CHARACTERISTICS AND EFFECTS OF MOTIVATIONAL MUSIC IN EXERCISE

A thesis submitted for the degree of Doctor of Philosophy

by

David-Lee Priest

Department of Sport Sciences, Brunel University

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ABSTRACT

The research programme had three principal objectives. First, the evaluation and extension of the extant conceptual framework pertaining to motivational music in exercise settings. Second, the development of a valid instrument for assessing the motivational qualities of music: The Brunel Music Rating Inventory-2 (BMRI-2). Third, to test the effects of motivational and oudeterous (lacking in both motivational and de-motivational qualities) music in an externally-valid setting. These objectives were addressed through 4 studies. First, a series of open-ended interviews were conducted with exercise leaders and participants (N = 13), in order to investigate the characteristics and effects of motivational music in the exercise setting. The data were content analysed to abstract thematic categories of response. These categories were subsequently evaluated in the context of relevant conceptual frameworks. Subsequently, a sample of 532 health-club members responded to a questionnaire that was designed to assess the perceived characteristics of motivational music. The responses were analysed across age groups, gender, frequency of attendance (low, medium, high), and time of attendance (morning, afternoon, evening). The BMRI-2 was developed in order to address psychometric weaknesses that were associated with its forbear, the BMRI. A refined item pool was created which yielded an 8-item instrument that was subjected to confirmatory factor analysis. A single-factor model demonstrated acceptable fit indices across three different pieces of music, two samples of exercise participants, and both sexes. The BMRI-2 was used to select 20 pieces of motivational music, which were delivered in a health club gymnasium. It was found that health club members (N = 112) exercised for longer under the condition of motivational music as opposed to oudeterous music (the club’s typical output); however, no differences were noted in terms of affective response.

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Those who have been subjected to doctoral theses before will already know that this is the best part; it is all downhill from hereon in! A PhD is a large undertaking and one’s net gain at the end of the degree is not so much the knowledge accrued as the experience of attaining it. Discipline, commitment, sacrifice, patience, organisation, and self-belief are all required as one sets about constructing the pilgrim thesis from humble foundations. There are well-meaning books with titles such as *How to Get a PhD*, which attempt, in the manner of a formulary, to provide a map over the uncertain terrain of doctoral study. However, there might just as well be books entitled *How to Be Unique* or *How to Fall in Love*, for the path of reading for such a degree will always be a personal, less-trodden one.

I would not attempt to flatter myself with talk of hardship, anguish, or pressure, as nobody forced me to undertake the degree. In fact, the obstacles and inequities that one faces are a blessing and serve an instrumental purpose in developing one’s competence. Thus, should I attain the award, I will be glad to have done it the hard way. Just as the ship cannot move without an ocean to sail on or wind for propulsion, the University and those supporting me made my scholastic voyage possible. It would be folly to acknowledge merely those who have given me direct academic support. I should extend the bounds of my gratitude to everyone who has contributed to my life, even those who have sought to hinder me or do me harm, for without them my path would have been entirely different; in the parlance of George Michael, different corners would have been turned.

Of all those in my corner, Dr. Costas Karageorghis is the most significant. If doctoral supervision were an Olympic event then Costas would own a set of gold medals that would induce Sir Steve Redgrave to hide his face in shame! Costas’ own pioneering doctoral work provided me with a roadmap to follow and a model of success to emulate. The unfailing support he provided was characterised by his sincerity, dynamic mind, and dedication that would have raised a smile from Roy Castle! At every juncture, Dr. Karageorghis set the bar higher and asked me to jump. His work ethic made work for me as the perspicacity of his criticism provided few answers but a multitude of robust and intelligent questions. Thus, he enabled me to work to my potential and plumb the depths of my own resources.

Behind his brusque and implacable façade, Costas proved himself to be unselfish and considerate. How things change; when I first met Costas, I was unruly,

quarrelsome, academically unpolished, and lacking in both direction and motivation, almost the anti-Costas! However, he tolerated my mischief, chaotic behaviour, and hostility with quiet equanimity. From those discordant beginnings our teacher-pupil relationship has blossomed into a brighter harmony. Presently, I attend our weekly meetings with the piety a Zen monk would reserve for his master. In time, even the softest water will wear down the hardest stone.

The wonderful community of Borough Road and the fine traditions of the Department of Sport Sciences provided me with the ideal social climate in which to pursue my studies. The warmth and intimacy of the fraternity in the earlier days of my tenure was a source of great nourishment. This spirit was epitomised by the mythic figure of Mr. Lipton, a latter-day ‘Mr. Chips’ who cultivated magical friendships with anyone willing to converse with him. He was universally revered like a tribal elder and his love and warmth inspired the familial sense of unity that typified the special ambience of Borough Road. Although I will never see him again, I will, like many others, always remember him with love; such is his monument.

My halcyon debut year at Brunel was made possible by the fortuitous occurrence of receiving a berth on the uppermost floor of Stockwell hall adjacent to my best friend from secondary school and sixth-form college, Andrew Walker. Our rooms overlooked the leafy, Augustan campus at Osterley like eyries, and on a clear day, one could see as far as the proud tower of Canary Wharf in the east, the stalagmitic radio masts of Crystal Palace to the south, and the broad plains of Hampstead in the north. Many reverent evenings were spent in the company of Andy, beholding the glittering metropolitan skyline and contemplating a future that was only just beginning, refreshed by seemingly endless rounds of cheese toasties and glasses of Diet Coke.

Latterly, during my post-graduate years, the infamous ‘goldfish bowl’ office in the corner of stately Lancaster House became a stronghold of similar significance. The rebellious and partisan climate of the goldfish bowl, where we worked hard and played harder, proved the perfect base camp from which to plan and execute my doctoral campaign. The studying was complemented by legendary bouts of ear-splitting music, vociferous banter, gambling, and office sports of every conceivable persuasion including a fabled conker tournament for which pewter trophies were specially commissioned!

Throughout the five years of my doctoral education, my various positions at the health club, L.A. Fitness in Isleworth, have comprised a wonderfully rewarding way of financing my degree. Indeed, the strong social support that I have received and the countless special friendships that I have made at the club probably contributed even more to my fortunes than the wages I earned. The former general manager of the club, Stephanie Earle, granted me access to the gymnasium in order to collect data for the final study of the research programme and for this consideration I extend my sincerest gratitude.

I certainly undertook financial sacrifices to continue my studies, especially taking into account the very poor background from whence I originate and the lack of financial support available for post-graduate students. However, when I was no longer able to afford living in London, I was able to move back into the family home in Norwich where I resided for two years. I have my parents, Edward and Linda Holland, to thank for this kind support and I trust that I have pulled my weight around the house!

The completion of the degree would have been an impossibility had I not secured, together with Dr. Karageorghis' backing, a £13k research grant from David Lloyd Leisure in 2000. Their interest in my work, financial support, and access to health club facilities for the purposes of data collection has been invaluable. The relationship that Dr. Karageorghis and I developed with senior David Lloyd executives such as John Rickets, Nick Wake, and Nick Smith proved a very rewarding and instructive experience. More recently, the strong association that our research group has formed with Tracktones Ltd. has proved inspirational. The backing and moral support provided by Steve Parkin, who shares our vision to develop music technology in gymnasia, has really fired the research programme with purpose.

My second supervisor, Professor Craig Sharp, is as fine an example of an academic as one could wish to find. His pre-eminence in the sport and exercise sciences, laconic benevolence, encyclopaedic knowledge of human and animal physiology, and astonishing gift of communication distinguish him from all others with whom I have worked. Grandiose language aside, Craig is simply a great guy whose friendliness and good humour seem to strike a chord with all who encounter him; I consider myself very lucky to be in their number.

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DEDICATION

This thesis, or rather, the effort I expended in producing it, is dedicated to my grandfather, Fred Lowe, who passed away recently at the age of 90 years, after a redoubtable life that I should be happy and proud to emulate.

Well done Grandad!

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Introduction to the Research Programme

Ich weiβ nicht, was soll es bedeuten	I know not, what it should mean
Daβ ich so traurig bin	This fable from ancient times
Ein Märchen aus uralten Zeiten	Like to a sorrowful dream
Das kommt mir nicht aus dem Sinn,	Beyond my power to divine
Die Luft ist kühl und es dunkelt	The air is cool, the sky darkens
Und ruhig flieβt der Rhein	And quietly flows the Rhine
Der Gipfel des Berges funkelt	The peaks of the mountains sparkle
Im Abendsonnenschein	Bathed in the eve sunshine
Die schönste Jungfrau sitzet	The most beauteous maiden is sitting
Dort oben wunderbar,	Upon yonder rock so fair
Ihr gold'nes Geschmeide blitzet	Her golden jewellery glistens
Sie kämmt ihr goldenes Haar	She combeth her golden hair
Sie Kämmt es mit goldenem Kamme	With a golden comb she is combing
Und singt ein Lied dabei,	While singing a soft lament
Das hat eine wundersame	Possessed of a melody roaming
Gewaltige melodei	Through scales of enchantment
Den Schiffer im kleinen Schiffe	The sailor afloat in his vessel
Ergreift es mit wildem Weh	Seized with a wild enthral
Er schaut nicht die Felsenriffe	Beholds not the rocky reef
Er shaut nur hinauf in der Höh'	He listens but for her call
Ich glaube, die Wellen verschlingen	I fear boat and sailor are swallowed
Am Ende noch Schiffer und Kahn;	They sink 'neath the waves and are gone
Und das hat mit ihrem Singen	And this fell work with her singing
Die Loreley getan	The Loreley has done
Heinrich Heine (1824/1993)	Translation by David-Lee Priest

The fabled saga of the Loreley is testament to the power of music and its significance within human cultural life. Indeed, music is synonymous with humankind; it prevails in all cultures (Dissanayake, 1992) and in every historical period (Trehub, Trainor, & Unyk, 1993). It characterises the defining moments of our lives; the rites of the wedding, birthday, christening, and funeral. It serves to cultivate nationhood and collective identity. It inspires worship, love, thought, labour, and expressive movement. It accompanies soldiers into battle like a sonic talisman and yet it is also used to heal the sick. In contemporary western society, the burgeoning leisure industry has created a new and rapidly developing role for music within the culture of physical recreation. Thus, the possibility has arisen that music may exert a widespread influence on exercise behaviour and consequently on public health; such is the rationale for the present programme of research.

Music and physical activity share a dyadic association that originated in the athletic games of the ancient Greeks (Hohler, 1989). The annals of history and legend are replete with fables of the power of music to command the body and mind (Karageorghis, 1998). This research programme is founded on the proposition that music possesses motivational qualities. Research into the ergogenic and psychophysical effects of music has arisen from an atheoretical base (Karageorghis & Terry, 1997). However, there is now accumulating evidence that appropriately selected music can improve physical performance and enhance subjective components of the exercise experience (Atkinson, Wilson, & Eubank, in press; Karageorghis, 1998; Matesic & Comartie, 2002; Nethery, 2002; Szabo, Small, & Leigh, 1999). Moreover, researchers and exercise leaders are now able to draw on an incipient conceptual framework in addition to an inventory, which can be used to rate the motivational qualities of music: The Brunel Music Rating Inventory (BMRI; Karageorghis, Terry, & Lane, 1999).

1.1 *Music*

Music has been formally defined as “that one of the fine arts which is concerned with the combination of sounds with a view to beauty of form and the expression of emotion” (Murray et al., 1989, p.126). Umemoto’s (1990) definition of music is simpler; “the art of sound” (p. 116). Yet such definitions provide little genuine insight. Friedrich Nietzsche, the great thinker of the nineteenth century, wrote that science offers ever more exacting descriptions yet never truly explains anything (Gane & Chan, 1999). Hence, in order to comprehend the phenomenon of music we must examine not the stimulus itself, which consists of vibrations in a gaseous medium, but our estimation of it. The twentieth-century writer Herman Hesse expressed the notion that music connects us with our spirituality: "However eagerly I sought salvation, oblivion, and deliverance in many other ways; however much I thirsted for God, understanding, and peace; I always found them in music alone" (1955, p. 6).

Music transcends the machinations of the intellect and bestows a form of understanding that surpasses the barriers of language. Indeed, Beethoven believed that music contains more wisdom than any philosophy (Clynes, 1986). Music is also an epitome of beauty, which has been described as, "the quality of integrity of form that echoes, to a greater or lesser degree, the grace and elegance of the patterns of existence" (Salas, 1990, p. 4). Similarly, Clynes (1986) wrote that music enables us to become, "participants and spectators of the universal drama of existence … Both joy and sorrow have their place in this empathetic view of existence and both contribute to the sense of harmony, coexistence, and peace which we name beauty" (p. 189). Thus, beauty offers us an enlightened comprehension of the universe and our place within it. Such ideas are not recent; it is documented that the ancient Greeks and Chinese believed music to be an analogue of cosmic order (Umemoto, 1990). Moreover, idealist philosophers such as Schopenhauer contended that music occupies a unique place among the arts because it represents a direct facsimile of the fundamental energy that animates the universe, whereas the visual and physical arts are mere copies of natural phenomena (Gane & Chan, 1999). Thus, the artist does not create beauty but reveals that which is already incumbent in the natural world (Newton, 1950).

1.2 *The Research Programme*

The research programme consists of four studies that are characterised by a logical progression. The collective aim of these studies is to investigate the characteristics and effects of motivational music in exercise settings. However, the findings may also be relevant to the related domain of sport training and competition. The programme is built upon the foundation of a broad and comprehensive literature review, which reaches beyond the compass of the sport and exercise sciences. A dearth of a qualitative and naturalistic research in motivational music research is addressed through the design of the programme's first study. In this study, the inductive content analysis of interview data was used as a basis to evaluate and extend the extant conceptual framework pertaining to motivational music in exercise settings (see Karageorghis et al., 1999).

The second study of the programme involved the assessment of the motivational qualities of music in a nation-wide sample of exercise participants. An open-ended questionnaire instrument was administered to a sample derived from the members of the United Kingdom's largest health club chain (N = 532). The responses to the questionnaire were content analysed to assess whether the reported characteristics and effects of motivational music differed according to personal variables including age, sex, and the time and frequency of gymnasium attendance. Hence, the second study represented a paradigmatic shift in the direction of nomothetic approach.

The utility of a valid instrument to assess the motivational qualities of music in sport and exercise setting has been established (Karageorghis et al., 1999). However, there were sufficient concerns regarding the psychometric integrity of the Brunel Music Rating Inventory (BMRI) to warrant the re-development and validation of the instrument. Hence, the third study of the programme comprised the development and validation of the BMRI-2, a task that was accomplished through multiple phases of data collection and instrument design. The fourth study of the programme addressed the need to establish external validity in motivational music research (see Pates, Karageorghis, Fryer, & Maynard, 2003). Previously, the ergogenic and psychophysical effects of motivational music have been demonstrated only in tightly-controlled experimental settings (see Sections 2.7.5-2.7.6). The effects of a motivational music selection on the behaviour and affective states of those using a large health club were tested using a quasi-experimental design. The dependent measures included the time spent in the gymnasium and feeling states, both upon entry and exit.

The programme encompasses an array of complementary methodologies, which include naturalistic and positivistic designs as well as both qualitative and quantitative data analyses. Moreover, the programme makes an original contribution to knowledge in several ways. First, a psychometrically robust instrument is provided to rate the motivational qualities of music in exercise settings. Second, the use of qualitative research paradigms promotes an extension of the conceptual framework that underpins research into the characteristics and effects of motivational music. Third, the nomothetic methodology selected for the second study of the programme permits an assessment of the role played by personal factors, such as age and sex, in the response to motivational music in exercise settings. Fourth, the naturalistic and externally valid designs that characterise the programme were chosen to address the prevailing bias towards microscopic and experimental approaches that Karageorghis (1998) identified. Specifically, the final study of the programme comprises an investigation of the behavioural effects of motivational music in an applied setting.

1.3 *Glossary of Operational Definitions*

In order to facilitate the understanding of this programme of study, key terms relating to musicology and sport and exercise psychology have been operationally defined.

Aesthetics: The study of the response to stimuli defined as being artistic or beautiful (see Martindale, 1988). The tradition of aesthetics research is centered on Berlyne's (1971) psycho-biological theory which states that preference for an aesthetic object results from the level of arousal it evokes.

Affect: A state of mind of bodily feelings ranging on a continuum from pleasure to displeasure (Rejeski, 1985).

Arhythmic: Music or movement lacking in regular rhythmic qualities (see also *rhythm*).

Dynamics: The intensity of musical sound as determined by the touch of the musician; i.e., the relative intensity of different notes within a piece (see also *rhythm*).

Emotion: A state of feeling that, in contrast to mood (see below), is considered to be relatively brief, related to a specific object, and with specific antecedents; indeed the precipitation of an emotion in response to an event may alter an individual's underlying mood (see also Section 2.1.1).

Extra-musical association: Extrinsic information that is evoked in response to certain musical pieces or segments thereof. Such associations typically pertain to personal or collective cultural experience and may provide a channel for the emotional response to music (see Baumgartner, 1992).

Flow: An optimal state involving altered awareness and total absorption in an activity (Csikszentmihalyi, 1990).

Functional music: "Goal-orientated works, well coordinated with the tasks and specifics of the session" (Kodzhaspirov, Zaitsev, & Kosarev, 1988, p. 39).

Galvanic skin response (GSR): An assessment of arousal that involves the measurement of the transmission of electrical pulses through the skin; reduced conductivity is indicative of greater arousal.

Harmony: A musical term referring to the simultaneous combination of two or more notes. The degree of consonance present within the harmony is particularly important in determining the emotional character of the music. For example, when a dissonant combination of notes is played, the sound is displeasing (see also *minor harmony*) whereas a consonant group of notes such as those that comprise a major chord (see also *major harmony*) produce the opposite effect.

Idiom: A particular category of music featuring its own distinct characteristics. Examples of musical idioms include rock, reggae, and jazz. Idioms are also defined in terms of the cultural groups that express a preference for them, for example, reggae music is predominantly associated with Afro Caribbean culture.

Major / minor harmony: A major harmony is used to invoke a "happy" sound whereas a minor harmony refers to the combination of notes that yields a "sad" sound. There are more complex harmonies, which perpetuate emotions such as expectancy, fear, or suspense.

Melody: An arrangement of single notes in a musically expressive succession, which is often the principal part in harmonised music. Non-musicians frequently refer to the melody as the tune.

