on the relationship between survey results and age. Only one selection may be made.	• (Text box available for participants to indicate their response)
Q2 Please indicate your gender	This demographic question may give more insight on the relationship between survey results and gender. Only one selection may be made.	• Male • Female • Prefer not to answer

Table 1. (cont'd)

Q3 Please indicate your competitive level in tennis	This question may give more insight on the relationship between survey results and competitive level. Only one selection may be made.	• NCAA Division 1 • NCAA Division 2 • NCAA Division 3 • Collegiate Club Team • Non-collegiate USTA player
Q4 Please indicate if you know your USTA player rating	This question may give more insight on the relationship between survey results and USTA player rating level. Only one selection may be made, with a text box available for participants to include their response. Only one selection may be made.	• I know my USTA Player Rating • I do not know my USTA Player Rating
Q5 Please indicate how many years of experience you have as a tennis player	This question may give more insight on the relationship between survey results and years of experience.	• Text box available for participants to indicate their response
Q6 Please indicate the percentage of competitive matches you won within the last year to the best of your ability	This question may give more insight on the relationship between survey results and success level. Only one selection may be made.	• Text box available for participants to indicate their response
Q7 Please indicate the amount of time you spend on court per week in terms of practice and match play	This question may give more insight on the relationship between survey results and amount of time per week spent on court in hours (hr). Only one selection may be made.	• 1-5 hr • 6-10 hr • 11-15 hr • 16-20 hr • 21 + hr

Table 1. (cont'd)

Q8 Have you ever used or tried listening to music? (In your general life)	This question serves as a stepping stone to more in depth questions regarding athlete's use of music in sport.	• Yes • No
Q9 Do you typically listen to music before playing tennis matches and/or practices?	This question will help the investigator develop a better idea of how many tennis players use music to prepare for tennis matches and practices. Only one selection may be made.	1. Never 2. Seldom 3. Sometimes 4. Frequently 5. Always
Q10 How important is listening to music for you in your everyday life?	This question provides insight into the relationship between importance of music for the individual and use of music in sport.	• 0 -10 • (0 being least important and 10 most important)
Q11 When do you to listen to music before playing tennis? Select all that apply.	This question will help the investigator understand when players listen to music, whether it is before play, during play, after play, or a combination of more than one response. Multiple choices may be selected.	• Before playing in tennis competitions/matches/performances • Before playing tennis practices • During tennis practices • After tennis practices • After tennis competitive matches
Q12 How important is listening to music for you before a tennis match?	This question will help the investigator understand the importance of listening to music prior to performance.	• 0 -10 • (0 being least important and 10 most important)
Q13 Do you typically listen to the same songs before a tennis match?	This question will help the investigator understand the selection process that tennis players partake in when choosing music to listen to before a tennis match.	• Yes - I listen to the same songs • Sometimes - I generally listen to the same songs but occasionally I listen to others • No - I listen to a wide variety of songs

Table 1. (cont'd)

Q14 How long do you listen to music for before playing tennis?	This question will help the investigator understand differences in duration of music listening between practices and matches. Only one selection may be made.	• 0-10 minutes •10-30 minutes • 30 -60 minutes • More than 60 minutes
Q15 For what purpose do you listen to music before playing tennis? Select all that apply	It has been demonstrated that to feel psyched up, relaxed, and to shift focus and attention were commonly cited reasons for listening to music (Bishop, 2007). Other options are explored. Multiple choices may be selected.	• To feel relaxed • To distract myself from anything stressful • To motivate myself/psych myself up • To reduce boredom • To feel confident • To help me focus • To remind myself of a time that I played well • Other reasons not listed here • I don't know why I listen to music before I play
Q16 What genre (s) of music do you prefer listening to before playing tennis? Please select all that apply	This question will help the investigator understand the types of music tennis players frequently listen to before a tennis match.	Alternative, African Music, Americana, Blues, Bollywood, Christian/Gospel, Classical Rock, Classical, Country, C-Pop , Dance, DJ Mixes and Live Sets , Electronic, Experimental, Film/TV, Stage, Hard Rock , Hip/Hop/Rap , Indie, Jazz, K-Pop, Kids/Family, Latino, Metal, Musica Mexicana, Tropical, Oldies, Pop, Pop Latino, R&B, Reggae, Rock , Rock y Alternativo, Singer/Songwriter, Soul/Funk, Urbano Latino, World
Q17 What specific songs do you listen to prior to a tennis match? (Please list at least 3 song names with artist names	This question will help the investigator examine specific songs and determine their beats per minute in order to learn more about the tempo preferences of tennis players.	• Text box available for participants to indicate their response

Table 1. (cont'd)

Q18 Before you listen to music as you prepare for a tennis match, what are at least three emotions that best describe how you feel?	Tennis players have reported experiencing a negative mood before listening to music (Bishop, 2007).	• Text box available for participants to indicate their response
Q19 After you listen to music as you prepare for a tennis match, what are at least three emotions that best describe how you feel?	Tennis players have reported experiencing improved emotional state after listening to music (Bishop, 2007).	• Text box available for participants to indicate their response
Q20 Do you listen to different types of music depending on whether you are in a positive or negative mood before a match?	The investigator seeks to understand the effect of mood on the music selection process.	• Yes, I listen to different types of music depending on my mood • No, I listen to the same types of music no matter what mood I am in
Q21 Does your music preferences change depending on what mood you are in? If yes, in what ways?	The investigator seeks to understand if one's mood predicts the type of music selection prior to a tennis match. Only one selection can be made.	• Text box available for participants to indicate their response
Q22 Does music affect your mood/emotional state before a match?	Answer choices include positive effect, negative effect, or neutral effect. Only one selection can be made.	• Overall, music leads to a more positive mood state • Overall, music leads to a more negative mood state • Overall, music does not affect my mood state

Table 1. (cont'd)

Q23 Does music put you in a positive mood after listening to it?	The investigator seeks to understand the role of music in ultimately affecting one's self-efficacy by influencing one's emotional state (Chase, Feltz, & Lirgg 2003). Only one selection can be made.	1. Never 2. Seldom 3. Sometimes 4. Frequently 5. Always
Q24 In those instances when music puts you in a more positive mood state after listening to what degree does this influence your confidence in your ability to play and perform at a high level?	The investigator seeks to understand the role of music in ultimately affecting one's self-efficacy by influencing one's emotional state (Chase, Feltz, & Lirgg 2003). Only one selection can be made.	1. Never 2. Seldom 3. Sometimes 4. Frequently 5. Always
Q25 Does music put you in a negative mood after listening to it?	The rationale for this question is the same as the question above. Only one selection can be made. Only one selection can be made.	1. Never 2. Seldom 3. Sometimes 4. Frequently 5. Always
Q26 In those instances when music puts you in a more negative mood state after listening to what degree does this influence your confidence in your ability to play and perform at a high level?	The rationale for this question is the same as the question above. Only one selection can be made.	1. Never 2. Seldom 3. Sometimes 4. Frequently 5. Always

Table 1. (cont'd)

Q27 To what degree do you practice visualization and/or remember past, successful performances before playing a tennis match?	Bandura's four sources of self-efficacy include mastery experience, which is when one's past, successful behaviors may help one feel more confident in his or her abilities to perform successfully in the future (Chase, Feltz, & Lirgg 2003). Only one selection can be made.	1. Never 2. Seldom 3. Sometimes 4. Frequently 5. Always
Q28 To what degree does music help you recall past, successful performances before playing a tennis match?	The investigator seeks to understand the relationship between music, recall of mastery experiences, and visualization. Only one selection can be made.	1. Never 2. Seldom 3. Sometimes 4. Frequently 5. Always
Q29 On a scale from 0 to 10, 0 being completely uncertain, 5 moderately certain, and 10 being completely certain, please select a number indicating how certain you are in your abilities to complete the following task in a competitive tennis match. (Only one response may be selected) " Successfully execute a forehand to win a point under pressure"	Hierarchical self-efficacy measures list questions which assess the certainty in which participants believe they can execute fundamental tasks and skills that vary in complexity, difficulty, and stressfulness (Garza & Feltz, 1998).	Totally Uncertain 0 1 2 3 Moderately certain 4 5 6 7 Totally certain 8 9 10

Table 1. (cont'd)

Q30 On a scale from 0 to 10, 0 being completely uncertain, 5 moderately certain, and 10 being completely certain, please select a number indicating how certain you are in your abilities to complete the following task in a competitive tennis match. (Only one response may be selected) " Successfully execute a backhand to win a point under pressure"	Hierarchical self-efficacy measures list questions which assess the certainty in which participants believe they can execute fundamental tasks and skills that vary in complexity, difficulty, and stressfulness (Garza & Feltz, 1998).	Totally Uncertain 0 1 2 3 Moderately certain 4 5 6 7 Totally certain 8 9 10
Q31 On a scale from 0 to 10, 0 being completely uncertain, 5 moderately certain, and 10 being completely certain, please select a number indicating how certain you are in your abilities to complete the following task in a competitive tennis match. (Only one response may be selected) " Successfully execute a volley to win a point under pressure"	Hierarchical self-efficacy measures list questions which assess the certainty in which participants believe they can execute fundamental tasks and skills that vary in complexity, difficulty, and stressfulness (Garza & Feltz, 1998).	Totally Uncertain 0 1 2 3 Moderately certain 4 5 6 7 Totally certain 8 9 10

