Understanding how to make physical activity pleasurable

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Abstract
The purpose of this dissertation was to understand how specific factors can be manipulated to affect participant’s experience with physical activity (PA). Three studies were conducted. Study 1 was a critical review, examining specific factors and measures that can be used to study the affective experience of PA participants. For Study 2, several focus group interviews were conducted, and a questionnaire distributed to Kinesiology students (n = 113) to determine how music affects PA participants. The qualities of songs provided were analysed. Finally, the purpose of Study 3 was to use the motivational playlist from Study 2 and determine whether adding music and choice of music resulted in participant’s (n = 20) enhanced pleasure and perceived exertion during a simulated stress test on a treadmill.

Study 1 resulted in the development of a list of five factors that can be manipulated in future research and applied practically to PA situations: psychological hedonism (intensity), music, principles of flow theory, playfulness (through choice), and social interaction. A list of recommendations to professionals in the health and fitness industry was provided.

Results from Study 2 indicated that university students all listen to music, but for various reasons and during different circumstances. Participants reported using music to relieve boredom, enhance their mood, and aid their exercise experience. During aerobic exercise, participants prefer to listen to music > 120 bpm, and songs < 120 bpm during strength-based exercise. Leisure PA are preferred when accompanied by songs that are both slow and in the minor chord. Furthermore, females prefer pop songs and males prefer rap/hip-hop during PA. Vast individual preferences emerged.

Findings from Study 3 revealed music enhances participant’s PA experience. As intensity increased, participant’s arousal increased, and enjoyment decreased. Music did not affect perceived exertion or continued intention, but did positively affect participant’s post-exercise enjoyment scores. Choice did not have a significant effect.

This dissertation confirms the necessity of studying the affective responses to PA and suggests several future studies. In conclusion, encouraging participants to enjoy PA and find autonomy and intrinsic motivation with a specific activity is crucial to PA adherence.

Keywords
Physical activity, pleasure, music, hedonism, dual-mode theory, exercise intensity, flow theory, social interaction, individual preferences.
Co-Authorship Statement

This dissertation is my original work, and I am the lead author on each of its three studies. However, my doctoral advisor, Dr. Alan Salmoni, was an integral contributor and thus the studies in this document reflect our collective efforts. Throughout, I use “we” and “our” to refer to Dr. Salmoni and myself.
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1. Introduction to Dissertation

1.1. Introduction

The lack of participation in physical activity and rise in sedentary behaviour (now defined as sitting too much) have become global health issues (Owen, Astell-Burt, & Lonsdale, 2013; Veitch, Salmon, & Ball, 2010; World Health Organization, 2015). Although too little physical activity and too much sitting time have been shown to be independent health risks for problems such as cardiovascular disease and metabolic syndrome, the root cause for these problems seems to be the same; inactive pursuits like watching TV are more pleasurable. Specifically, nearly 78% of Canadian adults and 91% of children and youth are not meeting Canadian Physical Activity Guidelines, as reported in the Canada Health Measures Survey 2012-13 (Pelletier et al., 2017).

Currently, researchers are studying factors that affect adoption of and adherence to a physically active lifestyle. As much of the research in this area takes a prescriptive stance to physical activity, exercise is the term often used. However, in this thesis, the more appropriate term of physical activity will commonly be used. Exercise will be used only as it relates to other studies, in which the term was used as a focus to prescribe behaviour. Affect is a term used to describe a general ‘valenced’ response or pleasure-displeasure feeling (Lox, Martin Ginis, & Petruzzello, 2014). Moreover, affect is more basic than emotions, which describe short-term and immediate responses to situations; affect is primitive and without forethought, like a reflex (Lox et al., 2014). One commonly asked question by many health researchers is to what extent an individual enjoys participating in physical activity (Kendzierski & DeCarlo, 1991; Martinez, Kilpatrick, Salomon, Jung, & Little, 2015; Motl et al., 2001; Murrock, Bekhet, & Zauszniewski, 2016; Nickrent, 2012; Zenko, Ekkekakis, & Ariely, 2016a). Feelings of pleasure or enjoyment have been demonstrated to play a significant role in adherence to an activity (Motl et al., 2001).

Specifically, if the physical activity provides a pleasurable experience, people are more likely to continue engaging in that health behaviour (Nickrent, 2012). In an effort to better understand the influence that affective research could have on designing more
effective health behaviour interventions, namely increasing participation in physical activity, current physical activity patterns and related effects on society have been reviewed (e.g. Ekkekakis & Dafermos, 2012). From a research perspective it has become imperative to increase efforts to study ways to encourage more people to be more physically active (Ekkekakis & Dafermos, 2012). In the studies described below, an attempt was made to better understand factors that may affect the pleasure derived from being physically active. Study 1 had a more general focus, whereas Studies 2 and 3 were centered on the role and impact of listening to music during physical activity.

1.2. Background

Hedonism has been presented as a complex topic that involves various objectives and ways of defining pleasure in order to find happiness (Jantzen, Fitchett, Ostergaard, & Vetner, 2012). Hedonic theory was developed to explain the phenomenon whereby people seek to enhance pleasure and avoid displeasure (Ekkekakis & Dafermos, 2012; Williams, 2008; Zhang, Berger, Darby, & Tobar, 2013). As a more specific derivative of the philosophy of hedonism and the basis for the studies in this thesis, psychological or motivational hedonism predicts that people are motivated to seek pleasurable experiences (Ekkekakis & Dafermos, 2012). Individuals inspired by hedonic motivation tend to focus on pleasure, fun and playfulness and are usually enjoyment-oriented (Chang, Liu, & Chen, 2014). Many people are more likely to base their behavioural choices on pleasure. Specifically, people innately strive to increase their pleasure and tend to avoid behavioural choices that decrease pleasure (Zhang et al., 2013).

Principles from motivational hedonism can be used to encourage healthy behaviours. For example, exercise intensity has been suggested to influence both affective responses to exercise (ventilatory) and cognitive awareness (perceived autonomy; Williams, 2008). Importantly, affective responses to exercise intensity can strongly influence a participant’s intentions to exercise again in the future based on anticipatory affective responses (Ekkekakis, Hall, & Petruzzello, 2008; Henderson, Glancy, Little, Hill, & Little, 1999). The intensity of exercise moderates the relationship between attentional processes and psychophysical effects (Karageorghis & Terry, 1997). Specifically, the determination of the level of exercise intensity that corresponds to the
transition from aerobic to anaerobic metabolism is called the ventilatory threshold (VT), which represents the point at which there is a systematic increase in the oxygen uptake without a corresponding increase in carbon dioxide output (Ekkekakis, 2003). The dual-mode theory (DMT) predicts that, for most study participants, exercise intensities that are less than the participant’s ventilatory threshold will be associated with positive affect compared to intensities at or above the ventilatory threshold, which are often associated with negative affect (Ekkekakis & Dafermos, 2012). This hypothesis is based on the understanding that participants are able to exercise for a longer duration at lower intensities with minimal homeostatic changes and therefore will be able to associate positive affect with the task. When a positive association, such as pleasure, is connected to an activity, the task is more likely to be repeated in the future. Both normal-weight and obese individuals tend to exercise (e.g. jog) at their own preferred intensity, which is usually between 75%-79% of maximum heart rate (Zhang et al., 2013). In a thesis entitled, “Effect of differing intensities of exercise on affect and enjoyment” (Nickrent, 2012), affect (as measured by the Feeling Scale) scores decreased as exercise intensity increased, regardless of whether the participant was normal weight, overweight or obese. Studies have shown that when participants exercise at 10% higher than their preferred exercise intensity, pleasure is reduced (Ekkekakis & Lind, 2006; Lind, Ekkekakis, & Vazou, 2008; Zhang et al., 2013). The American College of Sports Medicine has suggested that, “adherence is lower with higher-intensity exercise programs”, which is congruent with the literature (Ekkekakis et al., 2008; Ekkekakis, Parfitt, & Petruzzello, 2011; Whaley, 2006; Williams, 2008).

Self-determination theory suggests that how much pleasure a person experiences is partially affected by whether they act autonomously (i.e. exercise at their own pace and intensity) and by doing so, pleasure will be heightened compared to an externally controlled behavioural setting (i.e. prescribed exercise intensity; Ryan & Deci, 2000; Zhang et al., 2013). This theory can lend support to why an individual is able to gain more pleasure and enjoyment from preferred rather than prescribed exercise intensity. Therefore, self-determination theory (SDT) and hedonic theory are both applicable to the relationship between mood and physical activity, and furthermore, to explaining why more desirable mood changes take place because of participating in self-selected and self-
paced physical activity (Edmunds, Ntoumanis, & Duda, 2008; Ekkekakis & Lind, 2006; Williams, 2008; Zenko, Ekkekakis, & Ariely, 2016b; Zhang et al., 2013).

Reversal Theory focuses on understanding the dynamic qualities of normal human experience to describe how a person interchangeably reverses between psychological states, which in turn reflects their unique motivational style; this is a theory of personality, motivation and emotion. Reversal theory was used to develop the Telic Dominance Scale (Morgatroyd, Rushton, Apter, & Ray, 1978; Svebak & Murgatroyd, 1985), which is a scale that studies personalities in relation to motivation and from which the Felt Arousal Scale (FAS) emerged (Svebak & Murgatroyd, 1985). In a study based on Reversal Theory, Legrand, Bertucci, and Thatcher (2009) tested whether individual differences of telic, or goal-focused motivation could moderate affective responses during a treadmill running experiment. A telic-dominant person tends to avoid high levels of arousal whereas a paratelic, or intrinsically motivated individual may seek out high levels of arousal (Ekkekakis et al., 2011). Participants who scored high on telic dominance reported significantly less pleasure than those who scored low at minute 6 and 9 of the 10 minute running bout, after controlling for VO2max (Legrand et al., 2009). To this point, the dual-mode theory examines such affective responses to exercise and studies this from an evolutionary perspective (Ekkekakis & Dafermos, 2012; Ekkekakis et al., 2011). The theory postulates that affective responses to exercise are determined by the continuous interplay between two factors: cognitive (e.g., physical self-efficacy, body image) and interoceptive cues (e.g., signals from chemoreceptors, baroreceptors, thermoreceptors; Ekkekakis et al., 2011). The relative importance of these two factors is theorized to change systematically as a function of exercise intensity; as intensity increases to meet or surpass the individual’s ventilatory threshold (VT), their inherent affective state diminishes as all the (negative) physiological cues are being attended to and dissociative techniques are seldom effective. In contrast, physical activity at a low-to-moderate intensity allows both internal (e.g. kinesthetic) and external (e.g. music) cues to be processed in parallel (Karageorghis & Priest, 2012a). Furthermore, low-intensity physical activity (LIPA) has health benefits and improves metabolic fitness (Amagasa et al., 2018; Kim, Park, Trombold, & Coyle, 2014). Moreover, LIPA has been associated with an inverse relationship in cardiometabolic risk factors, all-cause mortality (Amagasa
et al., 2018), as well as increased temporal lobe activity with corresponding positive associations in growth factors (Mailey, Olson, Gothe, Potter, & Stephen, 2014). Therefore, promoting physical activity that is below an individual’s VT offers several health benefits.

An integrated model was created using both social cognitive theory as well and flow theory to predict continuance intention among multiplayer computer games (Chang et al., 2014). Flow is described as a dynamic state involving the holistic sensation people feel when they act with complete involvement and engagement; the autotelic experience (Csikszentmihalyi, 1975). Specifically, flow theory was utilized to capture the affective experience of each gamer in order to predict their likelihood of playing that game again based on future expectations. This model has been adapted and has been used to assess the future intentions of participants in the third study. Likewise, enjoyment has been defined as a positive affective state which promotes the participation in an activity for its own sake and will be repeated as a result of the positive association, such as pleasure, liking and fun (Csikszentmihalyi, 1990; Motl et al., 2001). Music renders moods and feeling states more positive across a range of physical activities and various tasks (Karageorghis & Terry, 1997). Music can influence mood, and mood in turn can influence performance (Karageorghis & Terry, 1997). When such an emotional response is elicited, physical movement is in turn stimulated, regardless of culture (Murrock & Higgins, 2009).

Music has become available to people in a variety of ways such as over loud speakers or through personal listening devices. Music appeals to diverse groups of people and is ubiquitous throughout most of society spanning cultures, ages, and socio-economic classes in its appeal. The psychological effects of music on exercise include the way in which music influences the participants’ mood, emotion, affect, cognition and behaviour (Karageorghis & Priest, 2012a). Specifically, summarizing past literature, three generalizations can be made about the impact of music on exercise behaviour: first, synchronization of sub-maximal exercise with music leads to increased work output; second, music reduces perceived exertion; and third, music enhances affective states at low to moderate exercise intensities (Karageorghis & Priest, 2012a, 2012b; Karageorghis & Terry, 1997; Murrock & Higgins, 2009). A natural human response to synchronous
music is to physically respond to the rhythmicity of music (Karageorghis & Priest, 2012a; Karageorghis & Terry, 1997), as demonstrated when people tap their foot or bob their head to the beat of the music. Aerobics class instructors often use the beat in music to keep participants moving at an intensity which is both safe and makes it easier for people to innately keep step with the choreography. In addition to increasing endurance, music also reduces perceived effort and may even promote metabolic efficiency (Jabr, 2013; Karageorghis & Priest, 2012a). When the body recognizes the onset of physical exertion, (e.g., lactate in the muscles, elevated heart rate) and needs a break, listening to music can compete with this physiological feedback. Moreover, music can change a listener’s perception of effort during a workout. For example, completing extra biceps curls when listening to upbeat and motivating music may make the activity seem easier. Lastly, music can focus a listener’s attention thereby diverting attention away from physical cues such as fatigue or lack of oxygen uptake (Karageorghis & Terry, 1997). As a result, this dissociation effect usually promotes a more positive mood state during submaximal exercise (Elliott, Carr, & Orme, 2005; Jones, Karageorghis, & Ekkekakis, 2014; Karageorghis & Terry, 1997). Musical accompaniment can enhance participants’ affective states during and after physical activity.

The Theory of Music, Mood and Movement was developed from physical activity guidelines, health concepts, and music theory (Murrock & Higgins, 2009). This theory was based on the psychological and physiological responses to music that could be employed to increase physical activity and improve overall health. Three outcomes of music listening are mood alteration, distraction and facilitated social interaction. For instance, listening to music with a positive disposition has been shown to significantly lower anger, fatigue and depression when compared to music with a negative disposition (Karageorghis & Terry, 1997). Moreover, music can alter mood by encouraging listeners to be social and interact with others (Murrock & Higgins, 2009). One important factor in this regard is choosing the right music to accompany physical activity; for instance, fast tempo (120-140 BPM) is most effective for aerobic exercise (Karageorghis & Priest, 2012b).

The Brunel Music Rating Inventory (BMRI; Karageorghis, Terry, & Lane, 1999) was created as a tool that could be used to evaluate the motivational quality of music for
its use as an ergogenic aid in exercise (Jones et al., 2014; Karageorghis, Priest, Terry, Chatzisarantis, & Lane, 2006; Karageorghis et al., 1999). The BMRI has been used as a tool by Karageorghis and other researchers in order to understand the many physiological, psychological, cognitive, and emotional effects musical accompaniment has on participants’ physical activity experience (Appendix D; Jones et al., 2014; Karageorghis & Jones, 2014; Karageorghis et al., 2006, 1999). Researchers wanted to study the effects of musical accompaniment during physical activity without incorporating individualized choice because they wanted to separate the effect of music and the effect of choice, since both might independently affect enjoyment (Alter et al., 2015; Baldari, Macone, Bonavolonta, & Guidetti, 2010; Bigliassi, Estanislau, Carneiro, Kanthack, & Altimari, 2013; Clark, Baker, & Taylor, 2015; Elliott et al., 2005; Hallett & Lamont, 2014; Jia, Ogawa, Miura, Ito, & Kohzuki, 2016; Karageorghis & Priest, 2008, 2012a; Seath & Thow, 1995; Taylor et al., 2007). Study 3 in the present research purposefully examines the differences the effect of music has on participants during different music-choice physical activity trials, with a particular emphasis on individualized music preferences.

Music offers a valued companion, helps provide a comfortable level of activation and can foster a positive mood (Schäfer, Sedlmeier, Städtler, & Huron, 2013). Participants may have individualized preferences for style or genre, aesthetics and overall choice of music (Schäfer et al., 2013). Thus, research suggests that adding personal choice may improve the effect music may have; music and choice may be separate and additive independent variables. Similarly, the association made between a specific music selection and particular activities can spark an emotional reaction. For example, when the theme from the movie “Rocky” plays, many people will feel inspired, hopeful, and eager to conquer a challenge. This association with overcoming foes and being your best self as a result of hearing the song may act as a powerful stimulus for the individual and increase their arousal (Karageorghis et al., 1999). Other examples include choosing a happy song to lift one’s mood or an angry song could be selected if someone needs help getting through an intense weight lifting set. Whatever the reason, musical accompaniment with physical activity has been studied but many variables like the effect of choice of music remain poorly understood.
Autonomy (e.g., personal choice of music) is one of the three primary needs that underpins self-determination theory (Ryan & Deci, 2000), the other two being competence and relatedness. Intrinsic motivation is enhanced when these three variables are satisfied, which encourages self-regulation and repeated behaviour. Most music research to date, because of a desire to study the effects of music without contaminating it with choice, have left a gap in the literature concerning the understanding of how much effect the power of choice of music has on one’s overall experience (e.g., Karageorghis & Priest, 2012a; Karageorghis & Terry, 1997; Karageorghis, Terry, Lane, Bishop, & Priest, 2012). Choice, acknowledgement of feelings, and opportunities for self-direction have been found to enhance intrinsic motivation because they allow people a greater feeling of autonomy (Ryan & Deci, 2000; Ryan, Vallerand, & Deci, 1984). Choice adds opportunities which foster intrinsic motivation. For example, during physical activity of low-to-moderate intensity, listening to music has been associated with a 10% reduction in perceived exertion (RPE) (Karageorghis & Priest, 2012a). The largest association with this reduction in RPE is when the music is preferred, which represents a type of music the participants choose to listen to for specific activities (Dyrlund & Wininger, 2008; Karageorghis & Priest, 2012a). How we listen to music is a very individualized practice and is done for different reasons: to relieve boredom, maintain or improve a certain mood state, and create a comfortable atmosphere (Schäfer et al., 2013). This emphasis on individuality and music is of paramount importance. Therefore, providing participants with the opportunity to choose their own music may be important if we are going to encourage and improve duration and frequency of physical activity.

1.3. Study 1

The first study is a critical literature review focused on selected factors that may impact the pleasure derived from participation in physical activity. A key reason for conducting the review was based on Hedonic Motivation Theory (Ekkekakis & Dafermos, 2012), which suggests that pleasure will be the key to motivating people to adopting and continuing a physically active lifestyle. In agreement with arguments put forward by Ekkekakis and Dafermos (2012), the review suggests that while cognitive, social and environmental factors are important, intervention attempts using many of these
factors to promote physical activity have not been successful in halting the steady decline in physical activity or increase in sedentary behaviour. In line with this shift in thinking, researchers have recently adopted the practice of employing not only physiological parameters (e.g. heart rate (HR), aerobic capacity) but also affective measures (e.g. feeling scale, exercise-induced feeling inventory; Lox et al., 2014, p. 321) to monitor a person’s physical activity experience. Specifically in our field, we have realized that researchers need to pay greater attention to how people feel during physical activity since people tend to repeat what they enjoy (Ekkekakis & Lind, 2006; Lind et al., 2008). With a focus on enjoyment, the review critically examines the role that factors such as music, flow, intensity, socialization, and choice may play in creating a pleasurable physical activity experience. Whereas all these factors have received attention in the past, they have less often been viewed through the lens of hedonic motivation theory.

1.4. Study 2

The second study employed a questionnaire examining individual music preferences and the effect music has on physical activity participation. People tend to listen to music to achieve: self-awareness, social relatedness, arousal and mood regulation. Musical functions have been grouped according to four dimensions: cognitive, emotional, social/cultural, and physiological/arousal-related functions (Schäfer et al., 2013). In a review, Karageorghis and Priest (2012a, 2012b) highlighted the potential benefits of music in sport and exercise, which was determined by Terry & Karageorghis (2006): improved mood, arousal control, dissociation, reduced RPE, greater work output, improved skill acquisition, flow state, and enhanced performance. The Brunel Music Rating Inventory (BMRI; Karageorghis et al., 2006) is a tool used to rate the motivational qualities of songs and was employed in this study. Music has been found to act as an ergogenic aid and wield physiological effects, especially when the physical activity is accompanied by appropriately selected (i.e. motivational) music (Karageorghis & Priest, 2012a). However, music’s influence is activity- and situation-specific, and is completely contingent upon the listener’s experiences and preferences (Karageorghis & Priest, 2012a). Individual differences are understudied (Lox et al., 2014). The predominant “nomoethic” approach to studying affective responses to exercise, or
studying the average response across individuals, may conceal important differences between individuals (Ekkekakis, 2005). Using the “ideographic” approach instead and examining responses at the individual level could highlight dissimilarities in affective responses currently not being shown. Therefore, this study had two parts: first, a questionnaire was administered to determine music listening preferences during three different types of physical activities (aerobic, strength-based, and leisure); and second, we used the BMRI to analyse and determine a list of motivational songs to accompany listeners during exercise. This study showcased the vast individual differences and preferences for music as an accompaniment to physical activity.

1.5. Study 3

The third study used the information regarding motivational music (BMRI) from the second study and tested the effects of both music and choice of music on affective experiences during and immediately following an intense bout of physical activity (incremental-running on a treadmill). Several tools were used to try and understand the participants’ experience during a bout of physical activity, under different conditions (music vs no music). Studies examining in-task affective responses have been rare, although there has been a recent surge in this type of research (Ekkekakis et al., 2011). The intensity of the physical activity is associated with the affective experience insofar as high-intensity physical activity causes an attentional shift from external stimuli (e.g. music) to physiological sensations (e.g. fatigue) arising from the physical activity. Moreover, positive affect tends to increase from pre- to post-, following intensities that are not exhaustive (Reed, 2013; Reed & Ones, 2006). Positively valenced affective states are generally increased following moderate-to-vigorous aerobic type activities and negatively valenced affective states are either unchanged or reduced following moderate exercise (Reed, 2013).

Music can be used as a motivating instrument and can benefit listeners from more than just a physiological standpoint or as an ergogenic aid; music can facilitate focus or act as a distraction. Specifically, music improves a person’s enjoyment of physical activity; aerobic exercise, strength training, and leisure physical activity alike (see Study 2). Furthermore, providing choice to participants (e.g., mode, duration, intensity of
exercise) fosters autonomy, one of the three innate needs required to promote self-determination and the facilitation of intrinsic motivation (Ryan & Deci, 2000; Ryan et al., 1984; Ryan, Williams, Patrick, & Deci, 2009). Study 3 used a repeated measures design, assigning participants to all four conditions, whereby they ran in a controlled environment to volitional cessation: no music (control), experimenter-provided music (BMRI), choice from experimenter-provided music, and participant’s own freely chosen music. This research provides rationale for using music to enhance enjoyment during a single bout of physical activity; allowing for choice of music had no additional effect.

1.6. Summary

Using theories of hedonic motivation, self-determination, and flow, as well as music and choice, we propose in Study 1 that when a person enjoys participating in an activity, the individual will become intrinsically motivated to continue participating in the specific activity. We can conclude that past and current efforts to encourage physical activity have not been effective since current societal sedentary behaviour and lack of participation in PA are the highest they have been in history. Moreover, regulating behaviour through autonomy-supportive motives and environments is beneficial for instigating a health behaviour change (Zahariadis & Biddle, 2000). Most people are more receptive to initiating such a behaviour change when they have social support, constant encouragement and frequent contact (Wing, 2000). Therefore, we have compiled a list of five factors (flow, hedonism, sociability, music and playfulness) and, as a result, have determined how to manipulate each factor in order to be effective in creating a pleasurable experience for physical activity participants.