Mood: A state of mind or feeling that can be either positive or negative. Mood has been described as temporary personality and as a collection of transitory emotional or affective states (Terry, 1995). In contrast to emotion itself, mood is considered to be more enduring, unrelated to a specific object, and without specific antecedents; indeed the precipitation of an emotion in response to an event may alter an individual's underlying mood (see also Section 2.1.1).

Orchestration: The combination of instruments or instrumental sounds used in a piece of music.

Oudeterous: A Greek word that Karageorghis et al. (1999) operationalised to denote the absence of both motivational and demotivational qualities in music.

Perceived exertion: A subjective estimation of physical exertion based upon Borg's (1970, 1980) Ratings of Perceived Exertion (RPE) scale, which elicits a high correlation with heart rate and work intensity levels.

Pitch: The frequency of sound, i.e., whether a sound is played in a high (treble) or low (bass) register.

Preference: A set of values acquired by experience and prior exposure but also based on innate personal differences in appreciation. Music preference is expressed as a behavioural choice. Further, such preferences are relatively constant and independent of temporary physiological and psychological changes (see also Section 2.3).

Rhythm: The feature of music relating to the periodical accentation (see also *dynamics*) and distribution of notes.

Score: The printed manuscript on which music is notated and displayed.

Sedative music: Music of a sustained melodic nature, largely lacking strong rhythmic and percussive elements (Gaston, 1951).

Socio-cultural background: The specific mode of nurture each individual receives resulting from the social forces that he or she is exposed to during upbringing.

Stimulative music: Music which enhances bodily energy, induces bodily action, and stimulates the emotions (Gaston, 1951).

Tempo: The speed at which a piece of music is played as measured in beats per minute (bpm).

Timbre: The characteristic quality of sounds produced by each particular instrument or voice. For example, the soft and rounded timbre of the grand piano contrasts with the shrill and acute timbre of the violin.

CHAPTER 2
Review of Literature

The whole picture offered by this review and research programme contains both micro and macro perspectives. Indeed, scientists use telescopes and microscopes so they might view phenomena and there is a need for both; i.e., there is nothing telescopes can tell us about the workings of the human body just as there is little microscopes might tell us about the movements of the stars. "One of the great tragedies in contemporary [music] research is the tendency to be so overwhelmed by the meticulous parts of each fragment of study that the whole picture cannot be clearly seen" (Campbell, 1988, p. 38).

The consideration of context is pre-requisite of the apprehension of music's function (Hargreaves & North, 1999). The appraisal of music's effects in contexts such as the retail industry, advertising, music therapy, and manufacturing, provides a springboard for Section 2.7, which is focussed on the effects of music in sport and exercise settings. Indeed, a problem that has plagued music preference research is the inadequacy of literature review and the tendency to restrict such reviews to a single discipline (LeBlanc, 1991). A natural consequence of the structure of this review is that there will be a minimal amount of repetition. For example, the affective response to music is relevant to music preference, music therapy, the use of music in marketing, and the ergogenic effects of music.

2.1 *The Emotional Response to Music*

Before one can appraise the impact of music on mood, emotion, and affect in sport and exercise settings, it is necessary to consider such responses in a generic sense. Operational definitions of the constructs in question will be presented in order to provide terms of reference for the review and discussion that follows.

2.1.1 *Definitions of Mood, Emotion, and Affect*

Sloboda (1992) underlined the intuitive association that binds music and emotion, "there is a general consensus that music is capable of arousing deep and significant emotion in those who interact with it" (p. 33). To comprehend the emotional response to music it is first necessary to arrive at an understanding of emotion itself. Emotion research is beset with semantic discrepancies regarding such terms as emotion, affect, and mood. Whereas the term 'affect' simply refers to a state which ranges from pleasure to displeasure (Rejeski, 1985), the concepts of emotion and mood are more specific and expansive. Both Ellis and Moore (1999) and Frijda (1993) identified emotion as the reaction or response to a stimulus, whereas moods are theorised to be less intense, more enduring, and more general in nature than emotions.

Armon-Jones (1991) distinguished between mood and emotion on the basis of their relationships to notional objects; while emotion is anchored to a particular object, mood is not. It has been suggested that moods and emotions have a transactional relationship of mutual influence (Parkinson, Totterdell, Briner, & Reynolds, 1996). Terry (2004) invoked a meteorological analogy to describe this reciprocity between mood and emotion: An individual's temperament (predisposition) is like the climate, moods are like weather fronts that can alter the prevailing climate, and emotions reflect the brief changes than can occur such as clouds covering the sun. According to Terry's conceptualisation, personal dispositions, moods, and emotions are not really discrete; rather, they vary along a type of continuum.

2.1.2 *Music as a Symbol of Emotion*

Music inspires physical movement but it is equally recognised for its propensity to 'move' people emotionally: "It becomes possible for motion in music to imitate the peculiar characteristics of motive forces in space … and on this, as I believe, essentially depends the power of music to picture emotion" (Helmholtz, 1863, as cited in Todd, 1992, p. 3540). Sabbe (1986) wrote that music suggests the physical properties of speed, force, and energy; properties that also belong to human emotion. It has been proposed that music sounds how emotions feel; "music is a tonal analogue of emotive life" (Langer, 1953, p. 27). Moreover, Trehub and Schellenberg (1995) wrote that music mirrors the human experience of feeling, which is essentially a continuous flow of tensions and resolutions.

2.1.3 *The Communicative Function of Emotion and Music*

A small set of *primary* emotions, comprising happiness, sadness, fear, and anger, are thought to bear distinctive relationships to processes of adaptation and survival (Juslin, 1997; Plutchik 1994). Scherer (1991) proposed that one of the key functions of emotion is to allow the organism to communicate behavioural intentions to others. Thus, music has been studied as a means to emotional communication (Gabrielsson & Juslin, 1996; Juslin, 1997; Nielzen & Cesarec, 1981). For example, Clynes (1986) proposed that music was one mode of expressing "specific, spatiotemporal forms biologically programmed into the central nervous system for the expressive communication and generation of emotional qualities" (p. 169). Certain types of musical structure, such as variations in harmonic progression, tempo, timbre, and dynamics, bear innate associations to particular emotional states (Gabrielsson & Juslin, 1996; Gundlach, 1935; Juslin, 1997; Nielzen & Cesarec, 1981).

Clynes (1986) proposed that the microstructural elements of music exert a pivotal effect on the emotional state of the listener. Microstructure refers to subtle deviations from the musical score that are enacted in performance. A review of relevant findings led Bruner (1990) to conclude that fast music is typically considered happier than slow music, whereas higher-pitched music is associated with happiness and music of a lower pitch is associated with sadness. Nevertheless, the relationship between tempo and affective response is likely to be curvilinear (see Section 2.3.1). Hevner's (1935) assertion that music in minor keys conveys sadness and mystery whereas the major modality conveys happiness and lightness has never been challenged.

2.1.4 *Emotion in the Human Voice*

Eifert, Craill, Carey, and O'Connor (1988) proposed that the human voice has a unique affective impact, which transcends the meaning of the words that are sung. It has been proposed that music evolved from an impassioned form of accentuated speech (Nettl, 1956; Storr, 1993). As with music, the acoustic correlates of the primary emotions in speech are pan-cultural, whereas those of *secondary* or complex emotions (e.g., irony, indifference) differ across cultures (Murray & Arnott, 1993). The bridge between vocal emotion and music may be singing. For example, lullabies form a distinct musical genre with a clear lineage to maternal infant-directed speech (Trehub et al., 1993).

2.1.5 *Music and the Release of Emotion*

Sloboda (1992) proposed that music serves to intensify or release emotions already present in the listener: "Music does not create or change emotion; rather it allows a person access to experience of emotions that are somehow already 'on the agenda' for that person" (p. 35). Hence, the emotional response to music is individual because it depends on the emotional life of the listener. As well as their general disposition, the present state of a listener may moderate the emotional effects of the music. Indeed, It has been reported that the prevailing mood of participants prior to music listening is very important in determining their emotional response to the music (Eagle, 1971; Sloboda, 1992; Wheeler, 1985).

2.1.6 *Localised Emotional Responses to Music*

There is evidence that both emotional responses such as feelings of elation and psychophysical responses such as crying and increased heart rate (HR) can be located to exact reference points on the musical score (Sloboda, 1991). The listener perceives certain segments of the music as more emotionally laden than others; hence, each piece of music possesses an 'emotional gradient' for the listener. Both Sloboda (1991) and Waterman (1996) noted that the emotional responses to specific musical segments increase in strength over time with repeated exposure to the music. Further, localised emotional responses are not found in young children nor are they found across different cultures (Sloboda, 1992). A sense of expectancy is generated when music moves towards a climactic segment "we often know what's coming but, much as in sex, it's the build-up that makes it worthwhile. The musical content at the peak has little effect without that which precedes it" (Button, 1988, p. 534).

2.1.7 *Extra-musical Associations*

Extra-musical associations are significant determinants of the emotional response to music (Baumgartner, 1992; Button, 1988; Carroll-Phelan & Hampson, 1996; Gabrielsson & Juslin, 1996; Meyer, 1956; Nielzen & Cesarec, 1981; Payne, 1980). "Tunes linked with rich environmental information such as films, strong autobiographical or emotional events in specific limited contexts, or subjected to extensive reflection, study or analysis are likely to elicit elaborate and specific cognitive and emotional associations" (Carroll-Phelan & Hampson, 1996, p. 548). Holbrook and Schindler (1989) found that extra-musical associations are typically developed in young adulthood and stem from emotionally powerful experiences that involve others. Such experiences included attending university, going to parties, or a first sexual relationship. Indeed, the associations evoked by music may represent a form of nostalgia or "yearning for the past" (Holbrook & Schindler, 1991, p. 330).

Baumgartner (1992) found that the associations, which young adults formed with music, were typically positive in nature. The associated experiences included past or current romantic involvements (43%) and times spent with friends (21%). Hence, nearly two thirds of these associations pertained to a significant other. For example, Davies (1978) described the *darling, they're playing our tune* phenomenon, which refers to the association of a musical piece with a lover. In conclusion, Baumgartner stated that the “emotional tone ascribed to a piece of music is a function of the affective characteristics of the personal experience with which the music is associated” (p. 618). Trehub and Schellenberg (1995) posited that certain musical melodies, timbres, and styles predispose the listener to form associations. Further, Carroll-Phelan and Hampson (1996) emphasised the specific role of melody in the development of extra-musical associations. Hence, the emotional response to music is best conceived as a reciprocal interaction between internal (music structure) and external (extra-musical) factors. Tormey (1971) suggested that music has an expressive ambiguity; thus, in the absence of text, no musical piece can truly express motifs as specific as love, hate, anger, or fear. Such ambiguity may explain the tendency to attach themes of personal significance to music.

2.2 *Music, Peak Experience, and Flow*

Maszlow (1962) defined *peak experiences* in terms of a profound and mystical sense of awe and revelation. Such altered states of consciousness derive from antecedents that include sex and love, moments of discovery and creativity, natural beauty, psychedelic substances, problem solving, athletic endeavour, and music (Maszlow, 1962, 1971). Remarkably similar antecedents are thought to lead to ‘flow’ experience, which entails an optimal state of absorption in an activity (Csikszentmihalyi, 1990). In the context of music therapy, Bonny (1987) described moments of total awareness that result from great concentration or exertion; “we reach oneness with the ongoingness of life, as in sexual experience, sport, and creativity in the arts” (p. 259).

Lowis (1998) found that listening to classical music elicited peak experiences, particularly if the music was fast and arousing. Familiarity with the musical pieces was positively correlated with the number of peak experiences that were reported (r = 0.28; p = 0.02). Hence, a conditioning or preference element may predispose a peak experience response to music. Moreover, participants who reported a greater history of peak experiences reported a higher number of peak experiences while listening to the music. Thus, the predisposition to peak experiences may form a stable trait. Indeed, Maszlow (1962) theorised that individuals who have self-actualised (reached a higher state of need-fulfilment) are especially predisposed to peak experiences. In addition to a cognitive aspect, peak experiences may also entail a strong emotional component. Lowis found positive correlations between the frequency of reported peak experiences and ratings of the enjoyment evoked by the music.

The tendency to experience the sense of absorption that characterises flow state and peak experiences may be related to hypnotic susceptibility. Indeed, those who exhibit a high degree of hypnotic susceptibility "are capable of non-hypnotic experiences characterised by deep absorption and concentration, pleasure, and loss of awareness of external reality" (Snodgrass & Lynn, 1989, p. 241). Hypnotic susceptibility has been shown to influence self-reported absorption in music (Snodgrass & Lynn). Specifically, those who were easily hypnotised were found to be more absorbed by pieces of classical music than those who were less hypnotically susceptible.

2.3 *Music Preference*

Music preference can be defined at different levels of generality that range from the consideration of expansive cultural processes (Hansen & Hansen, 1991) to preference for a series of computer-generated tones (Iwanaga, 1995). However, music preference is most commonly presented as "a set of values acquired by experience, which is relatively constant and independent of changes in the physiological and mental situation" (Jost, 1982, as cited in Schulten, 1987, p. 246). Music preference pertains not only to estimations of liking but to a behavioural choice made between stimuli. Indeed, preference implies its complementary opposite, aversion; music can only be preferred when a comparison is provided.

LeBlanc's (1982) interactive theory of music preference serves to demonstrate the complex clusters of personal, musical, and cultural variables that conspire to affect the preference decision, which is construed as an active process. Cultural variables such as the influence of family, peers, and authority figures can affect the development of music preference. Such factors interact with the perceived properties of the musical stimulus itself to form the 'input information' at the base of the model. Psycho-physiological processes such as attention and the current affective state serve as gateways or filters that determine the way in which the stimulus is attended to and interpreted. Trait variables such as musicality moderate the individual's processing of the music. In the context of the theory, the outcome of exposure to music is a preference decision, which determines future exposure. Various double-headed arrows and feedback loops illustrate the way in which different processes and variables interact with each other.

Music preference research has generally been without theoretical grounds (LeBlanc, 1982, 1991). This lack is due, in part, to the internecine complexity of the relationships between the variables that may be considered. Hence, LeBlanc's attempt to formulate a viable theoretical framework lends much needed structure to a diffuse subject. However, the model may be criticised on several grounds. Karageorghis (1998) emphasised that the model is too complex to be tested empirically. While this is certainly the case, it may be possible to test the relationships posited within certain segments of the model. It could be argued that the problem of explaining music preference is so vast that LeBlanc's model represents a grossly simplified account; an ideal model would be even more complex.

Karageorghis (1998) also questioned the hierarchical structure of the model. The model appears to lean towards an organic, information processing structure (i.e., input-throughput-output), yet the interconnections between the variables are tenuous and in some cases confusing. Indeed, a completely different interpretation of the relationships between the variables may be postulated. Nevertheless, LeBlanc's (1982) conceptualisation affords an overview of the scope and diversity of factors, which affect music preference. Indeed, since the development of LeBlanc's framework, no theorist has advanced a comparable model of the factors that are thought to determine music preference.

Despite the absence of theoretical structure in music preference research, LeBlanc's (1982) theory may be contrasted to theories and conceptual models that relate to aesthetics and the response to motivational music in the context of sport and exercise. Berlyne's (1971) aesthetic theory (see Section 2.3.1) posits that preference is determined by the arousal level induced by an aesthetic (e.g., musical) stimulus. Within the context of LeBlanc's broader theory, the role of arousal is considered less prominent. *Physiological enabling conditions* such as the state of arousal merely moderate the perception of the musical stimulus rather than directly determine preference. Whereas Berlyne's theory is microscopic and relates principally to the physical properties of the musical stimulus, LeBlanc's theory is more expansive and includes many cultural and personal variables that may influence the preference decision. Further, Berlyne's framework is applicable to *instances* of musical response whereas LeBlanc's depiction relates to a *developmental process*.

The model that Karageorghis et al. (1999) developed to predict the response to motivational music in the context of sport and exercise (see Figure 2.5) may also be contrasted to LeBlanc's (1982) conceptualisation. In both frameworks, the depicted process begins with musical and cultural factors, which appear to be processed in parallel, i.e., simultaneously. Notably, within the context of sport and exercise Karageorghis et al. posit that the physical properties of the musical stimulus, e.g., rhythm or melody, take precedence over cultural factors. Further, both models lead from stimuli to a behavioural outcome and therefore approximate an input-throughput-output framework. LeBlanc's general theory incorporates personal variables such as sex, ethnic group, and age that are not included in Karageorghis et al.'s conceptualisation.

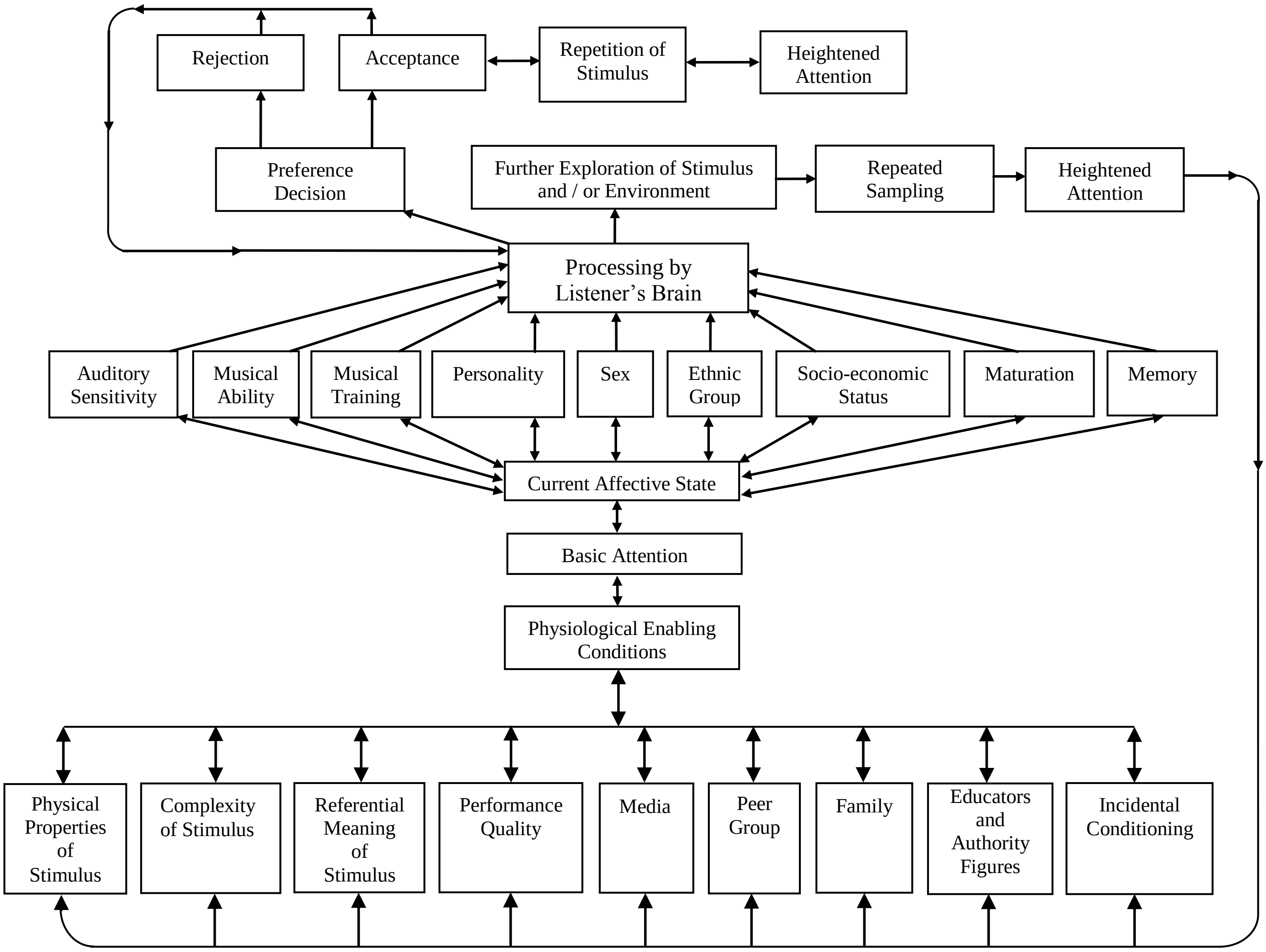

Figure 2.1. LeBlanc's (1982) interactive theory of music preference.