Table 1. (cont'd)

Q32 On a scale from 0 to 10, 0 being completely uncertain, 5 moderately certain, and 10 being completely certain, please select a number indicating how certain you are in your abilities to complete the following task in a competitive tennis match. (Only one response may be selected) " Successfully execute an overhead to win a point under pressure"	Hierarchical self-efficacy measures list questions which assess the certainty in which participants believe they can execute fundamental tasks and skills that vary in complexity, difficulty, and stressfulness (Garza & Feltz, 1998).	Totally Uncertain 0 1 2 3 Moderately certain 4 5 6 7 Totally certain 8 9 10
Q33 On a scale from 0 to 10, 0 being completely uncertain, 5 moderately certain, and 10 being completely certain, please select a number indicating how certain you are in your abilities to complete the following task in a competitive tennis match. (Only one response may be selected) "Successfully execute a serve to win a point under pressure"	Hierarchical self-efficacy measures list questions which assess the certainty in which participants believe they can execute fundamental tasks and skills that vary in complexity, difficulty, and stressfulness (Garza & Feltz, 1998).	Totally Uncertain 0 1 2 3 Moderately certain 4 5 6 7 Totally certain 8 9 10

Table 1. (cont'd)

Q34 On a scale from 0 to 10, 0 being completely uncertain, 5 moderately certain, and 10 being completely certain, please select a number indicating how certain you are in your abilities to complete the following task in a competitive tennis match. (Only one response may be selected) "Successfully hold your service game under pressure"	Hierarchical self-efficacy measures list questions which assess the certainty in which participants believe they can execute fundamental tasks and skills that vary in complexity, difficulty, and stressfulness (Garza & Feltz, 1998).	Totally Uncertain 0 1 2 3 Moderately certain 4 5 6 7 Totally certain 8 9 10
Q35 On a scale from 0 to 10, 0 being completely uncertain, 5 moderately certain, and 10 being completely certain, please select a number indicating how certain you are in your abilities to complete the following task in a competitive tennis match. (Only one response may be selected) "Successfully break your opponent's service game under pressure"	Hierarchical self-efficacy measures list questions which assess the certainty in which participants believe they can execute fundamental tasks and skills that vary in complexity, difficulty, and stressfulness (Garza & Feltz, 1998).	Totally Uncertain 0 1 2 3 Moderately certain 4 5 6 7 Totally certain 8 9 10

Table 1. (cont'd)

Q36 How vivid and detailed are the memories that a song may trigger?	The purpose of this question is to understand if tennis players can recall vivid memories due to listening to a song, and if so, the degree to their perceived vividness. Only one selection can be made.	1. Very detailed 2. Detailed 3. Neutral 4. Lacking detail 5. Lacking great detail
Q37 What factors help you decide if you like a song? Select all that apply	The investigator seeks to gather more information on the music selection process in tennis. It has been shown that tennis players listen to music based on extra-musical associations, film soundtracks and music videos, acoustic properties, and identification with artist or lyrics (Bishop, 2007). Multiple answers may be selected.	• The lyrics/artist • The beat/tempo • The melody/tune • The association of the song to other past events in my life or with a film/movie • Peers/friends • The cultural significance of the song • I don't know, If I like the song then I listen to it
Q38 Do you ever play a song in your head during a tennis match?	Based on evidence that suggests tennis players use music to trigger auditory imagery, the investigator seeks to understand if players use this form of imagery during a match (Bishop, 2007). Only one selection can be made.	1. Never 2. Seldom 3. Sometimes 4. Frequently 5. Always
Q39 How does playing a song in your head affect you? Select all that apply	The list of potential ways auditory imagery may affect athletes are listed regarding perceived rate of exertion, since listening to music during exercise has been shown to decrease perceived rate of exertion in low to moderate amounts of physical activity (Rejeski,1985). Multiple answers may be selected.	• It makes me less stressed out • It helps me play longer • It helps me enjoy tennis matches more • It distracts me • It motivates me • It makes me feel positive • It does not affect me • Other (Text box included)

Data Analysis

SPSS was used to calculate descriptive statistics to determine the percentage of respondents who listen to music before playing tennis, as well as frequency of other responses. For questions with open-ended responses, qualitative data was analyzed using content analysis, coupled with indictive reasoning, resulting in the formulation of universal themes. SPSS was used to calculate measures of central tendency, such as mean, median, and mode of responses. For questions measuring self-efficacy, scores were analyzed by summing each of the items (forehand, backhand, volley, overhead, serve, hold serve, break opponent's serve). The possible range of scores was 0 to 70. Spearman correlations were used to see if correlations exist between listening to music relative to memory recall, successful performances and self-efficacy, as well as other responses.

CHAPTER FOUR

RESULTS

This investigation was designed to examine five research questions. These included:

(1) Do tennis players typically listen to music before performing;

(2) What emotional states do collegiate tennis players attempt to reach by listening to music before performance;

(3) For athletes who report listening to listening to music that is associated with and or facilitates recall of past successful events, do they perceive that this impacts their self-efficacy?;

(4) Does listening to music that affects a player's emotional state before performance effect self-efficacy; and,

(5) Do athletes engage in auditory imagery during tennis matches and how does it affect their emotional state?

Based on the previous literature, it was hypothesized that:

(1) more than half of tennis players listen to music before performing and practicing;

(2) tennis players will attempt to experience a more positive mood state using music than the mood they were experiencing before listening to music;

(3) athletes who report listening to music that is associated with past, successful events will perceive that is this enhances self-efficacy;

(4) music that improves one's emotional state will be related to increased self-efficacy; and,

(5) that more than half of tennis players use auditory imagery and that it will be perceived to have positive effect on emotional states.

The results are organized around the stated purposes and hypotheses. However, before these primary findings are presented background information about the participants is provided.

It should also be noted that 62 respondents completed the survey. However, four participants did not meet the age requirement, which was 18 to 24 years. Additionally, six participants failed to answer most of the questions, including Question 9, which was deemed most important to the research questions. If participants failed to answer Question 9, which asked, “Do you typically listen to music before playing tennis matches and/or practices?” they were also removed from the study. Overall, 52 participants’ data were analyzed (n=52) and made up the final sample for the study.

Demographic and Background Information

Age, gender, competitive level, years of experience, percentage of matches won within the last year, and time spent on court are shown in Table 2. Out of the 49 participants that gave their age, 44 or 89.8 % were between the ages of 18-22, and 5 or 10.2% were of the ages 23 and older. Of the 51 participants who indicated their gender, 19 (37.3%) of respondents were female and 32 (62.7%) were male. Out of the 51 participants who indicated their competitive level, 24 or 47.1% were collegiate club team players, 5 or 9.8% were NCAA Division 1, 6 or 11.8% were NCAA Division 2, and 16 or 31.4% were NCAA Division 3 players. When asked about the USTA player rating, 30 of 42 participants (71.4%) indicated they did not know their ranking, while 12 (28.6 %) indicated they did know their USTA player rating. Of the 10 participants who indicated they knew their USTA player rating, four stated their level was 4.0, while the remaining six stated their level was 4.5. Of the 50 participants who indicated the amount of years they’ve been playing tennis, 18 or 36% have been playing for 0-10 years, 28 or 56% have been playing for 10-15 years, and 4 or 8% have been playing tennis for more than 15 years. Of the 40 participants who indicated the percentage of matches they won within the last year, 21 or 52.5% of participants won 0-25% of their previous matches, 4 or 10% of participants won 25-50% of their previous matches, 10 or 25% of participants won 50-75% of their previous matches, and 5 or 12.5% won 75-100% of their matches within the last year. Of the 51 participants who indicated the amount of time they spend on court per week in terms of practice and match play, 18 or 35.3% of participants spend 1-5 hours, 17 or 33.3% of participants

spend 6-10 hours, 12 or 23.5 % of participants spend 11-15 hours, 1 or 2% of participants spend 16-20 hours, and 3 or 5.9% of participants spend 21 or more hours.

Table 2: Background Information

Question	Answer Choice	Percentage	Frequency
Age Range	18-22 years	89.8%	44
	23 + years	10.2%	5
Gender	Female	37.3%	19
	Male	62.7%	32
Competitive level in tennis	Collegiate Club Team	47.1%	24
	NCAA Division 1	9.8%	5
	NCAA Division 2	11.8%	6
	NCAA Division 3	31.4%	16
Years of experience as a tennis player	0-10 years	36%	18
	10-15 years	56%	28
	16 + years	8%	4
Percentage of matches won within past year	0-25 % of matches won	52.5%	21
	25-50 % of matches won	10%	4
	51-75% of matches won	25%	10
	76-100% of matches won	12.5%	5
Time spent on court per week	1-5 hours:	35.3%	18
	6-10 hours:	33.3%	17
	11-15 hours:	23.5%	12
	16-20 hours:	2%	1
	21 + hours:	5.9%	3

In summary, these descriptive statistics show that the vast majority of participants were between 18 to 22 years of age. About 60% of the participants were males while the participant pool was about evenly split between club and varsity tennis participants. The majority had played tennis between 10 and 15 years with 38% reporting they won over 51% of their matches in the last year.