The purpose of the second study was to add a new perspective of motivation to current health research focused on motivating people to participate in regular PA. Music has the ability to captivate or distract the listener from physiological cues such as muscle fatigue or perhaps boredom, and can also motivate us to perform better and for a longer duration (Karageorghis & Priest, 2012a). Therefore, listening to music during PA could have implications for physical activity prescription, especially among overweight, sedentary adults, who are most in need of interventions that encourage initiation and adherence to exercise programs. Specifically, people seem to listen to music and choose
specific pieces based on their own music preferences and purpose for listening, i.e. mood enhancement, dissociation, emotional response. Individual differences in music choice is an important concept for practitioners and researchers to consider in their future work. Using the Brunel Music Rating Inventory (Karageorghis et al., 2006), we compiled a list of songs and analysed them based on their tempo, modality, genre, and assessed their motivational qualities; from this list, a BMRI (experimenter-provided) music playlist was created and used in the third study.

The research for Study 3 explored to what degree listening to music can impact the physical activity experience with regards to the participants’ pleasure and effort during exercise and whether providing choice afforded an additive effect. Music can be used as an accompanying tool to physical activity to prolong duration as well as overall affective experience. However, when intensity approaches or surpasses ones ventilatory threshold, physiological dissociation is no longer possible. The continuance intention (CI) scale is a measurement originally used to test gamers’ intention for future play and game loyalty (Chang et al., 2014). Although the tool was used in computer game research, the modified version of the scale used in Study 3 was adapted to predict physical activity adherence. In addition, the CI, the Physical Activity Enjoyment Scale (PACES), Feeling Scale (FS), Felt Arousal Scale (FAS), Borg’s rating of perceived exertion (RPE) scale and heart rate were monitored throughout the experiment to determine the participant’s reaction to the movement experience.

Therefore, since enjoyment is an intrinsic motive and this affective experience is related to adherence, we can conclude that if an activity is enjoyed, the participant will be more likely to repeat the experience. Thus, physical activity should be prescribed based on individual preferences, performed to appropriate music, and at an intensity below the ventilatory threshold, for the general participant (non-competitive athlete). A regular pleasurable experience will create an habitual response, thereby reinforcing physical activity into the participant’s routine.
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2. Study 1: Understanding how to promote physical activity by enhancing affective experiences

The lack of participation in physical activity and a rise in sedentary behaviour are global health issues (Conroy, Maher, Elavsky, Hyde, & Doerksen, 2013; J. P. Maher, Doerksen, Hyde, Pincus, & Conroy, 2014; Owen, Astell-Burt, & Lonsdale, 2013; Veitch, Salmon, & Ball, 2010). Globally, one in four adults is not participating in the minimum recommended amount of physical activity (World Health Organization, 2017). Physical inactivity is estimated to cause 3.2 million premature deaths globally each year (World Health Organization, 2013). Although too little physical activity and too much sitting time have been shown to be independent health risks for problems such as cardiovascular disease and metabolic syndrome, the root cause for these problems seems to be the same; non-active pursuits are more pleasurable (Maher, Olds, Mire, & Katzmarzyk, 2014; Wilmot et al., 2012). The many benefits of participating in physical activity (PA) are well known (Patel, Slentz, & Kraus, 2011). However, most people in developed countries are sedentary or are insufficiently active (Marcus et al., 2000; Papandonatos et al., 2012; Tremblay et al., 2011; World Health Organization, 2010, 2013, 2015, 2017). In short, the promotion of a physically active lifestyle has been a failure in most developed countries around the world. Rhodes and Kates (2015, p. 728) suggest, “Experimental tests that attempt to manipulate the affective experience during exercise and its impact on sustained behavior change and enjoyment (and potentially self-efficacy) are now needed”. Below, the argument is made that the desire to pursue pleasurable activities is often much stronger than the motivation to participate in PA and the way to counteract this is to better understand how to increase the pleasure/displeasure people derive from PA. In social marketing terms, pleasure and health seem to be competitors (Jantzen, Fitchett, Ostergaard, & Vetner, 2012). Whereas there is a huge volume of research to inform the prescription of PA to produce health outcomes, far less research has been conducted that informs the encouragement of such beneficial activities, and for the purposes of this paper, how to find better ways through which to teach people about the pleasures inherent in PA. While individual pieces of this puzzle exist in the pleasure-related research literature (Bhullar, Schutte, & Malouff, 2013; Cabanac, 2006; Ekkekakis, Hall, &
Petruzzello, 2008; Jallinoja, Pajari, & Abetz, 2010; Motl et al., 2001), there is much less written about how to put the pieces together to form a comprehensive picture. One notable exception to this trend is the chapter by Ekkekakis and Dafermos (2012).

Although much is known about the physiology of PA and its prescription for health, far less is known about motivating change in behaviour and then sustaining such a change over the longer term (Ekkekakis & Dafermos, 2012; Zahariadis & Biddle, 2000). Research has suggested several participation motives that exist, such as: fun, social aspects, physical and physiological benefits (e.g., increasing lean body mass), and skill development (World Health Organization, 2010; Zahariadis & Biddle, 2000). People tend to seek or participate in an activity that they anticipate will be fun or enjoyable (Henderson, Glancy, Little, Hill, & Little, 1999). Pleasure-seeking behaviour has been confirmed by Psychological Hedonic Theory as a person’s pursuit for an activity that will increase (or at least maintain) a positive affective state (Rhodes, Fiala, & Conner, 2009; Rhodes & Kates, 2015). More accurately for this paper, Psychological Hedonism suggests people are motivated to do what makes them feel better and to avoid what makes them feel worse (Ekkekakis & Dafermos, 2012, p. 301). Expounding on this point, physical pain is a negative sensation that many individuals actively pursue (e.g., masochism) if they consider that sensation to be pleasurable (Jantzen et al., 2012; Lind, Ekkekakis, & Vazou, 2008). Ekkekakis and Dafermos (2012) refer to this as the Hedonic Theory of exercise behaviour; throughout this paper, we will refer to this as Hedonic Theory. When a behaviour is paired with pleasure it becomes more likely to be repeated and thus a habit is formed (Cabanac, 2006; Ekkekakis & Dafermos, 2012). Moreover, Hedonic Theory suggests that people continue to participate in an activity when they find it pleasurable and personally worthwhile (Chang, Liu, & Chen, 2014).

The utilitarian motives related to PA are often geared toward health and exercise goals, particularly in the current exercise psychology literature that is predominated by a cognitive/analytic approach to motivation (the theory of planned behaviour, health protection motivation theory, social cognitive theory, and the health belief model are a few examples of theories that follow this paradigm). Alternatively, Flow Theory explains that participants must understand that their participation in a specific activity is simply for the sake of the activity itself; the activity is deemed enjoyable by the individual
Flow State is the experience one has when his/her ability is in balance with his/her ability to attend to the present challenges. The individual becomes immersed within the activity, thereby limiting his/her stimulus field and prolonging the time spent participating, as a result of not being bored or frustrated (Csikszentmihalyi, 1975, 1990). Thus, when an individual is motivated by enjoyment rather than a health benefit, his/her participation in PA is solely for resulting gained pleasure; critically, participation in PA is more likely to become habitual (Ekkekakis & Dafermos, 2012).

Still pending, how can pleasure in physical activity be “prescribed” simultaneously with how exercise physiologists view exercise prescription? Previous research focusing on increasing exercise adherence mostly uses extrinsic variables such as perceived health outcomes as preventative medicine (Motl et al., 2001). Extrinsic variables represent distal rather than proximal influences on behaviour change and may be more closely related to adoption of, rather than maintenance of PA (Motl et al., 2001). Importantly, these cognitively based variables account for little empirical evidence in PA behaviour (Ekkekakis, Parfitt, & Petruzzello, 2011). Alternatively, enjoyment may be more strongly related to health behaviour change as it provides immediate reinforcement for being physically active. Promoting the enjoyment of PA may increase PA adherence and, in turn, may reduce the attraction to sedentary activities, such as screen type games or watching television (Zenko, Ekkekakis, & Ariely, 2016; Zenko, Ekkekakis, & Kavetsos, 2016). Therefore, the remainder of the paper discusses how specific variables can be manipulated to make PA more pleasurable. Specifically, key variables that could be strategically manipulated to produce an enjoyable experience are described. These variables can be used in both a practical setting and in future research.

2.1. Dual-Mode Theory

Four factors connected to pleasure in physical activity have been identified to be: flow, sociability, mood, and music (Ellis, Stemmler, & Saloni, 2012). These four factors can act as psychological constructs (flow, sociability, mood) and a sensory stimulus (music) to schoolchildren in a physical education class, for example, and elicit psychological, physiological and psychophysiological responses (Ellis et al., 2012). Similarly, Ekkekakis and Dafermos (2012) suggested that for research to better inform the
motivation for PA, there needs to be a scientific revolution in exercise psychology. They argue that the past five decades have been dominated by a cognitive/analytic approach to PA motivation, and unfortunately this approach has not been very successful (explained variance below 25%); intention is not translating into action (Ekkekakis & Dafermos, 2012). Moreover, if significant strides are to be made to understand the promotion of motivation for PA, a different approach is required. Specifically, Ekkekakis contends the need to study affective variables like those aforementioned (Ellis et al., 2012) and their relation to PA participation. Dual Mode Theory examines the affective responses to exercise from an evolutionary perspective, namely Darwinian (Ekkekakis & Dafermos, 2012; Sanderson, 2001).

Ekkekakis and fellow researchers (Ekkekakis & Dafermos, 2012; Ekkekakis, Hall, & Petruzzello, 2005; Ekkekakis et al., 2008, 2011) have proposed the Dual Mode Theory (DMT) in an attempt to explain the experienced pleasure/displeasure resulting from participation in exercise. It is important for the current review to note that Ekkekakis typically refers to “exercise” when discussing Hedonic Theory (of exercise behaviour), whereas throughout this research document, the more general term of physical activity has been used. This distinction will be clarified below.

The hedonistic perspective on motivated behaviour and the dual-process view of behavioural decision making emphasizes momentary and anticipated affect (Brand & Ekkekakis, 2018). Therefore, the affective response to PA is the key driver for initiation and adherence of the behaviour in question. This affective response is hierarchically structured from basic affect to emotion. While basic affect is driven in a bottom-up process, emotional states are driven in a top-down fashion, and importantly, are cognitively modifiable. The experience of pleasure/displeasure is derived from the interplay of bottom-up and top-down processes and that ‘exercise intensity’ is the key currency for the affective state driven by bottom-up processes. Roughly, these two streams parallel System 1 and System 2 processes suggested by Kahneman (2003) and others to explain human behaviour and decision making. The older system from an evolutionary perspective, System 1, represents affectively based processing. Importantly for ‘exercise’ promotion, System 1 tends to dominate everyday decision making, compared to System 2 analytic processes. In this light, the affective responses to any PA
will be influenced by a continual interplay of interoceptive cues and cognitive parameters.

Alternatively, the DMT is a theory about the relationship between exercise intensity and affective responses. Whether ‘exercise’ is perceived to be pleasurable or not is determined by the interoceptive cues (e.g., signals from chemoreceptors) received during physical effort and the ongoing or ensuing cognitive appraisal (e.g., self-efficacy, pride) of the experience. Cognitive factors (“top-down”) affect the participants when they are exercising at an intensity that is proximal to their ventilatory threshold (VT) whereas interoceptive cues (“bottom-up”) take precedence when the intensity exceeds VT and a physiological steady state is difficult or impossible to maintain (Ekkekakis et al., 2011). Ventilatory threshold is the point at which aerobic consumption is no longer being matched with carbon dioxide production and the exerciser transitions from aerobic to anaerobic metabolism (Ekkekakis, 2003). DMT suggests that the promotion of exercise-induced pleasure, and therefore exercise behaviour, will ultimately rely on an understanding of these two processes, including their sometimes-conflictual interplay, and a careful manipulation of the factors affecting each. For example, exercise intensity is often manipulated as it directly affects the bodily cues experienced but far less is known about the interplay of bottom-up and top-down processes.

Specifically, overweight, obese, and sedentary individuals typically derive zero pleasure from PA, particularly exercise regardless of the intensity (Williams, 2008). Thus, we query how DMT can assist researchers and health promoters to motivate this population. Furthermore, according to DMT, although exercise participants can sustain some level of pleasure during low-to-moderate intensities and experience a spike in pleasure immediately following the bout, little is known about what takes place prior to PA. More specifically, how are the participants motivated to engage in PA; how are they positively affected pre-exercise? In their review paper, Ekkekakis and Dafermos (2012) offer few suggestions on how to promote pleasure in PA, focusing mainly on motivating affective responses and supporting the use of Psychological Hedonic Theory and DMT. The review below acknowledges this interplay and attempts to expand on the ideas for future research and in practical application.
2.2. Exercise Intensity

According to hedonic theory, the adoption and maintenance of a physically active life should focus on participant-enjoyment and positive affective experiences (Ekkekakis & Dafermos, 2012; Ekkekakis et al., 2008; Lind et al., 2008; Williams, 2008). Perceived experience is defined by the participant’s affective response to the behaviour and will determine whether the participant will repeat the activity (Williams, 2008). Affect is the pleasure and enjoyment that comes as a result of PA and is now recognized as a determinant of health behaviour (Ekkekakis & Dafermos, 2012; Ekkekakis et al., 2008; Ekkekakis & Lind, 2006; Hardy & Rejeski, 1989; Karageorghis & Priest, 2012a, 2012b; Lind et al., 2008; Papandonatos et al., 2012; Sparks et al., 2015; Williams, 2008).

However, a dichotomy exists between health and pleasure, particularly as it relates to PA and diet (Jallinoja et al., 2010). Therefore, we need to determine how to promote pleasure from healthy choices.

Pleasure has been suggested as being strongly related to maintenance of PA since it is a proximal influence of behaviour and provides immediate reinforcement for continuing to be physically active and eating properly (Motl et al., 2001). For example, despite the benefits associated with weight loss, regaining weight lost from dieting continues to be a problem. By three-to-five years post treatment, roughly 85% of patients who sought professional help regained or even exceeded their pre-treatment weight (Raman, Smith, & Hay, 2013). Werle, Wansink and Payne (2014) examined the difference between perceiving participating in PA for “exercise” and participating for “fun” and how this mindset affected the participants’ subsequent consumption patterns. Assuming this research could be replicated, when participants perceive being active as “exercise”, they will likely seek a reward and subsequently consume a high calorie dessert as their post-workout reward, thus compensating for their caloric deficit. Conversely, when participants choose to be active for “fun”, they should make healthier food choices. Therefore, framing PA as fun reduces an individual’s tendency to seek pleasurable rewards because it diverts their attention from the effort and sense of entitlement after participating in PA, which can be perceived as unpleasant (Werle et al., 2014).
Cabanac (2006) argued that pleasure is the common currency used by the brain to compare sensations aroused by muscular work performed by various parts of the body. Participants were instructed to climb a 300 m elevation on a treadmill at various combinations of speed and slope at a constant time. Participants were free to vary either speed or slope across conditions, thereby working the body at a constant intensity. Results supported the argument that behaviour was optimized by minimizing displeasure. When muscular exertion was interrupted, the individual’s perception immediately became more pleasurable. This finding is congruent with research that shows that the immediate post-exercise affective state can be more pleasant than the pre- and during-exercise states (Ekkekakis et al., 2008).

The literature suggests that as the rate of perceived exertion (RPE) increases, as measured on the Borg scale (Borg, 1998), pleasure is reduced, as measured on the Feeling Scale (Hardy & Rejeski, 1989; Jones, Karageorghis, & Ekkekakis, 2014; Karageorghis & Priest, 2012a; Rhodes et al., 2009) (Figure 1). Physiologically based exercise prescription is normally based on reaching some target intensity (most often HR).
to gain the greatest health benefit. However, this strategy does not encourage participants to exercise for pleasure. Reaching the goal of moderate-to-vigorous physical activity (MVPA) for most people results in diminishing pleasure. If adherence to PA is the goal then hedonic theory would suggest that lower intensities (that are more pleasurable) may be a more appropriate goal, particularly for beginners or people who have had negative previous experiences. Furthermore, research supports low-intensity physical activity (LIPA) and the associated health benefits (Amagasa et al., 2018; Kim, Park, Trombold, & Coyle, 2014; Mailey, Olson, Gothe, Potter, & Stephen, 2014). That is, for many people, pleasure and therefore lower intensity may be the most important outcome goal for a bout of PA.

Ekkekakis and colleagues (2008) determined in their study that As participants exceeded 10% of their personal VT, their affective valence declined significantly. Similarly, Papandonatos (2012) found that when people undergo MVPA (approximately 64-76% age-predicted maxHR), their affective valence was positively associated with future PA among previously sedentary adults. Importantly, affective responses to exercise vary between individuals (Ekkekakis & Dafermos, 2012) and have been linked to intensity of PA, affective responses, and perceived exertion (Ekkekakis & Lind, 2006; Williams, 2008).

Focusing on the resultant enjoyment rather than the intensity of an activity may increase intrinsic motivation and positive affect, which in turn reduces perceptions of associated exertion while increasing the desire to continue the activity in both the short and long term (Jallinoja et al., 2010; Jones et al., 2014; Rhodes et al., 2009; Werle et al., 2014). What is keenly missing is research that varies PA intensity across groups and subsequently measures the affective response during PA. In addition, research is required on the measures of adherence or “intended” adherence in the longer term. While DMT suggests that the threshold for the change from pleasure to displeasure for most people lies at their VT, little is known about whether the affective appraisal at this threshold can progressively change (Baldari, Macone, Bonavolonta, & Guidetti, 2010; Halldorsson, Thorlindsson, & Katovich, 2014; Jackson & Eklund, 2002; Jackson & Marsh, 1996; Jackson, Thomas, Marsh, & Smethurst, 2001; Karageorghis & Priest, 2012a, 2012b; Priest & Karageorghis, 2008; Tenenbaum & Eklund, 2007). Does the salience of bottom-
up and top-down processes change over time? That is, little is known about the interplay of bottom-up and top-down processes, apart from music, imagery, and video being added to the PA experience.

2.3. Music

Three psychological correlates of music are mood, distraction and social interaction (Murrock & Higgins, 2009). As a result of the direct connection between auditory and motor processing, music may also have the capability to directly influence a person’s movements (Murrock & Higgins, 2009). For example, the rhythm in music has been used to facilitate gait patterns in patients with Parkinson’s disease (Ashoori, Eagleman, & Jankovic, 2015; Murrock & Higgins, 2009). The present review will focus on the pleasure derived from physical activity when music accompanies the bout.

Music affects people’s emotions (Hunter & Schellenberg, 2010). Previously, the circumplex model was used to describe these emotional reactions (now, explicitly core affect) by rating the music experience in terms of valence (negative to positive) and arousal (low to high) (Williams, 2008). For example, music that invokes happiness is positive in valence and high in arousal in comparison to music which induces sadness and is negative in valence and low in arousal. Cues for happiness come from fast tempo, major-chord music and this type of music has often been used in both research and in exercise classes (Elliott, Carr, & Orme, 2005; Karageorghis & Priest, 2012a, 2012b). Emotional responses (e.g., happy and sad) to music come from rhythm and modality (major vs minor) and are attended to through subcortical processing (Bigand, Vieillard, Madurell, Marozeau, & Dacquet, 2005). The affective system can form an emotional response much faster (within roughly 250 ms of listening to a piece of music) than the cognitive system (Bigand et al., 2005). The ability of music to produce body movement (synchronization) has been termed “music groove” (Stupacher, Hove, Novembre, Schütz-Bosbach, & Keller, 2013). It is this “groove” that exercise leaders often take advantage of when they attempt to control exercise tempo or intensity in their fitness classes. “Moving to music is an essential human pleasure particularly related to musical groove” (Witek, Clarke, Wallentin, Kringelbach, & Vuust, 2014, p. 1). Likewise, many people consider music to be an essential component of their exercise routine, whether they are alone or
among others. However, other people add music to their bout of physical activity to make something they do not find pleasurable become more tolerable.

Within the exercise literature, researchers have cited “attentional dissociation as a cognitive mechanism underlying the psychological and ergogenic effects of music” (Jones et al., 2014, p. 528). This mechanism refers specifically to music drawing attention away from internal fatigue-related cues. Feelings of fatigue and negative affect deter many people from continuing PA participation and research demonstrates a link between dissociation and a more positive exercise experience (Jones et al., 2014; Karageorghis & Priest, 2012a; Rhodes et al., 2009). Music, especially asynchronous music, has been found to add enjoyment to both low- and moderate-intensity PA. Motivating music controls arousal, reduces perceptions of exertion, and improves mood (Karageorghis & Priest, 2012a). Use of this motivating, ‘upbeat’ music supports the suggestion made in a recent literature review that tempo between 125 and 140 beats per minute is ideal for asynchronous (physical response to music that does not sync to the beat) exercise (Karageorghis & Priest, 2012a, 2012b). This tempo also corresponds to that found in the dance music played in nightclubs (Hallett & Lamont, 2014). Most research studies have found a music main effect (versus a no music condition) suggesting that for most people, music adds pleasure as a pre-exercise stimulus, during, and/or after physical activity experiences (Karageorghis & Priest, 2012a).

Positive affective experiences have been found to increase PA enjoyment and therefore, increase the duration and performance of PA (Jones et al., 2014). Music has been shown to optimize arousal, improve simple motor task performance, capture attention, trigger a range of emotions, regulate mood, evoke memories, as well as enhance affect, reduce RPE, improve energy efficiency and lead to increased energy output during repetitive endurance-type activities (Karageorghis & Priest, 2012b). Furthermore, during low-to-moderate intensity PA, participants experience a 10% reduction in RPE when asynchronous music is played (Karageorghis & Priest, 2012b).

Affective reactions to high-intensity PA are different. As predicted by DMT, cognitive manipulations, such as listening to music, will have their most powerful influence at intensities below and approaching a participant’s VT, but much less so above VT when interoceptive cues dominate the affective responses to exercise (Ekkekakis &
Dafermos, 2012; Jones et al., 2014). Affective responses during PA that require high energy output and cause oxygen deprivation are perceived as not enjoyable, as music’s influence to draw the exerciser’s attention away from internal (unpleasant) physiological cues diminishes (Jones et al., 2014). Without music, the attentional shift from dissociative to associative cues occurs at about 69% maximum heart rate reserve (maxHRR), whereas with music, participants do not associate the physiological effects of exercise until approximately 78% maxHRR (Jones et al., 2014). At least as it relates to music and PA, making high-intensity exercise more pleasant for most participants is very challenging. It has been suggested that music has a bigger effect for untrained participants and for self-paced physical activity (Karageorghis & Priest, 2012a). Many exercise leaders use music to promote and maintain a certain intensity for a workout when self-paced exercise is not the goal. Unlike the focus of this review, much of the exercise-music research seems implicitly at least to be concerned with its ergogenic effect rather than pleasure.

Individuality and personal preference is important for PA adherence just as it is for the selection of music accompanying the activity. In relation to DMT, music provides an external cue that is then cognitively attended to by the participant. This cognitive appraisal can encourage the participant to prolong PA and perhaps perform better at a lower RPE, which in turn may lead to a more positive affective state. Music selected for exercise should match the participants’ personal characteristics (e.g., demographics such as age, cultural background) along with the environment in which the activity is taking place, as well as the desired outcomes (Karageorghis & Priest, 2012b). When an individual is exercising alone, this process is simple as the person can choose their own music playlist. However, regarding group exercise, the instructor should embrace democratizing the music selection and taking into consideration each participant’s upbringing, age, and the place the group is exercising, when considering the musical program. The Brunel Music Rating Inventory-3 (BMRI-3), which can be used to rate the motivational qualities of music tracks, is a suitable tool for the assessment and creation of population- and exercise-specific music playlists (Jones et al., 2014; Karageorghis, Terry, Lane, Bishop, & Priest, 2012b; Williams, 2008). Playing music during PA to make the experience more pleasant should lead to increased adherence (Jones et al., 2014; Karageorghis & Priest, 2012b).
It seems that there have been two main foci for more recent music and PA research. Both are related to an ergogenic effect. (Karageorghis & Priest, 2012a, 2012b) review the effects of synchronous music on exercise, which focuses on the effect music can have on a workout. In addition, research related to DMT has often been focused on the dissociative effect of music (see above). We think the implication of this latter focus is that “exercise” is not pleasurable and drawing an exerciser’s attention away from the PA will (hopefully) increase the enjoyment. To us this begs the question of what the “music effect” may be when PA is in itself already pleasurable (part of the answer here is the effect music has on self-paced, lower intensity exercise). Is there an “additive” effect? The circumplex model for music suggests that music itself can have significant effects on one’s mood. One might question, for example, what happens to pleasure when sad music (slow tempo/minor key) is added to PA? Anecdotally, physical activity instructors have professed often choosing music to accompany their PA to match their current mood. If they are sad, they pick sad music (e.g., Van den Tol & Edwards, 2013). Also, while much is known about the impact that music may have when accompanying PA and how this effect interacts with exercise intensity, less is known about the impact music accompaniment may have in the longer term. That is, the acute effects of music during PA seem relatively clear, but these music effects may not be sustainable.