2.3.1 *Aesthetics*

Familiar semantic difficulties are encountered when a definition of *aesthetic response* is sought. In fact, there is no consensual definition of aesthetic response within the relevant literature (Salas, 1990). Martindale (1988) defined aesthetics as "the study of how stimuli defined as being artistic or beautiful induce dis-interested pleasure" (p. 7). Such a definition is rooted in a philosophical approach to aesthetics (e.g., Burke, 1957; Stolnitz, 1960), whereby aesthetic pleasure is deemed to be disinterested because the aesthete is not motivated to take ownership of the stimulus or use it. Hence, Martindale's perspective is a cognitive one, for the aesthetic response is cast as mild and subtle in contrast to the 'hedonic' or affective response. This distinction is echoed in research on the subject of well-being, which is polarised around the opposing concepts of hedonism and eudaimonsim (see Ryan & Deci, 2001 for review); whereas *hedonism* represents the pursuit of pleasure as the apotheosis of well-being, *eudaimonism* refers to the fulfilment of human potential and the realisation of meaning. Hence, the aesthetic response to music may be characterised as a eudaimonic one when viewed through the lens of a cognitive perspective.

Definitions of aesthetic response are typically anchored to the notion of 'art' or 'beauty' (e.g., Hargreaves, 1986) and therein lies their flaw. For example, Martindale's definition of aesthetics (above) is not self-sufficient because it is contingent on 'beauty', a concept that he does not attempt to define. A route through the conceptual confusion surrounding the term 'aesthetics' can be found through examination of the tradition of aesthetics research. It is apparent that aesthetic research in the music domain is characterised by work that links structural variables of music with estimations of liking or *preference* (e.g., Berlyne, 1971). Hence, aesthetic research does not consist of investigations of what we find beautiful or artistic but investigations of what we like. The resultant equation between aesthetics and preference is not an ungainly one; it may be that we like what we deem to be beautiful. For example, there is a strong correlation between estimations of artistic merit and preference made in respect of different types of popular music (North & Hargreaves, 1998b).

2.3.2 *Berlyne's Aesthetic Theory*

The most influential of the aesthetic theorists was Berlyne (1971). His work owes its theoretical lineage to Wundt (1905), who proposed that pleasure is related to stimulus intensity in a curvilinear fashion. The Wundt curve (see Figure 2.2) represents the effects of 'general' arousal on both the pleasure and displeasure centres of the brain (Martindale, 1984). It was proposed that the pleasure centre has a lower activation threshold than the displeasure centre (see Figure 2.2). Thus, moderate levels of arousal generate more pleasure than displeasure. Berlyne proposed that arousal potential was determined by four properties, three of which relate to the focal stimulus:

1) The *psychophysical* properties of the stimulus comprise informational characteristics of the musical stimulus such as intensity and pitch.
2) *Collative* properties refer to the collation of the informational aspects of the stimulus, typically with prior expectations. Hence, collative properties such as novelty, complexity, and form are relative judgements.
3) *Ecological* properties refer to associations that the stimulus carries, which imbue it with meaning.
4) The arousal potential of *non-focal stimuli* is hypothetically added to that of the focal stimuli. For example, if an individual were attending to a picture (focal stimulus) in a gallery, the other pictures within his/her field of vision would constitute non-focal stimuli.

Berlyne proposed that the collative properties are the most salient. Hence, the hallmark of Berlyne's theory is that aesthetes prefer moderate levels of collative properties.

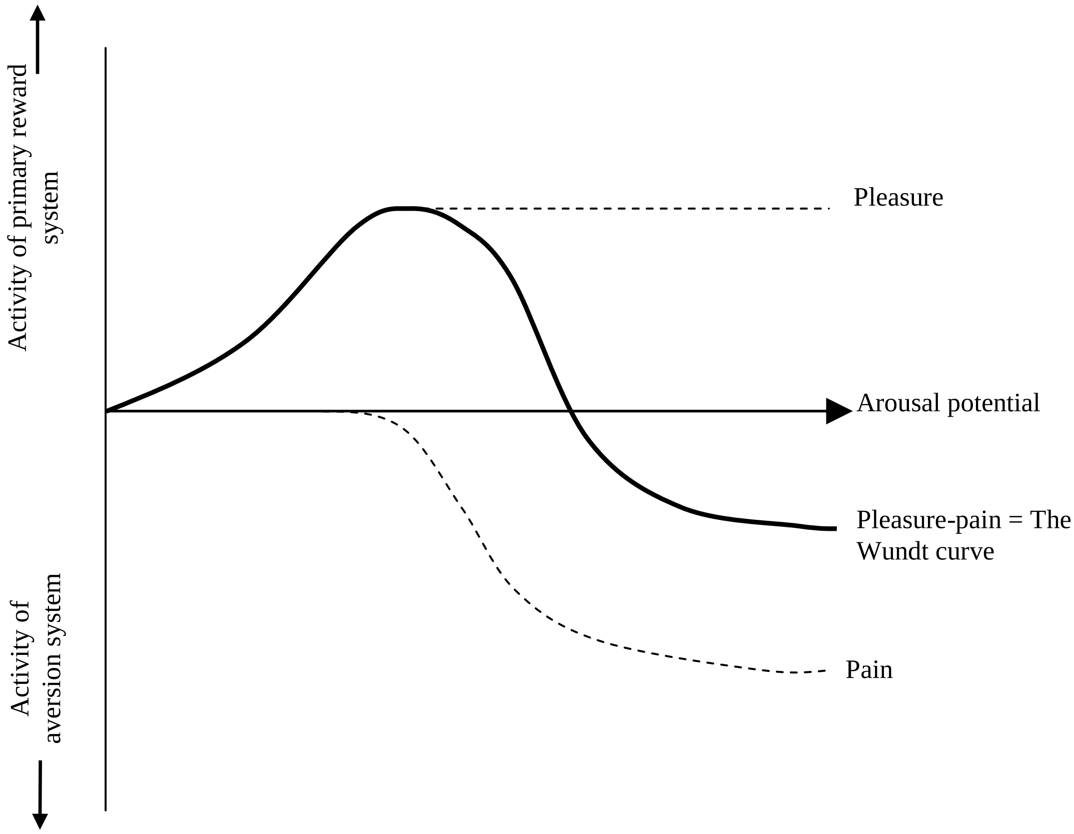

Figure 2.2. The Wundt curve.

Of the psychophysical variables, tempo is considered the most significant determinant of musical response (Brown, 1979; Budd, 1985; Hevner, 1935). When provided with a choice in terms of musical tempo, a preference is expressed for fast pieces (Finnas, 1989; LeBlanc, Colman, McCrary, Sherrill, & Malin, 1988; LeBlanc & Cote, 1983; LeBlanc & McCrary, 1983). Indeed, when permitted to manipulate the tempi of classical pieces, college students selected higher tempi than the original recordings (Wapnick, 1980). Further, a fast or ‘upbeat’ tempo was identified as a contributing factor to music preference in a factor analysis (Robinson & Fink, 1996) and a multidimensional scaling analysis (Tekman, 1998).

Berlyne (1971) predicted a curvilinear relationship between preference and tempo, an assertion that was borne out by the review of Bruner (1990). However, preference for tempo may be affected by the physiological arousal of the listener and the context in which the music is heard (see Section 2.7.5.3). Further, neuropsychologists assert that preferred tempo may be influenced by the optimal speed at which humans can process rhythmical stimuli (Carroll-Phelan & Hampson, 1996). Fast tempi and strong rhythms may contribute to preference because they are stimulative properties (see Gaston, 1951). Hence, Berlyne (1971) appears to be correct in the assertion that the arousal potential of stimuli determines preference.

A curvilinear relationship has been reported between preference and collative variables such as complexity and redundancy (McMullen 1974; Radocy, 1982; Vitz, 1966). However, contrary examples abound (see Finnas, 1989 for review). Indeed, Stevens and Latimer (1991) speculated that preference is determined not simply by the complexity of music but by higher-order interactive features such as the coherence of rhythm and tonality.

The relationship between ecological variables and preference has received minimal research attention. Konecni (1982) proposed that music which is deemed to be *appropriate* for the listening context will be preferred, an assertion that was supported by North and Hargreaves (1996b). Berlyne was unable to present any convincing evidence to support his assertion that ecological variables exhibit a curvilinear relationship with preference. Indeed, ecological variables have consistently demonstrated a positive linear relationship with preference (see Marintdale, 1988 for review). Hargreaves and North (1996) found that music preference differed markedly across 17 different listening situations (e.g., motorway driving, jogging with a walkman, making love, etc.). Further, the emotional character of the music that was preferred in each situation was associated with the emotional character of the situation itself. The authors concluded that situation-specific music preferences are determined by the optimal level of arousal that a given situation requires (see also Holbrook & Anand, 1990; North & Hargreaves, 1997).

Research has supported the conclusion that collative variables are far less salient than ecological and psychophysical variables (Martindale, 1984). A further weakness in Berlyne's (1971) conceptualisation was highlighted by Martindale; the collative, psychophysical, and ecological properties of music appear to be confounded rather than orthogonal. Berlyne's theory suggested that the arousal potential of different stimuli is added together. However, research has confirmed that a *contrast effect* occurs, whereby a pleasant stimulus induces greater pleasure when preceded by a less pleasant stimulus (Cantor & Zillman, 1973; Martindale 1984). The same is also true in reverse, i.e., an unpleasant stimulus is less favourably evaluated if preceded by a more pleasant stimulus. Whereas Berlyne (1970) theorised that the repetition of a stimulus should reduce preference, Stevens and Latimer (1991) found that the complexity of a musical piece determines the effects of repetition on preference: When repetitions of a musical piece are interspersed with other pieces then repetition does not reduce preference.

Martindale (1988) advanced a strong critique of Berlyne's psychobiological aesthetic theory. Specifically, Martindale questioned the putative role of arousal in determining preference. First, Berlyne did not account for the fact that arousal is a multidimensional construct (see Lacey, 1967). Second, although stimuli may generate similar levels of arousal, they may not be equally preferred (Dowling & Harwood, 1986). For example, a lottery win or bad news may lead to similar levels of arousal but very different experiences in affective terms. The emotional and affective components of musical response have been shown to moderate preference (Tekman, 1998).

2.3.3 *Cognitive Models of Music Preference*

The process of responding to a musical stimulus is hierarchical in nature (Martindale, 1988). For example, the simultaneous sounding of two notes would activate two specific cognitive units relating to these notes that would, in turn, lead to the activation of a higher-order unit relating to a specific kind of harmony. At the highest level of abstraction, a piece of music may lead to the activation of over-arching cognitive units that determine the meaning of the piece to the individual listener. Martindale theorised that higher-order cognitive units, which relate to 'meaning' are more salient, both in terms of preference and memory, than the perceptual details of the stimulus. Hence, Martindale's stance is an inversion of Berlyne's perspective, which was focussed on perceptual details rather than an overall sense of style or 'meaning'.

Extra-musical association may be explained in cognitive terms. "Activation of a stored representation will, in turn, lead to co-activation of information in a general purpose associative memory, allowing semantic, episodic, autobiographical, and emotional information to be related to the stimulus" (Carroll-Phelan & Hampson, 1996, p. 520). Repeated exposure to a stimulus results in either the fatiguing or the adaptation of cognitive units (Schubert, 1996). Hence, music that is frequently repeated loses its novelty as the stimulation threshold of the relevant cognitive units rises. The adaptation of the units may explain the development of personal preference for a piece. Conversely, the prolonged absence of a musical stimulus will promote the decay of the units' response.

2.3.4 *Prototypes and Music Preference*

Prototypes are highly representative exemplars of the category to which they belong (Rosch, 1973). For example, English people may find *God Save the Queen* a prototypical anthem. From a cognitive perspective, a prototype is more likely to activate a super-ordinate cognitive unit. For example, 'dog' is more likely to activate the cognitive unit that represents 'animal' than 'aardvark'. Whitfield (1983) developed the preference for prototypes model, according to which, the more typical an exemplar is of a category, the more likely it is to be preferred. Conversely, Smith (1997) proposed that preference is determined by optimal deviations from a prototypical form. Martindale and Moore (1988, 1989) suggested that the more typical a piece of music is in a given situation, the more likely it is to be preferred. Hence, music preference in sport and exercise contexts may result from a conditioning process.

The formation of a prototype as the average of learned instances is known as an *arbitrary* prototype whereas *natural* prototypes are biologically predetermined (Rosch, 1973, 1975). Examples of natural musical prototypes include the triad of tones that constitute a major chord (Cohen, Thorpe, & Trehub, 1987) and the distance of seven semitones between two notes that is referred to as the perfect fifth interval (Trehub & Unyk, 1991). Jones (1990) posited that *ideal* prototypes would result from experience but may be based on biological predispositions.

2.3.5 *Preference and Evolution*

Kogan (1994) developed the argument that all aesthetic judgements stem from sexual selection, a process that is highly dependent on preference judgements (Langlois, Ritter, Roggman, & Vaughn, 1991; Singh, 1993; Symons, 1987). The preference response may have an evolutionary function outside the context of sexual selection. For example, judgements regarding the edibility of food may require a visual assessment; there is an adaptive value in avoiding poisonous food. Notably, music preference is commonly described using the word 'taste' (Price, 1986). If music preference and the appreciation of beauty are inextricably linked to adaptive significance then the notion of beauty for beauty's sake is questioned (Kogan, 1994); is any aesthetic response really disinterested?

2.3.6 *Personal and Cultural Variables*

There does not appear to be a marked difference in general music preference between the two sexes (Abeles, 1980; Finnas, 1989; Wapnick 1976). However, males may prefer the stimulative qualities of music, such as exaggerated bass (McCown, Kesier, Mulhearn, & Williamson, 1997) and high intensity (Finnas, 1985, as cited in Finnas 1989; Kageyama, 1999). Further, traditional gender stereotypes affect preferences for music (Finnas, 1985, as cited in Finnas, 1989) and sounds (Kageyama, 1999). Music preferences are thought to differ across ethnic and racial groups (DiMaggio & Ostrower, 1990; Robinson & Fink, 1990). However, scant evidence has so far been amassed to support such intuitive propositions.

Personality traits have often been associated with music preference (Finnas, 1989). For example, the stimulative qualities of music have been linked with extraversion (Banks, Fucci, Petrosino, Leach, & Christopher, 1994; Dollinger, 1983; McCown et al., 1997) and sensation seeking (Litle & Zuckerman, 1986; Zuckerman, 1979). Further, conservative individuals prefer music that is familiar and low in complexity (Glasgow, Cartier, & Wilson, 1985). LeBlanc (1982) highlighted the importance of a trait akin to musicality in the formation of music preference; “a native talent to create, analyse, or perform music without the benefit of instruction” (p. 36). Whereas musical training is confounded by other variables such as socio-economic status and education, musicality is not.

There are strong relationships between music preference and age (Smith, 1994, as cited in Mark, 1998). Based on American survey data, Robinson and Fink (1996) concluded that the preference for different musical idioms is related to age in a curvilinear fashion. For example, preference for classical music reached a peak in those aged between 55 and 64 years, whereas preference for soul music was greatest in those between the ages of 25 and 34 years. The authors noted that age interacts with the variable of educational status. Hence, as individuals grow older they become more educated; in many cases their socio-economic status also improves. The importance of the teenage years in the development of music preference is paramount (Finnas, 1989). Such formative preferences continue to appeal to a cohort as it ages, “working their way through history like the devoured prey that passes through a snake” (Robinson & Fink, 1996, p. 238). Indeed, different styles of music attain popularity in different eras, thus contributing to the relationship between age and music preference.

A broad perspective is offered by Schulten (1987), who proposed that the formation of preferences in early adulthood is determined by a search for identity, whereas older individuals view their music preferences as “a concomitant of their life’s history” (p. 165).

Shared music preference can be the most distinguishing feature of diverse cultural groups within society. Thus, music can be integral to the formation of identity; whether at a cultural or an individual level. For example, the performance of anthems defines group membership through a process of symbolic inclusion and exclusion. Frith (1996) articulated that music is not merely an expression of identity; rather, it is an identity in itself. Identity is deemed to be a fluid process: “By listening to music we’re experiencing ourselves in a different way” (Frith, 1996, p. 109). Through affiliations with artists and other music fans, different identities are appropriated: “Within the one person there are a million types of personas according to the environment you’re in” (O’Brien, 1991, p. 100). Further, identities reflect who we would like to be or the social group we aspire to join, not necessarily who we are (Russell, 1997).