Purpose 1: Do Tennis Players Typically Listen to Music Before Performing

As shown in Table 3, of the 41 participants who indicated how important listening to music is to them in their everyday life on a scale of 0 being least important and 10 being most important, two or 4.9% of participants indicated 3 out of 10, one or 2.4% of participants indicated 4 out of 10, five or 12.2 % indicated 5 out of 10, five or 12.2% indicated 6 out of 10, five or 12.2% indicated 7 out of 10, six or 14.6% indicated 8 out of 10, nine or 22% indicated 9 out of 10, and eight or 19.5% indicated 10 out of 10. The mean was 7.54 (SD =2.05). Of the 41 participants who indicated how important listening to music to them is before a tennis match/practice, one (2.4%) of participants reported 0 out of 10, two (4.9%) reported 2 out of 10, three (9.8%) reported 3 out of 10, five (12.2%) reported 4 out of 10, six (14.6%) reported 5 out of 10, six (4.6%) reported 6 out of 10, four (9.8%) reported 7 out of 10, four (9.8%) reported 8 out of 10, nine (14.6%) reported 9 out of 10, and three (7.3%) reported 10 out of 10. The mean was 6.00 (SD=2.51)

In summary, when asked about the importance of listening to music in one's everyday life on a Likert scale of 0-10, the mean was 7.54 (SD=2.05), while the mean when asked about the importance of listening to music before one plays a tennis match was 6.00 (SD=2.51). This suggests that listen to music in everyday life is important to the players while listening to music prior to matches was moderately important.

Table 3: Importance of Listening to Music

Question	Data Type	0	1	2	3	4	5	6	7	8	9	10
How important is listening to music for you in your everyday life?	Percentage	0%	0%	0%	4.9%	2.4%	12.2%	12.2%	12.2%	14.6%	22%	19.5%
	Frequency	0	0	0	2	1	5	5	5	6	9	8
	Mean:7.54 (SD=2.05)											
How important is listening to music for you before a tennis match?	Percentage	2.4%	0%	4.9%	9.8%	12.2%	14.6%	14.6%	9.8%	9.8%	14.6%	7.3%
	Frequency	1	0	2	3	5	6	6	4	4	9	3
	Mean: 6.00 (SD=2.51)											

Frequency of Listening to Music Before Performing

It was hypothesized that over half of the players would listen to music prior to performing. The mean response to Question 9, which asked, "Do you typically listen to music before playing tennis matches and/or practices?" was 2.7, which is between 2 (defined as sometimes) and 3 (defined as frequently). The results of the frequency of music use before playing tennis is shown in Table 4. Of the 51 participants who indicated if they ever listen to music in their everyday life, 52 or 100% indicated they do. Of the 52 participants who indicated if they typically listen to music before playing tennis matches and/or practices, 14 or 26.9% of participants always listen to music, 16 or 30.8% of participants frequently listen to music, 17 or 32.7% of participants sometimes listen to music, three or 5.8% of participants seldomly listen to music, and two or 3.8% of the participants never listen to music. Collapsing the always and frequently listens to music question responses revealed that 57.7% of the respondents listen to music prior to performance. Hence, Hypothesis 1, that predicted that over half of the players would listen to music prior to performing was supported.

Of the 42 participants who indicated how long they listen to music before playing tennis, 13 or 31% indicated 0-10 minutes, 26 or 61.9% reported 10-30 minutes, and three or 7.1% reported 30-50 minutes.

Table 4: Frequency of Music Use Before Playing Tennis

Data Type	Always	Frequently	Sometimes	Seldom	Never
Percentage	26.9%	30.8%	32.7%	5.8%	3.8%
Frequency	14	16	17	3	2
Mean: 2.7 SD (=1.05)					

In summary, these descriptive statistics show that 100% of the respondents reported listening to music in their everyday life. Also, 57.7% of respondents either always or frequently listen to music prior to performance, supporting Hypothesis 1. Lastly, the majority of participants (61.9%) reported listening to music for 10-30 minutes prior to performance.

Purpose 2: Emotional States Players Attempt to Reach by Listening to Music Before Performance

The second purpose of this study was to determine what emotional states collegiate age tennis players attempt to reach by listening to music before performance. It was also hypothesized that players will attempt to experience a more positive mood state using music than the mood they were experiencing before listening to music. Of the 40 participants who indicated how music affects their mood/emotional state before a match, 36 (90%) of participants stated, “Overall, music leads to a more positive mood state,” four (10%) stated, “Overall, music does not affect my mood state,” and none (0%) stated “Overall, music leads to a more negative mood state.” Hence, support was found for the hypothesis.

Content analysis of qualitative data received in response to Question 18, which asked, “Before you listen to music as you prepare for a tennis match, what are at least three emotions that best describe how you feel?” revealed the following patterns:

1- The most common emotion experienced while preparing for a tennis match and before listening to music is nervousness (n=23).
2- The second most common emotion experienced while preparing for a tennis match and before listening to music is excitement (n=9).
3- The third most common emotion experienced while preparing for a tennis match and before listening to music is being focused (n=5).
4- Other less common emotions experienced while preparing for a tennis match and before listening to music include stress (n=3), feeling ready (n=3), and feeling alert, worried, bored, tired, calm, scared, relaxed, and slow (n=2).
5- The least common emotions experienced while preparing for a tennis match and before listening to music include being on edge, apprehensive, restless, eager, jumpy, confused, tentative, peaceful, confident, and happy (n=1).

Further abstraction of these patterns resulted in the following theme via the process of inductive reasoning: Most tennis players are nervous, excited, and somewhat anxious while preparing for a tennis match and before listening to music. Content analysis of qualitative data received in response to Question 19, which asked, "After you listen to music as you prepare for a tennis match, what are at least three emotions that best describe how you feel?" revealed the following patterns:

1- The most common emotions experienced after listening to music while preparing for a tennis match are feeling focused (n=13), excited (n=12) and energized (n=12, reported as energetic, pumped, amped up, and hyped).
2- The second most common emotions experienced after listening to music while preparing for a tennis match is relaxation (n=9).
3- The third most common emotions experienced after listening to music while preparing for a tennis match are calmness (n=6), confidence (n=6), and motivation (n=6).
4- The fourth most common emotions experienced after listening to music while preparing for a tennis match are readiness (n=4) and determination (n=4).
5- Other less common emotions experienced after listening to music while preparing for a tennis match are anxiety (n=3), and happiness (n=3).
6- The least common emotions experienced after listening to music while preparing for a tennis match are feeling competitive (n=2), optimistic (n=2) and rejuvenated, cool, strong, driven, able, engaged, distracted, intense, and serious (n=1).

Further abstraction of these patterns resulted in the following theme via the process of inductive reasoning: Most tennis players are excited, energized, focused, and are somewhat relaxed, calm, confident, and motivated after listening to music while preparing for a tennis match. To further explore these issues the respondents were asked if they "listen to different types of music depending on whether you are in a positive or negative mood before a match."

Findings revealed that 19 (48.7%) of participants indicated they listen to the same types of music no matter what mood they are in. On the contrary, 20 (51.3%) of participants indicated they listen to different types of music depending on what mood they are in. Content analysis of qualitative data received in response to question 21, which asked, "Does your music preferences change depending on what mood you are in? If yes, in what ways?" revealed the following patterns:

1- For most tennis players, there is a relationship between one's mood and choice of song played: e.g., "Yes, a lot has to do with the sort of mood I'm in and the time of day" and "sometimes when I'm feeling really moody I'll listen to something to match the mood (sad or somber)."
2- When seeking to get energized or get prepared for a tennis match, most tennis players choose an upbeat music tempo to listen to, such as Rap: "When it's going to be a good match I usually listen to rap" and "If I need to wake up or get pumped up I switch to rap."
3- Upbeat music is listened to when one is in a good mood or trying to get into a better mood: "if I am in a better mood I will listen to more upbeat music" and "If I feel worse I'll listen to more upbeat music."
4- Music is a coping mechanism to deal with anger or bad moods: "when im in a bad mood or feeling slightly off I listen to more meaningful music."

Further abstraction of these patterns resulted in the following theme via the process of inductive reasoning: For most tennis players, choice of music is based on mood and is used as a coping mechanism. Emotional states reached using music are shown in Table 5. When participants were asked, "For what purpose do you listen to music before playing tennis? Select all that apply," the most frequent responses were 25 or 61% reported "to motivate myself," 19 or

46.3% reported “to help me focus,” 17 or 41.5% reported “to feel relaxed,” and 13 or 31.7% “to feel confident. “These results suggest that players most often listen to music to motivate themselves, to relax and to feel confident.

Table 5: Emotional States Reached Via Music

Answer Choice	Percentage	Frequency
To Feel Relaxed	41.5%	17
To Distract Myself	24.4%	10
To motivate myself	61%	25
To Reduce Boredom	9.8%	4
To Feel Confident	31.7%	13
To Help Me Focus	46.3%	19
To Remind Myself of a Time I Played Well	9.8%	3
Calm myself down	26.8%	11
Psych myself up/arouse myself	26.8%	11
I use it because I am superstitious	2.4%	1
I do not know why I listen to music before I play	7.3%	3
Other reasons not listed here	7.3%	3

In summary, the findings showed that 90% of players believe that music improves their emotional state before playing tennis. Findings revealed that nearly half (48.7%) of participants listen to the same types of music no matter what mood they are in, while 51.3% of participants indicated they listen to different types of music depending on what mood they are in. Players tend to feel nervousness, excitement, and anxiety before listening to music prior to competing and tend to feel excitement, energized, and focused after listening to music prior to competing. Players most often listen to music to motivate themselves, to feel relaxed, to help them focus, and to feel confident.