As stated above, using the term exercise (note the recent interest on exercise is medicine) frames the question of the promotion of PA in a somewhat negative manner. This framing is consistent with PA guidelines for health that stress the importance of MVPA (Canadian Society for Exercise Physiology, 2013; Tremblay et al., 2011; World Health Organization, 2010, 2013). More recently, however, there has been a push to acknowledge that any PA is better than none (World Health Organization, 2013). By definition, “exercise” is defined as prescriptive. In contrast, “physical activity” is the term of choice for this paper and suggests that if the main goal is the promotion of pleasure, then topics such as “physical activity as play” need to be revisited. To this end, manipulating intensity may have a different effect on pleasure when PA is playful.
2.4. Playfulness

“Play” is the spontaneous activity in which individuals (children) engage to amuse and to occupy themselves (Burdette & Whitaker, 2005). Concepts from playfulness, such as choice, spontaneity, creativity, and lack of purpose, are suggested to make PA more pleasurable (Burdette & Whitaker, 2005; Halldorsson et al., 2014; Veitch, Bagley, Ball, & Salmon, 2006). As is our nature, people tend to be more playful when at least one other person is present to interact with or be social (Veitch et al., 2006, 2010). An individual will only play for as long as he/she considers the activity to be enjoyable, satisfying, and somewhat challenging to spark his/her creativity and intrigue; flow state is established (Csikszentmihalyi, 1975; Pressman et al., 2009). When the intrigue diminishes, people will choose to change activity. The influence of choice is consistent with self-determination theory (Williams, 2008). More specifically, when participants are offered choice, this often leads to enhanced perceptions of competence and autonomy (Williams, 2008).

The importance of providing choice has been emphasized in Ryan and Deci’s (2000) self-determination theory (SDT); which argues that one of the basic psychological needs, which leads to health and wellness when satisfied, is the need for autonomy. According to SDT, autonomous motivation is satisfied by the fulfillment of three basic needs: autonomy, competence and relatedness (Ryan & Deci, 2000; Sparks et al., 2015). Specifically, in Physical Education classes, students have demonstrated the importance of being provided choice, autonomy support and mastery for improving feelings toward PA; autonomy, competence and relatedness affect how PA is perceived by students (Sparks et al., 2015). The theory and its tenets have been used extensively to understand motivation for PA (Wilson, Mack, & Grattan, 2008). One way to support autonomy is for a leader/instructor to provide activity choices to participants. Support for autonomy facilitates self-authored, internal (integrated, intrinsic) motivation for an activity and this internalization of motivation leads to greater adherence to the specific activity (and greater enjoyment). Even though “choice making” is central to an autonomy supportive teaching style (Reeve, Jang, Carrell, Jeon, & Barch, 2004), no concrete operational definition for choice is part of the SDT. How often to offer choice is not clear, although in (free) play choice occurs whenever disinterest persists. Providing choice to each
participant at various times and among various forms of PA will provide a more intrinsically satisfying experience.

DMT would consider choice a top-down variable, as choice has been shown to facilitate feelings of autonomy and competence (Williams, 2008). DMT suggests that cognitive variables are more powerful determinants of affect at low-to-moderate intensity levels of physical activity (Ekkekakis, 2009). However, choice in PA as play would not be prescriptive by its very definition, and theoretically at least, have a more ubiquitous effect on the affective appraisal and thus the pleasure derived from PA. Many exercise leaders attempt to infuse their workouts with more playfulness but still with a prescriptive, exercise-intensity goal. Furthermore, “self-selection of intensity creates a sense of autonomy and control, allowing exercisers to cognitively ‘reframe’ the exercise experience” (Ekkekakis et al., 2011, p. 660). Intensity, as an independent variable, would cause a significant shift in the mindset of physical activity researchers. Therefore, researchers should study physical play with the same effort as has been expended for “exercise”. The end goal of this research effort will be to learn how to provide participants with an “autotelic” experience, as described in Flow Theory (Csikszentmihalyi, 1990) during PA. To the degree that these findings can be replicated, Werle and colleagues (2014) suggest that when an individual participates in PA and perceives it as fun rather than prescribed exercise, he/she will be less likely to compensate his/her energy deficit with hedonic rewards (caloric compensation). This would suggest that health professionals and health behaviour change researchers should encourage participants to enjoy their PA, for example adjusting the intensity or type of activity, in order to adhere to it longer term.

2.5. Flow Experience

After much in-depth research on positive human experiences, Csikszentmihalyi (1975) conceptualized flow as the optimal state of consciousness during which the activity performed is rewarding in and of itself, which is known as autotelic state. In sport, Jackson and Marsh (1996) described flow state as a positive experience, which occurs when a participant is completely connected to performing the task and their personal skills match the challenge. Flow has been described as “the holistic sensation that people
feel when they act with total involvement” (Csikszentmihalyi, 1975, p. 36). Playing a musical instrument is a good example of this total involvement. Imagine if you could get lost in a world where only the music exists and the particular piece you are playing is the singular concern; sense of time is a nonissue and the experience is out-of-body. While playing to the best of your ability, you are only aware of how the music makes you feel in that very moment (Chirico, Serino, Cipresso, Gaggioli, & Riva, 2015; Csikszentmihalyi, 1990; Mao, Roberts, Pagliaro, Csikszentmihalyi, & Bonaiuto, 2016). That loss of consciousness and concern coupled with the level of difficulty matching that of the participant’s skills allows the individual to become fully engaged in playing the instrument and deriving absolute pleasure, pure joy and happiness from the experience. As another example, rock climbing has been described as an activity conducive to a flow experience because it offers opportunities of control over choice of challenge with a degree of uncertainty (Brandtzæg, Folstad, & Heim, 2005; Csikszentmihalyi, 1975, 1990). Throughout a climb, the climber is faced with different hand and foot holds and various options for getting from the bottom to the top. Dance is also an activity whereby participants often achieve a flow state. Requirements of experiencing flow while dancing include: dancing for yourself rather than the audience, willingly participating, improvisational and spontaneous, as well as opportunities for challenge and various actions due to fellow dancers (Csikszentmihalyi, 1975). Music is a crucial component to dance if one wishes to experience flow, as music limits the stimulus field by focusing the dancer’s attention (on the beat) and eliminates distractions, focusing the attention entirely on the dance itself.

Flow state is comprised of nine dimensions (Csikszentmihalyi, 1990; Jackson et al., 2001), the most important of which is a balance between challenge and skill. As Csikszentmihalyi (1975, p. 181) wrote, “…something that is enjoyable to do gives a feeling of creative discovery, a challenge overcome, a difficulty resolved”. This skill-challenge balance motivates participants by adding difficulty and sometimes excitement to the activity. Challenges usually appear as problems, progressions or obstacles, which can either pose a threat to one’s self-esteem or can do the opposite and stimulate a desire to fight and achieve self-actualization (Jantzen et al., 2012). If the participant can master the challenge, their self-esteem is reinforced most likely bolstering the participant's
desire to prolong their engagement in the activity. Since skill level improves with practice, there is a need for the challenge to also increase over time for flow to be maintained. Flow is most likely to occur in structured activities where goals are clear and immediate and unambiguous feedback is provided for the performer. During a flow state, the performer perceives a sense of control. Whereas Csikszentmihalyi (reviewed in Csikszentmihalyi & Larson, 2014) used an event sampling technique during activities to understand the flow experience, Jackson and Marsh (1996) developed a flow state scale to be used following the performance of a PA.

Based on the measures mentioned above, much is known theoretically about flow state; however, there is a lack of research whereby flow has been manipulated. Manipulating flow, specifically the challenge-skill balance, to produce a more pleasurable experience for participants seems to have potential efficacy. Jackson et al. (1998) found that the likelihood of experiencing flow in sport increased as perceived ability increased. Offering participants different levels of challenge that they can independently match to their own ability should facilitate a more pleasurable experience. For example, computer games (Chang et al., 2014) are specifically designed to allow challenge and ability to coalesce. There is also unambiguous feedback during the game and performance goals seem clear to the players. Therefore, computer games facilitate a flow state experience and participation is evidently intrinsically driven; indeed, just ask any parent trying to remove their child from a computer game! “Adherence” is seldom an issue.

In relation to DMT, many of the dimensions of flow represent top-down factors; however, task feedback would be an example in flow of bottom-up processing. To produce enjoyment in PA, it may be necessary to create flow in much the same way computer game designers have mastered (e.g., video games can be addictive; Gray, 2018). In order to produce flow, future research should focus on the skill-challenge balance, goal and feedback clarity, and sense of control. In recent years, virtual reality has been used to provide physically active participation in computer games. This technology could be used to study those variables most influential in producing a flow state. Sweetser and Wyeth (2005) used the flow dimensions to assess the (potential) pleasure derived from video games. In keeping with the theme in the present paper, they
suggested that game derived fun was the key focus of computer games and as a result they felt flow was an appropriate concept for their assessment. Interestingly, their assessment tool incorporated social interaction (not a flow dimension), which they described as “a strong element of enjoyment in games” (Sweetser & Wyeth, 2005, p. 10) as an important factor with the potential to produce pleasure in a game environment. They suggested that competition and cooperation, social interaction, and social communities all had the potential to increase pleasure, and ultimately adherence to a game environment.

2.6. Social Interaction

Social interaction and social groups are a part of our very human existence; people depend on sociability. Self-Determination Theory (Ryan & Deci, 2000) addresses both the individual and social factors that elicit different types of motivation. As part of SDT, Ryan and Deci (2000) theorize that “relatedness” is a basic psychological need. To meet the need for relatedness, researchers have had PA leaders “dedicate psychological resources” to their participants (Edmunds, Ntoumanis, & Duda, 2008). Leaders conveyed to the participants that they were interested in their well-being. Furthermore, research has been conducted whereby the social environment was manipulated, namely the exercise leader, which demonstrated enriched social interactions among exercise participants (Loughead, Patterson, & Carron, 2008). As a result, research suggests that people innately seek approval, recognition and respect from their peers; they will remain engaged in the task in order to socialize and gain approval from fellow participants and potential advocates (Edmunds et al., 2008).

Regarding eating behaviours, Macht, Meininger and Roth (2005) confirmed that social interactions improve perceived pleasure while eating and that happy people tend to eat out more often and spend more time with friends. In the same study, university students in Germany were interviewed confirming that the highest levels of happiness were experienced when the students were involved in sports and games, eating and socializing (Macht et al., 2005). For example, students at school are likely to pursue social goals as much if not more than learning goals (Shell et al., 2010). Alternatively, social isolation can have negative personal and academic outcomes (keeping with the last
example). More specifically, a sedentary person striving to increase and regulate their PA behaviour will be more likely to succeed in adopting this new health behaviour change if they are socially supported. Friends of consistently active people are more likely to be more highly active than those with sedentary friends because active people will motivate each other to stay active (Janssen, Dugan, Karavolos, Lynch, & Powell, 2013). Not only is social interaction fundamental to need fulfillment, but central to well-being and happiness (Ryan & Deci, 2001).

Sex differences have been noted in the review by Van Dyck et al. (2014) who studied the data from three observational studies, internationally. Van Dyck and colleagues (2014) found that in regard to walking, social support from family was most important to women, and unexpectedly, men negatively associated perceived benefits with walking. Possibly, men who are aware of the benefits of exercise may choose to engage in more intense physical activity rather than a leisure walk, in order to increase the benefits incurred.

Self-determination theory stems from the understanding of intrinsic motivation and how an individual’s pursuit for “assimilation, mastery, spontaneous interest, and exploration” are essential to cognitive and social development that produce most of the enjoyment and vitality experienced throughout one’s life (Ryan & Deci, 2000, p. 5). Enjoyment has been described as, “a positive affective state that reflects feelings such as pleasure, liking, and fun” (Motl et al., 2001, p. 110). As a component of expectancy-value theories, enjoyment has been demonstrated to be associated with PA through intrinsic motivation (Motl et al., 2001). Correlations exist among enjoyment, PA, and PA involvement that support the importance of experiencing enjoyment while being active (Motl et al., 2001).

Given that PA can be a social event, how might physical activity be more social? Physical activity, when performed in a group setting, team sport or gym, produces a social experience. If PA is positioned as a party, social variables should be manipulated to create a party-like atmosphere, since parties cannot happen with just one person. We know that individuals who are sociable and fun-loving tend to also be dominant, spontaneous and active (Lucas & Diener, 2001). This pleasant affect or positive mood
state can increase the desire for social behaviour in the future if such behaviour is social and physically active (Lucas & Diener, 2001).

Specific to pleasure, an example of seeking a pleasurable social experience could be when an individual participates in team sports, resulting in a social phenomenon which produces more fun. Associated to this increase in pleasure and consequently fun is team cohesion; the specific sport or type of PA is the independent variable producing the social phenomenon. Alternatively, we want to use social as the independent variable to facilitate pleasurable PA. However, the problem is that this field of study lacks literature and research supporting this theory. Group exercise and team sports are more social than solitary exercises and sport; however, important to note is that sometimes people prefer and enjoy solitary exercise more than group activities. Personality will affect how individuals perceive social settings for PA. For example, when introverts and extraverts are put into the same social or nonsocial situation, if the situation is pleasant, the extraverts will rate the experience as more pleasant than the introverts (Lucas & Diener, 2001). Similarly, music contributes to social cohesion in a group setting by reducing social stress, for example (Schäfer, Sedlmeier, Städtler, & Huron, 2013). One song can unite a group; a crowd singing an anthem at a sporting event bounds the fans together. Thus, the social functions of music are manifested in three principle ways for the individual: self-identity, interpersonal relationships, and mood (Hargreaves & North, 1999). Music can alter mood by encouraging social interaction through the communication of feelings and identity (Murrock & Higgins, 2009). Therefore, in a group setting, individuals can better manage these three functions to improve their sociability and affective state.

Dual Mode Theory would position this social variable as a top-down factor as participants will not pay attention to physiological cues when at an intensity at or below VT so long as they experience attentional dissociation; for example, distractions from social interaction. Examples are when friends are playing hockey together or attending group spin class. Perhaps friends can bond over comparing their statistics recorded from their personal pedometres and online weight-trackers (Burke, Carron, Eys, Ntoumanis, & Estabrooks, 2006). Group cohesion has been linked to better exercise adherence and a more positive affective state. Longer-term research aimed at team building (e.g., Carron
could strategically manipulate the social atmosphere of PA and study its impact on pleasure. Although not everyone considers social PA to be enjoyable (Burke, Carron, & Shapcott, 2008), more social environments generally equate to more pleasure (Burke, Carron, & Eys, 2006; Carron, Hausenblas, & Mack, 1996).

### 2.7. Measurement of Pleasure

To determine whether “pleasure-enhancing” variables (intensity, music, flow, play, and sociability) are being manipulated effectively, reliable and valid measures of the affective response to PA are necessary. DMT suggests (Ekkekakis & Dafermos, 2012, p. 322) that pleasurable responses to PA are hierarchically organized from core affect to higher level emotions. As suggested by Ekkekakis and Dafermos (2012, p. 323), “…one challenge as this line of research moves forward is to investigate the salient types of cognitive appraisals and ensuant emotions that occur in the context of exercise…”. Ekkekakis and Dafermos (2012) also emphasize the importance of measuring pleasure/enjoyment both during and after the PA in question. This is critical since some research suggests that pleasure experienced during PA may predict long-term adherence more accurately than pleasure following the completion of PA (Williams, Dunsiger, Jennings, & Marcus, 2012). Furthermore, higher level emotions are top-down, cognitive-based appraisals. The measurement of pride for example, may be difficult to assess during high-intensity PA because it tends to turn off the possibility of top-down cognitive appraisal. Thus, it would appear that more complex emotions may only be reliably assessed after the PA ceases. In contrast, core affect seems amenable to in-task measurement. In concert with this thinking, the following measures exemplify that many measures have been used in this field of research; however, there does not appear to be consensus, which makes comparing studies difficult. A much more comprehensive discussion of the topic of measurement of affect has been developed by Ekkekakis (2013). Ekkekakis (2013a, 2013b) reviews how affect, mood, and emotions have been measured in health-behaviour research and more importantly offers a guide to their selection and use. We offer but a brief commentary below.
During PA

Among the tools used in the literature, emanating from the circumplex model, the Feeling Scale (FS) and Felt Arousal Scale (FAS) have often been used to measure core affect during PA. For example, these scales have been extensively reviewed with regards to the impact of music accompanying PA (Jones et al., 2014; Karageorghis & Priest, 2012a, 2012b). The FS (Hardy & Rejeski, 1989) is an 11-point scale assessing how one feels right now, with possible scores ranging from -5 (very bad) to +5 (very good). The FAS (Svebak & Murgatroyd, 1985) is a 6-point scale ranging from 1 (low arousal) to 6 (high arousal). A measure used with children’s PA but seldom with adults is the smileymetre (Hulley et al., 2008), which is similar to the Self-Assessment Manikin (SAM; Bradley & Lang, 1994). A pictorial rating scale made up of 3-5 “happy” to “sad” faces can be used to assess enjoyment during PA as well as immediately following, ranging from upset to ecstatic (Ekkekakis, 2013a, p. 126; Hulley et al., 2008). The smileymetre has produced reliable and consistent results and should be employed in future studies focusing on children and youth’s enjoyment of PA. In relation to affective research in the exercise domain, HR and RPE (independent variables) are often measured in concert with FS and FAS (dependent variables). Research has shown for example that music can decrease perceived exertion or increase enjoyment (Karageorghis & Priest, 2012a).

A limitation with employing this research with children and youth is the lack of valid and sophisticated measurement tools available. In continuing with studies related to measuring children’s enjoyment during PA using a Likert Scale, a study in which the children participating were required to complete a mood self-report was conducted (Burns-Nader & Hernandez-Reif, 2016; Burns-Nader, Hernandez-Reif, & Thoma, 2013). The participants were shown a scale of five facial expressions, varying from 1 (worried) to 5 (happy), and asked to “Point to the face that looks like how you feel right now” before and after their assigned activity (one of four groups; Burns-Nader et al., 2013). Next, the children were asked to describe the face that they chose to validate the scale. The group that was shown a medical information video was more comfortable, showing less difficult behaviour during procedures and appointments. Similarly, Sim, Macfarlane and Read (2006) wanted to develop a tool that could be used to measure how much fun a
child experiences with a specific activity. The team of researchers created a 5-point scale of smiley faces that was used to record the children’s opinions, before and after their activity. The researchers observed the children having fun and reported their level of fun as a reference to look back at during data analysis (Sim et al., 2006). The scale was validated by the notes the children made about how they were feeling and why a certain smile represented their present emotion. As a result, the researchers discovered a very strong and significant correlation between the software that the children thought was the most fun and the one that they would choose to play (p<0.05). When usability problems were reported, the children had less fun. Therefore, the more fun the children perceived the computer software to be, the more likely they would want to use it again.

*Following Cessation of PA*

While the FS, as reviewed above, has often been used both during and after a bout of PA, the end of PA offers an opportunity to obtain a more detailed account of the affect experienced. The timing of this measurement also offers sufficient time for a top-down, cognitively-based appraisal and therefore a reflection of more complex emotions. Since these more complex emotions are amenable to learning and experience, they may be attractive for longer-term PA experimentation. Much research has focused on acute bouts of PA, whereas there is also an interest in tracking pleasure and enjoyment over time and perhaps factors that affect improvements in emotion over time. Are there factors, for example, that can be manipulated to enhance a sense of pride in a PA. With the consideration of more complex emotions, as measured after a bout or bouts of PA, we are open to the possibility of many measures and some of the possibilities are reviewed below.

The Physical Activity Enjoyment Scale (PACES), as described by Kendzierski and DeCarlo (1991) is a questionnaire used to measure the extent to which an individual enjoys participating in PA. PACES is comprised of 18 items attached to a 7-point bipolar scale (I dislike it - I like it) with the instruction, “Rate how you feel at the moment about the PA you have been doing”. Higher PACES scores reflect more experiences of enjoyment. The questionnaire uses vocabulary that is best suited for individuals of at least high school age but can easily be modified to be age-appropriate for a variety of different PA populations (e.g., Motl et al., 2001).
A measure that has been used in PA research to assess mood following PA is the Profile of Mood States (POMS). Terry, Lane, and Fogarty (2003) validated the use of POMS for younger populations engaged in sport and PA. The 24-item scale requires participants to rate how they feel right now, from not at all to extremely (“anxious” for example). The scale is broken down into five negative moods (anger-hostility, confusion-bewilderment, depression-dejection, fatigue-inertia and tension-anxiety), but only one positive mood (vigor-activity). For some applications like “green” exercise (e.g., Barton & Pretty, 2010) this scale seems useful. Participants in this line of research often walk through different natural and urban settings, and after each their mood state is assessed. The POMS has a distinct bias towards negative moods which may make it less advantageous for some PA research focusing on the positive effects produced.

The exercise-induced feeling inventory (EFI) was developed by Gauvin and Rejeski (1993) in partial response to the negative focus of the POMS. The EFI was developed to measure feeling states related to acute bouts of PA. Questions ask participants how they feel at the moment in time from “do not feel” to “feel very strongly” (e.g. upbeat). The four subscales include: positive engagement, revitalization, tranquility and physical exhaustion. The limitations of using the EFI include: the definition of “exercise-induced feeling states”, that the participants will only experience the four states of feeling, as noted by (Ekkekakis, 2013b), and several methodological issues (Ekkekakis & Petruzzello, 2001, 2004; Gauvin & Rejeski, 2001).

In a study conducted by Maher and colleagues (2014), the researchers were interested in subjective well-being in the emerging-adulthood population (18 to 25 years of age); specifically, they sought to determine how PA influences satisfaction with life (SWL). Satisfaction with life is a term used to describe peoples’ physical and mental health and is a key determinant of happiness throughout an individual’s lifespan (Maher et al., 2014). A health behaviour such as PA, which has both top-down and bottom-up influences on SWL, affects overall physical health, anxiety, and self-esteem, for example. Self-esteem is one of the strongest top-down correlates of SWL; the researchers had the participants (n = 190 university students enrolled in an optional for-credit introductory psychology course) record their self-esteem in a diary for the duration of the study on a daily basis. Daily self-esteem (SE) was assessed using the Single-Item Self-Esteem Scale
whereby participants were prompted to, “Look back on everything that happened to you today and consider the day as a whole” and then rate their SE from 1 to 5 (Maher et al., 2014). Overall, participants reported greater SWL on days they were more physically active (bottom-up effect) and thus, SWL was impacted by individuals’ daily PA rather than long term trait level PA (Maher et al., 2014).

The Achievement Emotions Questionnaire (AEQ; Pekrun, Goetz, Frenzel, Barchfeld, & Perry, 2011) measures the emotions of students’ learning and performance. Items include emotions like pride, enjoyment, and hope, but also includes negative emotions such as anxiety and boredom. One study assessed a sample of Mexican tennis players using the AEQ as a model and the influence of three antecedents on achievement goals (fear of failure, personal standards, and concern over mistakes) as well as the influence of achievement goals on two affective outcomes (enjoyment and hope) (Puente-Díaz, 2013). This study extended the AEQ’s focus from understanding motivated behaviour in education to now encompass other achievement fields such as sports, testing the models of achievement goals and achievement emotions. Overall, mastery-approach had a significant influence on enjoyment and hope, and performance-goals had a significant influence on hope. Therefore, adopting goals and positive valence towards a mastery-approach goal, especially in a competitive achievement setting, is recommended to players and coaches alike (Puente-Díaz, 2013).