The popular musical arts are appreciated by those from different socio-economic strata in equal proportion, whereas the likes of opera, symphony, and ballet are attended almost exclusively by those of higher socio-economic status (DiMaggio & Useem, 1978). The role of music may be one of *cultural capital* or symbolic wealth that people seek to possess (Bordieu, 1977). Hence, music may serve as a marker to demonstrate higher social status. However, the traditional distinctions between classical and popular music forms have become blurred (Robinson & Fink, 1996). For example, artists formerly synonymous with popular music, such as Sir Paul McCartney, are composing symphonic music. Peterson (1992) proposed the concept of omnivorous and univorous cultural consumption: Those of higher socio-economic standing participate in all art forms, including those associated with the lower classes; they are, therefore, referred to as omnivores. Conversely, lower-status individuals participate in a more limited number of art forms; they are referred to as univores. Mark (1998) postulated that different styles of music compete for the limited attention and resources of listeners. Hence, it may be that univores experience greater demands on their time, energy, and financial resources than omnivores.

Mark (1998) considered that music preference is determined by the interaction of socio-demographic dimensions such as age, occupational prestige, education, and annual family income, which can be plotted in three-dimensional social ‘space’ (see Blau, 1993). Hence, each music form will typically be preferred by those from a specific ‘niche’ within social space. Indeed, Mark maintained that the transmission of preferences occurs predominantly between people who interact socially. LeBlanc (1982) emphasised the antagonistic factors that can affect the transmission of music preference. For example, preference can often develop in opposition to authority figures such as parents.

A concomitant of the close relationship between social groupings and music preferences is the association between such preferences and socially held values: “Music preferences are meaningful markers of social attitudes” (Hansen & Hansen, 1991, p. 346). An individual’s personality type predisposes them to prefer a music form that is congruent with their perception of social reality (Stack, Gundlach, & Reeves, 1994). For example, identification with the anger, fear, hopelessness, and despair inherent in heavy metal music is the most common reason that fans cite for listening to it (Wooten, 1992). An alternative perspective is that a music form such as heavy metal may shape the attitudes and beliefs of its consumers rather than merely responding to them (Sherman & Dominick, 1986). Such opposing perspectives were reconciled by Hansen and Hansen, who proposed that music listeners and music are mutually influencing.

2.4 *Physiological Responses to Music*

Research into the physiological effects of music is typically focussed on the same distinction between stimulative and sedative music that prevails in the domain of music and exercise research. The effects of sedative and stimulative music on HR are inconsistent (Iwanaga & Tsukamoto, 1997). In some cases, music has not affected HR (e.g., Fontaine & Schwalm, 1979; Zimny & Weidenfeller, 1963), whereas other findings support the conclusion that musical stimulation *per se* increases HR (e.g., Ellis & Brighouse, 1952; Iwanaga & Tsukamoto). Fontaine and Schwalm reported that familiar music significantly increased HR when contrasted with unfamiliar music. Thus, the personal interpretation of a musical piece may moderate the physiological response. Ellis and Brighouse reported a mean increase in HR in response to listening to various types of music. However, a case-wise analysis demonstrated that the HR of some participants rose, whereas, in other cases it fell.

The galvanic skin response (GSR) is a measure of the electrical conductivity of the skin that may be used as an index of physiological arousal; reduced conductivity is indicative of greater arousal. Stimulative music has been shown to elicit a reduction in GSR, whereas, sedative music exerted the opposite effect (Zimny & Weidenfeller, 1963). Wilson and Aiken (1977) tested the effects of successive bouts of rock music or white noise on GSR. Both conditions led to a reduction in GSR. This effect was stronger in the music condition, although not significantly so. Ellis and Brighouse (1952) tested the effects of three musical selections on respiratory rate (RR). The selections were characterised as subdued jazz, dynamic classical, and smooth classical. The dynamic classical piece led to the greatest increases in RR.

Researchers have concluded that HR and other physiological indices are ineffective when used to measure the emotional effects of music (Iwanaga & Tsukamoto, 1997; Yanagihashi, Ohira, Kimura, & Fujiwara 1997). Subjective measures are thought to be of far greater utility when the aim is to investigate emotional effects (Wilson & Aiken, 1977).

2.5 *Music in Context*

Hargreaves and North (1999) emphasised the significance of the social context in which music is heard. Indeed, music has become prevalent in the informal situations that pervade our lives (Konecni, 1982). Therefore, it is important to consider context when appraising the meaning of music. These contexts include music therapy, manufacturing, the retail industry, advertising, and the frame of this thesis: exercise and sport.

2.5.1 *The Effects of Music on Manual and Cognitive Tasks*

Uhrbrock (1961) reviewed the use of music in a manufacturing environment and drew the conclusion that music provision does not necessarily increase productivity. Indeed, Uhrbrock reported that music may impair performance either due to annoyance or by virtue of a distraction effect. Fox and Embrey (1972) found that music led to enhanced performance in repetitive tasks but only if the music was introduced after arousal had peaked. Music that was delivered throughout the tasks led to no improvements in efficiency. The utility of music in improving output is partly determined by the nature of the task in question: The performance of simple or repetitive tasks is aided by background music (Bailey, Patchett & Whissell, 1978; Richman 1976). This effect may be attributable to the propensity of music to alleviate tension and boredom during such tasks (Smith, 1961). Similarly, the effects of music on cognitive task performance depend on the exact nature of the task. For example, sedative music appears to improve performance in short-term memory tests (Smith & Morris, 1977) and reading comprehension tests (Kiger, 1989). Conversely, stimulative music aids performance in vigilance tests (Corhan & Gounard, 1976; Fontaine and Schwalm, 1979).

2.5.2 *Music and the Perception of Time*

The subjective assessment of time is an issue that is germane to many retail and service contexts including gymnasia. Isen (1993) contended that when mood is improved, both cognitive function and motivation to process information are elevated, thus leading to the overestimation of time durations. Conversely, Schwarz and Bless (1991) suggested that positive mood states promote a lack of logical consistency in cognitive processes and a low attention to detail. Hence, positive mood may impair estimations of elapsed time. Wansink (1992) proposed that the perception of time is reduced by feelings of comfort, which are related to positive affect; a perspective that mirrors the intuitive proposition 'time flies when you are having fun'. Notably, an important constituent of the flow experience is the transformation of time (Csikszentmihalyi, 1990). In summary, the affective experience of the time spent in a given setting may prove more significant than estimations of the duration of this time.

Zakay (1989) proposed that time perception is related to the number of discrete events that are perceived within a given timeframe; if all other factors are equal, a greater number of events will occupy more time. In concordance with Zakay's proposition, Kellaris and Altesch (1992) found that fast music increased the perception of time when compared to slow music. However, North, Hargreaves, and Heath (1998) found that fast music did not increase perceptions of time in a gymnasium context when compared to slow music. Changes in the attentional state of the participants induced by exercise may have nullified the effects of musical tempo on time perception.

2.5.3 *Music and Memory*

Material that is learned in a particular context is best recalled, recognised, or expressed in a matching environment (Waterman, 1996). For example, Balch and Lewis (1996) found that sequences of words were best recalled in the presence of music that was the same speed as music, which was heard during the learning of the words. Kenealy (1997) used classical music selections to induce either positive or negative mood states during the learning and recall of a map. The participants who learned and recalled the map in different mood states showed greater decrements in recall than those who learned and recalled the map while in the same mood. Notably, such *mood-congruency* effects have been shown to be greater in women than men (Clark & Teasdale, 1985).

Boltz, Schulkind, and Kantra (1991) found that the plot outcomes of short films were recalled more accurately when accompanied by music that was semantically congruent (positive or negative valence) with the outcome. Bargh (1988) postulated that memory is divided into two networks; one for negative information and the other for positive information. These two networks are thought to inhibit each other. Thus, it is difficult to retrieve information that has a negative valence when one is experiencing a positive affective state.

2.5.4 *Effects of Music on the Evaluation of Additional Stimuli*

If music is delivered in tandem with additional stimuli, then the qualities that are ascribed to the music may influence the perception of these other stimuli (Bolivar, Cohen, & Fentress, 1994). The marriage of audio and visual stimuli is essential to the impact of cinema and television. In particular, music television has become increasingly prevalent in physical activity contexts. Since the seminal work of Kaplan (1987), music television has been the subject of much critical analysis from a sociological perspective. Concurrently, psychologists have investigated the interaction between music and film using an experimental approach. For example, it has been demonstrated that viewers engineer a cognitive interpretation of an ambiguous video scene, which corresponds to the 'feeling' of the accompanying music (Bolivar et al., 1994; Cohen, 1993). Marshall and Cohen (1988) emphasised that significant events in a musical score will draw attention to visual events, which occur simultaneously. The term that describes this effect is *temporal congruency*. Conversely, Boltz et al. (1991) emphasised the importance of the *semantic congruency* between music and film, which was thought to prime attentional processes. Indeed, Bolivar et al. (1994) found that semantic congruence is a more significant determinant of the response to dual stimuli than temporal congruence.

May and Hamilton (1980) reported that music styles of differing affective valences altered evaluations of male attractiveness and personal qualities made by female students who were presented with photographic representations of the males. Rock music (positive affect) led the participants to impute greater attractiveness to the pictured males. Similarly, music is thought to influence the interpretation of advertisements principally through the induction of moods (Alpert & Alpert, 1990; Bruner, 1990). It has been theorised that the affective component of a musical piece may transfer onto a brand or product (Stout & Leckenby, 1988). In particular, both music in a major mode and fast music led to a more favourable evaluation of the advertisements that they accompanied (Stout & Leckenby, 1988).

Within the context of retail, North and Hargreaves (1998a) found that the perceived qualities of music transfer onto the evaluation of the listening environment. The delivery of popular music led diners to regard a university cafeteria as upbeat and aggressive, whereas classical music created the perception that the cafeteria was ‘up-market’. Potentially, music may affect the evaluation of a physical training environment such as a gymnasium.

From a cognitive perspective, the effects of music in relation to other stimuli may be explained by the tendency of a stimulus to ‘prime’ or partially activate related cognitive units (Martindale, 1988; see Section 2.3.3). In particular, Hermans, DeHouwer, and Eelen (1996) found that when music induced an elated mood, participants were more able to quickly identify positive images that were presented to them. The authors concluded that the improved response latencies were attributable to the operation of a motivational affect system, which promotes aversion to negative stimuli and preference towards positive stimuli. Such a system may bear some relation to the networks of positive and negative memory described in the previous section (2.5.3).

2.5.5 *Music and Behaviour*

Music has been shown to influence product choice and spending in a retail environment. In particular, fast music has been shown to increase walking speed in a supermarket (Milliman, 1982) and reduce eating time in a restaurant (Milliman, 1986) when compared to slow music. Further, slow music may increase the time spent in retail settings and thus provide longer opportunities for consumers to purchase items (Milliman, 1986). North and Hargreaves (1998a) reported that the type (idiom) of music that was delivered in a university cafeteria affected sales and the amounts that diners were willing to pay for food.

Alpert and Alpert (1990) found that sad music encouraged the purchase of greeting cards more so than happy music. Further, Areni and Kim (1993) reported that when delivered in a wine store, classical music encouraged greater purchase of wine than top-40 popular music. This result was attributed to the perceived congruence between the sophistication of classical music and wine drinking. Hence, classical music may have the propensity to prime knowledge structures that relate to affluence (North & Hargreaves, 1998a).

North, Hargreaves, and Kendrick (1997) found that French classical music improved the sale of French wine; whereas, German classical music had a similar effect on the sale of German wine. The customers in the wine store reported that they were unaware of the effect that the music had on their product choice. North and Hargreaves (1996a) found that preference for background music in a cafeteria predisposed diners to return to the setting. Additionally, preference for the prevailing music selection was positively correlated with participants' estimations of their willingness to interact with others. The propensity of music to promote social interaction and facilitate positive evaluations of others (see Section 2.5.4) may partly explain the ubiquitous presence of music in night clubs and public houses.

Music has been used as a conditioned stimulus in behavioural interventions. For example, Lowe (1973) made use of the stimulative properties of rock music to disinhibit an individual, thus counter-conditioning his public speaking phobia. Conceivably, the disinhibiting properties of stimulative music may be of utility in the exercise arena. For example, females are particularly prone to social physique anxiety in gymnasium contexts and this tendency may negatively impact upon their exercise behaviour (Yin, 2001). Eifert et al. (1988) used preferred music to counter-condition the animal phobias of six female participants. The intervention led to decreased estimations of fear in respect of the feared animals.

2.6 *Music Therapy*

The use of music as palliative and curative agent is as old as civilisation (Vandenberg, 1982). However, the twentieth century saw a renewed focus on the therapeutic uses of music; "when the therapeutic value of music is understood and appreciated, it will be considered as necessary in the treatment of disease as air, water and food" (Vescelius, 1918, p. 376).

2.6.1 *Music and General Health*

Ilsen proposed that “the vital functions of the body are all rhythmical when in a state of perfect health” (1926, p. 15). Similarly, Aldridge (1989) suggested that the principal link between music and health is rhythm. The high incidence of coronary heart disease in western cultures may be an accumulative stress response to the ubiquitous imposition of externally imposed (non-biological) time schedules and deadlines (Aldridge, 1991). Tempo is related to the pathology of certain conditions. For example, the incidence of hypertension is associated with individuals who speak quickly (Friedmann, Thomas, Kulick-Ciuffo, Lynch, & Suginohara, 1982). Fast speech is also a trait of type-A individuals, who are more prone to coronary heart disease (Aldridge, 1991).

Emotions are significant determinants of health and the quality of life (Hammer, 1996). Indeed, Vaillant (1979) found that the incidence of physical illness was predicted by various psychosocial and psychiatric factors. Thus, the emotional effects of music may promote good health. The physiological mechanism through which emotional state impacts upon health is thought to be hormone secretion (Hammer, 1996). Berry and Pennebaker (1993) discussed the links between music, health, and self-expression: Contemporary social constraints result in the inhibition of emotional expression. The persistent internalisation of emotion, particularly following a traumatic event, may lead to health problems in some individuals. Thus, the therapeutic utility of music may lie in its proclivity to facilitate emotional expression.

2.6.2 *Music and Mental Health*

Music can provide a vessel for self-expression and a means through which psychic trauma can be relieved. Music listening evokes fantasy and imagination, which prime expressive modes of thinking (Hilgard, 1974). Bonny pioneered a method of guided imagery and music (GIM) that harnessed the propensity of music to elicit imagery in a therapeutic setting (Hammer, 1996). Maack and Nolan (1999) found that GIM therapy allowed people to become more conversant with their emotions, gain insights into their problems, experience spiritual growth, relax, and discover new aspects of themselves. Further, Blake and Bishop (1994) reported that the imagery promoted by music in a therapeutic setting helped the participants to forge a link between their conscious and unconscious minds.

Ulfarsdottir and Erwin (1999) reported that a programme of music therapy improved the cognitive skills that are thought to underlie social interaction. Specifically, music provides a means of communication for those whose lingual faculties may be limited (Aldridge, 1989). Salas (1990) reported that musical improvisation led to improvements in the self-esteem of disturbed children; they were able to add artistic sensibility to their somewhat barren self-concepts.

The different facets of musical sound are personified in therapy. For example, a tick-tock rhythm may represent compulsive behaviour, whereas harmony may depict the resolution of different psychic forces (Volkman, 1993). Worden (1988) documented the negative reaction of abuse survivors to the strong rhythmical components of jazz music, which were described by one participant as unyielding. In this case, the rhythm may have been personified as an aggressor.

Thaut (1989) proposed that the emotional impact of music may be utilised to reverse the negative conditioning, which occurs when emotions become attached to unhealthy behaviours. Emotional literacy is a significant aspect of many psycho-pathologies. Consequently, music can facilitate healing by promoting the experience, identification, and expression of emotion (Salas, 1990; Thaut, 1989). Further, the accessibility of positive memories and cognitions may be increased by music that yields a positive affective response (Sutherland, Newman, & Rachman, 1982; Section 2.5.3).

2.6.3 *Music and Pain*

Pain is acknowledged to have a strong psychological component (Brown, Chen, & Dworkin, 1989). Hence, music has been used as an analgesic (Eagle & Harsh, 1988). For example, music has been used to distract patients from the symptoms of discomfort that accompany cancer treatment (McCaffrey, 1990). Further, Gardner and Licklider (1959) reported that music served as an auditory analgesic during dental procedures and thus reduced the need for exogenous pain-killers. Indeed, music has frequently been used to reduce the need for anaesthesia during invasive procedures (Taylor, 1981).

Music is thought to mitigate perceptions of pain by evoking positive associations or diverting attention away from discomfort (Hanser, Larson, and O’Connell, 1983). Such effects are also reported in relation to the unpleasant sensations of fatigue that accompany physical activity (see Sections 2.7.3.1 &

2.7.3.3). The anxiolytic effects of music may be mediated by beta-endorphins; hormones that accompany stressful events (McKinney et al., 1997).

2.7 *Music in the Contexts of Exercise and Sport*

2.7.1 *Sociological Perspectives*

Music is woven into the fabric of many social institutions and plays a defining role in gatherings such as weddings, funerals, and parties (Crozier, 1997). Indeed, “music fulfils the whole scala of important social and cultural functions: assembling, unifying, manifesting, monumental, representative, symbolic” (Hohler, 1989, p. 41). Much as music reinforces military, matrimonial, and religious practices, it lends a spiritual significance to sport itself. Music can enhance the mythic qualities and ideals of sporting contest, “it [music] differentiates sport action from the stereotypes of everyday life and takes the spectators into the world of play and imagination” (Hohler, p. 41).

Barker (1986) documented the historical association of music with sport, recalling the many musical pieces and songs that have been written for and about sport. In fact, certain sports and performers are now synonymous with a musical piece. In Australia, the association between sport and music has been formalised through the collaboration of the Australian Institute of Sport and the Australian National Academy of Music in Melbourne (Shireffs, 2001). The collaborative programme, founded in 2001, is entitled Excellence Squared and its directives include applying techniques developed through the sport sciences to assist the performance of musicians and the composition of musical pieces by academy musicians to facilitate the performance of athletes in specific events. In the media, sport has become fused with music into a form of entertainment; this is exemplified by the music titles, which envelope sporting coverage on television, and by the edited footage of sporting performances that is set to music (Barker, 1986).

Functionalists have argued that music is a tool used by those who wish to reinforce the institutional role of practices such as sport and religion; thus preserving certain hegemonic relationships within society (Horkenheimer & Adorno, 1944/1972). The emotive qualities of music may be selectively exploited to strengthen and reproduce dominant cultural structures, ideologies, and practices such as religion, political frameworks, and nationalism (Edgewater, 1999). For example, Jones and Schumacher (1992) documented the use of background music by the Muzak

Corporation to increase the productivity of factory workers.