Purpose 3: Impacts of Listening to Music on Player Self-Efficacy?

The third purpose of this study was to determine if athletes who report listening to music that is associated with and or recalls past, successful events perceive that this impacts their self-efficacy. It was further hypothesized that athletes who report listening to music that is associated with past, successful events will perceive that is this enhances self-efficacy. Table 6 shows the frequency of listening to music associated with past events. Of the 37 participants who responded to the question, “To what degree do you practice visualization and/or remember past, successful performances before playing a tennis match,” three or 8.1% of participants indicated “never,” seven or 18.9% indicated “seldom,” 13 or 35.1% indicated “sometimes,” 10 or 27% indicated “frequently,” and four or 10.8% indicated “always.” The mean was 1.41 (SD=1.28) which is between 1 (defined as seldom) and 2 (defined as sometimes). Of the 37 participants who responded to the question, “To what degree does music help you recall past, successful performances before playing a tennis match,” five or 13.5% reported “never,” 12 or 32.4% reported “seldom,” 11 or 29.7% reported “sometimes,” eight or 21.6% reported “frequently,” and one or 2.7% reported always. The mean was 2.32 (SD=1.06) which is between 2 (defined as sometimes) and 3 (defined as frequently).

To measure self-efficacy, participants were asked to indicate on a scale from 0 to 10, 0 being very uncertain and 10 being very certain, how certain they are in their abilities to successfully execute a forehand, backhand, serve, return, volley, overhead, hold serve, and break their opponents serve under pressure. Total self-efficacy scores could have ranged from 0-70. Results showed that the average total self-efficacy score was 47.76 (SD=8.9), while the range was from 26 to 64. Since using a Spearmen correlation was deemed more appropriate than a Pierson correlation for the given data, Spearmen correlations were conducted to examine if there was a relationship between frequency participants practice visualization and/or remember past, successful performances before playing a tennis match and self-efficacy, as shown in Table 6.

Table 6: Frequency of Listening to Music Associated with Past Events

Question	Data Type	Always	Frequently	Sometimes	Seldom	Never
To what degree do you practice visualization and/or remember past, successful performances before playing a tennis match	Percentage	10.8%	27%	35.1%	18.9%	8.1%
	Frequency	4	10	13	7	3
	Mean: 1.41 (SD=1.28)					
To what degree does music help you recall past, successful performances before playing a tennis match	Percentage	2.7%	21.6%	29.7%	32.4%	13.5%
	Frequency	1	8	11	12	5
	2.32 (SD=1.06)					

Results showed no significant relationship between frequency participants practice visualization and/or remember past, successful performances before playing a tennis match and self-efficacy ($r = .033$, $p > .05$). An independent t-test examining specifically the participants ($n=14$) who reported they "always" or "frequently" practiced visualization and/or remember past, successful performances before playing a tennis match to determine their relationship with self-efficacy scores showed they had a median self-efficacy score of 47.32, while the 22 remaining participants who reported they "sometimes," "seldom," or "never" practice visualization and/or remember past, successful performances before playing a tennis match showed they had a median self-efficacy score of 48.71 ($p > .05$).

When examining the relationship between degree music helps to recall past, successful performances before playing a tennis match and total self-efficacy scores, results showed no statistically significant relationship ($r = .007$, $p > .05$). An independent t-test examining participants who "always" or "frequently" use music to recall past, successful performances before playing a tennis match and total self-efficacy scores showed they had a median self-efficacy score of 47.78, while those who "sometimes," "seldom," and "never" had a median self-efficacy score of 47.89 ($p > .05$). For the Likert scale questions used to measure self-efficacy, the means were also calculated. The mean for Question 29, which asked one to indicate his or her ability to execute a forehand under pressure, was 7.26 (SD=1.96). The mean for Question 30, which asked one to indicate his or her ability to execute a backhand under pressure, was 6.49 (SD=2.22). The mean for Question 31, which asked one to indicate his or her ability to execute a volley under pressure, was 6.73 (SD=2.18). The mean for Question 32, which asked one to indicate his or her ability to execute an overhead under pressure, was 6.89 (SD=2.32). The mean for Question 33, which asked one to indicate his or her ability to execute a serve under pressure, was 7.08 (SD=2.42). The mean for Question 34, which asked one to indicate his or her ability to hold one's service game under pressure, was 6.95 (SD=1.89). The mean for Question 35, which asked one to indicate his or her ability to break the opponent's service game under pressure, was 6.19 (SD=1.68).

In summary, there was no statistically significant relationship between frequency participants practice visualization and/or remember past, successful performances before playing a tennis match and self-efficacy ($r = .033$, $p > .05$). There was also no statistically significant relationship between degree music helps to recall past, successful performances before playing a tennis match and total self-efficacy scores (r = .007, p > .05), showing Hypothesis 3 was incorrect.

Purpose 4: Does Listening to Music That Affects a Player's Emotional State Before Performance Affect Self-Efficacy?

The fourth purpose of this study was to determine if listening to music that affects a player's emotional state before performance affects self-efficacy. It was hypothesized that music that improves one's emotional state which will be related to increased self-efficacy. When asked, "Does music put you in a positive mood after listening to it," of the 40 participants who responded, six or 15% of participants selected "always," 26 or 65% selected "frequently," seven or 17.5% selected "sometimes," and one or 2.5% selected "never." The mean was 2.95 (SD=0.66) which is between 2 (defined as sometimes) and 3 (defined as frequently). As shown on Table 7, when asked, "In those instances when music puts you in more positive mood state after listening to what degree does this influence your confidence in your ability to play and perform at a high level," 22 or 57.9% of respondents stated "frequently," 15 or 39.5% stated "sometimes," and one or 2.6% stated "seldom." The mean was 2.55 (SD = 0.55) which was between 2 (defined as sometimes) and 3 (defined as frequently). Spearmen correlations showed a statistically significant relationship (r = 0.618, p < .01) between the frequency of music eliciting a positive mood after listening to it and the degree this influences one's confidence in one's ability to play and perform at a high level.

When asked, "Does music put you in a negative mood after listening to it," of the 38 participants who responded, two or 5.3% of respondents stated "sometimes%," 17 or 44.7% of respondents stated "seldom" and 19 or 50% of respondents indicated "never." The mean was 0.55 (SD = 0.6) which was between 0 (defined as never) and 1 (defined as seldom).

Table 7: Frequency of Music Eliciting a Positive Mood State and Confidence

Question	Data Type	Always	Frequently	Sometimes	Seldom	Never
Does music put you in a positive mood after listening to it	Percentage	15%	65%	17.5%	0%	2.5%
	Frequency	6	26	7	0	1
	Mean: 2.95 (SD=0.66)					
In those instances when music puts you in more positive mood state after listening to what degree does this influence your confidence in your ability to play and perform at a high level	Percentage	0%	57.9%	39.5%	2.6%	0%
	Frequency	0	22	15	0	1
	Mean: 2.55 (SD = 0.55)					

As shown in Table 8, of the participants who did not select “never,” when asked “In those instances when music puts you in a more negative mood state after listening to it what degree does this influence your confidence in your ability to play and perform at a high level,” eight or 47.1% of respondents selected “sometimes,” six or 35.3% selected “seldom,” and three or 17.6% selected “never.” The mean was 1.29 (SD = 0.77) which is between 1 (defined as seldom) and 2 (defined as sometimes). Spearmen correlations showed no statistically significant relationship ($r = 0.249$, $p > .05$) between frequency music which elicits a negative mood after listening to it, and the degree this influences confidence in one’s ability to play and perform at a high level. In summary, participants stated music elicits a positive mood, while very few participants (2.5%) indicated that music never elicits a positive mood. There was a statistically significant relationship between music which elicits a positive mood and self-efficacy. This finding confirms Hypothesis 1, which stated that music that improves one's emotional state will be related to increased self-efficacy. However, there was no statistically significant relationship between music which elicits a negative mood and self-efficacy.

Table 8: Frequency of Music Eliciting a Negative Mood State and Confidence

Question	Data Type	Always	Frequently	Sometimes	Seldom	Never
Does music put you in a negative mood after listening to it	Percentage	0%	0%	5.3%	44.7%	50%
	Frequency	0	0	2	17	19
	Mean: 0.55 (SD = 0.6)					
In those instances when music puts you in a more negative mood state after listening to it what degree does this influence your confidence in your ability to play and perform at a high level	Percentage	0%	0%	47.1%	35.3%	17.6%
	Frequency	0	0	8	6	3
	Mean: 1.29 (SD = 0.77)					

Purpose 5: Do Athletes Engage in Auditory Imagery During Tennis Matches and How Does it Affect Their Emotional State?