Finally, although not designed as a measure of affect per se, Chang et al. (2014) created the continuance intention (CI) questionnaire which they produced to predict gamers’ intentions to continue playing computer games as well as their level of enjoyment and loyalty with regards to specific games. This questionnaire also delves into questions pertaining to Flow State, Hedonism, Social Influence, in addition to intrinsic and extrinsic motivators. As such, this questionnaire or an adaptation of it, could be useful when assessing pleasure and its impact on adherence to PA. For shorter term studies, intention to continue playing is obviously a potentially useful measure as it looks at both the cognitive and affective angle of predicting future game-play. The questionnaire measurement items are: utilitarian outcome expectations, hedonic outcome expectations, subjective norm, critical mass, peer influence, external influence, flow, and continuance intention (Chang et al., 2014).
While the measures reviewed above are not exhaustive, it is obvious that a researcher has many options available (see also Ekkekakis, 2013) when measuring affect, mood, and emotion during and particularly after a bout of PA. For example, the Positive and Negative Affect Schedule (PANAS), the Physical Activity Affect Scale (PAAS), and the Activation-Deactivation Adjective Checklist (AD ACL), although similar to the aforementioned, were not included in this review, since they were not appropriate for use in the following two studies (Lox, Martin Ginis, & Petruzzello, 2014). For the field to move forward conceptually, it may be necessary to use multiple measures simultaneously. In particular, if adherence to PA is a focus of pleasure in PA research, then the hierarchy of resultant reactions in the short and longer term will be important to understand.

2.8. A Summative Model

We understand that participation in PA is more likely to become habitual if the individual enjoys the activity and finds a sense of personal enrichment through participation. Obese and overweight adults are more likely to experience exercise that exceeds their VT as unpleasant, such as a quick walk (Williams, 2008). Since overweight and obese individuals are of particular interest for exercise interventions, self-paced exercise, probably of low-intensity, will eventually lead to greater energy expenditure and associated health benefits with long term adherence to PA (Decker & Ekkekakis, 2017; Williams, 2008). Throughout this paper, the factors that affect the pleasure experienced during and after a bout of PA and as a result the adherence to a physically active lifestyle have been explained. The model presented below (Figure 2) is meant to be a summary of these factors, as well as how the variables emanating from these factors may be used to promote pleasure.
Intensity. The primary factor to take from the hedonism literature is obviously the impact of intensity on pleasure. Typically, there is a reciprocal relation between intensity and pleasure. When exercise is performed at or below VT, the during-exercise affective states of participants is generally not negatively impacted and such intensities have even improved some participant’s affect during the PA task (Ekkekakis et al., 2011). Low and moderate intensity activities below the ventilatory threshold are more pleasurable, whereas high-intensity activities cause the interoceptive cues produced by physical effort to often produce an unpleasant experience. Only the most dedicated exercisers would normally choose these levels of intensity. As health promtors, we want to promote the enjoyment derived from PA and we suggest that the first thought for PA leaders and health practitioners should be the consideration of pleasure rather than the prescription of the quantity and quality of exercise. Changing the emphasis to pleasure will encourage
more people to adhere regularly to PA, and ultimately produce greater mental and physical health.

**Music.** Research demonstrates a link between dissociation and a more positive exercise experience (Jones et al., 2014; Karageorghis & Priest, 2012a; Rhodes et al., 2009). Music can be used by PA participants to dissociate feelings of fatigue and discomfort from their enjoyment of doing the activity. Playing music during PA should lead to regular participation in PA as a result of positive association to the experience (Jones et al., 2014; Karageorghis & Priest, 2012b). Music can be used to make PA more pleasurable by manipulating the tempo, beat and loudness of the music. For example, faster paced music has been associated with improvements in arousal whereas music played in a major key has been linked with positive affective states (Clark, Baker, & Taylor, 2015; Jones et al., 2014; Karageorghis & Priest, 2008; Karageorghis & Terry, 1997; Karageorghis, Terry, Lane, Bishop, & Priest, 2012a; Priest & Karageorghis, 2008; Seath & Thow, 1995). Furthermore, asynchronous music is evidenced to facilitate more pleasure during exercise in which the participant’s heart rate corresponds to the beat of the music (Hallett & Lamont, 2014; Karageorghis & Priest, 2012a). Rhythm affects physical movement whereby the body responds in turn to the motivational quality of the piece of music (Priest & Karageorghis, 2008). In addition, music can be used to remove the attention from the interoceptive cues connected to perceived effort and physiological discomfort, which in turn prolongs PA duration, reduces RPE and improves performance and affective state during and following the activity (Jones et al., 2014; Priest & Karageorghis, 2008; Taylor et al., 2007). Importantly, music has its own inherent enjoyment-effect, independent of PA as proven conceptually by the circumplex model (Bigand et al., 2005; Russell, 1980).

**Flow.** Flow state is the phenomenon of intrinsically motivated activities, referred to as being autotelic, which describes doing an activity for the sake of it rather than for an extrinsic reward (Nakamura & Csikszentmihalyi, 2002). When in flow state, the person operates at their full capacity, in a state of dynamic equilibrium (Nakamura & Csikszentmihalyi, 2002). The purpose of flow is to experience the autotelic state, which depends on establishing the balance between perceived challenge and skills. Thus, flow experiences are inherently enjoyable and participants are more likely to seek optimal
experiences and establish complete engagement (Mao et al., 2016). Intrinsic motivation is a principle source of enjoyment; flow is experienced when a person participates in the activity without the need for external reward or recognition, but rather they are participating for the sake of the activity itself (Ryan & Deci, 2000). Flow can be manipulated in terms of the challenge and skill requirement. Inappropriate challenge has been demonstrated through research to disrupt the autotelic state due to boredom (the activity is not difficult enough) or frustration (the activity is too difficult for the participant’s capabilities). With appropriate modifications and available professions, individual participants will be able to match the task-difficulty to their own skill level thereby encouraging prolonged participation.

**Playfulness.** Play can be described as performing a task or activity for the pleasure of it without expectations of reward, rather for the satisfaction of doing the activity. Playfulness has concepts such as choice, spontaneity, creativity and lack of purpose, which are suggested to make PA more pleasurable (Burdette & Whitaker, 2005; Halldorsson et al., 2014; Veitch et al., 2006). Additionally, a situation that offers social interaction and is considered to be fun will promote the activity’s playfulness and contribute to task adherence. We have suggested through our research that providing choice to individual exercise participants will vary their experiences and will increase the likelihood of a positive experience. Therefore, in order to manipulate play to improve pleasure and thereby adherence, choice will be the variable. Participants will be given the opportunity to choose from a variety of options within the activity itself to satisfy their own personal needs and aspirations. This can be complicated as there are many choices that can be made within exercise, including but not limited to: intensity of the exercise, music selection, exercise apparatus, whether to exercise alone or with others, etc. The researcher will need to be specific in their decision and define which choice they are giving to their participants for certain trial conditions in future research.

**Social Interaction.** Self-determination theory has evolved from the theory of intrinsic motivation and how an individual’s pursuit for being a part of society, being creative and excelling at certain tasks are essential to cognitive and social development (Ryan & Deci, 2000). This internal drive in turn produces most of the enjoyment and vitality experienced throughout one’s life. Fundamentally, humans require relatedness
therefore, a social atmosphere will inherently motivate people to be physically active. Ekkekakis and colleagues (Decker & Ekkekakis, 2017; Ekkekakis et al., 2008, 2011; Ekkekakis & Lind, 2006; Jones et al., 2014; Lind et al., 2008; Zenko, Ekkekakis, & Ariely, 2016) have explored and demonstrated the effectiveness of using affective processes as the theoretical basis of their research. Specifically, these researchers have demonstrated that hedonic motivation can be used to change exercise behaviour as well as predict subsequent exercise adherence. In future studies, research should aim to demonstrate and support the use of social experience as an independent variable. We need to manipulate variables that are most likely to produce team cohesion. According to Burke (Burke et al., 2006; Carron & Burke, 2005), exercise participants show improved adherence rates for exercise classes where team building and group-dynamics principles were used to increase cohesiveness, which they aptly referred to as ‘true groups’, when compared to standard exercise classes led by a fitness instructor, home-based exercise and exercise performed alone at a gym. Further to this point, social support lends credence to intention to engage in PA, efficacy for said activity, and affect relating to that activity (Burke, Carron, & Eys, 2006; Carron et al., 1996). As previously mentioned, both extraverts and introverts prefer a pleasant situation compared to an unpleasant one regardless of whether it is social or nonsocial; however, extraverts experience more positive affective states when the environment is social (Lucas & Diener, 2001). We expect that, in general, a more social experience will linearly correlate to a more pleasurable experience during an individual’s participation in PA, thus encouraging future PA participation.

The proposed model is intended to promote future research and in addition, to suggest variables that can be manipulated to increase enjoyment. This paper has shown that current literature supports the use of the five factors (intensity, music, flow, play, and social interaction); however, future research is needed to further elucidate the specific variables that can be manipulated to increase enjoyment. Specifically, how can variables, such as music, be manipulated in order to increase enjoyment in PA. Also, little is known about individual differences for people (age, sex, personality) with various proclivities for PA. There are several researchers who suggest that affect should be a central focus for future research in PA, particularly as it relates to long-term adherence (Ekkekakis, 2003;
Karageorghis & Terry, 1997; Priest & Karageorghis, 2008). The ultimate goal of this research focus is the promotion of mental and physical health, but also life satisfaction.

2.9. Conclusion

Positive emotions broaden an individual’s momentary thought-action processing (Robinson, Kennedy, & Harmon, 2012). Joyfulness of an activity encourages a person to play, which can increase the development of physical, intellectual, social, and psychological characteristics (Robinson et al., 2012). According to a recent international survey, less than 20% of youth reported engaging in at least 60 minutes of daily MVPA (Gray, Larouche, Barnes, & Colley, 2014). Specific to Canada, only 7% of children and youth 5 to 17 years old are meeting these PA guidelines (Gray et al., 2014). Related to the steady decrease in participation in PA is the increasing rate of obesity among Canadians of all ages. More specific, one in three Canadian children are obese or overweight (Shi, Groh, & Morrison, 2013). Furthermore, obese children and adolescents have higher risk and are more likely to stay obese into adulthood (Shi et al., 2013).

Past research has focused on cognitive, social and environmental factors. Throughout this paper, we have argued and supported the use of affective processes as determinants of adoption and maintenance of PA behaviour (Williams, 2008). Future research regarding exercise adherence and physical health intervention studies should employ hedonic motivation theory and test the hypothesis that enjoyment will predict future exercise adherence intentions. “Fun” is specific to the individual and is brought out by the participation in an activity found pleasurable to the individual. Therefore, in order to encourage children, adolescents and adults alike to participate in more frequent and regular bouts of PA, activities need to be inherently interesting and modifiable to a variety of individual’s needs and skills to allow for flow and thus, an enjoyable experience.

Measuring the level of enjoyment derived by individuals participating in different activities can both quantify and qualify the effectiveness of the recommended modifications: hedonic principles, music, flow, play, and sociability; smileyometre, FS, FAS, HR, BP, PACES, and Chang et al.’s (2014) CI questionnaire. Future research should use these measurement tools in order to effectively and accurately test if the
modification of certain variables allows more participants to enjoy participating in PA and therefore participate in more activity more regularly. Promoting the experience of pleasure during PA has been theoretically demonstrated to increase the adherence and desire to regularly participate in various forms of PA, thereby reducing the attractiveness of alternative sedentary activities currently prevalent among all ages throughout our society. Expanding on DMT and the use of distraction/attentional dissociation to encourage PA participation, individuals are encouraged to enjoy PA for the sake of it. As people learn to love being physically active, individually, they will choose their desired activity and foster a healthy, active lifestyle.
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3. Study 2: Student music preferences during different forms of physical activity.

Music is a culturally accepted pastime, which has become linked with various aspects of our daily life (Clark, Baker, & Taylor, 2015). People listen to music when they are at work, while walking their dog, socializing, cleaning, during exercise, and more; its prevalence in everyday life is putative. Specifically, music is ubiquitous in the daily lives of most North Americans; in particular, the adolescent and young adult generations seem to be ‘plugged in’. These generations have access to music anywhere and at any time, regardless of the activity or circumstance; exercise is simply one subset of music listening behaviour. Listening to music affects people through one or more of its four functions: cognitive, social, physiological, and emotional (Hunter & Schellenberg, 2010; Husain, Thompson, & Schellenberg, 2002). Previous research (Elliott, Carr, & Orme, 2005; Karageorghis & Priest, 2012; Karageorghis & Terry, 1997) has demonstrated that using music manipulates affect and arousal and thus, music during can exercise enhance an individual’s exercise experience. Moderate- and fast-tempo music has been shown to reduce the number of (physiological effort-related) associative thoughts during exercise and in turn has a positive influence on the participant’s affective valence during and after physical activity (Karageorghis & Jones, 2014).

A paucity of research has focused on individual differences in music preferences during exercise (aerobic and strength training) or leisure activities (e.g., Baldari, Macone, Bonavolonta, & Guidetti, 2010; Bigliassi, Estanislau, Carneiro, Kanthack, & Altimari, 2013; Jones, Karageorghis, & Ekkekakis, 2014; Jones, Tiller, & Karageorghis, 2017; Karageorghis & Priest, 2012b; Karageorghis, Terry, & Lane, 1999; Karageorghis et al., 2012; Taylor et al., 2007). As a result, less is known regarding individual music preferences during exercise and indeed research has been done controlling for individual differences in song choices. For sake of control, researchers often use the Brunel Music Rating Inventory scale (BRMI-3) to categorize songs as high, moderate, or low on the motivation scale in order to standardize the music provided to the group of trial participants (Elliott et al., 2005; Karageorghis, Priest, Terry, Chatzisarantis, & Lane, 2006). Preference has been shown to be important for intrinsic motivation; thus, specific
music selections may affect individuals differently and needs to be considered for interventions and practical suggestions to be effective (Dobrota & Ercegovac, 2015; Karageorghis & Jones, 2014; Karageorghis, Jones, & Stuart, 2008). Music preferences seem to be associated with personality, physiological arousal and social identity (Rentfrow & Gosling, 2003) and emotional response (Dobrota & Ercegovac, 2015; Hunter & Schellenberg, 2010; McQueen, Hallam, & Creech, 2018; Nater, Abbruzzese, Krebs, & Ehlert, 2006). Moreover, participants will spend more time in an activity in which pleasure is derived, which will increase their intrinsic motivation (Dobrota & Ercegovac, 2015; Karageorghis et al., 2008).

Music can be identified by the speed of the song, rhythm, or key it is played in, the lyrics of the song, and the familiarity or emotional connection one has to certain pieces. The modality of a song refers to the key a song is played in, minor or major. The speed or tempo of music is measured in beats per minute (BPM). The tempo of a piece of music can take on any value; however, humans appear to have a predisposition for repetitive movement at cadences around 120 BPM, and this is commonly reflected in popular Western music (Clark et al., 2015; Karageorghis & Terry, 1997). According to the music and exercise literature, music that is considered to be ‘upbeat’ has a tempo of 125-140 BPM, which is ideal for exercise; such as cycling at a gym and listening to the music played (Karageorghis & Priest, 2012). Tempo greater than 140 BPM is considered fast, whereas music with a tempo below 120 BPM would be considered slow for exercise purposes. Tempo manipulations are suggested to affect the listeners’ arousal, whereas mode manipulations affect mood (Husain et al., 2002). This is expressed in the circumplex model, which categorizes songs into one of 4 quadrants (2 dimensions of tempo (x-axis) by 2 dimensions of mode (y-axis)) and this model has been used in exercise and music research (Bigand, Vieillard, Madurell, Marozeau, & Dacquet, 2005; Ekkekakis, 2013; Hardy & Rejeski, 1989; Karageorghis & Jones, 2014; Svebak & Murgatroyd, 1985).

The rhythmic component of music or the synchronization of repetitive movement to music can increase the precision of a listener’s movement response, which often leads to improved energy efficiencies, prolongs the duration of the activity and can increase the participant’s exercise intensity (Clark et al., 2015). In addition to enhancing exercise
intensity and endurance, Karageorghis and colleagues have determined that exercising with synchronous music also reduces oxygen consumption in comparison to exercising with asynchronous music or no music at all (Karageorghis & Priest, 2008, 2012; Karageorghis & Terry, 1997). Specifically, music affects processes in the autonomic nervous system and can be used to regulate heart rate and blood pressure (Clark et al., 2015; Karageorghis & Priest, 2012; Karageorghis & Terry, 1997; Murrock & Higgins, 2009). The central nervous system reacts automatically to musical cues (Clark et al., 2015) such as tempo, harmony, melody, and rhythm. Therefore these can be manipulated to excite and support high-energy activity with songs that are fast tempo/major key or to calm and relax with slow tempo/minor key music (Clark et al., 2015; Salimpoor, Benovoy, Larcher, Dagher, & Zatorre, 2011).

Nearly all studies relating to music and how it affects participants during physical activity are focused specifically on exercise; leisure physical activity is seldom mentioned nor is it studied (e.g., Hutchinson et al., 2018; Jones et al., 2014, 2017; Karageorghis & Jones, 2014; Karageorghis et al., 2008). More specifically, we do not fully comprehend whether current fitness levels or frequency of physical activity participation also impacts music preferences. For instance, a sedentary individual most likely requires more motivation to be active than a varsity athlete, therefore music preference may be more effective in motivating them to become physically active (Cline, 2017; Karageorghis et al., 2012a). A study found that the experience of pleasure when listening to music was mediated by the release of the brain's reward chemical, dopamine (Salimpoor et al., 2011). Music seems to tap into the circuitry in the brain that has evolved to drive human motivation; when we do something our brains want us to do again, dopamine is released into these circuits. In addition, there is little research regarding sex differences with regards to music preferences in relation to physical activity. However, there is more research highlighting the differences between sexes with regards to general musical listening preferences, specifically in emotion research (Dobrota & Ercegovac, 2015; Nater et al., 2006). Therefore, our understanding of sex differences with regards to music preferences during physical activity and how music affects participants differently depending on their sex is limited (Karageorghis et al., 2012a).
3.1. Purpose

The purpose of this study was to describe the types of music chosen (genre, tempo, modality) by university-aged students to accompany their physical activity and the utility made (e.g., distraction) of the music chosen. To do this, a questionnaire was developed that asked about song selection and uses made of these selections during three different types of physical activity.

The following research questions were investigated:

1. What song preferences do university students report when participating in aerobic exercises, strength training, and leisure physical activity?
2. Are song preferences for each type of physical activity further explained by grouping the songs into the categories of the Circumplex Model?
3. What uses do university students report for their music accompaniment for exercise and leisure physical activity?
4. Do sex differences exist for music preferences during physical activity and uses made of music accompaniment?
5. Does frequency of physical activity impact the uses reported for music accompaniment?

3.2. Methods

Participants and Questionnaire Development

To inform questionnaire development, graduate students (n = 9) that attended a weekly seminar were asked questions about their music preferences during physical activity (see Appendix A) during a focus group interview. The interview ran for one hour and was led by the primary researcher (CE). A second focus group (n = 8 graduate students) was held in order to achieve saturation. Resulting from focus group input, a pilot questionnaire was administered to 50 university undergraduate and graduate students (33 females and 17 males). Pilot data were analysed to check the usability of the questionnaire. As a result of the focus groups and pilot test, the final version of the questionnaire used for this study was created (Appendix B).
Ethics approval was obtained through the University’s Research Ethics Board. A convenience sample of undergraduate students enrolled in third year Kinesiology classes was recruited for this study. We knew that the vast majority of university-aged students reported using music to accompany their physical activity, which in this case was 100% of this study’s participants. Since our primary interest was in type of musical accompaniment during physical activity, the biased sample with active participants was justified. Participants’ years of birth ranged from 1989-1995; participant ages ranged from 20 to 26 years (one outlier participant was born in 1968). There was a total of 113 participants who filled out the questionnaire: 63 females (55.8%) and 48 males.

Instrument

Participants completed a 13-item questionnaire (Appendix B) that asked them questions concerning their utilization of music with regards to: music listening behaviour in everyday life, aerobic and strength-based exercise separately, and leisure activity. Demographical information regarding their age, sex, fitness level (through frequency of weekly exercise) and frequency of leisure activity participation were requested. As a result of our literature review and pilot tests, a list of five utilities for music listening purposes was created: “to facilitate the workout”, “to distract me from physiological cues”, “to change my mood”, “for motivation”, and “to keep out extraneous noise”.

Procedure

During recruitment, participants were provided with a brief description of the purpose of the study and what the questionnaire entailed. Once completed, the questionnaires were collected and answers were numerically coded by CE and entered into an excel spreadsheet. Songs were coded for modality and tempo. Each song was also assigned to the appropriate genre category, defined as a category that recognizes the characteristics of a particular music file belonging to an established form of music (e.g., rock or country) (Tao, Li, & Bakker, 2017).

Music analysis

Songs were analysed by CE using Internet software: http://www.notediscover.com, www.songbpm.com, and https://blog.key-notes.com. This
software allowed the researcher to enter the song and artist into a search engine that provided the tempo and modality of each song. In some cases, the mode was not provided or there were two or more options of the song’s tempo in which case the song was checked against another search engine or the song’s notes using the song’s score sheets. Professional assistance was also obtained from a music expert to analyse the songs. The expert was a graduate student from the Faculty of Music. He analysed all of the songs by listening to each song and identifying the modality as major or minor, as well as the tempo using a metronome to find the exact beat. Some participants’ answers concerning music selection were not analysable if specific songs were not provided but instead a general playlist, album or artist was reported.

In comparing the software to the expert’s analysis, the answers were largely the same and thus, the analysis was validated. Each song was then recoded as fast or slow depending on whether it was faster or slower than 120 BPM; Karageorghis and colleagues (Karageorghis & Jones, 2014; Karageorghis & Priest, 2012) deemed music with a tempo greater than or equal to 120 BPM to be up-tempo, stimulating, or in this case fast (for exercise), while their categories of slow and medium music were labelled as slow (<120 BPM) for the purposes of this research. Furthermore, Ekkekakis & Dafermos (2012) suggested that high-intensity exercise is 60-85% of a participant’s VO2 reserve; 60% of a 22 year old’s (mean age of this study’s participants) maximum heart rate is roughly 120 BPM. With regards to synchronizing our repetitive movement to the beat of the music and heart rate, 120 BPM would be on the slow end of the spectrum in terms of slow versus fast tempo. Along with the two tempo categories, the songs were also grouped into two modality categories; major or minor. These four categories were grouped into four quadrants: fast/major, slow/major, slow/minor, or fast/minor (Ekkekakis, Parfitt, & Petruzzello, 2011; Husain et al., 2002; Russell, 1980). Each song was then assigned to a single quadrant in the circumplex model.

Data Analyses

SPSS Statistics Version 21 (release 21.0.0.0) was used for statistical analyses. It is important to note that for the analyses of song preferences during physical activity there was a significant amount of missing data for some analyses. When participants were
asked to list their favourite song during physical activity, several students did not list a single song, but rather a playlist, radio station, or artist. Ten such instances occurred when something other than a favourite song was reported for aerobic exercise, 14/113 for resistance training, and 13/113 for leisure activities. Thus, tempo, mode and genre could not be obtained from these participants’ data. Therefore, the sample sizes varied for different analyses. Also of note is the fact that for uses made of music during physical activity participants could check off all uses that applied. As reported below, this meant that multiple analyses were run and the chance of experiment wide type I error likely elevated. However, since the study was somewhat exploratory in nature a significance level of $p \leq 0.05$ was maintained throughout the analyses.

For part I of the questionnaire, which requested information about general music use, simple frequencies of responses were recorded and reported. Two questions asked under what circumstances (e.g., driving, studying) participants listened to music and for what reasons (e.g., change mood). These questions were asked to get a sense of how “plugged-in” to music the participants were.

The remaining analyses were based on Part II (music and physical activity) and III (demographic information) of the questionnaire and were directly connected to the five research questions listed above. Research question one asked about music preferences during physical activity. Since a vast number of individual songs were listed, the song preferences for aerobic, strength-based training, and leisure physical activity were each converted to their music genre and the frequencies for various genres were recorded and reported. Although songs can cross genre categories, each song was categorized into the genre deemed most appropriate. For research question two, the songs were initially coded for tempo (fast or slow) and mode (major or minor) as described above. Each song could then appear in one of the quadrants in the Circumplex model. The frequencies were then analyzed using a separate 2 x 2 (tempo x mode) Chi square analyses for aerobic, resistance training, and leisure physical activity.