Functional music was defined by Jones and Schumacher (1992) as “music used principally to support and encourage some other primary activity, whether the production and consumption of goods and services or the reproduction of social and symbolic order in public spaces” (p. 166). The concept of music as a social force that is open to manipulation inevitably incurs some consideration of the issues of control and power (Edgewater, 1999); who decides which music will pervade public spaces and whose interests are being served therein? Such concerns clearly have a bearing on the current programme of research. Functionalists would assert the value of popular music in purely commercial terms, its function being to sell. However, from the perspective of the listener, popular music achieves popularity because it has personal reverence, “pop value is thus dependent on something outside of pop, it is rooted in the person” (Frith, 1996, p. 120-121). Hence, the functionalist perspective is limited in its explanatory merit.

Tolleneer (1986) proposed that the sport and popular music *scenes* are similar social sub-systems with analogous structure and functions. The fundamental functions shared by sport and popular music include mythology, heroism, escapism to compensate the monotones of devalued social contact, a form of play, contemporary ritual, and identity. To some extent, both popular music and sport have usurped the role of traditional religion and mythology (Tolleneer, 1986). The functions of exercise are suggested here as a point of comparison to those of popular music and sport. Exercise fulfils little that is artistic, but it does represent a form of play (see Huizinga, 1950) or involved distraction, much as music and sport do. However, there are marked extrinsic as well as intrinsic motivations to exercise; a statement that cannot be as easily levelled at music consumption. Hence, the presence of music in the exercise arena could be seen to obviate the absence of other intrinsic benefits and to bolster the extrinsic ones.

The view could be taken from the study of manufacture that music personalises the workspace of the gymnasium, lends a touch of the domestic and personal, thus blending work with leisure (Jones & Schumacher, 1992). Indeed, adolescents use popular music to relieve the boredom of homework, cleaning, and driving (Gantz, Gartenberg, Pearson, Schiller, 1978). Hence, the monotony of exercise is something that might require *compensation* by some form of escapism. The purpose of music in exercise would therefore be to enhance the ritual, mythology, and ideology, which are present in minimal amounts.

Music provides an orthodox bridge between sport and nationalism through the medium of the national anthems that are performed prior to many notable sporting events (McCallum, 1996). The rendition of a national anthem prior to a sporting contest has a hostile undercurrent in that members of one group are proclaiming their virtues to those who are excluded from the group. The New Zealand rugby union team invoke a famous variation on the theme of singing a national anthem prior to competition (Jackson & Holowhitu, 2002). The All Blacks, as they are known, perform a Maori tribal chant called the *Haka* with the intention of reinforcing their collective identity and intimidating their opponents. There is a certain candour about the *Haka* because the hostility that exists towards the All Blacks' opponents is expressed overtly rather than being shrouded in the pomp and pageantry of a national anthem.

It may be argued that, in peaceful times, sport is substituted for warlike competition between nations in order to vent an innate confrontational imperative within humanity (Faure, 1995; Fischer, 2002; Kellett, 2002). This being so, sporting teams now march into battle to the beat of patriotic drums, as once did soldiers (McCallum, 1996). Such a phenomenon was in evidence prior to Wales' epic victory against Italy during the qualification rounds of the 2004 European football championships: "When the RAF St. Athan Band struck up *Men of Harlech*, one could have been forgiven for expecting to see a thousand Zulu Warriors appear from the tunnel" (Ley, 2002, p. S2). From national anthems to club supporters' songs, music is key to the identity function of sporting competition.

Music functions as a socialising force within sport and exercise spheres, reinforcing shared tastes and related cultural affiliations. This is especially so in the case of exercise-to-music classes, in which not only does the musical stimulus provide an audible unifier, but also a shared reference to lives outside of the gymnasium. Martin (1997) described how the movement patterns of a hip-hop aerobics class are drawn from African American bodily ideals and performance rites. However, these patterns were 'enacted' by a largely White and Asian American group thus complicating notions of race and identity. Martin's work opens up a discourse on the role of African American (or Afro Caribbean) culture within the *exercise-to-music* culture. Indeed, it is not inconceivable that exercise might provide an arena for the improvement of race relations and a type of socialisation, which is beneficial to society. If so, music must be seen as a highly prominent factor within this socialisation.

2.7.2 *The Importance of Physical Activity in the Context of Health*

Regular physical activity has been shown to confer many physiological and psychological health benefits (Bouchard, Shephard, Stephens, Sutton, & McPherson, 1990; Paffenbarger, Hyde, Wing, Lee, June, & Kampert, 1993). However, English adults typically lead sedentary lifestyles and fail to engage in sufficient physical activity (National Audit Office, 2001). Indeed, 70% of English adults partake of inadequate physical activity (Allied Dunbar National Fitness Survey, as cited in Hillsdon & Thorogood, 1996). Even after the assumption of an exercise programme, the rate of attrition is high. Thus, issues relating to exercise adherence assume great importance (Dishman, 1988). Myers and Roth (1997) modelled the factors relating to the perceived barriers to and benefits of an exercise programme. Exercise adoption was seen as a progression of successive stages from pre-contemplation through preparation and action to maintenance. Using factor analytic techniques, four benefit factors (social, psychological, body image, and health) and four barrier factors (time-effort, social, physical effects, and specific obstacles) were formed. Music can add to potential benefits of exercise by heightening the social aspects of the exercise experience and also by yielding psychological gains such as improved mood. Music may also detract from the potential barriers to exercise; for example, music may lessen the awareness of the unpleasant physical sensations, which some may experience during exercise. Hence, it is possible to consider the role of music in the wider context of exercise adoption and maintenance.

2.7.3 *The Psychophysical Effects of Music*

2.7.3.1 *Attention.*

The capacity of the afferent nervous systems is limited (Hernandez-Peon, 1961); thus, stimuli such as music can impede the physiological feedback resulting from exertion and subsequently attenuate the response of the sympathetic nervous system thereby lowering physiological activation (Mockel et al., 1994). The processing of sensory cues through different levels of consciousness to focal awareness was modelled by Rejeski (1985). Stimuli emanating from music (external) or physical work (internal) are processed at a pre-conscious level and filtered into the perceptual field, a term that refers to all of the processed material to which one *can* attend. A limited amount of information from this perceptual field is then transferred to a conscious state of focal awareness.

A tenet of the model is that affective (emotional) information is processed in parallel with sensory information in a pre-conscious phase. This phase of processing is thought to be active rather than passive. Thus, sensory cues are not simply combined in an additive fashion; rather, pre-conscious elaboration serves as a filtering process. Sensory cues resulting from physical work may interact with psychological factors such as the emotion evoked by a musical stimulus. The strength of the musical stimulus is an important factor in the active filtering process (Nethery, Harmer, & Taaffe, 1991). Moreover, the intensity of the exercise stimulus will determine the extent to which psychological factors can influence the pre-conscious processing of sensory cues. Specifically, at high intensity levels of exercise, physiological cues predominate processing whereas psychological variables exert a greater influence at submaximal levels of intensity. In order to avoid unnecessary repetition, this aspect of Rejeski's (1985) model will be referred to hereafter as the *load-dependent hypothesis*.

The posits of Rejeski's (1985) model may be substantiated by reference to neurological detail. For example, Hess (1957) described the thalamus in terms of a 'switching centre' on the sensory pathway; its stimulation interferes with the reception of sensory information. The effects of music on attention have been explained in terms of the function of the limbic system in combination with the hypothalamus (Eagle & Harsh, 1988). The limbic system is responsible for perception, recent memory storage, the mobilisation of motor output, and the dispensation of painful and pleasurable sensations (Roederer, 1975, p. 164). Indeed, Critchley and Henson (1977) proposed that the extra-verbal characteristic of music enables it to pass the cerebral filter of the auditory cortex and reach the central aspect of the limbic system.

In the context of cognitive tests, personality type has been shown to moderate the effects of music on task performance; the mnemonic performance of extraverts is unaffected by pop music whereas introverts experience a deficit in performance (Furnham & Bradley, 1997). Notably, there are thought to be neuropsychological differences between those who demonstrate different levels of attentional ability (Crawford & Gruzelier, 1992; Pribram, 1991). In the context of exercise, such personal differences in terms of attention may moderate the effects of music on performance. For example, extraverts may require greater distraction during exercise than introverts. Crawford and Strapp (1994) found that vocal music was a more potent distractor than instrumental music during a visuo-spatial task. Much like unattended speech, vocal music may disturb the processing of information in working memory (Salame & Baddeley, 1989). Hence, as a stimulus becomes more meaningful, it will prove more distracting.

Based on an extensive review, Tenenbaum (2001) proposed a guiding conceptual model depicting the factors, which are thought to determine ratings of perceived exertion (RPE). Such factors relate to the person, environmental conditions, task, coping strategies, and the person's mood state. *Personal factors* include dispositions such as introversion vs. extraversion and demographics such as sex and cultural background. *Environmental factors* may pertain to the social setting, e.g., the presence of co-actors, or physical factors such as heat and humidity. The *task* may be predominantly aerobic, anaerobic, or a combination of both. As the intensity of the task increases and the individual begins to experience extreme exertion, attention is thought to shift from external cues, such as music, to internal cues relating to the body. This aspect of Tenenbaum's model concurs with the load-dependent hypothesis of Rejeski's (1985) framework.

Active and passive *coping strategies* may be used (see Section 2.7.6.2). Music is used as a passive coping strategy, whereas an active strategy would entail proactive thought processes such as those used in solving mathematics problems. Further, a distinction is drawn between the use of associative and dissociative strategies (see Section 2.7.6.2). Music typically serves to dissociate individuals from the physical sensations of effort rather than drawing attention to them; a process that is referred to as association. Whereas Rejeski's (1985) model refers specifically to information processing, Tenenbaum's (2001) approach is broader. Notably, Tenenbaum commented on the general nature of his model, stating that the individual relationships that fall within its scope (e.g., the association of personality type and exertion tolerance) have not been extensively studied and do not yield formative conclusions as yet. Hence, the model is presented here as a broad framework that contextualises further discussion (see Section 2.7.6.2).

2.7.3.2 *Arousal and activation.*

In exercise and sport contexts, music is often presented as a sedative or stimulant (Dorney, Goh, & Lee, 1992; Hall & Erickson, 1995; Karageorghis, Drew, & Terry, 1996; Pearce, 1981). The term *arousal* refers to the psychological and physiological intensity of the organism (Gould & Krane, 1992). The arousal literature in the sport and exercise sciences is predicated on Lacey’s multidimensional arousal theory (1967), which posits different dimensions of arousal including electro-cortical (e.g., electro-encephalograms), autonomic (e.g., HR, blood pressure, galvanic skin response), and behavioural (e.g., nervous movements and postures). According to Lacey’s theory, these different dimensions of arousal can function differentially rather than in a unitary way; this process was referred to as directional fractionation. However, this is not meant to imply that physiological and psychological arousal mechanisms are entirely independent of one other.

The distinction between *arousal* and *activation* was first introduced by Pribram and McGuiness (1975) and later reinforced by Hardy, Jones, and Gould (1996). Within this specific frame of reference, *arousal* is the response of the organism to a new stimulus whereas *activation* is a cognitive and physiological state or pattern reflecting the organism’s readiness to respond (Hardy et al., 1996). Hence, a stimulus that induces temporary arousal may alter an individual’s activation pattern. Some arousal responses are pre-conscious such as the ‘knee-jerk’ reaction to a sudden shock. Such a reaction may bypass the attentional processing mechanisms proposed by Rejeski (1985). A prominent musical rhythm is thought to promote heightened arousal (Gluch, 1993; Lucaccini & Kreit, 1972); hence, the absence of a prominent rhythm may promote decreased arousal.

Semantic difficulties arise from the fact that arousal is often used as a blanket term to describe the psychological and physiological intensity of the organism (Hardy et al., 1996). Consequently, the term *activation* will be used in preference to the term *arousal* in accordance with the distinction established by Pribram and McGuiness (1975). Different activation patterns are appropriate for different sporting events and for different individuals (Hardy et al., 1996). For example, Ebbeck and Weiss (1988) found optimal activation levels to be specific to individual athletes whereas Oxendine (1984) theorised that there are different optimal levels of ‘arousal’ for different activities.

There is a reciprocity between activation patterns and attentional processes. Narrowed attention is a known consequence of heightened levels of activation (Parfitt, Jones, & Hardy, 1990). Indeed, activation and attention appear to be inversely proportional (Easterbrook, 1959). Wilkes and Summers (1984) found that preparatory activation strategies had the effect of improving performance in a leg strength test, concluding through the use of self-report measures that this result was attributable to improved attentional focus. Aldridge (1989) proposed that the activation of the cardio-vascular system reflects the organism's intention to receive information from the immediate environment. Thus, an increased HR is indicative of cognitive processing and reduced attention to the environment. Conversely, a switch to environmental attention is accompanied by a decrease in HR. Further, the stable trait of attentional style describes an individual's responsivity to their environment and their consequent state of activation. *Field-dependent* individuals are very sensitive to changes in their environment and are more easily activated than *field-independent* individuals.

2.7.3.3 *Extra-musical association and imagery.*

Extra-musical associations are thought to influence activation patterns (Gfeller, 1988; Karageorghis & Terry, 1997). Such associations may be cultural, e.g., the theme song of the *Rocky* motion picture series, or personal, such as an athlete's use of a favourite 'psych-up' track prior to performance. A personal association may refer back to a particular formative incident such as the occasion when a musical piece captured the imagination of a performer and become the catalyst for a winning performance. Thereafter, the same musical selection might activate the performer in an echoic manner.

One possible pathway for a learned association between music and exercise is imagery. Imagery may be thought of as quasi-sensory representations, which exist in the absence of their genuine perceptual counterparts (Richardson, 1969). Much work has established that imagery is the dominant form of musical response and that it acts a vessel for the emotional resonance of the music (McKinney et al., 1997; Osborne, 1981), or even the repository for consciousness itself (Ashen, 1977). Within sport and exercise contexts, there is an established association between imagery and activation interventions (Martin, Moritz, & Hall, 1999). Just as imagery can activate muscle neurons in similar patterns to the movement being imagined (Vealey & Walter, 1993), so it can also evoke physiological and emotional responses (Bandura, 1986; Lang

1977, 1979). Further, there is evidence that music activates the right-hemisphere brain centres, which are also responsible for imagery processes (Tham, 1994).

Music may facilitate the potency of exercise- and sport-related imagery (Tham, 1994). For example, Karageorghis and Lee (2001) compared the effects of motivational music, imagery, and a combination of motivational music and imagery on isometric endurance. The combination of music and imagery yielded greater endurance than music alone. However, it was unclear if the music and imagery interacted in some way to produce an ergogenic effect, or if this effect was merely an addition of the motivational impact of the music and the imagery. Notably, the music and the music with imagery conditions did not differ in terms of the type of imagery experienced assessed with an adapted version of the Sport Imagery Questionnaire (Hall, Mack, Paivio & Hausenblas, 1998). Hence, motivational music evoked imagery but the effects of the imagery were greater when primed by imaging instructions. Using qualitative methods, Gluch (1993) found that music enhances the potency of imagery in a sport context.

There are stable traits that account for differences in imaging ability and the direction of imagery, which can be either internal or external (Tham, 1994). In the sport domain, Murphy (1990) and Orlick (1990) have shown that the same image can yield varying interpretations across different athletes.

2.7.3.4 *Mood, affect, and emotion.*

The important semantic issues pertaining to mood, affect, and emotion have previously been clarified and discussed (see Section 2.1.1). It has been proposed that improved mood is one of the psychophysical effects of exercising to motivational music (Karageorghis et al., 1999). Further, music is regarded as a principal mood-regulating strategy in sporting contexts (Stevens & Lane, 2000; Terry, 2004; Thayer, Newman, & McClain, 1994). Terry (2004) concluded that there are gender, age, personality, diurnal, and situational factors which affect mood. However, the volatility of mood change is one factor which is reasonably constant within an individual case, i.e., a person is given to either mood variability or stability. The mood profiles of athletes who perform successfully (by their own estimation) are highly varied (Terry, 1995). Indeed, Hanin (1997) postulated that different levels of positive and negative emotions may prove functional or dysfunctional for each individual. For example, negative emotions such as fury may facilitate sport performance for some individuals.

Hence, negative emotions may also improve exercise performance contingent upon person and task variables, e.g., fury would have little utility within the context of a yoga class but might facilitate the performance of an individual engaged in intense resistance training.

Terry (1995) suggested that mood influences sport performance not via the facilitative effects of positive mood, but through alleviating the debilitative effects of negative mood. Moreover, depression acts as a catalyst that may influence the interrelationships among other mood factors such as anger, fatigue, confusion, and vigour and their subsequent effects on performance (Lane & Terry, 2000). Therefore, the role of music in regulating mood states and affect is of primary importance, particularly in assuaging the debilitative effects of depression. Szmedra and Bacharach (1998) proposed that the psychological states evoked by music during exercise, such as the alleviation of anxiety, may contribute to vasodilation, thereby influencing haemodynamic variables and lactic acid clearance. Hence, the psychological effects of music during exercise may influence physiological indices and consequently, performance.

Exercise influences mood states irrespective of music. For example, aerobic exercise is ideal for precipitating mood change; its predictable rhythmicity encourages introspection and creative thinking (Berger & Motl, 2000). In particular, the distraction effect resulting from exercise leads to improved self-concept, self-efficacy, and feelings of control (Berger, 1996). Low intensity exercise has typically been shown to improve mood, whereas high intensity exercise has not (Berger & Owen, 1992; O'Connor, 1997; Steptoe & Cox, 1988) although such results are not without contradiction (e.g., Kennedy & Newton, 1997) and may be moderated by individual preferences. Music contributes an element of enjoyment to sport training, thus potentially increasing adherence (Gluch, 1993; Mann, 1979). Similarly, the positive mood states evoked by music are thought to lead to increases in exercise adherence (Karageorghis, 1998).