Several questions were designed to assess the players use of auditory imagery and how using such imagery is perceived to improve the respondents' emotional state. It was also hypothesized that more than half of tennis players will have used auditory imagery and that it will be perceived to have positive effect on emotional states. Of the 38 participants who responded to the question "Do you ever play a song in your head during a tennis match," three or 7.9% selected "always," 12 or 31.6% selected "frequently," 11 or 28.9% selected "sometimes," 8 or 21.1% selected “seldom,” and 4 or 10.5% selected “never.” Thus, 68.4% of the respondents indicated that they sometimes to always engage in auditory imagery during their matches. This finding supports the first portion of the hypothesis.

When asked, “How does playing a song in your head affect you? Select all that apply,” 44.4% selected “It makes me less stressed out,” 5.7% selected ,”It helps me play longer,” 17.1% selected “Helps me enjoy tennis matches more,” 48.6% selected “It distracts me,” 31.4% selected “It makes me feel positive,” 31.4% selected “It motivates me,” and 5.7% selected “It does not affect me.”

The responses pertaining to making one feel positive and motivates me showed that approximately 30% of the participants viewed auditory imagery as having a positive effect on them, although the way the question was posed does not really provide for a direct test of the hypothesis as the number of individual players who indicated they used imagery in both ways cannot be detected. However, the author checked the raw data to determine the total number of participants who checked both response choices. This revealed that 42.8% of the respondents felt auditory imagery had a positive effect on their emotional state which refutes the hypothesis that over half of participants would perceive that auditory imagery would be perceived as having a positive effect.

In summary, the finding that 68.4% of the respondents stated that they sometimes to always engage in auditory imagery while playing tennis matches, supports the first part of Hypothesis 5, which stated that over half of participants would report they engage in auditory imagery. However, the second part of the hypothesis, which stated that over half of participants will report that auditory imagery has a positive effect on one’s emotional state, was rejected. Only 42.8% of respondents felt auditory imagery had a positive effect on their emotional state.

Additional Findings

This study was exploratory in nature and addressed several gaps in the literature outside of the main research questions. When participants were asked, "What factors help you decide if you like a song? (With the purpose of listening to it for tennis) Select all that apply," participants listed several factors such as beat/tempo (86.8%), lyrics/artist (55.3%), melody/tune (44.7%), association of the song to other past events (23.7%), peers/friends (13.2%),"I don't know, If I like the song then I listen to it"(7.9%) and cultural significance of the song (5.3%). When participants were asked to name three songs they typically listen to before playing tennis, the beats per minute for each song was identified using a simple Google search. Then, the average beats per minute of all three songs was calculated by adding the three scores, and dividing the total score by three, producing an average beats per minute score for each participant. This was used to calculate the average beats per minute for all participants, which was 125, while the range was 89 to 161 beats per minute.

After conducting an independent t-test, it was found that there was a statistically significant difference in beats per minute for those who listen to music to "to feel confident" when compared to those who did not ($M = 134.1$ vs $M = 119.8$, $p = 0.05$). However, there were no statistically significant relationships in beats per minute for those who listen to music when compared to those who did not relative to the following responses: "to feel relaxed" ($p= 0.69$, $p > .05$), "to distract myself" ($p = .301$, $p > .05$), "to motivate myself" ($p = 0.60$, $p > .05$), "to reduce boredom" ($p = 0.91$, $p > .05$) "to help me focus" ($p = 0.83$, $p > .05$), "to remind myself of a past event in my life" ($p = 0.70$, $p > .05$), "to calm myself down" ($p = 0.55$, $p > .05$), and "to psych myself up/arouse myself" ($p = 0.24$, $p > .05$). In addition, after conducting a spearman correlation to determine if a relationship existed between beats per minute and frequency music put one in a positive mood after listening to it, it was determined there was no statistically significant relationship ($r = .08$, $p = 0.69$). There was also no statistically significant relationship between beats per minute and degree one practices visualization and/or remembers past, successful performances before playing a tennis match ($r = -0.012$, $p= 0.95$). Lastly, there was no statistically significant relationship between beats per minute and degree to which music helps one recall past, successful performances before playing a tennis match ($r = -0.320$, $p = 0.13$). However, a statistically significant relationship was found between degree one practices visualization and/or remembers past, successful performances before playing a tennis match and frequency that music puts one in a positive mood after listening to it ($r = 0.39$, $p = 0.015$).

Finally, a central aspect of the study was to examine music use and self-efficacy. Using a spearman correlation, it was determined there was no statistically significant relationship between frequency of listening to music before playing tennis and total self-efficacy scores ($r = -0.10$, $p=0.57$). However, there was a weak to moderate relationship between frequency of listening to music before playing tennis and frequency of engaging in auditory imagery during tennis matches ($r = 0.32$, $p=.05$). There was no statistically significant relationship between frequency of listening to music before playing tennis and frequency of music putting one in a positive mood after listening to it ($r = 0.24$, $p = 0.13$). Lastly, when participants were asked, "How vivid and detailed are the memories that the songs may trigger?" (Specifically the three songs the participants listed previously) four or 10.8% selected "very detailed," eight or 21.6% selected "detailed," 14 or 37.8% selected "neutral," eight or 21.6% selected "lacking detail," and three or 8.1% selected "lacking great detail."

In summary, beat/tempo was the most common (86.8%) factor which helped players determine if they like a song. Players who listen to music to feel confident showed a statistically significant relationship with selecting music with more beats per minute compared to those who did not listen to music to feel confident. Also, there was a low to moderate relationship between frequency of listening to music before playing tennis and frequency of engaging in auditory imagery.

CHAPTER FIVE

DISCUSSION

The purpose of the present study was to understand if listening to music is a common and integral part of tennis players' pre-performance routines. The study was also designed to understand if and how music is associated with a player's emotional states, the relationship between a player's emotional state and its influence on the recall memories of past, successful events, and how a change in a player's emotional state and recall of successful performances may be perceived to influence self-efficacy. Lastly, this study was designed to understand if auditory imagery is commonly used during match play.

Results show that, when asked how frequently players listen to music before playing tennis matches and/or practices, 27% of participants selected "always," while 31% of players selected "frequently." In other words, 58% of players typically listen to music before playing, either always or most often, confirming the first hypothesis that over half of tennis players typically incorporate music in their pre-performance routines. This finding is best explained by the role music plays in enhancing one's overall emotional state. Of the 40 participants who indicated how music affects their mood/emotional state before a match, 36 (90%) of participants stated, "Overall, music leads to a more positive mood state" while only four (10%) stated, "music does not affect my mood state." None of the respondents reported that "music leads to a more negative mood state." Since the majority of participants listen to music because it improves their overall mood state, this confirms our second hypothesis, which stated that tennis players will attempt to experience a more positive mood state using music than the mood they were experiencing before listening to music.

When players were asked to state three emotions that accurately describe their emotional state before competing, it was revealed that most tennis players are nervous (n=23) and excited (n=9) before listening to music. When asked, “After you listen to music as you prepare for a tennis match, what are at least three emotions that best describe how you feel?” the most common emotions experienced were feeling focused (n=13), excited (n=12) and energized (n=12). Players also cited relaxation (n=9) and calmness (n=6) as well. These findings show that players tend to experience more negative emotions before listening to music and more positive emotions after listening to music. This finding is consistent with previous literature, which showed that tennis players reported a negative mood before listening to music and a positive mood after listening to music (Bishop, 2007) and that music is a commonly used strategy to elevate and enhance one’s emotional state (Thayer, Newman, & McClain, 1994).

Also, when asked, “Does music put you in a negative mood after listening to it,” of the 38 participants who responded, two or 5% of respondents stated “sometimes,” 17 or 45% of respondents stated “seldom” and 19 or 50% of respondents indicated “never.” The mean response was 1.45 meaning that on average respondents seldom or negative reported music leading to a negative mood state. This shows that the majority of participants do not commonly experience a negative mood after listening to music, which also supports the claim that music is generally used to elicit positive emotions.

In the present study, participants showed that mood was related to the tempo of the music they listened to. When asked, “Does your music preferences change depending on what mood you are in? If yes, in what ways?” one of the patterns found was that participants listen to faster tempo, upbeat music when in a good mood or when attempting to get into a better mood. One participant stated, “if I am in a better mood I will listen to more upbeat music.” Another said, “If I feel worse I’ll listen to more up beat music.” This finding supports previous literature which shows that tennis players prefer high tempo music over slow tempo music and that high tempo music is associated with higher valence and higher subjective arousal (Bishop, 2007).

When asked to select factors which help participants decide if they like a song, 87% participants cited “beat/tempo,” making it the most commonly cited factor. Other factors mentioned were lyrics/artist (55%), melody/tune (45%), association of the song to other past events (24%), peers/friends (13%) and cultural significance of the song (5%). Although former studies mention that lyrics/artist, melody/tune, association of the song, peers/friends, and cultural significance were mentioned in qualitative interviews (Bishop, 2007), this study indicated that some of these factors, such as beat/tempo, are more popular, and thus more important, than others in helping them decide if they like a song. This finding may be due to the role of tempo in eliciting positive emotions.

Also, participants who listen to music “to feel confident” listened to music with an average of 134 beats per minute, while those who did not select “to feel confident” listened to music with an average of 120 beats per minute. Previous literature shows that medium tempo music is defined as music with 115-120 beats per minute, while fast tempo music has 135-140 beats per minute (Karageorghis, et al., 2013). Although this study merely points to a statistically significant association between those who listen to music to seek confidence and listening to higher tempo music, previous literature has demonstrated that listening to music with faster tempo is associated with heightened self-confidence and arousal (Priest & Karageorghis, 2008).