Research question three asked the uses made of the music accompaniment during physical activity. Note that for this question aerobic and resistance training were lumped together as uses during “exercise” and were contrasted to uses during leisure physical
activity. Frequencies for each use made were recorded and reported, allowing for a visual inspection of differences.

Research question four asked whether there were sex differences for music preferences and uses made of music accompaniment. The first analysis was simply to record the genre preferences for each of aerobic, resistance training and leisure physical activity separately for males and females, allowing for a visual inspection of differences. In addition, 2 x 2 (sex x fast/slow tempo and sex x major/minor mode) Chi square analyses were computed for aerobic, resistance training and leisure physical activity. Finally, separate 2 x 2 sex (male/female) x use (use/no use) Chi square analyses were run for each of the possible uses a participant could choose for exercise and leisure physical activity.

Research question five asked whether frequency of physical activity was related to uses made of musical accompaniment. For these analyses frequency of participation was grouped into infrequent and frequent participation in exercise or leisure physical activity. Separate 2 x 2 (low/high frequency x use/no use) Chi square analyses were computed for those individuals who reported using music to accompany their exercise or leisure physical activity.

3.3. Results

Music preferences for each type of activity

The summary table in Appendix C is a complete list detailing all of the results from the questionnaire and displays the descriptive frequencies for each question. One hundred percent of participants reported listening to music. Table 1 shows the frequencies for the circumstances under which music listening occurred and general uses made of music listening. Other than during studying, music listening appeared ubiquitous in the lives of the participants. Promoting pleasure and mood were frequently reported uses made of music in everyday life.
Table 1. General use of music in everyday life; Percentages from Questionnaire, Part 1. Questions 3 and 4.

<table>
<thead>
<tr>
<th>Question</th>
<th>Use/Purpose of Music</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Circumstances</strong></td>
<td>Exercise</td>
<td>109</td>
<td>96.5</td>
</tr>
<tr>
<td></td>
<td>Driving</td>
<td>108</td>
<td>95.6</td>
</tr>
<tr>
<td></td>
<td>Social events</td>
<td>103</td>
<td>91.2</td>
</tr>
<tr>
<td></td>
<td>Cleaning</td>
<td>101</td>
<td>89.4</td>
</tr>
<tr>
<td></td>
<td>Studying</td>
<td>67</td>
<td>59.3</td>
</tr>
<tr>
<td><strong>Purpose</strong></td>
<td>For pleasure (sake of listening to music)</td>
<td>109</td>
<td>96.5</td>
</tr>
<tr>
<td></td>
<td>Enhancing my mood</td>
<td>98</td>
<td>86.7</td>
</tr>
<tr>
<td></td>
<td>Prevent boredom</td>
<td>71</td>
<td>62.8</td>
</tr>
<tr>
<td></td>
<td>Pass the time</td>
<td>66</td>
<td>58.4</td>
</tr>
<tr>
<td></td>
<td>Emotional reasons</td>
<td>64</td>
<td>56.6</td>
</tr>
<tr>
<td></td>
<td>Blocking out extraneous noise</td>
<td>60</td>
<td>53.1</td>
</tr>
<tr>
<td></td>
<td>To change my mood</td>
<td>61</td>
<td>54</td>
</tr>
</tbody>
</table>

Presented in Table 2, large individual differences exist for genre preferences across the three types of physical activities. Hip-hop, pop, and dance were very common preferences for aerobic and strength training, whereas genre preference for leisure activity was more diverse. Regarding missing data, for aerobics, one participant reported listening to rock music but did not identify their gender, and another participant failed to report their gender and song. This was also the case for strength training exercise. As for leisure activity songs, two participants did not report their gender or song.
Music preferences for each type of activity using the Circumplex Model

As shown in Tables 3-5, the songs were spread across the four quadrants in the circumplex model and therefore we can conclude that tempo and mode are independent variables. Participants generally preferred fast music for aerobic exercise and slow music for strength training. Participants tended to choose slow music in a major key for leisure physical activity. Eighty one songs were reported for aerobic exercise. Table 3 shows the 2 x 2 Chi square analysis (tempo x mode) performed for the songs provided for aerobic exercise ($\chi^2 = 0.182, p = 0.669$). Within mode, no preferences are discerned. Within tempo, participants prefer to listen to fast music while participating in aerobic style activities.

Table 3. Chi square of song categorizations (tempo and mode) for Aerobic Exercise.

<table>
<thead>
<tr>
<th>Genre</th>
<th>Aerobic Song</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Female</td>
<td>Male</td>
<td>Total</td>
<td>Female</td>
<td>Male</td>
<td>Total</td>
<td>Female</td>
<td>Male</td>
<td>Total</td>
</tr>
<tr>
<td>Hip-hop/Rap</td>
<td>9</td>
<td>15</td>
<td>24</td>
<td>22</td>
<td>24</td>
<td>46</td>
<td>3</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>Pop</td>
<td>19</td>
<td>3</td>
<td>22</td>
<td>12</td>
<td>1</td>
<td>13</td>
<td>9</td>
<td>3</td>
<td>12</td>
</tr>
<tr>
<td>Dance</td>
<td>13</td>
<td>9</td>
<td>22</td>
<td>8</td>
<td>5</td>
<td>13</td>
<td>4</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Alternative</td>
<td>6</td>
<td>2</td>
<td>8</td>
<td>3</td>
<td>2</td>
<td>5</td>
<td>7</td>
<td>7</td>
<td>14</td>
</tr>
<tr>
<td>Rock</td>
<td>2</td>
<td>4</td>
<td>7</td>
<td>2</td>
<td>4</td>
<td>7</td>
<td>3</td>
<td>7</td>
<td>10</td>
</tr>
<tr>
<td>Singer/Songwriter</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>Country</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>R&amp;B/Soul</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Electronic</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Classical</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Inspirational</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Folk</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Podcast</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Soundtrack</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Reggae</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>missing data</td>
<td>10</td>
<td>9</td>
<td>19</td>
<td>14</td>
<td>7</td>
<td>21</td>
<td>25</td>
<td>16</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>63</td>
<td>48</td>
<td>112</td>
<td>63</td>
<td>48</td>
<td>112</td>
<td>63</td>
<td>48</td>
<td>122</td>
</tr>
</tbody>
</table>

Seventy four songs were reported for strength-based exercise. Table 4 shows the 2 x 2 Chi square analysis (tempo x mode) performed for the songs provided for strength
exercise ($\chi^2 = 0.437$, $p = 0.509$). Within mode, no preferences are discerned. Within tempo, participants prefer to listen to slow music while participating in strength-based exercise.

**Table 4. Chi square of song categorizations (tempo and mode) for Strength-based Exercise.**

<table>
<thead>
<tr>
<th></th>
<th>Major</th>
<th>Minor</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fast</td>
<td>12 (16%)</td>
<td>16 (22%)</td>
<td>28 (38%)</td>
</tr>
<tr>
<td>Slow</td>
<td>25 (34%)</td>
<td>21 (28%)</td>
<td>46 (62%)</td>
</tr>
<tr>
<td>Total</td>
<td>38 (51%)</td>
<td>36 (49%)</td>
<td></td>
</tr>
</tbody>
</table>

Fifty six songs were reported for leisure physical activities. Table 5 shows the 2 x 2 Chi square analysis (tempo x mode) performed for strength exercise ($\chi^2 = 0.881$, $p = 0.348$). Within within mode, participants prefer to listen to songs played in major chord, and within tempo, participants prefer to listen to slow music while participating in leisure physical activities.

**Table 5. Chi square of song categorizations (tempo and mode) for Leisure Activity.**

<table>
<thead>
<tr>
<th></th>
<th>Major</th>
<th>Minor</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fast</td>
<td>12 (21%)</td>
<td>8 (14%)</td>
<td>20 (36%)</td>
</tr>
<tr>
<td>Slow</td>
<td>26 (46%)</td>
<td>10 (18%)</td>
<td>36 (64%)</td>
</tr>
<tr>
<td>Total</td>
<td>38 (47%)</td>
<td>18 (32%)</td>
<td></td>
</tr>
</tbody>
</table>

Uses for music during physical activity.

While participating in exercise (aerobic and strength-based combined), 96.5% participants reported listening to music. During leisure physical activities, 73.5% of participants reported listening to music.

**Table 6. Purpose for listening to music during different types of physical activities and sex differences.**

<table>
<thead>
<tr>
<th>Purpose</th>
<th>Exercise</th>
<th>Leisure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Females</td>
<td>Males</td>
</tr>
<tr>
<td>To facilitate the workout</td>
<td>74.6%</td>
<td>62.5%</td>
</tr>
<tr>
<td>To distract me</td>
<td>73.0%</td>
<td>50.0%</td>
</tr>
<tr>
<td>To enhance my mood</td>
<td>63.4%</td>
<td>66.7%</td>
</tr>
<tr>
<td>To motivate me to exercise</td>
<td>76.1%</td>
<td>77.1%</td>
</tr>
<tr>
<td>To keep out external noise</td>
<td>60.3%</td>
<td>50.0%</td>
</tr>
</tbody>
</table>
Sex Differences in music accompaniment and utility

Females prefer pop music whereas males prefer hip-hop and rap for aerobic exercise (Table 2). Both sexes prefer to listen to hip-hop/rap music while participating in strength training types of exercise. Leisure activity song preferences are much more spread out across the genres.

As previously mentioned, people use music for a variety of reasons, whether its ergogenic, mood enhancing or for dissociative purposes. In general, there were no sex differences in listening to music while performing different daily activities. Exercise, both aerobic and strength-based utilizes music differently than leisure, although no sex differences were observed, as suggested in Table 6. Both females and males prefer to exercise to fast music for aerobic activities ($\chi^2 = 0.668$, $p = 0.414$) and slow music for strength-based activities ($\chi^2 = 0.027$, $p = 0.868$). Neither sex showed a preference for mode ($\chi^2 = 0.016$, $p = 0.901$; $\chi^2 = 0.659$, $p = 0.417$) for both aerobic and strength exercise, respectively. The 2 x 2 Chi square analysis for mode and tempo for songs reported for leisure physical activities indicate that both sexes prefer slow music ($\chi^2 = 0.574$, $p = 0.449$) played in a major chord ($\chi^2 = 0.573$, $p = 0.449$).

There was an exception with sex differences, which was a greater percentage of females than males who reported listening to music while driving ($\chi^2 = 7.084$, $p = 0.029$). Social events and exercise are two other circumstances in which music is used more by females than males and trend towards being correlated ($\chi^2 = 4.900$, $p = 0.086$; $\chi^2 = 5.165$, $p = 0.060$, respectively). The data also provides evidence which supports a lot of people who use music during exercise to act as a (physiological) distraction; there is a tendency for a greater proportion of females to use music to distract them during exercise more than males ($\chi^2 = 3.643$, $p = 0.056$). The other categories did not show any sex differences, thus the variables are independent: participants used music to facilitate their workout ($\chi^2 = 0.408$, $p = 0.523$), enhance their mood ($\chi^2 = 0.715$, $p = 0.398$), for motivation ($\chi^2 = 0.914$, $p = 0.339$), and to block out extraneous noise ($\chi^2 = 0.914$, $p = 0.442$). There were not any statistically significant differences between sex and uses of music for leisure physical activities.
Music accompaniment and frequency of physical activity participation

According to the 2 x 2 Chi square (hi/lo frequency of activity) analyses, there were no associations between reported frequency of exercise and specific uses made of music during exercise. In contrast, reported frequency of leisure activity was associated with use made of music during leisure activities. Specifically, people who reported more frequent participation in physical activities reported using music to enhance their mood more often than people who reported less frequent participation in leisure activities ($\chi^2 = 5.527, p = 0.019$). A similar finding occurred for the use of music to block out noise while participating in leisure activities ($\chi^2 = 8.201, p = 0.004$). Participants who are more physically active use music more often for the purposes of blocking out noise.

Table 7. Comparing exercise and leisure with fitness of participants and their Chi-square results.

<table>
<thead>
<tr>
<th>Question</th>
<th>Result</th>
<th>Chi Square</th>
<th>Asymp Sig. 2-sided</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is frequency of exercise associated with use made of the music when exercising?</td>
<td>2.3A – facilitate</td>
<td>1.940</td>
<td>0.164</td>
</tr>
<tr>
<td></td>
<td>2.3B – distract</td>
<td>0.044</td>
<td>0.833</td>
</tr>
<tr>
<td></td>
<td>2.3C – enhance mood</td>
<td>0.145</td>
<td>0.704</td>
</tr>
<tr>
<td></td>
<td>2.3D – motivate</td>
<td>0.072</td>
<td>0.789</td>
</tr>
<tr>
<td></td>
<td>2.3E – keep out noise</td>
<td>1.198</td>
<td>0.274</td>
</tr>
<tr>
<td>Is frequency of leisure activities associated with the use made of music when participating in leisure activity?</td>
<td>2.6A – facilitate</td>
<td>1.999</td>
<td>0.157</td>
</tr>
<tr>
<td></td>
<td>2.6B – distract</td>
<td>3.136</td>
<td>0.077</td>
</tr>
<tr>
<td></td>
<td>2.6C – enhance mood</td>
<td>5.527</td>
<td>0.019*</td>
</tr>
<tr>
<td></td>
<td>2.6D – motivate</td>
<td>0.103</td>
<td>0.748</td>
</tr>
<tr>
<td></td>
<td>2.6E – keep out noise</td>
<td>8.201</td>
<td>0.004*</td>
</tr>
<tr>
<td>Are there differences between listening behaviours for purposes of listening to music for more/less active participants in leisure and exercise?</td>
<td>2.3D – motivate</td>
<td>11.176</td>
<td>0.004*</td>
</tr>
<tr>
<td>Are there differences between listening behaviours for participants who are more/less active in leisure and exercise for purposes of listening to music during leisure activities?</td>
<td>2.6A – facilitate (2-3x)</td>
<td>4.818</td>
<td>0.090</td>
</tr>
<tr>
<td></td>
<td>2.6B – distract (2-3x)</td>
<td>4.961</td>
<td>0.084</td>
</tr>
<tr>
<td></td>
<td>2.6B – distract (5+)</td>
<td>11.163</td>
<td>0.025*</td>
</tr>
<tr>
<td></td>
<td>2.6D – motivate</td>
<td>7.921</td>
<td>0.048*</td>
</tr>
<tr>
<td></td>
<td>2.6E – block noise (0-1x)</td>
<td>5.622</td>
<td>0.060</td>
</tr>
<tr>
<td></td>
<td>2.6E – block noise (3-4x)</td>
<td>10.968</td>
<td>0.027*</td>
</tr>
</tbody>
</table>
3.4. Discussion

In general, music is commonly used to affect a listener’s arousal and mood, to increase self-awareness, and to offer expressions of social relatedness (Husain et al., 2002; Schäfer, Sedlmeier, Städtler, & Huron, 2013). As demonstrated in this study, participants (100%) listen to music and use it for a variety of reasons and in a number of situations, for example: cleaning, studying, driving, for social events, and more importantly for this study, for exercise. Music appears also to transcend ages and cultures (Schäfer et al., 2013) and specifically resonates with the university-aged participants in this study as they seem to rarely not be ‘plugged in’. For instance, this study’s participants employ music for a variety of reasons, namely to affect their mood or simply for the sake of listening to music; 96.5% of participants listen to music for pleasure. Pleasure is seldom derived from physical activity and other healthy lifestyle behaviours (Jallinoja, Pajari, & Absetz, 2010). Thus pleasure is often promoted by accompanying exercise with music and this is consistent with the fact that 96.5% of the study participants reported listening to music during exercise. Listening to music during physical activity has been positively correlated with physical activity adherence and performance, reducing RPE, and encouraging a more positive affective response (Clark et al., 2015; Jia, Ogawa, Miura, Ito, & Kohzuki, 2016; Karageorghis, 2017; Karageorghis & Priest, 2012; Karageorghis & Terry, 1997; Karageorghis, Terry, Lane, Bishop, & Priest, 2012b; Murrock & Higgins, 2009).

Specifically, the purpose of this study was to determine whether music selection was associated with the type of physical activity (aerobic exercise, strength training, and leisure activity). In addition, we were interested in highlighting individual differences in the examples of songs chosen.

Beyond the current literature, however, we have discerned a need to examine individual differences, namely participants’ preferences for different types of music (tempo, mode, genre) for different types of physical activities. As Kinesiology students, our participants were a very homogenous demographic and yet their preferences for songs were varied, particularly as preferences related to genre (Table 2). Underlying the genre choices, the Circumplex model analysis showed commonalities across songs. As suggested above, song preferences are normally controlled for during typical exercise and music research. For example, researchers typically employ the BMRI to standardize the
music listened to across participants and exercise conditions (Bigliassi et al., 2013; Karageorghis & Priest, 2012; Karageorghis, Priest, et al., 2006). Specifically, participants have not been provided the opportunity to choose their music during exercise protocols (Karageorghis & Priest, 2012; Tenenbaum & Eklund, 2007). Self-determination theory suggests that when an exercise participant is deprived the right to choose which activity protocol to perform and instead is prescribed exercise, their lack of autonomy could limit intrinsic motivation for future exercise participation (Ekkekakis & Lind, 2006; Lind, Ekkekakis, & Vazou, 2008). The methodology chosen for Karageorghis’ multiple research studies was done so intentionally to control for extraneous variance in the methodology. Likely, the music effect seen in these experiments underestimates the power of music as a utility to the listener, such as a distractor or mood enhancer. Thus, using the BMRI to create a list of generally motivating songs for a specific demographic like Karageorghis and colleagues suggest to researchers and practitioners (Karageorghis, Priest, et al., 2006; Karageorghis et al., 1999, 2012a; Priest & Karageorghis, 2008) may not be as effective as suggested.

The data on genre of music demonstrated large individual differences among participants and type of physical activity: 88.5% of participants provided a song for aerobic exercise; 85.8% of participants reported a song for strength training; and, 67.3% of participants reported a song for leisure activities. Specifically, 15 different genres were identified through the analysis of the songs provided. Of these genres, participants preferred hip-hop/rap music during aerobic and strength-based exercise (24/93 songs, 46/91 songs, respectively). Leisure activities were more diverse in terms of music listening preferences since songs from several types of genres were reported. We can conclude from this assortment of songs that people enjoy listening to different genres of music with commonalities across tempo and mode.

When the song preferences were analyzed for tempo and mode, there was general consistency within each type of physical activity, but differences across types of physical activities. For aerobic exercise, more people reported to prefer the use of faster music with little distinction for choice of chord. For strength training, participants preferred listening to slower music with again no preference for chord. In the literature, it has been suggested that participants in the weight room would likely be more affected by a song
played at a moderate-to-fast pace for arousal purposes and the song likely will be played in a minor key (Clark et al., 2015; Husain et al., 2002; Karageorghis & Priest, 2008, 2012; Karageorghis & Terry, 1997). However, our participants generally preferred listening to slower music while strength training, which would suggest that they do not need much physiological activation to derive pleasure from this type of exercise. Since arousal is largely mediated by rhythm, this preference for slow songs indicates that the participants may be synchronizing their strength-based exercises to the beat of the music, at a pace less than 120 BPM (Clark et al., 2015). Many participants in this study tended to prefer to listen to slow, major chord songs during leisure activities (26/56 songs), which suggests that they enjoy listening to more relaxed and lyrical songs when they are engaged in leisure physical activity. This result provides further support to the literature as people can feel relaxed and at ease while listening to this type of music (Clark et al., 2015).

Motivational effects of music have been studied even so far as to touch upon music preferences and accepting that individual differences would need to be considered in a practical, non-experimental setting (Cole & Maeda, 2015; Nakamura, Pereira, Papini, Nakamura, & Kokubun, 2010). However, sex differences between genders and how music preference may affect them is lacking. Some researchers suggest that preferred music has a greater effect on women than men, specifically with regards to motivation and perceived exertion (Cole & Maeda, 2015; Dobrota & Ercegovac, 2015; Karageorghis, Jones, & Low, 2006). In the present study, we also found few sex differences regarding music listening preferences in different physical activities. Similarly, we discovered that females (46/63) use music to distract them from physiological cues during exercise. During aerobic exercise, there were no sex differences; both males and females prefer fast/minor songs. During strength training exercise, females prefer major songs whereas males prefer minor songs. Both sexes identified slow/major songs on the circumplex model as their preferred music to listen to during leisure physical activities.
3.5. Application

The term “motivating music” (Priest & Karageorghis, 2008) must be used more sparingly and appropriately in research regarding the promotion of using music to enhance the affective experience during physical activity to be effective at improving adherence rates. Current research often misconstrues motivating music to describe a greater work output (Bigliassi et al., 2013; Cline, 2017; Hallett & Lamont, 2014; Karageorghis, Priest, et al., 2006; Karageorghis et al., 1999) whereas our description is of the kinds of music people use when they are being active, regardless of intensity, output or duration. Primarily, we are concerned with encouraging people to use music to help them enjoy an activity, thereby aiding in their decision to repeat the experience. Subsequently, we propose these terms be used hereafter: mood inducing or exercise accompaniment. Notice that these terms represent what it is music can affect, such as: valence, arousal, ergogenic properties, with respect to our understanding that some individuals do not necessarily use music for motivation (although, 74.3% of this study’s participants used music to motivate them during exercise).

Previous research by Karageorghis and Priest (2012b) highlights the common practice by researchers to judiciously select music on behalf of the exercise participants rather than conforming to the preferences of the study’s participants. Researchers are beginning to accept and understand that one cannot simply attribute an all-for-one model and prescribe a music playlist to a group of participants for every activity. Rather, the benefits of effectively using music deemed appropriate for each individual or group is based on the “interaction between elements of the musical stimulus itself and factors relating to the traits and experiences of the listener, and aspects of the exercise environment and task” (Karageorghis & Priest, 2012). Particularly for physical activity leaders/fitness instructors, our advice with regards to utilizing music to positively affect the participants’ experience is the following:

- We must accept that each group/class will have vast individual music preferences and thus we must either accommodate the masses with general tempo-driven music or rotate participant suggestions and requests.
• When teaching an aerobic style class (e.g., step class, a running group, cardiovascular boot camp), university-aged students prefer songs that are fast; play music at a tempo of at least 120 BPM.
• When teaching a strength-based exercise program (e.g., resistance training, weight lifting, circuit training), this study’s demographic preferred slower songs. Thus, our recommendation is to play songs that are slower than 120 BPM.
• When leading a leisure activity (e.g., nature walk), we recommend playing slower music (≤ 120 BPM) and one that is in the minor chord.
• Sex differences were minimal; therefore, physical activity leaders need not concern themselves too much with musical preferences (tempo and mode) differing between females and males.
• That being said, females prefer listening to pop music whereas males prefer hip-hop and rap while partaking in aerobic types of exercise. For example, in a spin class, if the class is female-only, have pop music playing in a fast tempo.
• Both sexes prefer to listen to hip-hop/rap music while participating in strength training types of exercise.
• Leisure activity song preferences are much more spread out across the genres, regardless of sex. Therefore, we suggest playing music slower than 120 BPM that is considered age- and culture-appropriate (ask the group for suggestions to create a better understanding of their preferences).

3.6. Limitations

Participants did not altogether provide a specific song; consequently, we lost a substantial amount of data for the circumplex model. This premise lead to an incomplete data set postulating our participants music preferences. In hindsight, we should have insisted explicitly that a specific song be reported. However, this error does provide insight into the reality of our participants music-listening behaviour; the use of music and that some participants use playlists or genres rather than specific favourite songs is a result in and of itself.

Future research should also work with other demographics. For example: children in physical education classes; recreational teams, such as a swimming teams or hockey
teams; church groups, such as craft groups, card-game groups, or youth-groups; as well, future work should repeat the BMRI protocol with university-aged students to determine an up-to-date playlist, since we know that preference for songs changes with time, trends, culture, and relevance.