2.7.3.5 *Rhythm response.*

Rhythm has been defined as the "periodic accent and duration of notes" (Carroll-Phelan & Hampson, 1996, p. 536); it relates to "the organisation of musical events in time, however flexible in metre and tempo, irregular in accent or free in durational values" (Arnold, 1983, p. 1562). There is a reciprocity between musical rhythm and bodily movement. Music performance stems from physical movements and is perceived due to the internal motion of the inner ear mechanisms (Todd, 1992). Thus, the rhythmical features of music resemble those of physical movement (Kronman & Sundberg, 1987). For example, it was found that the retards (slowing) in classical and baroque music closely resemble the decreased stride cadences that occur when runners decelerate at the end of a run (Kronman & Sundberg, 1987). Further, Todd (1992) developed a model of musical dynamics, which was based on the physical properties of energy and mass that are normally applied to the modelling of matter in space. Notably, Kendall and Carterette (1992) described the closure of an Anglican hymn as possessing an almost “kinaesthetic feel” (p. 119).

Many researchers have emphasised the significance of the innate response to rhythm (Brown, 1980; Gaston, 1951; Hohler, 1989; Karageorghis & Terry, 1997; Lucaccini & Kreit, 1972; MacDougal, 1903; Mann, 1979; Worden, 1988). Hevner (1937) reported that music is not just experienced with the sense organs but with whole body; musical sounds are translated into eye movements and muscular tensions. Travers (1969) suggested that the insistent rhythms of popular music stimulate certain areas of the brain, thus leading to ergogenic effects. Further, Mann (1979) proposed that neural triggers are responsible for subconscious movements made in response to music, such as foot tapping, and conscious, but equally spontaneous responses, such as hand clapping and dancing.

Strong rhythmical qualities characterise stimulative music, which is proposed to enhance vigour and induce bodily action (Gaston, 1951). Moreover, the phenomenon of rhythm response is demonstrated through the prevalence of dance music within both western and non-western cultures (Jain & Brown, 2001). Karageorghis and Terry (1997) made reference to the predisposition of the organism to synchronise movement with the rhythmical component of music. As early as 1903, MacDougal identified the isomorphism between musical rhythm and natural forms of movement such as walking and running. Moreover, he attributed the innate pleasure in musical rhythm to its replication of natural movement-based rhythms. Indeed, musical rhythm relates to the periodicities of the human body: The firing of neurons, respiration, the heart-beat, the cycle of sleeping and waking, and ultimately, the macro cycle of the lifespan itself (Burrows, 1984, as cited in Bonny, 1987). Music taps into a physical and conscious reality that is also temporally displaced along the index of time.

All rhythm is indexed to tempo, which characterises different intensities of exercise and varying states of activation, as well as being a salient percept of musical sound. Indeed, stimulative and sedative music, proposed to differently affect the human body, are most clearly differentiated by tempo (see Gaston, 1951). Humans perform motor tasks at a preferred tempo that reflects their optimum level of temporal and rhythmical accuracy and biomechanical efficiency (Smoll & Schultz, 1982). Hence, for a given motor task, a person is both more accurate and mechanically efficient when moving at a self-selected or preferred tempo, which is relatively constant over time. Coast, Cox, and Welch (1986) found that participants of differing fitness levels had different optimally-efficient cycling tempi.

Personal tempo develops during infancy (Briggs, 1991). For example, Fraiss (1982) suggested that each infant displays a characteristic sucking cadence during feeding. Babies begin to move their bodies in response to rhythm at the age of 6 months (Chang & Trehub, 1977). Between the ages of 9 and 18 months, infants develop the capacity to respond to a musical stimulus by moving specific body-parts as opposed to their whole bodies (Moog, 1976). Faber (1996) contended that rhythm response emanates from the experience of the foetus in the womb and the primacy of the maternal heart-beat. Notably, Meerloo (1961) reported that the HR of the mother is exactly half that of the foetus.

Karageorghis and Terry (1995) introduced a distinction between synchronous music and asynchronous music. When movement is consciously synchronised with music, that music is referred to as synchronous, otherwise it is referred to as asynchronous. An example of the use of synchronous music would be an exercise-to-music class, in which musical tempo provides a meter of the sequences of steps and moves. Musicologists assert that tempo is not an absolute concept; sometimes the *true beat*, which is felt in response to the music, differs from the metrical signature that is printed on the score (Radocy & Boyle, 1979).

Anshel and Marisi (1978) found that endurance in a cycle ergometer test was prolonged by the use of synchronous music relative to asynchronous music and a no-music control condition. In both the non-synchronous conditions, a blinking light was provided for participants to synchronise themselves to. Karageorghis and Jones (2000) revised Anshel and Marisi’s methodology and produced a different result. Both synchronous and asynchronous music increased time-to-exhaustion in a cycle ergometer test. However, synchronous music elicited a higher HR prior to exhaustion when compared to the other conditions. Studies involving circuit-based activities have shown that music used synchronously has improved work output (Michel & Wanner, 1973; Uppal & Datta, 1990). Mertesdorf (1994) found that participants cycled harder when the tempo of the accompanying music was controlled by the speed of their movement as opposed to music of a fixed tempo. The participants also preferred the music-controlled tempo condition, even when the effects of exercise intensity were controlled for.

Rhythm response can also be considered within the context of arousal and activation. The most resonant frequency range within the auditory spectrum is the lower bandwidths or *bass*, which contributes the prominent rhythm to most dance and rock music. The impact of bass tones resonates in the stomach and is ‘heard’ by deaf people (Pridmore, 1992). Thus, bass frequencies may be inherently arousing due to the amount of energy they contain. There is a band of tempi, which is thought to be effective in generating arousal, namely 120-140 bpm (Travers, 1969). Mann (1979) also subscribed to the notion that fast music is arousing in addition to its role as a ‘pace-maker’. Neher (1962) found that drum rhythms led to muscle-twitching, increased electrical activity in the brain, and, in some cases, unusual perceptions. Such findings invite an analogy between the stimulative effects of music and pharmacological substances (see Lyttle & Montagne, 1992).

Both LeBlanc (1995) and Karageorghis (1998) have advocated research into preference for musical tempo at different intensity levels of physical activity. Correspondingly, Iwanaga (1995) has researched the association between HR and preference for musical tempo. The hypothesised relationship between HR and preferred musical tempo is not necessarily a perfect linear relationship, i.e., the preferred tempo may not correspond exactly to HR but may vary in the same direction. For example, practitioners such as Raul Espinosa have advocated that the tempo of the music used should be 10-15 bpm higher than the target HR (Vogel, 1986).

Notably, brain waves and cyclical physiological rhythms such as the HR become synchronised to the tempo of music in a laboratory setting (Ostrander, Schroeder, & Ostrander, 1979). The association between HR, musical tempo, and movement tempo may depend on an intricate regulation of all temporal functioning. Wilson (1986) made reference to the notion of an inner clock as a “pacemaker in the brain” (as cited in Iwanaga, 1995, p. 71). Neuropsychologists have found that the supplementary motor area of the brain plays an important part in both the perception of musical rhythm and the rhythmic ordering of motor tasks (Carroll-Phelan & Hampson, 1996; Zatorre, Halpern, Perry, Meyer, & Evans, 1996). Hence, it appears that there is always some tacit motor response to auditory stimulation or imaging. Clynes and Walker (1982) highlighted a property of the central nervous system called *time form printing*; the propensity to execute repetitive patterns of movement with only the initial command requiring specific attention. Thus, once the shape and rate of the pattern have been established, attention can be directed elsewhere.

2.7.3.6 *Motivation.*

This title of this thesis refers to ‘motivational music’, hence, it is appropriate to examine what is meant by the term *motivation* in the context of musical accompaniment to sport and exercise. The classical definition of motivation refers to the intensity and direction of effort (see Sage, 1977). However, the issue of motivation is complicated by the fact that the term is used vaguely and in a wide range of different senses and contexts (Weinberg & Gould, 1999). For example, instead of being used to describe a pattern of behaviour (as above), the term may refer to a stable trait. Further, as in the case of this thesis, motivation may be defined in terms of the action of some external influence upon behaviour, i.e., this music *motivates* me to exercise.

The hallmark of Deci and Ryan’s (1985) self-determination theory (SDT) is that different types of motivation are distinguished by the reasons or goals that give rise to action. The most significant distinction lies between *intrinsic* and *extrinsic* motivation. Intrinsic motivation refers to engaging in an activity for its own sake; for the pleasure derived from participation. Extrinsically motivated behaviour is aimed towards an end that is external to the activity itself. An example of extrinsic motivation would be an individual who plays sport in order to achieve social status. One of the posits of SDT is that there are different types of extrinsic motivation, varying according to the relative autonomy felt by an individual: *External regulation* refers to behaviour that is determined entirely by external rewards or punishments. *Introjection* relates to behaviour that is motivated by the approval of others. *Identification* refers to behaviour that is motivated by goals that the individual endorses, thus leading them to value the activity. Finally, *integrated regulation* concerns the point at which an individual has totally assimilated a given behaviour into their sense of self and is therefore aware of how the activity is congruent with other aspects of their life. Thus, the different forms of extrinsic motivation represent various degrees of integration; integrated regulation is closest to intrinsic motivation, whereas, at the opposite extreme, external regulation is flanked by *amotivation*, a term that denotes an absence of interest in a given activity.

Deci & Ryan (1985) contended that three factors facilitate intrinsic motivation: the basic psychological needs of competence (mastery within one's environment), autonomy (self-directed behaviour), and relatedness (sense of community in relation to others). Evidence has suggested that the fulfilment of these needs also plays an important role in facilitating the progression from external to integrated regulation (Ryan & Deci, 2000). Vlachopoulos, Karageorghis, and Terry (2000) stated that the attainment of flow might promote intrinsic motivation. Indeed, flow may represent the apotheosis of intrinsic motivation (Pates et al., 2003).

Vallerand's (1997) hierarchical model of intrinsic and extrinsic motivation (HMIEM) is arguably the most prominent approach towards motivation in the context of the sport and exercise sciences. The model, depicted in Figure 2.3, is built upon the assertion that three types of motivation underlie human behaviour: intrinsic motivation, extrinsic motivation, and amotivation (see above). Hence, HMIEM incorporates the key tenets of SDT.

A characteristic of Vallerand's (1997) framework is that intrinsic motivation, extrinsic motivation, and amotivation exist at three hierarchical levels of generality: situational (or state), contextual (or life domain), and global (or personality). An important postulate of the model is that the degree of motivation (whether intrinsic, extrinsic, or amotivation) present at each level of generality can influence motivation in the levels above and below, i.e., contextual motivation may affect global motivation (above) and situational motivation (below). At each level, motivation is determined by social factors relating to that level. For example, at the situational level, motivation is determined by situational factors, e.g., factors specific to a single bout of exercise. The influence of social factors on motivation is mediated by the individual's perceptions of their degree of autonomy, competence, and relatedness. Finally, the consequences of motivation at each level of generality are affect, cognition, and behaviour. The scope of Vallerand's model reflects the complexity of motivation and provides a theoretical reference point for the discussion sections of that follow.

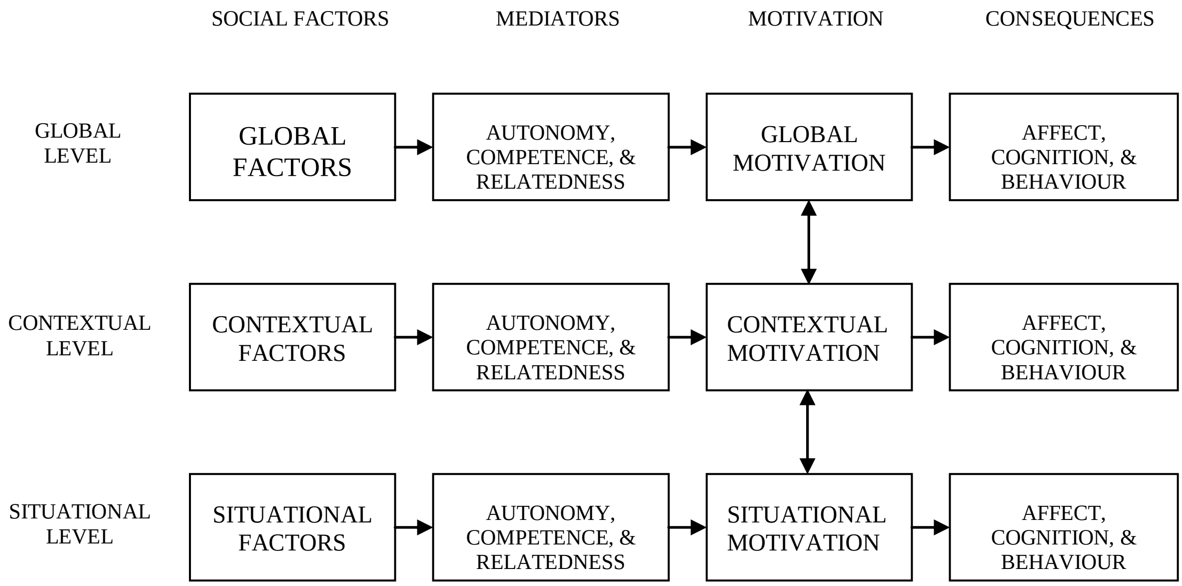

Figure 2.3. A simplified version of Vallerand's (1997) Hierarchical Model of Intrinsic and Extrinsic Motivation in Sport and Exercise.

The use of music in physical activity contexts can be related to the hierarchical model of intrinsic and extrinsic motivation (Vallerand, 1997). First, music may serve as a situational factor and thus promote motivation during a single bout of exercise. Conceivably, music may heighten any of the three types of motivation (intrinsic, extrinsic, or amotivation). However, it is most likely that music enhances the intrinsic motivation to exercise as it promotes the enjoyment of the activity (see Karageorghis & Terry, 1997). There is no current evidence to support the proposition that music promotes extrinsic motivation. Indeed, for those who exercise for predominantly extrinsic reasons (e.g., health or physical appearance), the provision of music might increase intrinsic motivation.

Concerning the contextual level, music has been established as a ubiquitous factor within the context of the facility-based exercise experience. Hence, music may contribute to contextual motivation and, by extension, global motivation. The behavioural effects of motivation promoted by music at the contextual level might include increased exercise adherence (see Karageorghis, 1998; Schwartz, Fernhall, & Plowman, 1990). Based on the preceding discussion, the use of the term 'motivating music' can be further qualified. References to motivation in relation to music pertain to: (a) intrinsic motivation as opposed to extrinsic motivation or amotivation, and (b) the situational level of motivation as opposed to the contextual or global levels. Both Deci and Ryan's (1985) SDT and Vallerand's (1997) HMIEM are relatively broad in their scope; music directly influences only limited aspects of the models. Hence, in the context of the present programme of research, information processing models such as Rejeski's (1985), which can be directly related to the musical stimulus, are considered to be more pivotal.

2.7.4 *Conceptual Approaches*

2.7.4.1 *Conceptual models.*

Karageorghis and Terry (1995) developed a conceptual model to predict the psychophysical responses to asynchronous music during submaximal exercise. The model predicted the responses to *functional* music, which was defined using a citation from Kodzhaspirov et al.'s paper (1988): "Goal-orientated works, well co-ordinated with the tasks and specifics of the session" (p. 39). Music must be considered functional in order to promote the following psychophysical effects: An alteration in arousal levels, a reduction of perceived exertion, and improved mood.

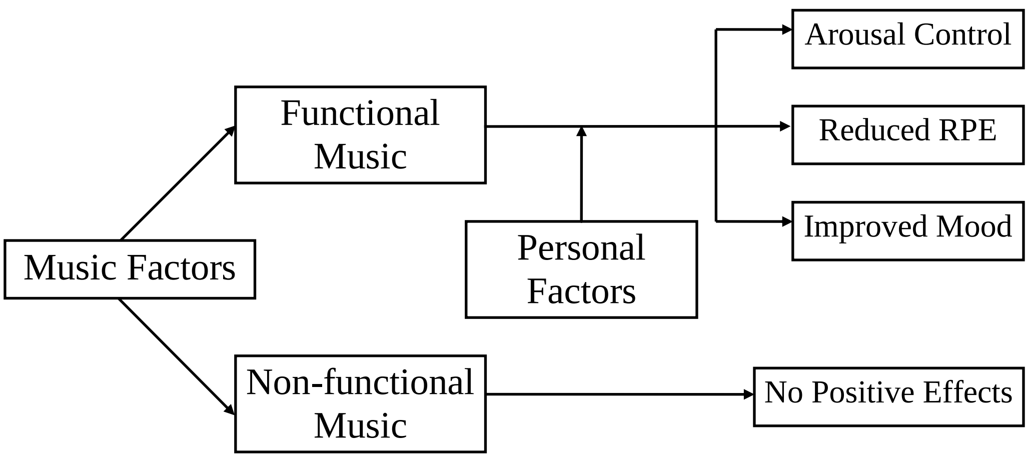

Figure 2.4. A conceptual model to predict the psychophysical responses to asynchronous music during submaximal exercise (Karageorghis & Terry, 1995).

The model specifies that the intrinsic properties of the musical composition, such as tempo and harmony, are of primary importance and these constitute the logical starting point for the model (see Figure 2.4). *Personal factors* refer to the subjective component of musical response and include socio-cultural background and preferences. Within the conceptual model, the influence of personal factors is secondary to the functionality of the music. Thus, if the music is non-functional, then no positive outcomes will occur irrespective of personal factors. The variables that determine functionality were not represented within the model but were listed by Karageorghis and Terry (1995): (a) congruence of tempo with expected HR; (b) congruence of rhythm with nature of exercise; (c) the mood induced by the harmony, which can be either happy and bright (major) or sad and subdued (minor); (d) a melody which is pleasing to the ear; (e) use of lyrics which include affirmations of exercise; (f) the inclusion of instruments which yield a prominent beat (e.g., percussion instruments); and (h) ensuring the volume is not obscured by the noise of the exercise environment.