Another finding was that, “to motivate myself” was the most popular purpose for listening to music (61%). When asked, “For what purpose do you listen to music before playing tennis? Select all that apply,” common responses included “to motivate myself” (61%), “to help me focus" (46%), "to feel relaxed" (42%), "to feel confident" (32%), "to psych myself up" (27%), "to calm myself down" (27%), and "to distract myself" (24%), which was consist with previous research (Bishop, 2007). One theory which would explain the diversity of responses given is the arousal hypothesis.

According to the arousal hypothesis, altering one's arousal at high intensity exercise can lead to prolonged exercise performance. Heightened arousal is beneficial for high intensity exercise, but not for low intensity activities, such as golf or yoga (Szabo & Hoban, 2004). Although this explanation may assist in understanding why some players use music to increase their arousal levels, the sport of tennis involves continuous breaks in between points, games, and sets. Tennis as a sport is also very reliant upon precise biomechanics, similarly to golf. Therefore, an extremely heightened level of arousal may not be beneficial to tennis players compared to athletes of more rigorous sports such as boxing. Also, "to feel relaxed," and "to calm myself down" were other popular reasons listed by participants, which suggest that participants use music to decrease arousal as well. Based on the diversity of responses, which include reasons for listening to music "to psych up" (27%) and "to calm myself down" (27%), each participant most likely uses music to either increase arousal or decrease and achieve their desired and preferred arousal level before playing, which varies by individual. Literature shows that preperformance routines should be tailored to the specific characteristics of the individual and that one's general anxiety level is an individual characteristic that influences one's pre-performance routine. Highly anxious people may need to emphasize relaxation techniques in their routine, while less anxious athletes may need to emphasize activation techniques to achieve a state of readiness (Cohn, 1990). The Individual Zones of Optimal Functioning (IZOF) states that athletes are more likely to perform at their best when their state anxiety is at an individually optimal level. Previous literature also shows that athletes whose pre-start anxiety levels are within their optimal range typically perform better than those whose pre-start anxiety levels fall outside of their optimal range (Salminen, 1995). It is possible that people who are highly anxious may have chosen reasons such as “to calm myself down” to reduce their arousal and achieve their preferred optimal level of anxiety, while those who are less anxious chose reasons for listening to music such as “to psych myself up” to increase their arousal and achieve their preferred optimal level of anxiety.

To the investigator’s surprise, and contrary to the investigator’s third hypothesis, there was no statistically significant relationship between frequency of listening to music that helps recall past, successful performances before playing tennis and self-efficacy. It was expected that music which elicited the recall of past, successful experiences would be perceived to increase self-efficacy because mastery experience, which involves experiences one performed successfully in the past, is one of the strongest and well-supported sources of self-efficacy (Warner, et al. 2014). However, one factor which could have led to the present findings involves the vividness of memories which were triggered by music in the present sample.

One possible explanation of findings which show no statistically significant relationship between music which triggers the recall of memories and self-efficacy involves the vividness of the memories which were recalled. When participants were asked, “How vivid and detailed are the memories that the songs may trigger? (Specifically the three songs you listed previously)” only 32% of the participants stated the memories that songs may trigger were very detailed or detailed, while the majority (68%) of participants reported either neutral, lacking detail, or lacking great detail. Previous literature shows that vividness has been described as the most important characteristic of memory. Memory for important emotional events tend to remain vivid for as long as 50 years after the event occurs (Sutin & Robins, 2007, p. 404). Vividness has also been used to differentiate between perceived from actual events (Sutin & Robins, 2007, p. 404). Since most of the participants (68%) stated their memories which were triggered by music were either neutral, lacking detail, or lacking great detail, this may weaken the internal validity of this finding, because it is unclear whether some of these memories were accurate, inaccurate, or imagined.

Pre-task music has been shown to facilitate task-relevant imagery (Karageorghis & Priest, 2012). Although the primary research question addressed the role of music in triggering the recall past, successful performances and how this may be related to self-efficacy, given that the present study was exploratory in nature, an additional finding was that there was no statistically significant relationship between visualization and self-efficacy, which could be due to several reasons. When asked how frequently participants visualize/recall past, successful events before playing tennis, most participants do not typically do so, but rather they "sometimes" (35%), "seldom" (19%), or "never" (8%) engage in this pre-performance routine. In other words, most participants (62%) do not always or frequently engage in visualization before playing tennis. This analysis aligns with several studies which note that visualization was not effective when they were reliant upon very brief interventions. The studies note that the interventions, which were found to be ineffective, were only comprised of one to two sessions (Harwood & Thrower, 2019). Although the literature discusses brief visualization interventions that were ineffective in affecting performance, it is also possible that brief visualization interventions may also be ineffective in affecting psychological variables such as self-efficacy as well.

Although it is possible the present study found no statistically significant relationship between visualization before playing tennis self-efficacy due to the lack of consistency in which players engaged in this pre-performance routine, an independent t-test showed that even those who "always" (11%) and "frequently" (27%) practice visualization before playing tennis also did not show a statistically significant relationship with self-efficacy ($p > .05$). An alternative explanation for this finding may be that most participants may have not had proper training in how to correctly practice visualization/recall of previous events.

Literature shows that there are five specific functions of mental imagery, which are motivation general-mastery, motivation general-arousal, motivation-specific, cognitive-general, and cognitive-specific (McCarthy, 2010). One study which tested youth athletes showed that of the five categories, the participants only demonstrated an understanding of motivation-specific imagery, which involves imagining winning a prize, motivation general-mastery imagery, which involves imagining one coping in the face of challenging situations, and cognitive-general imagery, which involves imagining strategies for a competitive event. However, they did not display motivation general-arousal, which is associated with decreased anxiety, or cognitive-specific, which is associated with performance improvements. In addition, participants only demonstrated an understanding of the visual sense of mental imagery, which allows them to create an experience in their mind, but they lacked other mental imagery processes such as "hearing" or "feeling" stimuli. Suitable education was deemed necessary to help them fully understand visualization, in order to properly integrate these skills into practice (McCarthy, 2010). Although the study tested a sample of youth between the ages of 10-15, the participants in the present study, who were mostly of the age 18-22, may be similar in that they were not trained by a sport psychologist, mental skills trainer, or qualified coach to properly understand and practice visualization, especially when considering that the present sample consisted of many club-team players (45%) who may not have had the same access to the same resources as NCAA collegiate athletes.

Another additional finding regarding visualization was there was a statistically significant relationship found between the degree one practices visualization and/or remembers past, successful performances before playing a tennis match and frequency that music puts one in a positive mood after listening to it ($r = 0.40$, $p = 0.02$). Although there was a relationship found, due to the nature of the study, causation cannot be stated directly or implied.

There was a statistically significant relationship ($r = 0.62$, $p < .01$) between music eliciting a positive mood after listening to it and the degree this influences one’s perceived self-efficacy, which confirmed the investigator’s fourth hypothesis. This finding may be explained by one of Bandura’s four sources of self-efficacy, physiological and affective states. Positive affect can help one feel confident in his or her abilities to execute a specific task (Bandura, 1977). This finding may also be related to music related memory associations and episodic memories, which occur when a trigger, such as music, causes strong emotions that one experienced in the past along with a memory of an event, which may influence one’s psychological state. Being in a positive mood may directly lead to self-efficacy by improving one’s affective state, or may also lead to more frequent recall of more positive memories, since positive affect has been shown to influence the type of memories one recalls (Blais-Rochette & Miranda, 2016; Blaney, 1986; Chase, Feltz, & Lirgg 2003). In the present study, it is unclear whether music which elicits a positive mood directly affected perceived self-efficacy, or if there was a complex interaction between positive mood, the recall of positive memories, and perceived self-efficacy. Due to the nature of the study, although a relationship exists between these variables, causation cannot be stated directly or implied.

The last research question addressed the frequency tennis players use auditory imagery during tennis matches, and how they perceive it affects their emotional state. The majority (68%) of respondents indicated that they sometimes to always engage in auditory imagery during their matches, which supports the first portion of the hypothesis that over half of participants would engage in auditory imagery. However, only 43% of participants indicated they perceive auditory imagery has a positive effect on their emotional state, and since this is less than half of the total number of participants, the second portion of the hypothesis was not supported. The present study, which found that the majority (68%) of players sometimes to always engage in auditory imagery on the court, is consistent with previous research findings which also cite that players who use auditory imagery while competing (Bishop, 2007). However, this study is the first to report the specific frequency players use auditory imagery, while previous research only reported it as a theme which emerged during qualitative interview questioning.

Another finding which emerged was there was a weak to moderate relationship between frequency of listening to music before playing tennis and frequency of engaging in auditory imagery during tennis matches ($r = 0.32$, $p=.05$). This may imply that players who engage in auditory imagery on the court do so as a consequence of their music listening during their pre-performance routine. This is also consistent with previous research which found that players engaged in auditory imagery as a consequence of music listening and that auditory imagery may be a means to achieve a performance-facilitating emotional state (Bishop, 2007). This finding in the literature may help to explain why, when asked, “How does playing a song in your head affect you? Select all that apply,” 44% selected “It makes me less stressed out.” Feeling “lessed stressed out” may be related to decreased anxiety, which may help in achieving one’s optimal state of arousal necessary to perform at their best (Szabo & Hoban, 2004).