3.7. Conclusion
As many researchers have suggested, listening to music during activities such as exercise may not only prolong the participant’s duration but also improve the affective state achieved during and after the activity (Baldari et al., 2010; Bigliassi et al., 2013; Jones et al., 2014; Karageorghis & Priest, 2012; Schäfer et al., 2013). This positive association with the activity may result in the behaviour becoming a repeated effort and eventually a habit. The promotion of pleasure during exercise is of importance at this point in time, taking into consideration societal problems and epidemics such as sedentary lifestyles, physical inactivity, cardiovascular disease and obesity. When people enjoy doing something, they are more likely to do it again; together, we should promote a hedonic lifestyle rather than prescribe exercise. Just enjoy it. Therefore, the effect of allowing and encouraging participants to self-select their music is of upmost importance and should be explored in future research.
References


Ekkekakis, P., & Dafermos, M. (2012). Exercise is a many-splendored thing, but for some it does not feel so splendid: Staging a resurgence of hedonisitic ideas in the


Rentfrow, P. J., & Gosling, S. D. (2003). The Do Re Mi’s of Everyday Life: The


4. Study 3: Using music and choice of music to affect the pleasure experienced during a single bout of physical activity continued to volitional cessation

The need for physical activity to promote one’s health is well documented (Blair, 2009; Ekkekakis, Parfitt, & Petruzzello, 2011). Most health behaviour models such as the Theory of Planned Behaviour (Ajzen, 1991), Transtheoretical model (Prochaska & DiClemente, 1982) and the Health Action Process Approach (Schwarzer & Luszczynska, 2008) ignore positive affect when designing and evaluating behaviour change interventions. Enjoyment of a health behaviour is excluded in this approach, possibly because such models that relate to health behaviours would not normally be associated with enjoyment (Hallett & Lamont, 2014). Education about the benefits of regular physical activity has not been an effective strategy and researchers have begun to advocate for the promotion of pleasure during physical activity as a more useful health promotion strategy (Ekkekakis & Dafermos, 2012; Ekkekakis, Hall, & Petruzzello, 2008; Lind, Ekkekakis, & Vazou, 2008; Nickrent, 2012; Williams, 2008; Zhang, Berger, Darby, & Tobar, 2013). For instance, listening to music has been advocated as an effective means for improving pleasure during exercise (Karageorghis & Priest, 2012a). The ways to most effectively add music to a bout of exercise are still unclear. Therefore, the purpose of the present study was to understand the role that music and participant choice of music might play in improving the enjoyment aspect of a bout of exercise.

4.1. Literature Review

The dual-mode theory predicts that most study participants associate increases in pleasure with exercise intensities that do not exceed their ventilatory threshold (Ekkekakis & Dafermos, 2012). Moreover, the theory postulates that affective responses to exercise are determined by the constant interplay between two factors: “top-down” cognitive factors (e.g., physical self-efficacy, body image, listening to music) and “bottom-up” interoceptive cues (e.g., signals from various internal receptors) (Ekkekakis & Dafermos, 2012; Ekkekakis et al., 2011). Intensity of exercise moderates the relationship between attentional processes and psychophysical effects (Karageorghis & Terry, 1997).
Exercise intensity has been suggested to influence both affective responses to exercise (ventilatory) and cognitive awareness (perceived autonomy) (Williams, 2008). Importantly, affective responses to exercise influence a participant’s intentions to exercise again based on anticipated affect. The dual-mode theory (Ekkekakis & Dafermos, 2012; Ekkekakis et al., 2011) suggests that high intensity exercise causes an attentional shift from external stimuli such as music, to physiological sensations such as fatigue. As a psychological ergogenic aid, music affects exercise performance before, during, and immediately post-task, in addition to the following effects: reduced rate of perceived exertion (RPE), dissociation from physiological cues, motivation to prolong exercise duration, altered mood state, social interaction, and increased intensity during exercise (Bigliassi, Estanislau, Carneiro, Kanthack, & Altimari, 2013; Hallett & Lamont, 2014; Karageorghis, Terry, & Lane, 1999). Similarly, music produces physiological effects in terms of improved motor control and increased aerobic endurance (Karageorghis & Priest, 2012a; Murrock & Higgins, 2009). For example, exercise study participants have indicated that the use of music, regardless of tempo, elicits a broad response that has been generalized as an “enhanced exercise experience” (Karageorghis & Jones, 2014, sec. Table 3). During exercise of a low-to-moderate intensity, listening to music has been associated with a 10% reduction in RPE (Karageorghis & Priest, 2012a), which is affected the most when the music is participant-preferred (Dyrlund & Wininger, 2008; Karageorghis & Priest, 2012a). Beyond music preference, self-determination theory suggests that when an exercise participant is deprived the right to choose which activity protocol to perform and instead is prescribed exercise, their lack of autonomy could limit intrinsic motivation for future exercise participation (Ekkekakis & Lind, 2006; Lind et al., 2008). In short, themes have emerged from music-exercise experiments revealing benefits that can be categorized into three main outcomes: positive mood state, increased arousal, and dissociation (Karageorghis et al., 1999).

In addition to music having acute effects, music also can potentially have longer term effects as well. Psychological hedonism (Ekkekakis & Dafermos, 2012) predicts that when a person enjoys participating in an activity (which music can potentially provide) they will become intrinsically motivated to continue participating in that activity, thereby improving exercise adherence. In contrast, displeasure, discomfort, and
pain are frequently noted by participants as perceived barriers to exercise participation (Ekkekakis & Dafermos, 2012). When intrinsically motivated, participants choose to participate in an activity for its own sake, reinforcing habitual behaviour (Ekkekakis & Dafermos, 2012; Ryan & Deci, 2000; Ryan, Vallerand, & Deci, 1984). Chang, Liu, and Chen (2014) studied continuance intention (CI) of online multiplayer computer games designed to enhance pleasure when playing a game. An integrated model was created using both social cognitive theory as well as flow theory (Chang et al., 2014). Specifically, flow theory was utilized to capture the affective experience of each gamer in order to predict their likelihood of playing that game again based on future expectations. Borrowing this concept in the present research, exercise participants’ continuation intention would be predicted to be greater when their enjoyment was higher while participating.

Much of the past music research has used experimenter-provided music for the exercise participants (Karageorghis, 2017; Karageorghis & Priest, 2012a; Karageorghis, Priest, Terry, Chatzisarantis, & Lane, 2006; Karageorghis et al., 1999; Priest & Karageorghis, 2008). Participant choice of music has seldom been studied. Self-determination theory predicts that giving participants choice over their behaviour leads to enhanced perceptions of competence and autonomy (self-determination), thereby increasing persistence at that behaviour (Ryan & Deci, 2000; Williams, 2008). For example, when participants are provided with the ability to choose their own mode of exercise, their affective response is more positive than when the mode is prescribed (Williams, 2008). In parallel with this, the American College of Sports Medicine (ACSM, 2000) suggests that “individualized preference for exercise must be considered to improve the likelihood that the individual will adhere to the exercise program” (Lox, Martin Ginis, & Petruzzello, 2014, p. 188).

Based on what has been published, the research has primarily been focused on studying the effects of music on exercise performance without incorporating individualized music choice (Alter et al., 2015; Baldari, Macone, Bonavolonta, & Guidetti, 2010; Bigliassi et al., 2013; Clark, Baker, & Taylor, 2015; Elliott, Carr, & Orme, 2005; Hallett & Lamont, 2014; Jia, Ogawa, Miura, Ito, & Kohzuki, 2016; Karageorghis & Priest, 2008, 2012a; Seath & Thow, 1995; Taylor et al., 2007). The
Brunel Music Rating Inventory (BMRI; Karageorghis et al., 1999) was created to evaluate the motivational quality of music for its use as an ergogenic tool (Jones, Karageorghis, & Ekkekakis, 2014; Karageorghis et al., 2006, 1999). The BMRI has been used as a tool to study the many physiological, psychological, cognitive and emotional effects music may have had on exercise participants (Jones et al., 2014; Karageorghis & Jones, 2014; Karageorghis et al., 2006, 1999). Choice has been deliberately eliminated from these studies in an attempt to add experimental control. However, as Study 2 showed, individual study participants had individualized preferences for style and genre, aesthetics and overall choice of music (Ellis & Salmoni, 2018, under review; Schäfer, Sedlmeier, Städtler, & Huron, 2013). The relationship between type of music and type of activity being performed is unique and individualized. Thus one of the conditions in the present study is allowing the participants to select their own music during their physical activity session to determine whether choice may add to the effect of music itself on exercise performance (Karageorghis & Priest, 2012a; Karageorghis & Terry, 1997).

4.2. Research Questions and Design

Two primary research questions were investigated in the present study. First, does the addition of music (compared to exercise without the accompaniment of music) improve the response to a bout of exercise? Second, will allowing participants to choose their own motivational music further enhance the response to a bout of exercise? To study these questions, participants exercised until volitional cessation under four separate conditions: no music, experimenter-provided motivational music (as determined using the BMRI tool), participant chosen, but within the experimenter-provided (BMRI) playlist of motivational music, and participant-freely-chosen (“personalized”) music. Order of conditions was randomized across participants and bouts were separated by approximately one week. The feeling scale (FS), felt arousal scale (FAS), rate of perceived exertion (RPE), and heart rate (HR) were used for assessment during each bout of physical activity. The Physical Activity Enjoyment Scale (PACES) and Continuation Intention (CI) questionnaires were completed by participants after each bout.
4.3. Methods

4.4. Participants

The G*Power software v.3.1.9.2 was used to a priori determine the required sample size given $\alpha$, power, and effect size. Given the number of groups (time points/conditions) ($n = 4$), a total sample size of $n = 24$ would be needed to achieve a power of 0.80 in a test based on $\alpha = 0.05$, for differences in outcome variables across conditions/time (i.e., repeated measures) with minimum effect sizes of $f = 0.25$ (medium; i.e., $\eta_p^2 = 0.06$) to be detected. The current sample was one of convenience; participants were recruited from Kinesiology undergraduate classes at Western University. A PowerPoint presentation was created and delivered by the Primary Researcher (CE), informing participants of the purpose of the study, requirements for participation or physical ailment/disorder that would prevent them from completing the exercise tasks (e.g., asthma). Research approval was granted from the Research Ethics Board at Western University. Consent was obtained through the school’s online portal and included: the Letter of Information, e-Consent Form, as well as a PAR-Q (Physical Activity Readiness Questionnaire; CSEP, 2002). All three of these forms had to be completed appropriately in order to satisfy the inclusion criteria before the recruited student was accepted as a participant in this study. The PAR-Q was designed by the Canadian Society of Exercise Physiology (Canadian Society for Exercise Physiology, 2002) to screen physical activity readiness and appropriately direct individuals to their physicians prior to engaging in exercise. Following successful completion of all forms, the eligible participants (13 females, 7 males) were contacted and scheduled to meet at the Exercise Health Psychology Lab in the Health Sciences Building during three different recruitment periods. The participant’s pretest was performed at this initial visit and the demographic and anthropometric measures (height and weight for BMI) were collected: participant’s partake in an average of 4.6 bouts of physical activity weekly (range= 2-10 bouts/week). Each participant was scheduled for the four exercise bouts (to occur at the same day/time each week, for the following four weeks).
4.5. Instruments

The scales and questionnaires used during and immediately-following each exercise bout were: Feeling Scale (FS; (Hardy & Rejeski, 1989), Felt Arousal Scale (FAS; (Svebak & Murgatroyd, 1985), Borg’s 6-20 RPE Scale (Borg, 1998), Physical Activity Enjoyment Scale (PACES; Kendzierski & DeCarlo, 1991), and Continuance Intention (CI) Questionnaire (Chang et al., 2014).

4.5.1. Feeling Scale. The feeling scale (Hardy & Rejeski, 1989) is an 11-point Likert scale, which has exercise participants identify what their present mood is from -5 “very bad” to +5 “very good”, with zero being neutral.

4.5.2. Felt Arousal Scale. The felt arousal scale (Svebak & Murgatroyd, 1985) is a 6-point Likert scale that has exercise participants identify their current state of arousal, from 1 “low arousal” to 6 “high arousal”.

4.5.3. Ratings of Perceived Exertion. Using Borg’s (1998) RPE scale participants are asked, “On a scale from 6 to 20 where 6 means no exertion and 20 indicates maximum exertion, how hard are you working?”. The RPE is meant to provide overall feelings of sensations and feelings of physical stress and thus, an overall exertion state experienced by the participant (Borg, 1998).

4.5.4. Heart Rate. Heart rate was used as an objective measure of exercise intensity. A Polar heart rate monitor (Polar H10 Heart Rate Monitor) was attached to each participant during each bout of exercise. The primary researcher (CE) wore the corresponding Polar Watch to monitor and record the exerciser’s HR. The age-predicted maximal heart rate was estimated based on the following formula: maxHR = 220 – age (in years).

4.5.5. Physical Activity Enjoyment Scale. The Physical Activity Enjoyment Scale (PACES) is a tool used to measure enjoyment of physical activity (Kendzierski & DeCarlo, 1991). Specifically, PACES differentiates between pleasant and unpleasant exercise conditions and between modes of physical activity selected by the participant.
versus the investigator (Motl et al., 2001). Furthermore, PACES examines perceived physical attributes and is predictive of physical activity behaviour (Kendzierski & DeCarlo, 1991; Papandonatos et al., 2012). PACES has been validated as a measure among various populations for interventions to increase physical activity with high internal consistency (Motl et al., 2001; Murrock, Bekhet, & Zauszniewski, 2016; Papandonatos et al., 2012). In the present study, post exercise enjoyment was measured using PACES. It is comprised of 18 items rated on a seven-point bipolar scale such as “I enjoy it”, “I feel bored”, or “I hate it” (Kendzierski & DeCarlo, 1991). We adapted Motl and colleagues (2001) version of PACES to consist of 14 items. This version is easy to interpret and uses a five point Likert (Kendzierski & DeCarlo, 1991), instead of the original seven point scale. Reverse scoring for questions 2, 3, 5, 7, 12, 13, was implemented with overall scores ranging from 14-70, with 70 being more enjoyable. PACES can both measure exercise enjoyment trait (general enjoyment from exercise) and the exercise enjoyment state (exercise enjoyment at the moment) using different instructions (Kendzierski & DeCarlo, 1991; Zhang et al., 2013). For example, the instruction for the state measure (as used in the present research) of exercise enjoyment is, “Please rate how you feel at the moment about the physical activity you have been doing”. Participants were asked to complete the questionnaire immediately following the cessation of each exercise bout.

4.5.6. **Continuance Intention Questionnaire**: The continuance intention (CI) questionnaire is a tool that has integrated cognitive, affective and social influences and looks at how these effects relate to a participant’s continuance intention, with flow as a moderator (Chang et al., 2014). The modified questionnaire is made up of 27 statements, with 8 categories: utilitarian outcome expectations, hedonic outcome expectations, subjective norm, critical mass, peer influence, external influence, flow, and continuance intention. Participants can answer that they either “agree” or “disagree” with each statement and can score a potential 27 points.
4.6. Procedure

Before the actual participant testing began, it was necessary to determine what music constituted “motivational” (Karageorghis et al., 2006) music and the Brunel Music Rating Scale (BMRI-3) was employed to do this (Appendix D). The original tool was a 13-item scale specifically designed to measure the motivational qualities of music for use within the exercise environment (Karageorghis et al., 1999; Taylor et al., 2007). The BMRI-3 has been refined into a 6-item scale, with each item being rated as 1 “strongly disagree” to 7 “strongly agree” (Karageorghis & Priest, 2008). Once the items have all been added, the score indicates if the track is high, moderate or lacks motivational qualities. The BMRI-3 was used to assess and create a motivational playlist from the most popular songs derived from a separate homogeneous sample (undergraduate kinesiology students); the top 15 motivational songs made up the playlist (Table 1) for the present study.

<table>
<thead>
<tr>
<th>#</th>
<th>Song (Title, Artist)</th>
<th>BMRI-3 Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Stronger, Kanye West</td>
<td>35.2</td>
</tr>
<tr>
<td>2</td>
<td>Bad, David Guetta</td>
<td>34.7</td>
</tr>
<tr>
<td>3</td>
<td>Sorry, Justin Bieber</td>
<td>34.4</td>
</tr>
<tr>
<td>4</td>
<td>Baillando Remix, Kygo</td>
<td>33.6</td>
</tr>
<tr>
<td>5</td>
<td>Lose Yourself, Eminem</td>
<td>32.5</td>
</tr>
<tr>
<td>6</td>
<td>Til I Collapse, Eminem</td>
<td>32.4</td>
</tr>
<tr>
<td>7</td>
<td>Shake it off, Taylor Swift</td>
<td>31.4</td>
</tr>
<tr>
<td>8</td>
<td>How deep is your love, Calvin Harris</td>
<td>31.3</td>
</tr>
<tr>
<td>9</td>
<td>Under control, Calvin Harris</td>
<td>31.0</td>
</tr>
<tr>
<td>10</td>
<td>Panda, Desiigner</td>
<td>29.0</td>
</tr>
<tr>
<td>11</td>
<td>Work, Rihanna</td>
<td>28.9</td>
</tr>
<tr>
<td>12</td>
<td>What do you mean, Justin Bieber</td>
<td>28.8</td>
</tr>
<tr>
<td>13</td>
<td>Roses, Chainsmokers</td>
<td>27.9</td>
</tr>
<tr>
<td>14</td>
<td>Workout, J.Cole</td>
<td>27.7</td>
</tr>
<tr>
<td>15</td>
<td>0-100, Drake</td>
<td>26.8</td>
</tr>
</tbody>
</table>

Table 8: The top 15 motivating songs, as per BMRI.

Each participant came to the lab on five separate testing days (4 conditions plus the initial pretest trial), completing one condition at each visit. Each participant was tested individually in order to control for the effect of social interaction. These testing
days were roughly the same time and day of the week for each condition. During the first
day (pretest), demographic information was gathered: sex, age, height, weight, resting
heart rate, and frequency of aerobic exercise (30-minute bouts) participation per week.
Once this information was collected, the format of the trials was described along with
explanations of each of the tools being used: FS, FAS, RPE, HR, PACES, and CI. After
the participants confirmed that they understood what was expected of them and how to
properly answer each of the questions, a heart rate monitor was fitted around their torso
to rest against their sternum and the practice test began. The participants completed their
practice bout of physical activity as follows: they walked for their 1 minute warm-up at
1.5 mph, then started the bout at 2 mph for three minutes, increasing by 1mph every 3
minutes, taking their walk to a run and, for some, a sprint. Each participant was exposed
to and instructed on how to appropriately respond to the FS, FAS, and RPE and were
asked to provide each of the scores during the last 15 seconds of a few intervals to
familiarize them with the scales in preparation for the four exercise bouts. FS, FAS, HR
and RPE were also tested immediately following volitional cessation, (choosing to end
the bout of physical activity) along with the PACES and CI questionnaires, which
participants answered after they cooled down and stepped off the treadmill. On Days 2-5,
participants performed under one of the four experimental conditions. The order of
conditions was randomized across participants. Participants were exposed to four
conditions: no music, experimenter-provided music (BMRI), choice from experimenter-
provided music (BMRI), and personalized music playlist. In the “personalized”
condition, participants were instructed to choose their own music and create a playlist on
their music listening device (phone, iPod, MP3 player) with more than enough songs to
play beyond the duration of their pretest. In the “BMRI” condition, an iPod with the
experimenter-provided music selection was provided to the participants. These 15 songs
were randomized for each participant by putting the playlist on shuffle. In the “BMRI
choice” condition, the participants were instructed to choose and organize the songs they
would like to listen to from the list of 15 BMRI songs, which created their music playlist
for that bout of exercise. In the “no music” condition, no music was available to listen to
during the exercise test and conversation was limited to data collection and safety
inquiries.
During each experimental condition, the participants followed the protocol by starting the exercise with a short warm-up walk at 1.5mph (until they felt ready to begin, which usually took about one minute), then commenced the trial with Stage 1 at 2mph (~3.2km/h) for three minutes, maintaining the treadmill at 0% grade. The protocol was consistent with typical aerobic endurance tests (The Bruce Protocol) looking to determine a participant’s exercise tolerance (Bruce, 1963). Specifically, the protocol was based off of similar experiments (e.g., Jones et al., 2014), but maintained a grade of 0% working from low to high intensity, increasing the speed by 1 mile every 3 minutes, which allowed participants to continue to volitional cessation. This protocol was ideal to allow the feeling scores to unfold naturally until exhaustion. During each bout of exercise, the intensity was increased by 1 mph at regular 3-minute intervals. Participants were instructed to continue exercising to volitional cessation, explained as, “until you get to the point that it will not be possible to complete another 3-minute session.” During the last 15 seconds of each 3-minute interval, participants were shown the scales for FS, FAS, and RPE and asked to provide their score. HR was available continuously and recorded in the last 15 seconds of each 3-minute interval. Immediately following the bout of exercise for each condition, FS, FAS, RPE and HR were obtained. Once the participant spent time cooling-down, they were given the PACES and CI questionnaires to fill out and their HR monitor was retrieved.

4.7. Data Analyses

During each experimental testing session (bout of physical activity) responses to the exercise experience were determined by collecting data on HR, RPE, FS, FAS, PACES, and CI. Statistical significance was set at \( p \leq 0.05 \) and IBM SPSS version 25 was used to complete all analyses. Before computing each analysis of variance, Mauchly’s test was computed to ensure the assumption of sphericity was not violated. The Greenhouse-Geisser correction was used when the assumption was violated.

Since different participants completed different numbers of stages before volitional cessation within any exercise bout, it was necessary to “normalize” the stages analyzed. Stage 1 was the data collected initially with the treadmill speed set at 2 mph. Stage 2 was the middle stage (middle if an odd number of stages were completed or the
averaged data from the middle two stages if an even number of stages were completed). Finally Stage 3 was the data from the last stage completed for each participant. Using this data a 3 x 4, Stages by Conditions, analysis of variance (ANOVA) with repeated measures for both factors was completed separately for each of the FS, FAS, and RPE dependent measures. If significant, main effects were further analyzed using Bonferroni statistics. For significant interactions, one way ANOVAs and follow-up pairwise comparisons were computed. For the PACES and CI dependent variables, simple oneway repeated measures ANOVAs were computed across the four music conditions. Tukey HSD statistics were used to determine differences among the four music conditions.

Finally, since the above analyses resulted in the elimination of some participant data, a further descriptive regression analysis was computed. To do this, each endpoint HR for each 3-minute interval was converted to a percent of maximum HR (220 – age). Following this conversion and combining the data from all 20 participants, a simple linear regression analysis was run where FS was predicted by % maxHR separately for each music condition. Separate scatterplots with a line of best fit were also produced for each music condition (Figures 2-5).

4.8. Results

The experimental protocol assumed that both HR and RPE would increase (i.e., exercise intensity would increase) as participants moved through each 3-minute stage of exercise within any music condition. As illustrated in Table 2, this assumption was met, as HR and RPE increased from the beginning of exercise (Stage 1) to the end of the exercise bout (Stage 3) under all four music conditions.

<table>
<thead>
<tr>
<th>Stage</th>
<th>Mean HR</th>
<th>Std. Deviation</th>
<th>Mean HR</th>
<th>Std. Deviation</th>
<th>Mean HR</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>98.5500</td>
<td>12.15027</td>
<td>100.2500</td>
<td>11.82715</td>
<td>98.6000</td>
<td>13.51179</td>
</tr>
<tr>
<td>2</td>
<td>149.1500</td>
<td>13.40179</td>
<td>151.1000</td>
<td>14.13618</td>
<td>147.9250</td>
<td>14.22310</td>
</tr>
<tr>
<td>3</td>
<td>188.5000</td>
<td>10.90389</td>
<td>192.6500</td>
<td>10.69813</td>
<td>187.8500</td>
<td>8.78560</td>
</tr>
</tbody>
</table>

Table 9. HR and RPE across three stages within each music condition
As it relates to stages completed by the participants during the exercise bouts, all (20) participants performed for at least five 3-minute stages during the exercise bouts. Additionally, 19 participants completed 6 stages, 12 completed 7 stages, five completed 8 stages, and three participants made it through 9 stages. If a participant ran more stages during one or more condition as compared to another condition, it was only ever for one additional stage (11 participants did this); for example, participant #19 ran through 8 stages for conditions 1 and 4, whereas they were able to run through 9 stages for conditions 2 and 3. However, since most participants were consistent in the number of stages completed across all music conditions, no analysis of the stage completion data was run.