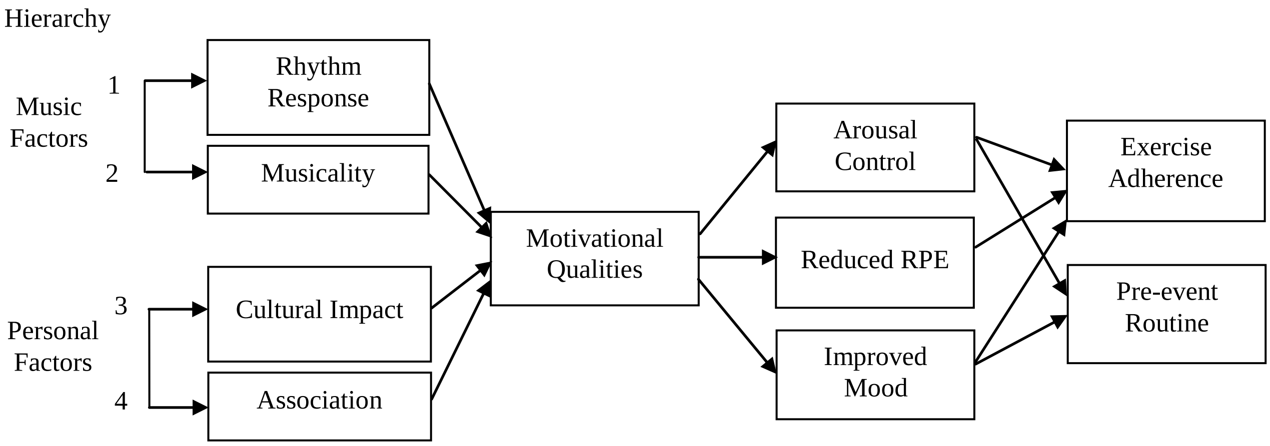

Figure 2.5. Revised conceptual framework for the prediction of responses to motivational asynchronous music in exercise and sport (Karageorghis et al., 1999).

Four years after the publication of the conceptual model, Karageorghis et al. (1999) shifted the terminological focus from *functional* music to *motivational* music. Motivational music is defined in terms of both music and personal factors: “The variables that influence the motivational qualities of the music can be either *internal*, pertaining to factors inherent to the composition of music, or *external*, pertaining to how the individual interprets the music” (p. 2). In order to rate the motivational qualities of music in sport and exercise environments, a psychometric instrument was developed: The BMRI (Brunel Music Rating Inventory). Exploratory factor analysis resulted in a four-factor structure that was subsequently tested using confirmatory factor analysis and yielded acceptable fit indices. The four factors that are proposed to determine the motivational qualities of music are present in the revised conceptual model (see Figure 2.5).

The revised model differs from the original conceptual model on several grounds. First, the personal factors are more prominent in the revised model. Second, both the music factors and the personal factors are split into separate components. The music factors consist of rhythmical factors and *musicality*, which includes melody, harmony, and other musical elements that are pitch- as opposed to rhythm-related. The personal factors are divided between cultural impact and association. Cultural impact concerns the pervasiveness of a musical piece within society and association refers to the extra-musical associations that a piece of music may carry. The factors exhibited a hierarchical structure, i.e., rhythm response is the most important, and association the least important.

Researchers using the BMRI are able to ascertain whether the individual components that contribute to the motivational qualities of music exert different effects. For example, rhythm might affect bodily responses whereas musicality might influence affective responses (Karageorghis et al., 1999). The revised model also differs from the original model in that meaningful consequences are now posited which contextualise the model and provide a framework that can be tested empirically.

The four subscales of the BMRI are weighted and added together to yield an overall motivational quotient for a given piece of music. Whereas high scores indicate that a piece of music has high motivational qualities, low scores do not indicate that a piece of music is demotivational. Rather, such pieces are referred to as *oudeterous*, a Greek word that Karageorghis et al. (1999) invoked to denote the absence of both motivational and demotivational qualities. In defining motivational music, the authors referred to the copybook description of stimulative music: “Motivational music tends to have a fast tempo (> 120 bpm) and a strong rhythm, and is proposed to enhance energy and induce bodily action (see Gaston, 1951)” (p. 2). Further, the authors documented the musicological argument that stimulative and sedative qualities are separate, not opposite ends of the same continuum. If stimulative qualities are analogous to motivational qualities then it so follows that there cannot be a scale between motivational and demotivational. Therefore, motivational and demotivational qualities can exist in parallel.

2.7.4.2 *Qualitative approaches.*

Gluch (1993) used qualitative methods of inquiry with the intention of providing a more comprehensive understanding of musical response in the environment of sport. In-depth interviews were used to assess the effects of music used in the pre-competition strategies of six collegiate athletes. The data analysis involved the abstraction of themes from the raw data; these themes were subsequently formed into categories. Gluch's results are presented graphically in a style that facilitates comparison with the revised conceptual model, as illustrated in Figure 2.6.

Leaving aside the fundamental differences between the work of Karageorghis et al. (1999) and Gluch (1993), points of comparison remain. Indeed, a parallel can be drawn between the *feelings of well being* category that Gluch reported and the *improved affect* consequence in the revised model (see Figure 2.5). Further, *self-regulation* is the direct counterpart of *arousal control* in the revised model. It is apparent from the examination of Gluch's various categories that attentional mechanisms play an important role in the preparation for sport performance. In the revised model, only arousal control and improved mood are linked to pre-event routine.

Gluch (1993) reported that the response to music in the context of a pre-event routine involves a complex array of cognitive and affective states including confidence, imagery, and task-related memory and associations. Hence, Gluch's findings in respect of the psychophysical effects of music extend beyond the scope of the revised conceptual model. The work of Gluch strengthens the rationale for the further use of qualitative research methods to research the use of music in sport and exercise settings.

Unfortunately, Gluch's (1993) data do not include detailed references to music factors and it follows that future research of this ilk could prove even more insightful if grounded in existing theory. Finally, Gluch stated that the phenomenon of musical response within sport represents a complex reaction, which includes type of music and person variables and that the relationship a person has to music is highly individual, possibly unique. Karageorghis and Terry (1997) wrote of the possibility that "the individual's *interpretation* of music, rather than the musical characteristics *per se*, determines the psychophysiological response" (p. 57).

Gfeller (1988) used a qualitative methodology to investigate the music preferences of young adults during exercise-to-music classes. A structured questionnaire was used to examine attitudes towards the effects of musical style (idiom) and musical components on motor activity. The participants identified style (idiom), rhythm, and association as the most salient characteristics of music in the exercise-to-music setting. Gfeller's sample was delineated into subgroups according to age (18-19 years, 20-21 years, 22-25 years, and 25+ years). The exercise-specific music preferences of each subgroup were most highly correlated with the adjacent subgroups. Hence, Gfeller suggested that music preference in exercise is a developmental process. Further, she proposed that as people age, the nature of their general music preferences change in that they prefer music, which has a less-prominent rhythm. Thus, general music preferences become dissociated from exercise-specific music preferences, which continue to be based on the rhythmical qualities of music.

The exercise-specific music preferences of the males and females in Gfeller's (1988) sample exhibited a high degree of correlation. Therefore, although age differences were in evidence, there were no sex differences. With reference to psychophysical effects, the respondents reported increases in motivation to exercise, reductions in perceptions of exertion, the evocation of imagery and extra-musical associations, and a synchronisation effect whereby the music acted as a temporal cue for movement.

In criticism of Gfeller's (1988) study, it should be noted that the structure of the questionnaire she used might have prompted the responses of the participants; for example, questions such as "do you think the music takes your mind off any part of the physical activity" (p. 33) resulted in 91% positive response (i.e., yes it does). A similarly high percentage of positive responses resulted from the other questions. These results may be compared with those of Kodzhaspirov et al. (1988) who undertook a longitudinal investigation of the use of music in the training sessions of Russian weightlifters. Kodzhaspirov et al. also used questions that implied their responses and found that, with a similar degree of certainty (97%), music improves bouts of exercise. Indeed, a clear belief was reported that music improves weightlifting performance. Notably, Lucaccini and Kreit (1972) asserted that studies in an industrial setting unanimously indicate that workers *report* that background music improves their working performance; yet none of these studies demonstrated an *actual* improvement in performance. Hence, caution must be applied when considering the findings of self-report questionnaires.

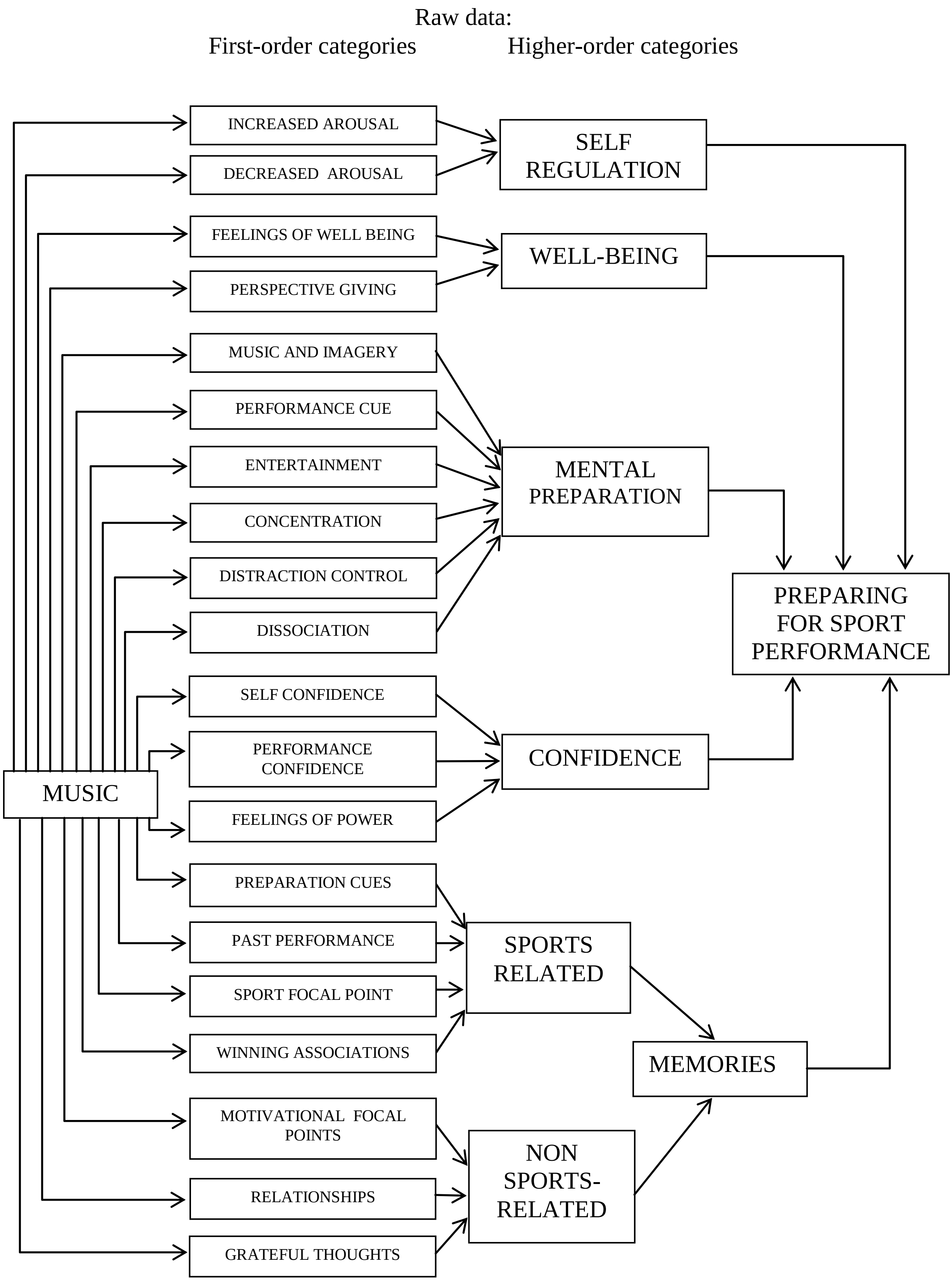

Figure 2.6. Conceptualisation based on the qualitative data analysis of Gluch (1993).

Vogel (1986) reported on the work of a practitioner, Raul Espinosa, who was a pioneer of the rating of musical selections for exercise. Espinosa even used the rationale and terminology that Karageorghis et al. (1999) would later adopt. “People should be aware that there are many elements that make up the motivational quotient of a song” (p. 12). The factors that were proposed to influence the motivational quotient of music included the congruence of music tempo with exercise HR, the familiarity of the music, and perceptible shifts in rhythm and lyrical arrangements. These factors were thought to contribute to or *detract* from the motivational quotient of a particular piece of music. Thus, the same qualities of music can prove motivational or demotivational. The importance of what Karageorghis and Terry (1995) termed *functional* music was asserted: “Good exercise music ... depends on what kind of exercise you’re doing, at what level, and with what purpose” (p. 12). A further theoretical contribution relates to the distinction between music preference *per se* and exercise-specific music preference: Espinosa asserted that general musical preference can impair decisions concerning music prescription for exercise contexts. He also proffered the following admonition that relates to rhythm response: “There is much more to the effect that music has on the human system than toe-tapping and keeping time” (p. 12).

2.7.4.3 *The psychometric approach.*

A basic tenet of the revised conceptual model (see Figure 2.6) is that music itself can be either motivating or demotivating regardless of the listener; a very positivistic approach. Indeed, the model is predicated on the assumption that factors such as musicality and cultural impact can be objectively scaled and quantified. If such factors are inherently subjective, then the appropriateness of using a psychometric instrument to assess the motivational qualities of music is drawn into question. However, such misgivings should be weighed against the efficiency of psychometric measurement and the facility to question large samples of exercise and sport participants.

The development of an instrument to measure the motivational qualities of music derives its lineage, in part, from earlier systems designed to relate stimulus properties to emotional responses. For example, Hevner (1935) classified the affective impact of music by scoring its physical properties, e.g., happy music was of a fast tempo and in a major harmony. Lucaccini and Kreit (1972) theorised that such classification systems do not account for individual differences: “One’s cultural milieu, personal experiences, situational factors, and perhaps even genetic factors may all help shape the mood that characterises an individual’s immediate response to a particular musical selection” (p. 239). Arguably, such personal variables should be assessed in combination with the perceived qualities of music, which the BMRI assesses.

Mann (1979) proposed that the psychophysical effects of music may operate differentially, i.e., music may motivate but not stimulate. It has been suggested that different components of musical structure may induce different psychophysical effects (Karageorghis et al., 1999; Lucaccini & Kreit, 1972). Further, the multidimensionality of arousal affords the possibility that music may elicit psychological arousal while failing to yield physiological arousal. Gluch (1993) stated that the phenomenon of using music to prepare for sporting competition should be regarded as “an integrated whole rather than something that is necessarily divided into distinct categories” (p. 51). Consequently, the different categories in his analysis were regarded as interactive and overlapping (see Figure 2.6).

The conception that different facets of the musical response interact must lead to a questioning of the concept of an overall motivational quotient, which implies that these different responses can be neatly aggregated. Nevertheless, it is quite possible to use the factor scores (e.g., rhythm response etc.) individually and investigate relationships between them. A hierarchical confirmatory factor analysis would reveal whether or not the motivational quotient does indeed represent a higher-order factor and thus a global construct; hence shedding light on the foregoing discussion.

Despite the aforementioned limitations of the psychometric approach, there is little doubt that it has beneficial application in the prescription of motivational music. Studies which have incorporated music that was selected on the basis of its rated motivational qualities have provided evidence to support the discriminant capability of the BMRI and the psychophysical effects of music in sport and exercise settings (Karageorghis & Deeth, 2002; Karageorghis & Jones, 2000; Karageorghis & Terry, 2000). The theoretical approaches that have been presented operate at different levels of generality. However, such models and frameworks do not specify the physiological processes by which the predicted effects actually occur. Hence, there is a need for what Parncutt (1998) referred to as physiological realism. From an ‘organic’ perspective, simplified mathematical models of hypothetical constructs are unhelpful because they conceal genuine understanding.

2.7.5 *The Effects of Music on Motor Performance*

2.7.5.1 *Early work.*

Perhaps the original piece of work in the subject area of this thesis is the oft-cited study of Ayres (1911), who found that cyclists in a 6-day cycle race held in New York City cycled faster, and hence further, in the presence of a band playing. One of the criticisms later applied to this study by Lucaccini and Kreit (1972) was that the crowd noise was not controlled; hence, the better cycling performances, which coincided with the presence of music, could have been due to greater crowd noise stimulated by the music. Similarly, Nelson (1963) stated that the effects of music during exercise may be influenced by the presence of others and the context. Consequently, part of the motivational impact of music may be manifested through other exercise participants.

Prior to the 1970s, several researchers investigated the effects of different musical selections on cycling performance. This initial work was representative of the micro-analytic, experimental approach that became prevalent within the field of study. For example, Nelson (1963) varied music intensity and tempo over a series of three experiments in which the distance pedalled during a 90-s supramaximal cycle-ergometer test was measured. The result, like that of other similar studies (see Coutts, 1965; Hart, 1965; Nelson & Finch, 1962), was that music did not influence performance. Thereafter, evidence has accumulated to support the assertion that music affects motor performance.

2.7.5.2 *Anaerobic performance.*

The ergogenic effects of music in short-duration, explosive tasks have been frequently investigated. For example, Karageorghis et al. (1996) tested the effects of stimulative (dance) music, sedative (easy-listening) music, and a control condition (white noise) delivered prior to a grip-strength test. The results were in the expected direction; grip strength following the stimulative music was significantly higher than in the other two conditions. The aim of the study was to repeat Pearce’s work (1981) whilst accounting for certain methodological limitations, which Karageorghis et al. highlighted. Pearce found that sedative music yielded lower grip strength than either stimulative music or a control condition. However, stimulative music did not increase grip strength over that measured in the control condition.

As early as 1926, Diserens established that both stirring and depressive music improved grip strength endurance when compared to a no-music control condition; the measure in this case was the ability to exert sustained grip pressure over 60 s. More recently, Papa (1990) tested the effects of stimulative and sedative music on both absolute grip strength and grip strength endurance. Absolute strength was defined as an all-out effort (similar to the measure used by Karageorghis et al., 1996), whereas strength endurance was measured by the percentage grip strength attrition over ten 3-s repetitions. Stimulative music significantly improved grip strength over both sedative music and the control condition, thus concurring with the findings of Karageorghis et al. (1996). A non-significant trend indicated that percentage grip strength attrition over the three trials was lowest in the stimulative music condition (Stimulative = 9.70%, Sedative = 12.50%, Non-Musical = 15.60%).

Hall and Erickson (1995) used the *Rocky* theme to heighten the activation levels of athletes prior to a 60-yard sprint; this intervention produced faster times than two control conditions. The stimulative music also lead to higher scores on the somatic anxiety subscale of the CSAI-2. This result indicates that stimulative music either increased physiological arousal, heightened the participants' awareness of their own arousal symptoms, or both. More recent research has drawn into question the independence of activation and anxiety. For example, Ekkekakis and Petruzzello (2002) introduced a circumplex model of affect that comprised two dimensions (axes): activation (low vs. high) and valence (positive vs. negative). According to this approach, anxiety results from a heightened state of activation accompanied by a negative valence.