There were several limitations in the present study which should be recognized. One limitation of the present study was that no assessment regarding one's understanding of the proper use of visualization and recall of past, successful events was made. This limitation may weaken the internal validity of the finding which suggested there was no relationship between visualization and self-efficacy, as well as the finding that there was no relationship between music which assists in the recall of past, successful events and self-efficacy because it is possible that participants did not practice these strategies properly.

Another limitation is that, although relationships between variables were found, causation cannot be inferred. For example, it is unclear whether music which elicits a positive mood directly affected self-efficacy, or if there was a complex interaction between positive mood, the recall of positive memories, and perceived self-efficacy. Also, it is possible that those with high self-efficacy tend to listen to music which elicits a positive mood. Directionality and causality both cannot be inferred in the present study.

Although the present study has contributed to the literature in several ways, the findings can only be generalized to other tennis players of the same age and competitive level. For example, when participants were asked, "For what purpose do you listen to music before playing tennis? Select all that apply," common responses included "to motivate myself" (61%), "to help me focus" (46%), "to feel relaxed" (42%), "to feel confident" (32%), "to psych myself up" (27%), "to calm myself down" (27%), and "to distract myself" (24%). However, these findings cannot be generalized to athletes of other sports, because the arousal levels that tennis players seek to achieve before playing tennis may differ from the preferred arousal levels that other athletes may seek to achieve due to the nature of the sport they are competing in. High levels of arousal have been shown to be beneficial for high intensity exercise, but not for low intensity activities (Szabo & Hoban, 2004). Tennis is a physically demanding sport which not only demands players to demonstrate high levels of endurance and precise biomechanics when playing, but also consists of many short breaks between points, games, and sets, making it fundamentally unique when compared to most sports.

Another limitation in the present study was the use of an unvalidated survey and its length. Questions for this study were based on the previous research and theory, but scale validation and psychometric properties were not established. Future researchers should address this issue. Similarly, although 52 participants took the survey, only 35 participants answered every question. Survey fatigue may have affected participants ability to fully complete the survey and answer every question to the best of their ability.

The sample size was also a limitation of this study. Originally, it was hoped to collect data from at least 100 collegiate aged players but only 52 participants completed the survey. The small sample size weakens the generalizability and external validity of the data. More participants in the present study were needed to fully represent the population of tennis players that this study intended to understand and examine. Since the sample size was small, this made it difficult for the investigator to understand how multiple variables were related, which is why the investigator did not conduct a regression analysis. One of the reasons why it was difficult to obtain a larger sample size was because of the COVID-19 pandemic. The COVID-19 pandemic made it impossible to collect in-person data and disrupted the collegiate season which likely influenced the response rate. Also, when asked how many hours players spend on court playing and practicing, the COVID-19 pandemic most likely affected their response, since it directly impacted their ability to play. Also, participants had to rely on their own memory to recall how they would engage in their pre-performance routines prior to the epidemic, which was several months prior to taking the survey. This may have impacted the results of the study, and it is likely that it would have been easier for participants to recall their pre-performance routines if they were given the survey during the season, instead of months after they competed. The time this study was conducted represented a unique lifestyle situation on athletes due to the global pandemic. Although this was out of the investigator's control, this limitation should be addressed in future investigations.

Despite its limitations, the present study contributes to our knowledge base regarding the role music plays in tennis players' preperformance routines, and how it is related to their emotional state, self-efficacy, and use of auditory imagery. Future research should continue to investigate the role of music in eliciting emotions in tennis players and the way this may impact self-efficacy. Such research should not only investigate the relationship between self-efficacy and music which triggers memories and visualization, but it should also assess players' proper understanding of visualization. Studies should also investigate the role of music, emotion, and memory in relationship to not only self-efficacy in certain tasks, but in relationship to one's overall self-esteem as well. Although one of the limitations of this study was that participants were asked to remember details of their pre-performance routine several months after their last match due to the COVID-19 epidemic, which may have been difficult for some players, future investigations should assess players' pre-performance routines during the time of their collegiate tennis season.

These studies should be conducted in a concise manner to avoid survey fatigue. The present study only tested players 18 years old and older, but future investigations should examine the role of music in adolescent and youth tennis players as well. Future investigations should also examine if there are differences between the effects of tennis players listening to music as a team and players listening to music on an individual level before performing. Research should be conducted regarding the frequency in which athletes of both individual sports such as tennis and also team sports incorporate group music listening traditions into their pre-performance routines, and how this may impact one's emotions, memory recall, and self-efficacy both on an individual level as well as on a collective level.

One additional finding which should be explored further was that players reported music to be more important in their everyday lives when compared to before a tennis performance ($M = 7.54$, $M = 6.00$). Future investigations should further explore other areas of tennis players' lives in which they engage in music listening other than prior to performance to identify the specific contexts in which music is used in one's everyday life and to better understand the way players use music to achieve various emotional states. To date, only one study (Bishop, 2007) explored the music listening patterns in tennis players' everyday lives, and more research is required to explore this area of research.

Future investigations should also seek to understand if music is used by tennis players to achieve an optimal level of arousal, and if so, what specific elements of music contribute to this process more than others. These studies should examine the relationship between one's preferred arousal levels and individual preferences regarding tempo, as well as other aspects of music such as memory association, to determine the extent to which music is used to achieve flow state and one's individual zone of optimal functioning (IZOF).

Future investigations should also seek to better understand the origins of music listening as it relates to neurobiology and evolutionary biopsychology. Previous research indicates that patterns between exercise and music tempo correspond to electroencephalographic delta activity in the brain, acting as a "pattern generator," and that there is increased activity in the ventral premotor cortex when listening to music with a preferred tempo (Karageorghis & Priest, 2012). This area in the literature, which suggests that neurological factors allows us to perceive sound and develop rhythm between exercise and music tempo has yet to be fully understood and explored. Further exploration of this area of literature may advance our current understanding of how species change and evolve over time, and can help us understand why humans have the unique ability to perceive and interpret various sounds as a collection of patterns, commonly referred to as music, while all other species have not demonstrated this ability.

In conclusion, the present study found that over half of tennis players use music prior to playing tennis. Most players reported a positive mood state after listening to music. Although there was no relationship found between music which elicits memories of past, successful events and perceived self-efficacy, there was a statistically significant relationship found between music which elicits a positive mood and self-efficacy. Also, over half of players used auditory imagery during match play, but less than half of participants perceived this had a positive effect on them. Finally, further research is required to continue to explore the relationship between music, emotion, memory, and self-efficacy in tennis players, as well as athletes of other sports.

APPENDICES

Appendix A

Consent Form

Consent to Participate in Research

You are being asked to participate in a research study.

This study seeks to bridge the gap between our understanding of music in the realm of tennis. The investigator seeks to understand if listening to music is in fact a common and integral part of tennis players' pre-performance routines and acquire statistical data to support this claim. The study is also designed seek to understand if and how music is associated with a player's emotional states, how a change in a player's emotional state may influence the recall memories of past, successful events, and how one's emotional state and memories of successful performances may be perceived to influence self-efficacy. Other questions of interest focus on what emotional state players seek to achieve by listening to music and how tennis players use auditory imagery during match play.

Each survey contains 39 questions and should take around 15 minutes to complete. There are no foreseeable risks or discomforts of this research study. There are no other foreseeable alternative procedures. All participant responses are completely anonymous under all circumstances. There are no additional costs to participating, or any external monetary or financial rewards. There will be at least 100 men and women participating in the survey. All results may be shared with the participants upon completion of the study and request of the participant.

Your participation in this research is voluntary, and you will not be penalized or lose benefits if you refuse to participate or decide to stop. By taking the survey, this means that the research study, including the above information, has been understood and that you voluntarily agree to participate.

If you have concerns or questions about this study, such as scientific issues or how to do any part of it, please contact the researcher (Adam Alamah; alamahad@msu.edu).
If you have questions or concerns about your role and rights as a research participant, would like to obtain information or offer input, or would like to register a complaint about this study, you may contact, anonymously if you wish, the Michigan State University's Human Research Protection Program at 517-355-2180, Fax 517-432-4503, or e-mail irb@msu.edu or regular mail at 4000 Collins Rd, Suite 136, Lansing, MI 48910.

Appendix B

Pre-performance Music Questionnaire

Music and Sport

This study seeks to bridge the gap between our understanding of music in the realm of tennis. The survey contains 39 questions and should take around 15 minutes to complete. All responses are anonymous. By taking the survey, this means that the research study, including the above information, has been understood and that you voluntarily agree to participate.