**Feeling Scale Scores**

<table>
<thead>
<tr>
<th>Stage</th>
<th>No Music</th>
<th>BMRI</th>
<th>BMRI Choice</th>
<th>Free Choice</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mean RPE</td>
<td>6.6500</td>
<td>6.9000</td>
<td>7.0000</td>
</tr>
<tr>
<td></td>
<td>Std. Deviation</td>
<td>.74516</td>
<td>.96791</td>
<td>.85840</td>
</tr>
<tr>
<td>2</td>
<td>Mean RPE</td>
<td>11.2000</td>
<td>11.9500</td>
<td>11.6000</td>
</tr>
<tr>
<td></td>
<td>Std. Deviation</td>
<td>1.39925</td>
<td>1.99934</td>
<td>1.72901</td>
</tr>
<tr>
<td>3</td>
<td>Mean RPE</td>
<td>16.8000</td>
<td>17.3000</td>
<td>16.8500</td>
</tr>
<tr>
<td></td>
<td>Std. Deviation</td>
<td>1.64157</td>
<td>2.31926</td>
<td>1.89945</td>
</tr>
</tbody>
</table>

**Table 3. FS across all four music conditions for three stages.**

<table>
<thead>
<tr>
<th>Conditions</th>
<th>Stage</th>
<th>$M$</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 No music</td>
<td>1</td>
<td>3.6</td>
<td>1.465</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>2.85</td>
<td>1.623</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>.05</td>
<td>2.605</td>
</tr>
<tr>
<td>2 Predetermined BRMI</td>
<td>1</td>
<td>3.85</td>
<td>1.137</td>
</tr>
<tr>
<td>music</td>
<td>2</td>
<td>3.18</td>
<td>1.184</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>1.05</td>
<td>2.544</td>
</tr>
<tr>
<td>3 Choice from</td>
<td>1</td>
<td>3.95</td>
<td>1.234</td>
</tr>
<tr>
<td>Predetermined</td>
<td>2</td>
<td>3.35</td>
<td>.890</td>
</tr>
<tr>
<td>BRMI music</td>
<td>3</td>
<td>.55</td>
<td>2.819</td>
</tr>
<tr>
<td>4 Choice of music</td>
<td>1</td>
<td>3.90</td>
<td>1.447</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>3.28</td>
<td>1.118</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>.9</td>
<td>2.382</td>
</tr>
</tbody>
</table>
A 3 x 4, Stage by Condition, repeated measure on both factors ANOVA was conducted to determine the effect music conditions and exercise stages had on feeling scores. Results indicated a statistically significant effect for the stage factor (adjusted with Greenhouse-Geisser) $F = 27.654, p < .000, \eta^2_p = .593$. Therefore, nearly 60% of the variance in the feeling scores is explained by exercise stages. Neither the music main effect nor the Stages x Music interaction were significant. Since the effect of music on feeling scores is critical to the present research, the music main effect statistics are reported here: $F = 1.685, p > .05, \eta^2_p = .081$. Also, Figure 1 shows the means for FS scores at each stage for the four music conditions. The profile plot represents the Stage by Condition, 3 x 4 ANOVA results and shows the mean FS scores for the four music conditions. As a result, music had the anticipated effect, albeit not significant; as intensity increased, feeling scores decreased.

![Figure 3. Mean FS scores for all participants across all three stages of single bout of physical activity](image-url)
Using the Bonferroni correction for multiple comparisons, follow-up comparisons indicated that there was a significant pairwise difference between Stages 1 vs 3 (p < .000), and Stages 2 vs 3 (p < .000). Therefore, feeling scores changed significantly at the last stage.

The following four graphs, one for each music condition, illustrate the huge variance across participants in their feeling scores (FS) when plotted against exercise intensity (heart rates converted to percentage of estimated maximum HR). The plots show that for all music conditions, the feeling scores are negatively related to intensity.

![Figure 4](image4.png)

**Figure 4. FS scores for different exercise intensities for the no music condition**

![Figure 5](image5.png)

**Figure 5. FS scores for different exercise intensities for the BMRI condition**
Figure 6. FS scores for different exercise intensities for the choice from BMRI condition

Figure 7. FS scores for different exercise intensities for the choice of music condition
Felt Arousal Scores

The FAS scores for each exercise stage within each music condition are presented in Table 4. In general, arousal scores increased across the three stages of each exercise bout.

Table 4. FAS scores across all four music conditions and three exercise stages.

<table>
<thead>
<tr>
<th>Conditions</th>
<th>Stage</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No music</td>
<td>1.8</td>
<td>1.005</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.8</td>
<td>.750</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4.2</td>
<td>1.704</td>
</tr>
<tr>
<td>2</td>
<td>Predetermined BRMI music</td>
<td>2.05</td>
<td>1.099</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3.58</td>
<td>.712</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5.15</td>
<td>.988</td>
</tr>
<tr>
<td>3</td>
<td>Choice from Predetermined BRMI music</td>
<td>1.85</td>
<td>1.137</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3.18</td>
<td>.712</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5.1</td>
<td>.852</td>
</tr>
<tr>
<td>4</td>
<td>Choice of music</td>
<td>2.15</td>
<td>1.268</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3.38</td>
<td>.809</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5.05</td>
<td>1.050</td>
</tr>
</tbody>
</table>

A 3 x 4, Stage by Condition, repeated measures on both factors ANOVA was conducted to determine the effect music and exercise stages had on the participants’ felt arousal. Results (all adjusted using Greenhouse-Geisser) indicated statistically significant effects for stage ($F = 66.411, p < .000, \eta_p^2 = .778$) and music condition ($F = 5.821, p = .008, \eta_p^2 = .235$). The analysis also indicated a marginally significant interaction effect for stage by music ($F = 2.626, p = .051, \eta_p^2 = .121$). As can be seen, nearly 78% of variance in arousal scores is explained by stages.

Using Bonferroni adjusted alpha levels, the follow-up comparisons indicated that there was a pairwise difference among all three stages ($p < .000$): Stage 1 ($M = 1.963$), Stage 2 ($M = 3.231$), and Stage 3 ($M = 4.875$). A similar analysis of the music main effect showed generally that the no music condition had lower FAS scores than the other three music conditions. However, only the no music condition ($M = 2.933$) was statistically different than the BMRI condition ($M = 3.592$), ($p = .016$).
To understand the Stage X Music condition interaction, the music simple effects were analyzed within each stage. A simple effect of music on FAS scores was found for Stage 2 (sphericity assumed, $F = 5.969, p = .001, \eta_p^2 = .239$) and Stage 3 (sphericity assumed, $F = 6.085, p = .001, \eta_p^2 = .243$). For both of the simple effects analyses, the general trend within each stage mimicked the music main effect in that the no music condition produced lower FAS scores than the music conditions. For Stage 2 only, the no music versus BMRI comparison was significant ($p < .000$). For Stage 3, the no music condition was lower than the other three music conditions ($p = .040, p = .027, p = .055$, respectively for the BMRI, choice within BMRI, and free choice conditions).

**RPE**

The RPE scores are shown below for the four music conditions across the three exercise stages (Table 5).

<table>
<thead>
<tr>
<th>Conditions</th>
<th>Stage</th>
<th>$M$</th>
<th>$SD$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 No music</td>
<td>1</td>
<td>6.65</td>
<td>.745</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>11.2</td>
<td>1.399</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>16.80</td>
<td>1.64</td>
</tr>
<tr>
<td>2 Predetermined BRMI music</td>
<td>1</td>
<td>6.90</td>
<td>9.68</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>11.95</td>
<td>1.999</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>17.30</td>
<td>2.32</td>
</tr>
<tr>
<td>3 Choice from Predetermined BRMI music</td>
<td>1</td>
<td>7.00</td>
<td>.858</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>11.60</td>
<td>1.73</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>16.85</td>
<td>1.899</td>
</tr>
<tr>
<td>4 Choice of music</td>
<td>1</td>
<td>6.90</td>
<td>1.16</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>11.50</td>
<td>1.78</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>16.90</td>
<td>2.02</td>
</tr>
</tbody>
</table>

A 3 x 4, Stage by Condition, repeated measure on both factors ANOVA was conducted on the RPE scores. Results indicated a statistically significant effect for the stage factor (sphericity assumed, $F = 464.33, p < .000, \eta_p^2 = .961$. Neither the music main effect nor the stages x music interaction were significant.
PACES and CI Results

A one way repeated measures ANOVA for (post) PACES scores determined a marginally significant effect of music: \( F = 3.296, p = .06, \eta^2 = .148 \). While none of the paired comparisons were significantly different, the general trend was for post exercise enjoyment to be higher in the three music conditions compared to the no music condition \((M = 60.40, 61.75, 62.45, \text{ and } 62.40 \text{ respectively})\). The one way ANOVA for the post CI scores failed to reveal any significant results across the four music conditions.

4.9. Discussion

Music influences the pleasure experienced during and at exercise cessation of an acute bout of physical activity (Karageorghis & Priest, 2012a). In general, studies have shown that music improves enjoyment, specifically, FS and FAS are improved in music vs no music conditions (Hunter & Schellenberg, 2010; Husain, Thompson, & Schellenberg, 2002; Jones et al., 2014; Karageorghis & Priest, 2012b; Salimpoor, Benovoy, Longo, Cooperstock, & Zatorre, 2009). In particular, songs that are positively valenced and have a fast tempo, provide a motivational stimulus that participants tend to associate with positivity (Jones, Tiller, & Karageorghis, 2017). The results from the present study demonstrate a similar trend to the literature; music affected participant’s enjoyment during an acute bout of physical activity. Similarly, arousal was positively associated with intensity; that is, as intensity increased (shown here as stages 1 though 3), FAS scores also increased, and were higher with music than without.

Researchers suggest that music promotes approximately 10% more dissociation during moderate-to-vigorous physical activity, or when the participant reaches around 78% max Heart Rate Reserve (HRR; Clark et al., 2015; Jones, Karageorghis, & Ekkekakis, 2014; Karageorghis & Jones, 2014) compared with the no music conditions whereby association with physiological cues begins around 69% maxHRR. Also, exercisers prefer a tempo of 125-140 BPM, implying that a high-arousal setting (e.g. aerobic exercise) requires corresponding stimulating music as an accompaniment (Hallett & Lamont, 2014; Karageorghis & Priest, 2012a). The present study’s results reached similar conclusions; participants preferred listening to music (motivating and/or preferred) while performing a repetitive aerobic task (i.e. treadmill running) in
comparison to not having music. However, the trends for the music effect were not
significant for the FS scores and music conditions only explained approximately 8% of
the variance in FS scores. The question then is why was music not more powerful among
participants in the present study?

Firstly, the lack of music-effect might be because intensity may not have been
manipulated effectively. However, this does not appear to be the case as the protocol
employed provided the anticipated results in intensity; as intensity increased, so did
exertion, as shown by increases in HR and RPE across the stages. Second and more
likely, a potential explanation for the lack of power of music may be the sample of
participants recruited for this study. Particularly, Kinesiology students may be a very
biased sample since this demographic is, in general, predominantly active and may have
behaved more like trained athletes: participants participated on average in 4.6 bouts of
physical activity per week (min = 2, max = 10, SD = 2.55) with an average BMI of 23.
For example, in the review by Ekkekakis and colleagues (2011), Lochbaum (2006)
conducted a study with two groups (inactive and active university students) who
participated in a treadmill exercise task. The inactive group showed increases in TA
(tense arousal) and SAI (State Anxiety portion of the State-Trait Anxiety Inventory) over
time, whereas the active group showed no change in TA and a decrease in SAI from pre
to post. Thus, choosing a sample whereby the participants are not inclined to enjoy
physical activity may be more advantageous for discovering how effective music could
be with regards to enhancing pleasure. Generally, adding music was beneficial across FS
and FAS scores. This suggests that it might be fruitful to study more closely what type of
participants could be ergogenically-aided with the accompaniment of music or under
what circumstances (e.g., Study 2 examined reported uses for music, such as to avoid
boredom), which is not necessarily a specific “pleasure” effect.

Adding choice of music is often a strategy used by exercise leaders, for example:
offer participants the opportunity to suggest songs and provide feedback regarding music,
or perhaps encourage them to bring in their own playlist (if appropriate, for a circuit style
class for instance), etc. A concept of SDT, need fulfillment, is thought to justify
individual differences in the development and portrayal of motivation across the lifespan
(Teixeira, Carraça, Markland, Silva, & Ryan, 2012). For instance, autonomy (one of three
basic psychological needs), is only satisfied when a person believes that he/she has a sense of choice and volition (Ryan & Deci, 2000). Thus, individual differences in FS scores can be explained by having participants choose their own music and the need for autonomous motivation. Furthermore, DMT mentions that there can be large individual differences in FS scores, particularly at higher intensities (Ekkekakis & Dafermos, 2012). The vast individual differences in FS scores, particularly at higher intensities, reveal that perceived enjoyment during intense physical activity, even with a homogeneous active sample, decline. Individual differences have been found to be an important variable with regards to the use of music and music preferences and should be considered in future research studies (e.g., Hutchinson & Sherman, 2014). Stork, Kwan, Gibala, and Martin Ginis (2015) were interested in determining if listening to self-selected music could reduce the unpleasantness of an acute session of sprint interval training by improving affect, motivation and enjoyment, and to examine the effects of music on performance. Even though a music effect and a choice effect were confounded, Stork et al. (2015) found that perceived enjoyment increased over time, and was consistently higher in the music condition suggesting that choice (self-selection) may be a factor.

In contrast, the results from the present study did not support the idea that adding choice to the music playlist affected the physical activity experience differently than music, in general, vs no music. Specifically, conditions 3 (choice from BMRI playlist) and 4 (choice of music) were not different than condition 2 (BMRI playlist) for FS and not systematically for FAS. Importantly, choice also did not affect CI and PACES scores for post-exercise affective states, revealing that the intention to partake in the same type of physical activity was not determined by whether or not participants could choose which music they listened to during each trial. This begs the question; why did choice not have an effect? It may be that choice is not an “acute” factor for enjoyment in the same light as adding music, but rather the effect of choice may require a longer term to impact a person’s intrinsic motivation (as supposedly measured by CI scores in the present research). As demonstrated by SDT, a positive relationship between autonomous motivation and physical activity exists, with intrinsic motivation being predictive of long-term exercise adherence (Teixeira et al., 2012). Therefore, research over a longer term (e.g., several weeks) could potentially differentiate between an “acute” and “chronic”
effect of providing choice. It would also be necessary to employ participants who are optimally affected by the addition of music to their physical activity experience.

Some exercise studies (Chow & Etnier, 2017; Karageorghis, Terry, Lane, Bishop, & Priest, 2012; Seath & Thow, 1995) have shown music to decrease RPE. Research examining the effects of music vs no music on exercise (below the anaerobic threshold) have found that perceived exertion is reduced by approximately 10% with music, regardless of genre (Karageorghis & Priest, 2012a, 2012b). Specifically, during repetitive, aerobic activities, music that is self-selected and motivating has been shown to enhance affect and reduce RPE. Dissociative attentional stimuli (e.g., music, video) have been effective in decreasing RPE during low-to-moderate intensity exercise, however high-intensity exercise has yielded inconsistent results (Chow & Etnier, 2017). Moreover, Karageorghis and Priest (2012b) categorize music as ineffective in reducing RPE at intensities greater than the anaerobic threshold. Therefore, since the results of this study did not generate a music effect on perceived exertion (just a stage effect), more research is required to clarify the influence of music and the effects of intensity on RPE. If music had a more powerful effect on FS and FAS scores in the present study, it may have also had a more powerful effect on perceived exertion.

4.10. Strengths and Limitations

Unlike some studies that had only two conditions, music and no music, our study had four conditions, including a no music control condition. Many studies in this field of research could have biased results since the introduction of music during the exercise bout may alert the participants to the experimental hypothesis and thus alter their behaviour (Karageorghis & Priest, 2012a). Since our protocol did not reveal which of the four conditions the participant would be tested under until right before each bout, the participants were not likely to have been aware that the purpose of the experiment was to assess the effects of music on their perceived affective state. Similarly, our protocol asked participants to provide scores for not only the feeling scale but also their perceived exertion, heart rate and state of arousal.

The interactive effects of music and choice during an acute bout of moderate-to-vigorous physical activity, lends to the original contribution of this work. Distraction
techniques, such as listening to music, are often found in the exercise domain; however, this area of research has just recently started receiving attention. Thus, the tools used to measure the variables may not have been the most accurate, although they were appropriate. More work is needed to clarify the effectiveness of tools used to measure affective pre-, during, and post-bout of physical activity. Furthermore, having a larger sample size would have added more power (suggested $n = 24$) to this study to more accurately demonstrate the effect music has on affect. Also, in hindsight, having participants report their initial FS score (before each trial began) would have given us a better understanding of their mood state prior to exercise. This information would have allowed us to control for the fluctuation in daily-affect, and could have analysed the data using ANCOVAs, with the pre-test FS score as the covariate.

Participants could adjust the music volume at any time during the three music conditions, which could have affected the stimulus associative effect. More research is needed controlling for the volume (decibels) of the music during the trials. Furthermore, non-Kinesiology students may also have been more affected by music during the exercise trials since most Kinesiology students are already regularly physically active.

4.11. Future Research

As noted by Karageorghis and Priest (2012) in their review, most of the studies that investigated the effects of music on physical performance were experimenter-selected rather than self-selected. Therefore, this is an area of research that requires further exploration; individual differences affect the motivational effects of music. More research studies need to be performed with the affective exercise experience as the primary concern. Specifically, repeating this study with homogeneous samples of different demographics (e.g., school children, undergraduate university students outside of Kinesiology, office workers) would give support to our understanding.

4.12. Conclusion

With regards to physical activity, music enhances the affective state, offers a distraction to dissociate from physiological discomfort (until VT is approached), and can increase duration (as seen in the extra stages completed during the music conditions). Music can
be used to increase arousal with faster-paced songs, in addition to affecting our mood state through the modality of the song (major or minor chord). However, the effects of tempo and mode need to be explored more. In comparison to running to volitional cessation without the accompaniment of music, music has been shown to positively affect participants’ FS, FAS, and PACES scores. Specifically, when participants listen to music during an acute bout of high-intensity physical activity, their intention to repeat the behaviour shows a positive but insignificant trend. Therefore, in order to determine whether individuals will be more likely to choose to participate in physical activity again, more investigations employing the protocol from the present study are required.
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5. General Discussion

A noticeable rise in physical inactivity and sedentary behaviour (World Health Organization, 2010) is associated with various negative health outcomes, including a positive correlation with overweight and obese populations (O’Donoghue et al., 2016; Rhodes, Fiala, & Conner, 2009; World Health Organization, 2010, 2013, 2015). A recent growth in sedentary behaviour among Canadian youth and various barriers currently deterring boys and girls from physical activity has been noticed (Gray, Larouche, Barnes, & Colley, 2014; Leatherdale & Ahmed, 2011; Murtagh, Hegarty, Mair, Kirby, & Murphy, 2016). Data from the most recent round of the Canadian Health Measures Survey (CHMS) indicate that only one third of Canadian children and youth are meeting the recommended guidelines of being active (moderate-to-vigorous intensity) for at least 60 minutes per day (Colley et al., 2017). Furthermore, the CHMS (Colley et al., 2017) also reported that less than half of this population are abiding by the recommended sedentary time (less than two hours of screen time per day), and nearly one in seven Canadian children are classified as obese (Rao, Kropac, Do, Roberts, & Jayaraman, 2016). Furthermore, as of 2016, the World Health Organization (WHO) reported that globally, 39% of men and 39% of women over 18 years of age were overweight; in the Americas, that number is now greater than 60% (World Health Organization, 2015). In addition, an increase in inactivity and sedentary behaviour in the older adult population suggests that finding a way to effectively motivate more individuals to be physically active is imperative. Finding new methods to motivate more Canadians to initiate and/or maintain a regular physical activity routine is necessary.

Specific to adherence, a motivating message is not always sufficient to generate change and additional support may be required to help participants that are motivated to adopt a new behaviour translate their intentions into action (Harris et al., 2014). The initiation phase requires separate psychological processes from the maintenance phase. People who form implementation intentions with specifics detailing where, when, and how they will achieve their goals are more likely to translate their intentions into action (from a meta-analytic review by Gollwitzer & Sheeran, 2006 in Harris et al., 2014).
Initiation of a health behaviour change focuses on the positive future state (positive association with the activity) and being hopeful when creating an action plan (Voils et al.,
After a behaviour change has been accepted, the maintenance phase takes place by which the behaviour has been adopted for at least six months (Voils et al., 2014). For example, participants (16 veterans, 90% male) reported that self-monitoring their behaviour as well as obtaining constant social support was helpful regarding limiting relapses.

Physical activity maintenance interventions, especially for children, should also encourage constant contact with participants during the maintenance phase (Marcus et al., 2000). Moreover, maintenance of a new health behaviour may be enhanced both by the formation of new, healthy habits during initiation and detailed, explicit planning for adopting a habitual response. A positive affective state is one of the many beneficial side effects of being physically active; maintaining exercise in the long term depends particularly on positive affect during exercise in addition to social support (Mcauley, Jerome, Elavsky, Marquez, & Ramsey, 2003). However, widely used health behaviour models such as the Theory of Planned Behaviour (Ajzen, 1991), Trantheoretical model (Prochaska & Di Clemente, 1982) and the Health Action Process Approach (Schwarzer & Luszczynska, 2008) ignore positive affect in favour of a focus on rational decision-making, a sense of competency and subjective evaluations of a behaviour as beneficial from one’s own perspective. Enjoyment of a health behaviour is excluded in this approach, possibly because such models that relate to health behaviours would not normally be associated with enjoyment, such as taking medication (Hallett & Lamont, 2014).

Evidently, studying enjoyment (i.e. intrinsic motivation) as an aim for health behaviour change interventions is of vital importance. Currently, an abundance of research in this domain employs extrinsic variables, such as perceived health outcomes of activity, and typically represent distal influences of behaviour (i.e. the adoption phase). However, intrinsic motivation supports the maintenance of physical activity as it is a proximal influence of behaviour and thus provides immediate reinforcement for being physically active (Motl et al., 2001). Therefore, from a theoretical standpoint, more investigations are required with the participant’s affective states during physical activity being of primary concern. Moreover, practical application of this working knowledge
necessitates the approach of promoting pleasure with regards to physical activity, which, in general, was the approach of this dissertation.

5.1. Summary

The purpose of the extensive review (Study 1) was to support the argument that, to strengthen efforts to promote physical activity, it is essential for researchers to place more emphasis on enhancing affective experiences. Specifically, the following five factors were explored: intensity (through psychological hedonism), music, flow principles, sociability, and playfulness (through choice). More specifically, both in research and in practical settings, the following suggestions need to be focused on: (a) regulating the intensity of physical activity to encourage activities are performed below the ventilatory threshold; (b) using music as an ergogenic aid, a pleasant distractor as well as a positive aesthetic experience in its own right; (c) aiming to create flow experiences, primarily by ensuring a balance between individual abilities and challenges; (d) encouraging combining physical activity with positive social interactions; and, (e) promoting playfulness by encouraging choice and autonomy. As a result of this comprehensive review, professional physical activity leaders can take this information and apply it to their classes/sessions and encourage their participants to enjoy physical activity.

Furthermore, this review demonstrated that although more research is using affect and variables such as music to study the effects on physical activity, extrinsic variables are usually still the desired outcome being measured. Additionally, the measurements employed are not consistent from study to study, and therefore, comparisons of the effectiveness of these tools is limited. With a better understanding of factors that influence the affective states of exercise participants as a result of conducting this research, an investigation was needed to appreciate the motivational components of music. Specifically, Study 2 explored under what circumstances listeners consider music to be effective, and what purpose(s) people listen to music for, with respect to individual differences.

Consequently, Study 2 explored how music affects participants’ experience of physical activity as well as what types of music serve a particular purpose. After several focus group interviews, a questionnaire was created, which had two objectives:
determining general music listening behaviour, as well as specific exercise and leisure activity music listening behaviour, and if differences existed. Music listening, in general, was determined by questions that focused on possible different uses of music, different circumstances that music could be employed, and what purpose music served. Interestingly, 100% of participants reported listening to music and using music to serve various purposes for various activities (e.g., exercise, studying, cleaning). Participant’s rated “to motivate me to exercise” and “to facilitate the workout” as the two leading reasons for listening to music (74.3% and 68.1% of participants, respectively).

In addition, the exercise section separated aerobic training from strength-based training and asked how music affects the listener and why they choose to listen to music during the specific type of activity. Examples of songs were also requested and later analysed in terms of the song’s tempo, mode, and genre. The same was repeated for leisure activities. Results provided insight into the vast differences in music preferences (i.e., genre, tempo, lyrics, mode). With regards to tempo, participants preferred fast music (tempo of $\geq 120$ BPM) for aerobic training and slower music (tempo of $\leq 120$ BPM) for strength training and leisure physical activity. Both forms of exercise were preferred when accompanied by rap/hip-hop or pop music.

A second component of this study was to create a motivational music playlist. This was accomplished through compiling the most popular songs (from those provided on the questionnaire) and conducting focus group interviews with a different sample of similar demographic homogeneity; the BMRI was employed during these music-listening sessions. The results from the BMRI provided the scores for each of the songs in terms of their motivating qualities specifically for aerobic training. As shown in Table 1 of Study 3, the top 15 motivating songs created the BMRI motivating playlist that was later used in Study 3. With the striking individual differences in specific song choices reported by the participants in Study 2, it seemed logical to explore the role choice of music might play in enhancing enjoyment in physical activity.

Therefore, the purpose of the third study was to determine if listening to music and, specifically providing choice of music, could enhance a participant’s affective experience, perceived exertion, and performance during a simulated stress test on a treadmill. Music showed a positive trend towards enhancing enjoyment during a single
bout of intense aerobic physical activity. Allowing participants to choose which songs they listened to from a motivational music playlist or choose their own music playlist had no additional significant effects. This study revealed differences in FS scores across various intensity levels. The results from Study 3 repeated those from similar studies whereby intensity had a direct effect on FS and FAS ratings; as intensity increased and approached/surpassed VT, FS declined and FAS increased. Music was associated with greater FAS scores than no music but showed no effect on perceived exertion. Music was one factor from Study 1 that could be manipulated to enhance pleasure experienced during physical activity; unfortunately, perhaps due to the homogeneous sample (active, Kinesiology students), a music effect and choice effect were not significant. One line of research that would be worthwhile to conduct in the future is to study what participant characteristics (e.g., trained vs untrained) might determine how powerful adding music might be for different people when attempting to enhance enjoyment. Therefore, future investigations should recruit inactive participants to test the effectiveness of music and any additive effects of choice to FS and RPE scores. Furthermore, future studies allocating choice of instrument (i.e. type of physical activity) and intensity should be tested, since autonomy has been proven to impact enjoyment and adherence to physical activity.

5.2. Contribution of this thesis to physical activity professionals.

As a result of conducting the above three studies, a list of recommendations to professionals, such as physical activity leaders, fitness instructors, personal trainers, physiotherapists, Kinesiologists, etc., has been developed. With regards to utilizing the various aforementioned factors (intensity, music, flow, choice, and social interaction) to assist professionals with positively affecting participants’ physical activity experience, the following should be adhered to:

- Use appropriate music (tempo, genre) for specific types of exercise:
  - At least 120 BPM when teaching an aerobic style class (e.g., step class, a running group, cardiovascular boot-camp);
  - Slower than 120 BPM for strength-based activities (e.g., resistance training, weight lifting, circuit training; and,
Play hip-hop/rap music and pop music (lyric appropriate depending on demographics), specifically for university-aged students during exercise.

Accommodating individual differences may be challenging, but accepting that vast preferences exist among any given class may prove fruitful with regards to enhancing pleasure:

- Offer participants to choose from different instruments/equipment, intensity, duration; and,
- Encourage participants to make suggestions regarding the music, perhaps even playing student-selected songs.

When leading a leisure activity (e.g., nature walk), play songs that are slower (< 120 BPM) and in the minor chord:

- The literature suggests that songs played in the key of minor (and are less arousing) elicit feelings of serenity and relaxation (for e.g., Hunter & Schellenberg, 2010); and,
- Ask the group for suggestions to create a better understanding of their preferences, since individual music preferences will affect participant enjoyment.

Sex differences were minimal. However, some differences in preference should be considered:

- Females preferred listening to pop music whereas males preferred hip-hop and rap while partaking in aerobic exercise;
- In a spin class, for example, if the class is female-only (or mostly), have pop music playing in a fast tempo; and,
- Play hip-hop/rap music when classes have a more balanced mix of sexes in a strength training type of exercise.

This research sought to understand how to manipulate factors of pleasure and enjoyment during and following physical activities, specifically with university students. However, this research could be expanded and investigate more on the effects of manipulating specific factors with people of all ages and capabilities. Determining participants’ perspectives of how much pleasure they can derive from a single bout of physical activity can be measured and analyzed. This information can then be used as the
basis of measurement for subsequent research studies and provide practical knowledge that physical activity instructors and exercise leaders can apply to their classes to enhance the affective experience. This information can be utilized for better insight into chronic commitment as well and what participants, who are habitually active, enjoy most. In summary, future research should continue to study how factors could be manipulated to ensure more people are motivated to commit to a physically active lifestyle. Since long term adherence to physical activity should be more likely when intrinsic motivation is infused into the participant’s experience, the principle concepts from self-determination theory (Ryan & Deci, 2000) should be considered: is the activity offering autonomy, is there opportunities for social relatedness, and can individual competencies be satisfied?

5.3. Limitations

Kinesiology students are of a homogeneous sample that is biased towards physical activity. Therefore, the effects and positive trends of music on perceived exertion and feelings in the present research should not be discounted; further investigation is required. Furthermore, the BMRI measures songs for their qualities of motivation; this tool has been validated, yet since choice was not an additive factor for enhanced feeling during aerobic exercise, the effectiveness of the BMRI versus the preference for individualized playlists needs more corroboration. As previously mentioned, the tools and measurements under study and employed throughout the present studies have been validated and confirmed as appropriate to affective exercise research; however, there is a lack of consistency throughout the literature, which makes comparing the tools and making informed decisions on which tool to employ for specific protocols imprecise. Lastly, the BMRI playlist from Study 2 was compiled several months prior to the commencement of Study 3. Therefore, although the participants were of the same demographic, preferences for songs (i.e., the top 40) could have changed. Future research should simultaneously gather information for the BMRI and conduct the exercise-experiments for a more accurate representation of motivational music, for a given population.
5.4. Future Research

More research studies need to be performed with the affective exercise experience as the primary concern. Specifically, repeating this study with homogeneous samples of different demographics (e.g., school children, undergraduate university students outside of Kinesiology, office workers) would give support to our understanding. As a result of this research, individual differences should be considered both professionally and academically, to enhance felt and perceived pleasure from physical activity. Furthermore, the same protocols should be enlisted for studies investigating the effects of music on participants’ affective states under different circumstances; for example, weekly, acute bouts of strength-based exercise. Longer-term longitudinal studies would be very beneficial, whereby people factors (e.g., current activity levels, sex, age, socioeconomic state, mental health state) would be examined that would affect pleasure outcomes. This might also include recruiting people for which music does not have a positive effect. For instance, many competitive athletes who are more familiar with training/practicing and playing games/competing without music (e.g., swimmers), may find music distracting or ineffective in heightening their affective state or performance. Therefore, more research is required to understand what else can be done, besides utilizing and manipulating music, to promote pleasure before, during, and after physical activity.

Potential research studies that could emanate from Study 1 include studying the effects of manipulating the aforementioned factors on children and youth. Future research should use the information provided from the studies in the above chapters to determine how to effectively manipulate physical education classes and unstructured physical activities with fun principles for school-age children. Promoting adherence and enjoyment of participating in regular physical activity should be a priority for physical education instructors and curriculum developers. This research should provide a greater understanding of how boys and girls in the early stages of life perceive physical activity and how this presents health challenges (e.g., obesity and cardiovascular-related diseases, attention deficit disorders, etc.). This study would attempt to manipulate and measure "fun" (i.e., pleasure and enjoyment) as a method of encouraging children to participate in more regular bouts of physical activities. The hypothesis would query whether a more thorough understanding of how to accurately and consistently manipulate fun-factors
would result in more children having fun, and thereby intend on participating in physical activity.

Specifically, researchers would recruit two elementary school classes as the target audience of the intervention. The students will be asked to do an activity in their school gymnasium for approximately 20 minutes. This activity will be dance-focused, and comprised of various of dance moves. As a group, the participants will learn and perform all of the different moves. Music will be playing and they can stand with friends and be sociable. Before the activity starts, the children will be asked to complete a short questionnaire at their desks in class, which they will use to record how they are feeling, according to a Happy Scale (1-Angry, not happy to 5- very happy, excited) (Bradley & Lang, 1994; Buckley, 2015; Fowler, 2013). There will be an option to write out "why" they feel this way, to validate their score. They will leave the questionnaire on their desk and exit the room and go to the gym. After the activity, the children will be asked to fill out the same questionnaire once they return to their classroom. These questionnaires (pre and post) will remain anonymous. Once completed, the questionnaires will be collected and later analyzed to determine how well the activity was enjoyed and if the students perceived the activity as fun; the ratings will be tested for their corroboration with researcher-observation during the activity. The factors that should be considered for manipulation during the activity are: aspects of flow theory (e.g., skill vs ability, autotelic experience), sociability, music and mood. Currently, there are no interventions specifically manipulating flow to enhance the affective experience of physical activity. The importance of socio-demographic variables for music preference, and their relationship with style, release date and performer are not yet well understood (Karageorghis, Priest, Terry, Chatzisarantis, & Lane, 2006). These four factors are based on the literature by Ellis, Stemmler, and Salmoni (2012) and need to be explored.

Future research recommended as a result from the information gathered in Study 2 is to continue exploring how music impacts pleasure and effort during physical activity. For example, music prolongs exercise duration (Baldari, Macone, Bonavolonta, & Guidetti, 2010) but to what degree? In Study 3, when music accompanied the bout of aerobic exercise (simulated stress test), one extra stage was achieved by 11 of the 20 participants. However, the music effect did not differ among the three different music
conditions. Therefore, future studies should investigate solely the reason(s) the participant stops exercising; what specifically contributes to the cessation of an acute bout of physical activity? The hypothesis for this research would position physiological cues as the foremost influencers, as research suggests that as VT is approached/surpassed, external stimuli can no longer compete. However, music as a distraction should be further investigated; when a participant exercises at or above his/her ventilatory threshold, do other cues still get recognized? Is this effect negated by physiological cues or are their other personal factors, such as: physical fitness, type of activity, social interaction, and the specific stimulus (i.e., music vs video vs reading) that can lead to physiological dissociation beyond the VT?

A suggested investigation is to study the difference between using music for enjoyment versus using music to negate boredom. Specifically, music has the ability to captivate or distract the listener from physiological cues, such as muscle fatigue or perhaps boredom, and can also motivate us to perform better and for a longer duration (Karageorghis & Priest, 2012). A study found that the experience of pleasure when listening to music was mediated by the release of the brain's reward chemical, dopamine (Salimpoor, Benovoy, Larcher, Dagher, & Zatorre, 2011). Music seems to tap into the circuitry in the brain that has evolved to drive human motivation; when we do something our brains want us to do again, dopamine is released into these circuits. Since listening to music during physical activity could have implications for exercise prescription, especially among overweight, sedentary adults, who are most in need of interventions that encourage initiation and adherence to exercise programs, this sample of the population should be tested. A suggestion to take pre- and post- blood samples, testing specifically for the hormonal responses to exercise during the different conditions, could yield greater insight into encouraging this sedentary, and inactive group of people to adopt and maintain a physically active lifestyle.

Moreover, if the environment or type of activity can be adjusted so that it becomes pleasurable to the specific group of people, to encourage they continue to participate in the activity. Specifically, choose an appropriate tool to measure mood, affect, enjoyment (e.g., POMS, FS, PACES) of participants in different groups: nature vs treadmill vs mall, for example. This study should follow a protocol of a repeated
measures design to compare condition effects within subjects. An additive effect would be offering another stimulus, such as music, to determine whether music affects the individual’s perceived enjoyment of each activity in the various environments, beyond the environment itself. Specifically, people seem to listen to music and choose specific pieces based on their own music preferences and purpose for listening, such as: mood enhancement, relieving boredom, physiological/emotional dissociation, and triggered emotional responses. The effects of external stimuli on affect needs more attention.

As a result of the first study, five factors originated that could be manipulated to increase pleasure during physical activity: exercise intensity (through psychological hedonism), music, flow, playfulness (through choice), and socialization/social interaction. For the third study, the protocol used music and choice of music to test the effects on affect, arousal and intensity. Potential research studies could compare two variables per experiment in order to look into the interaction effects of the variables in the study. The purpose of these studies will be to add a new perspective of motivation to current health research that is focused on motivating people to participate in regular physical activity. Using theories of Hedonism, Self-determination Theory, Flow Theory, as well as music and play justifications, the hypothesis is that when a person enjoys participating in an activity, the individual will become intrinsically motivated to continue participating in the specific activity. Past and current efforts to encourage physical activity have lacked long-term effectiveness since current societal sedentary behaviour and lack of participation in physical activity are the highest they’ve been in history. Therefore, the following studies could be conducted to inquire to what degree the aforementioned factors affect a participant’s physical activity experience and continuation intention.

Firstly, the factors of interest are intensity and choice of exercise apparatus. Eight groups of participants should be used per trial, with one control group. Intensity will be tested during each condition at low and high perceived intensity, calculated using an estimated %VO2. Literature suggests that dissociation occurs at a low-to-moderate intensity experience and association to physiological cues resume once ventilatory threshold is surpassed (Karageorghis & Priest, 2012). Participants will be exposed to the following four conditions at two intensities (low-to-moderate and high): (1) music and
choice interaction, (2) music and no choice interaction, (3) no music with choice interaction, as well as (4) no music and no choice interaction. A stationary bicycle, elliptical, and treadmill will be the exercise apparatuses used. Heart rate will be monitored using a monitor affixed to the participant’s sternum, which is relayed to a synced watch, worn by the researcher. Each participant will visit with the researcher to exercise a total of five times (1 pretest, 4 experimental tests), and complete each condition at each visit in a randomized order. Each participant will be tested individually to avoid confounding socialization effects. These testing days should be the same day of the week each week and occur at roughly the same time. The research questions would query to what degree music enhances the experience and whether providing choice also affects the experience.

Secondly, research could focus on manipulating pleasure experienced during physical activity with the additional factor being social interaction. Therefore, participants will be encouraged to socialize with fellow participants during the social conditions. A stationary bicycle is the recommended exercise apparatus, as the researcher has optimal control over the participants’ intensity on this piece of equipment. Heart rate will be monitored using a heart rate monitor affixed to the participant’s sternum. Each participant will visit with the researcher to exercise four times (1 pretest, 3 music conditions with two tests for each condition) completing each condition at each visit. Each participant will be tested individually, except for during the trials with social conditions. Sex-matched pairs will be used during the social group sessions. These testing days should be the same day of the week each week and occur at roughly the same time. Two variables will be combined at each condition to learn if an additive effect or interaction effect encourage more pleasure during exercise. The order of the conditions will be randomized. Multiple regression analysis allows for an estimate of the combined potency of several independent variables to explain variances in a dependent measure. A stepwise procedure should be used to illustrate how contrasting theoretical approaches might lead to various explanations of sociability (Gifford, 1981). More specifically, comparing within subjects, are ratings of social interaction linearly related to exercise intensity? Do individual preferences for social interaction during physical activity
(introversion vs extraversion, trained vs untrained athlete, previous experience with group or individual exercise/sport) affect perceived enjoyment of an activity?

Furthermore, it is not known whether exercisers’ music choices reflect their age when they are able to choose their own music (Hallett & Lamont, 2014). Music played over community centre public areas, like the main exercise room of a gym, should include tracks from a range of eras to reflect the various ages of the exercisers present (Karageorghis & Priest, 2008). Therefore, in the aforementioned future research studies, choosing a sample whereby the participants are not inclined to enjoy physical activity (i.e. not Kinesiology students or varsity athletes) may be more advantageous for discovering how effective music could be with regards to enhancing pleasure. Generally, adding music was beneficial across FS and FAS scores. This suggests that it might be fruitful to study more closely what type of participants could be ergogenically-aided with the accompaniment of music or under various circumstances (e.g., Study 2 examined reported uses for music, such as to avoid boredom, which is not necessarily a specific “pleasure” effect). Conducting the recommended studies with various groups of participants (specific homogeneous samples) and specific conditions will not yield generalizable results, however, a better understanding of how pleasure can be infused into physical activity programs and bouts can be applied practically.
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Appendices

Appendix A: Focus Group Questions

Focus Group Questions
1. Do you enjoy listening to music?
2. For what reasons/ purposes do you listen to music? (e.g. is it for enjoyment?)
3. Under what circumstances do you listen to music?
4. Do you listen to music during physical activity such as exercise, walking, playing?
   a. Purpose of listening to music?
   b. How do you select the music each time?
5. What effect does music have on your physical activity level?
Appendix B: Questionnaire

Instructions

Please read and consider each question carefully. Please circle or list the answer(s) that best describe your position.

Part I: Music

1. Do you listen to music?
   a. Yes (If “Yes”, please continue to Question 3)
   b. No (If “No”, please continue to Question 2)

2. If no, why not? (After answering #2, please proceed to Part III: Demographics.)

3. Under what circumstance(s) do you listen to music? Please circle all that apply.
   a. Cleaning
   b. Studying
   c. Driving
   d. Social Events
   e. Exercise
   f. Other (Please list)

4. For what purpose/reason do you listen to music? Please circle all that apply.
   a. For emotional reasons
   b. Pass the time
   c. Prevent boredom
   d. Blocking out extraneous noise well studying
   e. Enhancing my mood
   f. For pleasure (for sake of listening to music)
   g. To change my mood
   h. Other (Please list)

Part II: Music and Physical Activity

To answer the questions below, please define “exercise” to mean moderate-to-vigorous physical activity that causes an increased heart rate and laboured breathing; and “leisure activity” to mean physical activity that does not significantly raise heart rate and is set at a casual pace (e.g. walking in the park).
1. Do you listen to music when you are exercising?
   a. Yes
   b. No (If “No”, why not? Please list) ____________________________

2. If “Yes”, what is a song that you listen to most frequently when you are exercising?
   (Artist, Title)
   a. Aerobic Exercise (e.g. running)
   b. Strength Training (e.g. weight lifting)

3. For what purpose do you listen to music while exercising? Please circle all that apply.
   a. To facilitate the workout (e.g. keeping beat, using speed of music)
   b. To distract me from physiological cues (e.g. laboured breathing, fatigue, making time pass)
   c. To enhance my mood
   d. To motivate me to exercise
   e. To keep out external noise (e.g. traffic, construction, people talking)
   f. Other (please list) ____________________________________________

4. Do you listen to music when you are taking part in a leisure activity (e.g. walking)?
   a. Yes
   b. No (If “No”, why not? Please explain) __________________________

5. If “Yes”, what is a song you listen to most frequently during leisure activity? (Artist, Title)

6. For what purpose do you listen to this song during a leisure activity? Please circle all that apply.
   a. To facilitate the workout (keeping beat, using speed of music)
   b. To distract me from physiological cues (e.g. laboured breathing, fatigue, making time pass)
   c. To enhance my mood
   d. To motivate me to be active
   e. To keep out external noise (e.g. traffic, construction, people talking)
   f. Other (please list) ____________________________________________
Part III: Demographics

1. __________ Year of birth (Please list the year you were born, e.g. 1995)

2. Gender (please circle)
   a. Female
   b. Male

3. Typically, how many times do you exercise (for at least 30 minutes each time) in 1 week?
   a. 0-1
   b. 1-2
   c. 2-3
   d. 3-4
   e. 5 or more times

4. Typically, how many times do you participate in a leisure activity (for at least 30 minutes each time) in 1 week? (e.g. walking)
   a. 0-1
   b. 1-2
   c. 2-3
   d. 3-4
   e. 5 or more times
## Appendix C: Questionnaire Summary Table

<table>
<thead>
<tr>
<th>#</th>
<th>Question</th>
<th>Code</th>
<th>Frequency</th>
<th>Percent</th>
<th>Rank w/in Q</th>
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<td>1.4F</td>
<td></td>
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<td>1.4G</td>
<td></td>
<td>to change my mood</td>
<td>61</td>
<td>54</td>
<td>6</td>
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Appendix D: Brunel Music Rating Inventory (BMRI-3)

Exercise 8.2

The Brunel Music Rating Inventory-3

This questionnaire is designed to assess the extent to which the piece of music you are about to hear would motivate you during [insert activity here]. For our purposes, the word motivate means that you would want to pursue [insert activity here] with greater intensity, stay with it for longer, or both. As you listen to the piece of music, indicate the extent of your agreement with the six statements listed by circling one of the numbers to the right of each statement. Provide an honest response to each statement. Give the response that best represents your opinion, and avoid dwelling too long on any single statement.

<table>
<thead>
<tr>
<th></th>
<th>The rhythm of this music would motivate me during [insert activity here].</th>
<th>Strongly disagree</th>
<th>Strongly agree</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td></td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>The style of this music (i.e., rock, dance, jazz, hip-hop) would motivate me during [insert activity here].</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>The melody (tune) of this music would motivate me during [insert activity here].</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>The tempo (speed) of this music would motivate me during [insert activity here].</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>The sound of the instruments used (i.e., guitar, synthesizer, saxophone) would motivate me during [insert activity here].</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>The beat of this music would motivate me during [insert activity here].</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
</tbody>
</table>

BMRI-3 Scoring Instructions

Add the items for a score between 6 and 42. A score in the range of 36 to 42 indicates high motivational qualities in the piece of music, a score in the range of 24 to 35 indicates moderate motivational qualities, and a score below 24 indicates that the track lacks motivational qualities.

Appendix E: Ethics Approval

Western University Non-Medical Research Ethics Board
NMREB Delegated Initial Approval Notice

Principal Investigator: Dr. Alan Salmoni
Department & Institution: Health Sciences/Kinesiology, Western University

NMREB File Number: 162
Study Title: Manipulating variables in order to produce a more pleasurable experience during physical activity.
Sponsor:

NMREB Initial Approval Date: September 11, 2015
NMREB Expiry Date: September 11, 2016

Documents Approved and/or Received for Information:

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<th>Document Name</th>
<th>Comments</th>
<th>Version Date</th>
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<td>Felt Anxial Scale: questionnaire during and post-exercise</td>
<td>2015/05/27</td>
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<tr>
<td>Other</td>
<td>Feeling Scale: during and post questionnaire</td>
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<td>Questionnaire following exercise session</td>
<td>2015/05/27</td>
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<td>Other</td>
<td>BMRI-3 Music Questionnaire</td>
<td>2015/08/11</td>
</tr>
<tr>
<td>Revised Letter of Information &amp; Consent</td>
<td>Recruitment PowerPoint Presentation</td>
<td>2015/08/12</td>
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<td>Recruitment Items</td>
<td>Par-Q as seen in OWL. If student wishes to learn more about the study and consent to participate</td>
<td>2015/08/12</td>
</tr>
<tr>
<td>Revised Western University Protocol</td>
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<td>2015/08/30</td>
</tr>
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Further information:

The Western University Non-Medical Research Ethics Board (NMREB) has reviewed and approved the above named study, as of the NMREB Initial Approval Date noted above.

NMREB approval for this study remains valid until the NMREB Expiry Date noted above, conditional to timely submission and acceptance of NMREB Continuing Ethics Review.

The Western University NMREB operates in compliance with the Tri-Council Policy Statement Ethical Conduct for Research Involving Humans (TCPS2), the Ontario Personal Health Information Protection Act (PHIPA, 2004), and the applicable laws and regulations of Ontario.

Members of the NMREB who are named as Investigators in research studies do not participate in discussions related to, nor vote on such studies when they are presented to the REB.

The NMREB is registered with the U.S. Department of Health & Human Services under the IRB registration number IRB00007198.

This is an official document. Please retain the original in your files.
Curriculum Vitae

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London, Ontario, Canada
2007-2011 B.A. (Honors), Kinesiology

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2011-2013 M.A., Kinesiology

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Lecturer
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2015-2018

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Ivey Business School
2018-2020

Publications:


https://www.researchgate.net/publication/283731460_Fun_and_physical_activity_Environmental_influences_for_stimulating_fun