Q1 Please indicate your age range

____

____

____

____

____

Q2 Please indicate your gender

○ Male

○ Female

○ Prefer not to answer

Q3 Please indicate your competitive level in tennis

- NCAA Division 1
- NCAA Division 2
- NCAA Division 3
- Collegiate Club Team
- Non-collegiate USTA player

Q4 Please indicate your USTA player rating using the appropriate text box below

- I know my USTA Player Rating ____________________
- I do not know my USTA Player Rating, but this is my estimate ____________________

Q5 Please indicate how many years of experience you have as a tennis player

Q6 Please indicate the percentage of competitive matches you won within the last year to the best of your ability

Q7 Please indicate the amount of time you spend on court per week in terms of practice and match play

- 1-5 hours
- 6-10 hours
- 11-15 hours
- 16-20 hours
- 21 + hours

Q8 Have you ever used or tried listening to music? (In your general life)

- Yes
- No

Q9 Do you typically listen to music before playing tennis matches and/or practices?

- Never
- Seldom
- Sometimes
- Frequently
- Always

Skip To: Q29 If Do you typically listen to music before playing tennis matches and/or practices? = Never

---

Q10 How important is listening to music for you in your everyday life?

- ○ 0
- ○ 1
- ○ 2
- ○ 3
- ○ 4
- ○ 5
- ○ 6
- ○ 7
- ○ 8
- ○ 9
- ○ 10

Q11 When do you tend to listen to music before playing tennis? Select all that apply

- ☐ Before playing tennis matches
- ☐ Before playing tennis practices
- ☐ During tennis matches
- ☐ During tennis practices
- ☐ After tennis matches
- ☐ After tennis practices

Q12 How important is listening to music for you before a tennis match?

- ○ 0
- ○ 1
- ○ 2
- ○ 3
- ○ 4
- ○ 5
- ○ 6
- ○ 7
- ○ 8
- ○ 9
- ○ 10

Q13 Do you typically listen to the same songs before a tennis match?

- ○ Yes - I listen to the same songs
- ○ Sometimes - I generally listen to the same songs but occasionally I listen to others
- ○ No - I listen to a wide variety of songs

Q14 How long do you listen to music for before playing tennis?

- ◯ 0-10 minutes
- ◯ 10-30 minutes
- ◯ 30 -60 minutes
- ◯ More than 60 minutes

Q15 For what purpose do you listen to music before playing tennis? Select all that apply

- ☐ To feel relaxed
- ☐ To distract myself
- ☐ To motivate myself
- ☐ To reduce boredom
- ☐ To feel confident
- ☐ To help me focus
- ☐ To remind myself of a time that I played well
- ☐ Calm myself down
- ☐ Psych myself up/arouse myself
- ☐ I use it because I am superstitious
- ☐ I don't know why I listen to music before I play
- ☐ Other reasons not listed here

Q16 What genre (s) of music do you prefer listening to before playing tennis? Please select all that apply

- ☐ Alternative
- ☐ African Music
- ☐ Americana
- ☐ Blues
- ☐ Bollywood
- ☐ Christian/Gospel
- ☐ Classical Rock
- ☐ Classical
- ☐ Country
- ☐ C-Pop
- ☐ Dance
- ☐ DJ Mixes and Live Sets
- ☐ Electronic
- ☐ Experimental
- ☐ Film, TV, Stage
- ☐ Hard Rock
- ☐ Hip/Hop/Rap

- [ ] Indie
- [ ] Jazz
- [ ] K-Pop
- [ ] Kids/Family
- [ ] Latino
- [ ] Metal
- [ ] Musica Mexicana
- [ ] Musica Tropical
- [ ] Oldies
- [ ] Pop
- [ ] Pop Latino
- [ ] R&B
- [ ] Reggae
- [ ] Rock
- [ ] Rock y Alternativo
- [ ] Singer/Songwriter
- [ ] Soul/Funk
- [ ] Urbano Latino

☐ World

Q17 What specific songs do you listen to prior to a tennis match? (Please list at least 3 song names with artist names)

____
____
____
____
____

Q18 Before you listen to music as you prepare for a tennis match, what are at least three emotions that best describe how you feel?

____
____
____
____
____

Q19 After you listen to music as you prepare for a tennis match, what are at least three emotions that best describe how you feel?

____
____
____
____
____

Q20 Do you listen to different types of music depending on whether you are in a positive or negative mood before a match?

- ○ Yes, I listen to different types of music depending on my mood
- ○ No, I listen to the same types of music no matter what mood I am in

Q21 Does your music preferences change depending on what mood you are in? If yes, in what ways?

____

____

____

____

____

Q22 Does music affect your mood/emotional state before a match?

- ○ Overall, music leads to a more positive mood state
- ○ Overall, music leads to a more negative mood state
- ○ Overall, music does not affect my mood state

Q23 Does music put you in a positive mood after listening to it?

- Never
- Seldom
- Sometimes
- Frequently
- Always

Skip To: Q25 If Does music put you in a positive mood after listening to it? = Never

Q24 In those instances when music puts you in more positive mood state after listening to what degree does this influence your confidence in your ability to play and perform at a high level?”

- Never
- Seldom
- Sometimes
- Frequently
- Always

Q25 Does music put you in a negative mood after listening to it?

- Never
- Seldom
- Sometimes
- Frequently
- Always

Skip To: Q27 If Does music put you in a negative mood after listening to it? = Never

Q26 In those instances when music puts you in a more negative mood state after listening to what degree does this influence your confidence in your ability to play and perform at a high level?"

- ○ Never
- ○ Seldom
- ○ Sometimes
- ○ Frequently
- ○ Always

Q27 To what degree do you practice visualization and/or remember past, successful performances before playing a tennis match?

- ○ Never
- ○ Seldom
- ○ Sometimes
- ○ Frequently
- ○ Always

Q28 To what degree does music help you recall past, successful performances before playing a tennis match?

- Never
- Seldom
- Sometimes
- Frequently
- Always

Q29 On a scale from 0 to 10, 0 being very uncertain and 10 being very certain, please select a number indicating how certain you are in your abilities to complete the following task in a competitive tennis match. (Only one response may be selected) " Successfully execute a forehand to win a point under pressure"

- 0
- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10

Q30 On a scale from 0 to 10, 0 being very uncertain and 10 being very certain, please select a number indicating how certain you are in your abilities to complete the following task in a competitive tennis match. (Only one response may be selected) " Successfully execute a backhand to win a point under pressure"

- ○ 0
- ○ 1
- ○ 2
- ○ 3
- ○ 4
- ○ 5
- ○ 6
- ○ 7
- ○ 8
- ○ 9
- ○ 10

Q31 On a scale from 0 to 10, 0 being very uncertain and 10 being very certain, please select a number indicating how certain you are in your abilities to complete the following task in a

competitive tennis match. (Only one response may be selected) " Successfully execute a volley to win a point under pressure"

- ○ 0
- ○ 1
- ○ 2
- ○ 3
- ○ 4
- ○ 5
- ○ 6
- ○ 7
- ○ 8
- ○ 9
- ○ 10

Q32 On a scale from 0 to 10, 0 being very uncertain and 10 being very certain, please select a number indicating how certain you are in your abilities to complete the following task in a

competitive tennis match. (Only one response may be selected) " Successfully execute an overhead to win a point under pressure"

- 0
- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10

Q33 On a scale from 0 to 10, 0 being very uncertain and 10 being very certain, please select a number indicating how certain you are in your abilities to complete the following task in a

competitive tennis match. (Only one response may be selected) "Successfully execute a serve to win a point under pressure”

- ○ 0
- ○ 1
- ○ 2
- ○ 3
- ○ 4
- ○ 5
- ○ 6
- ○ 7
- ○ 8
- ○ 9
- ○ 10

Q34 On a scale from 0 to 10, 0 being completely uncertain and 10 being completely certain, please select a number indicating how certain you are in your abilities to complete the following task in a competitive tennis match. (Only one response may be selected) “Successfully hold your service game under pressure”

- 0
- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10

Q35 On a scale from 0 to 10, 0 being completely uncertain and 10 being completely certain, please select a number indicating how certain you are in your abilities to complete the following task in a competitive tennis match. (Only one response may be selected) “Successfully break your opponent’s service game under pressure”

- ○ 0
- ○ 1
- ○ 2
- ○ 3
- ○ 4
- ○ 5
- ○ 6
- ○ 7
- ○ 8
- ○ 9
- ○ 10

Q36 How vivid and detailed are the memories that the songs may trigger? (Specifically, the 3 songs you listed previously)

- ○ Very detailed
- ○ Detailed
- ○ Neutral
- ○ Lacking detail
- ○ Lacking great detail
- ○ I never listen to music

Q37 What factors help you decide if you like a song? (With the purpose of listening for tennis)
Select all that apply

- ☐ The lyrics/artist
- ☐ The beat/tempo
- ☐ The melody/tune
- ☐ The association of the song to other past events in my life or with a film/movie
- ☐ Peers/friends
- ☐ The cultural significance of the song
- ☐ I don't know, If I like the song then I listen to it
- ☐ I never listen to music

Q38 Do you ever play a song in your head during a tennis match?

- ○ Never
- ○ Seldom
- ○ Sometimes
- ○ Frequently
- ○ Always

Skip To: End of Survey If Do you ever play a song in your head during a tennis match? = Never

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Q39 How does playing a song in your head affect you? Select all that apply

- [ ] It makes me less stressed out
- [ ] It helps me play longer
- [ ] It helps me enjoy tennis matches more
- [ ] It distracts me
- [ ] It motivates me
- [ ] It makes me feel positive
- [ ] It does not affect me
- [ ] Other ____

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