Contrary to the previously discussed findings, Pujol and Langenfeld (1999) found that fast music (120 bpm) did not affect performance in the Wingate Anaerobic Cycle Test, which represents supramaximal exercise intensity. The music condition consisted of the participant's choice from a selection of different musical pieces, which were all of equal tempo. There were no differences between the music condition and a control condition for various indices relating to anaerobic performance and fatigue. The authors attributed these results to the predominance of physiological as opposed to psychological cues at higher exercise intensities. However, Pujol and Langenfeld introduced the music to coincide with the start of the test, whereas researchers who have found that music improves anaerobic performance (e.g., Karageorghis, et al. 1996; Papa, 1990) introduced their music conditions prior to the test. Thus, if stimulative music enhances performance by ‘psyching-up’ athletes as researchers have posited, then it is clear that the effects of the music are most pronounced when pre-test music is used.

Doiron, Lehnhard, Butterfield, and Whitesides (1999) tested the effects of loud (70-80 dB) upbeat (120 bpm) music on performance in a circuit of resistance exercises. Each station of the circuit consisted of 30 s of repetitions at a load equivalent to 65% of the one-repetition maximum for that exercise. The presence of the music did not affect the number of repetitions performed. Dorney et al. (1992) investigated the effects of music and imagery on sit-up performance. The participants listened to stimulative music as a ‘psych-up’ intervention prior to performing a 30-s sit-up test. An initial trial was followed by a rest period during which participants were given imaging instructions; one of the groups listened to music, whereas the other group did not. Both interventions increased the number of sit-ups when compared to the initial trial; however, there was no difference between the two conditions. Hence, music did not moderate the effect of imagery techniques on sit-up performance. However, the music led to an increase in HR, indicating some degree of physiological activation. In a similar study, Karageorghis and Lee (2001) found that motivational music improved isometric strength endurance when compared to a no-music condition. However, even greater strength endurance was recorded when the music was combined with an imagery protocol.

2.7.5.3 *Aerobic performance.*

Several investigators have tested the effects of music on aerobic endurance (Ciccomascolo, Finn, Barbarich, & Rinehardt, 1995; Copeland & Franks, 1991; Schwartz et al., 1990). In some instances, music conditions have led to small but non-significant improvements in performance. For example, in Schwartz et al.’s cycle ergometer test, upbeat music yielded an endurance time for females (M = 25.6 min), which was over 4 min longer than the time recorded in the control condition (M = 21.3 min). However, the difference did not reach statistical significance. Interestingly, no such trend was found in the male group. Similarly, Ciccomascolo et al. reported a non-significant improvement in treadmill endurance of 4 min in response to a music condition.

Music has been shown to exert significant effects on exercise endurance. For instance, Copeland and Franks (1991) found that soft, slow music improved treadmill endurance when compared to a control condition. Makowicki (1982) allowed participants to select their own music and found that this music increased endurance times in a graded treadmill test when compared to a no-music control condition. A very similar study by Brownlow (1985) replicated these findings, although it should be noted that both Brownlow's and Makowicki's studies were masters theses.

Karageorghis and Jones (2000) found that both synchronous and asynchronous music increased the time to exhaustion in cycle ergometer trials. Becker et al. (1994) studied the effects of 'mellow' and 'frenetic' music on the distance ridden by children (9-11 years), adults (18-55 years), and seniors (60-80 years) in a 2-min, submaximal cycle-ergometer trial. Both of the music conditions led to significant increases in the distance cycled when compared to the white-noise control condition. In addition, ergogenic effects were reported regardless of whether the music was presented prior to or during the task. However, the prevailing trend was that concurrent music elicited higher mean distances (1.00 miles) than antecedent music (0.91 miles); although the difference between these two means was not tested for significance. As stated by the authors, the performance enhancing properties of the music cannot be explained purely by attentional distraction but also by alterations of mood and / or motivational states. However, attentional distraction might have explained the higher distance pedalled when accompanied by concurrent music.

Matesic and Comartie (2002) delivered alternate 5-min segments of 'techno' music and silence using a portable cassette player and headphones during a 20-min self-paced run on an indoor athletics track. The participants recorded faster lap times during the musical segments of the prepared tape. The authors acknowledged as a limitation the fact that the participants may not have been sufficiently exerting themselves during the test. However, by refraining from imposing a level of exercise intensity upon the participants, Matesic and Comartie increased the external validity of their findings. Atkinson et al. (in press) assessed the effects of trance music (a melodic variant of dance music) on performance in a simulated 10-km cycle ergometer time-trial. Under the music condition, the participants completed the task in less time than under the control condition. The ergogenic effects of the music were particularly marked during the first 3 km of the trial, when RPE was found to be relatively low in comparison to the latter stages.

Szabo et al. (1999) reported that a music condition, which included an increase in tempo from slow to fast, promoted the accomplishment of a greater workload in a graded cycle-ergometer test, than music conditions that consisted purely of either fast or slow music. Szabo et al.'s results may be attributable to a contrast effect (see Section 2.3.2), whereby the fast-tempo music appeared to be more stimulating by virtue of the contrast elicited by the precedent slow-tempo music.

In some cases, music has been found to exert no effect on aerobic endurance. For example, Scott, Scott, Bedic, and Dowd (1999) used a multiple baseline approach to ascertain whether various interventions increased the distance rowed in 40-min training sessions on an ergometer. A selection of top-40 hits neither improved performance from baseline nor enhanced subjective ratings of technique made by a rowing coach. Tenenbaum et al. (in press) investigated the effects of three music conditions on the endurance demonstrated by participants who underwent a treadmill test to exhaustion at 90% of $\dot{V}O_2$ max. The music conditions consisted of rock music, dance music, and inspirational music, i.e., music that was deemed to evoke inspirational associations (e.g., the theme that accompanied the *Rocky* motion picture series). None of the music conditions increased endurance relative to the control condition. A subsequent test comprised similar music conditions but the task consisted of an outdoor 2.2 km run that was to be completed in the shortest time possible; similar findings ensued. The authors attributed these findings to the high intensity of the running tasks which was thought to distract the participants' attention from the accompanying music. The foregoing explanation of the findings is complicit with Rejeski's (1985) parallel processing model and in particular, the load-dependent hypothesis.

In addition to the conventional dependent measures that they used, Tenenbaum et al. (in press) solicited subjective feedback from the participants in order to conduct a subtler assessment of the effects promoted by the experimental conditions. The participants indicated that inspirational music had exerted the greatest effect in terms of distraction and motivation during both of the running tasks. Further, the music was thought to have elicited the highest motivational impact during the early, as opposed to the latter, stages of the tasks. This result mirrored that reported by Matesic and Comartie (2002) and corroborated the authors' postulation that music is more able to exert a motivational effect at lower exercise intensities.

In summary, various music conditions including stimulative, self-selected, and motivational have led to increases in aerobic endurance when compared to a control. However, such effects are more prominent during submaximal or self-paced tasks. The series of studies reported by Tenenbaum et al. suggest that music is unlikely to influence performance in tasks of very high intensity (> 90% $\dot{V}O_2$ max.).

2.7.6 *Psychophysical Measures*

If ergogenic effects have been attributed to music then it logically follows that researchers should enquire as to how these effects were manifested. Psychophysical measures such as affect, HR, or RPE can illuminate the underlying mechanisms, which promote ergogenic effects and enhance the experience of exercise.

2.7.6.1 *Physiological and neurological measures.*

Physiological measures are often limited to HR but can include the assay of blood lactate, maximum oxygen uptake, minute ventilation, blood pressure, and the respiratory exchange ratio. Typically, the purpose of these measures is to assess the effect of musical stimuli on exercise intensity. There is scant support for the proposition that music affects physiological measures during submaximal tests on cycle and treadmill ergometers (Boutcher & Trenske, 1990; Ciccomascolo et al., 1995; Ferguson, 1994; Johnson & Siegel, 1987; Lee, 1987; Karageorghis & Terry, 2000; Kitch, 1986, as cited in Ferguson, 1994; Miller, 1984; Patton, 1991; Schwartz et al., 1990; White & Potteiger, 1996). Copeland and Franks (1991) recorded HR at minutely intervals during a treadmill test to exhaustion. During the earlier stages of the test, the HR recorded in the slow music condition was significantly lower than that recorded in either the fast music or control conditions. However, close to the time of volitional exhaustion, both music conditions elicited a higher HR than the control condition. Thus, in the presence of music, the participants sustained a greater intensity of exercise.

Notably, Matesic and Comartie (2002) found that, despite increasing the running speed of untrained male participants when compared with a no-music control condition, techno music actually lowered the participants' HR. This result suggests that music may have increased the efficiency of movement, possibly through a synchronisation effect. However, the finding applied to only 6 participants so it may have been anomalous. In a second group of trained participants (who ran at least three times per week), techno music did not influence HR. Nevertheless, the music did increase the running speeds of the trained participants without raising their HR.

Szmedra and Bacharach (1998) subjected 10 trained male participants to a 15-min treadmill run at 70% of $\dot{V}O_2$ max. under conditions of popular classical music and no-music. Despite the equivalence in work rate, the participants' HR, systolic blood pressure, and plasma lactate were found to be lower during the music condition. These findings would support the conclusion that, during the music condition, equivalent output was maintained with less effort than under the control condition. Brownley, McMurray, and Hackney (1995) studied the influence of stimulative (fast) music, sedative music, and a control condition on physiological indices during graded treadmill ergometer tests at low, medium, and high exercise intensities. Regardless of intensity, stimulative music led to higher respiratory rate when compared to sedative music and the control condition. This result suggests that stimulative music prompted the participants to expend more effort than the control or sedative music conditions in order to achieve an equivalent level of work rate.

Miller (1984) found that, during submaximal treadmill running, self-selected music reduced BE levels, which are indicative of physiological stress. Conversely, Doiron et al. (1999) reported that loud (70-80 dB) upbeat (120 bpm) music exerted no effect on plasma levels of BE during a maximal intensity circuit of resistance exercises. In summary, the effects of music are typically too subtle to alter the physiological changes that accompany exercise. However, physiological measures might serve as a signpost to changes in exercise intensity that are influenced by musical accompaniment. Nevertheless, in some instances, music conditions have affected physiological measures independently of work-output and appear to have improved movement efficiency. Additional discussion of the limitations of physiological measures is located in Section 2.4.

2.7.6.2 *Ratings of perceived exertion.*

Copeland and Franks (1991) delivered loud, fast music; soft, slow music; and a control condition (silence) during a treadmill test to exhaustion. At the conclusion of the test, there were no differences in RPE between the conditions. It is of interest that the participants' HR was higher in both music conditions when compared to the control condition at the end point of the test. Thus, music did lower perceived exertion; otherwise, the RPE would have reflected the greater cardio-vascular strain present in the music conditions. Hence, RPE measures should ideally be discussed in tandem with physiological measures. Miller (1984), in a masters thesis, reported that a self-selected music condition reduced RPE during submaximal treadmill running when compared to a control condition. Similar findings were reported by Makowicki (1982) and Brownlow (1985).

Boutcher and Trenske (1990) adopted a treadmill protocol whereby participants ran for 6 min at light, moderate, and heavy workloads, representing 60%, 75%, and 85% of $\dot{V}O_2$ max. respectively. In addition to self-selected music and a control condition, there was a sensory deprivation condition, which was introduced in apposition to the music “to block out external stimuli and channel attention to internal information, making sensations associated with exercise more salient” (p. 168). Only in the light intensity condition did music elicit a significantly lower RPE than sensory deprivation, which consisted of opaque goggles and earplugs. Thus, the load-dependent hypothesis of Rejeski’s parallel processing model (1985) was supported in that music did not lower RPE relative to the control condition at the moderate and higher workloads because physiological cues dominated processing. Further support for the load-dependent hypothesis was generated by Tenenbaum et al. (in press), who reported that various music conditions failed to affect RPE during running tasks completed at relatively high intensities, i.e., 90% $\dot{V}O_2$ max. (see Section 2.7.5.3).

Johnson and Siegel (1987) introduced a mathematics problem solving condition to serve as an *active* distraction in apposition to the *passive* distraction of music listening. Participants ran for 5 min on a treadmill at an intensity level of either 60% or 90% of $\dot{V}O_2$ max. The RPE in the maths condition was lower than that measured in either the music condition or the control condition. The data displayed a non-significant linear trend indicating “lower perceived exertion with greater ancillary task demands” (p. 44). Notably, this linear trend was more pronounced and the differences between the means greater in the high-intensity condition. Therefore, this result appears to contradict the load-dependent hypothesis. In the gymnasium environment, music is only one of many distractors, both passive and active. Johnson and Siegel’s findings indicate that active distraction has a more marked effect on perceived exertion than passive distraction.

Nethery et al. (1991) compared the effects of visual distraction, auditory distraction, no distraction, and sensory deprivation on RPE during a submaximal cycling task. Results showed that RPE (collapsed over 5-minutely time intervals) was lowest in the auditory condition, which consisted of self-selected motivational music. Further, RPE was lower in the visual condition and the control condition than the deprived condition. Mixed support was obtained for the load-dependent hypothesis in that the size of the distraction effect was reduced at the latter stages of the test when exertion was greatest, but the effect remained statistically significant. Nethery (2002) undertook a subsequent experiment based on a similar task and experimental conditions, and found that, during a cycle-ergometer task at both 50% and 80% of $\dot{V}O_2$ max., RPE was lower in a music condition than it was during the conditions of visual distraction, sensory deprivation, and no distraction.

Potteiger, Schroeder, and Goff (2000) tested the effects of several types of music (fast, jazz; slow, classical; self-selected) on RPE during a submaximal cycle ergometer test. Throughout the test, each music condition elicited lower RPE than a control condition. However, the three music conditions did not differently affect RPE. White and Potteiger (1996) tested the effects of visual, auditory, and mixed auditory and visual distractions on RPE during a submaximal cycle ergometer task. At various increments during the test, the RPE in the visual condition was higher than that in the mixed condition and sometimes the audio condition as well. However, the auditory condition did not elicit a lower RPE than the control condition. The authors proposed that affective schema mediated the result: “Stimulations which evoke a strong emotional response may actually heighten awareness of physical sensations” (p. 824). The possibility that emotionally relevant stimuli *potentiate* perceptions of exertion may provide an alternative to the simplistic linear relationship that has been posited between RPE and the informational load borne by stimuli (see Johnson & Siegel, 1987). Moreover, Hernandez-Peon (1961) maintained that pleasurable sensory stimuli could promote electrical activity in one sensory pathway while inhibiting information in another.

The role of affect might offer the best available explanation of the relationship between music, RPE, and exercise performance. However, such a relationship may prove to be inherently complex; Hardy and Rejeski (1989) measured affect and RPE during varying intensities of exercise and concluded that, for a given rating of perceived exertion, affect can differ strongly between individuals. Hence, the importance of individual difference must be recognised when considering the effects of music on attentional processes.

Since 1997, research by Karageorghis and his associates has incorporated greater standardisation in music selection through the use of the BMRI (see Section 2.7.4.1). The effects of motivating music on RPE during a submaximal treadmill test lasting 25 min were investigated by Karageorghis and Terry (2000). Motivating music significantly reduced RPE relative to a control condition, whereas oudeterous music did not. There was a clear linear trend whereby motivating music elicited the lowest RPE, followed by oudeterous music, and the control condition. Notably, concurrent measurements of affect yielded similar results; i.e., a linear pattern with the most positive affect associated with the motivating condition and the least positive affect associated with the control condition. This result is concurrent with the proposition that affective processes influence RPE; a relationship that was proposed by Hardy and Rejeski (1989). The results of Karageorghis and Terry (2000) may be taken as evidence to support the predictive validity of the BMRI instrument and the assertion that the scaled motivational qualities of music are reflected proportionally by measurable psychophysical consequences as suggested by Karageorghis et al. (1999).

In some cases, music conditions have not been shown to impact upon RPE during exercise. For example, Ciccomascolo et al. (1995) found that neither music nor a recording of ambient sounds from a basketball game affected the RPE reported by female basketball players undergoing a treadmill run to exhaustion. Wales (1985) tested the effects of fast music, slow music, and a control condition on RPE during a submaximal cycle-ergometer test. He also formulated a second level of conditions; splitting the participants into groups listening to either ‘positive’ or ‘negative’ musical selections. However, RPE did not differ between the conditions. Patton (1991) tested the effects of preferred, familiar music and non-preferred, unfamiliar music on RPE during an exercise-to-music class. She found that RPE was unaffected by the music conditions. Finally, Loucks (2000) found that neither fast music nor slow music (easy-listening) influenced RPE during a 30-min submaximal treadmill test, when compared to a no-music control condition.

Mertesdorf (1994) proposed that an individual’s attentional style might mediate the effects of music during exercise. For example, those using an *associative strategy* are focused on bodily sensation whereas a *dissociative strategy* would entail distraction from sensations of exertion (Scott et al., 1999). Hence, music could facilitate a dissociative strategy but impede those wishing to employ an associative strategy. Morgan and Pollock (1977) reported that dissociative strategies are the preserve of all levels of endurance athletes except the very elite. Nethery et al. (1991) suggested that dissociation could prove potentially dangerous for athletes who train near tissue thresholds and would thus need to be aware of subtle injury-related physiological feedback.

Hardy and Rejeski (1989) documented the responses of an elite cyclist who reported that he actively enjoyed perceptions of exertion because he felt that intense effort related to his cycling goals. State anxiety is viewed as either facilitative or debilitative to performance depending on the individual (Jones & Swain, 1992). Likewise, high perceptions of exertion may prove beneficial for some exercisers and detrimental for others. Atkinson et al. (in press) found that participants who undertook a cycle-ergometer time-trial over 10 km cycled faster under a condition of fast (142 bpm) dance music when compared to an absence of music. However, RPE was also higher in the music condition (throughout the test) indicating that the stimulative music had not distracted the participants but had motivated them; outcomes that Atkinson et al. regarded as distinct.

Scott et al. (1999) found that dissociative strategies were not as effective in improving the performance of novice rowers as an associative strategy. The two dissociative strategies comprised a video of rowers competing (visual) and popular music (auditory), whereas the associative strategy consisted of taped performance-instructions read by the team coxswain. The authors concluded that associative strategies were more likely to improve endurance performance than dissociative strategies. Such a conclusion does not account for the fact that dissociative strategies such as music can possess motivational impact. For example, the elite track and field athlete, Haile Garbriesellasie, utilised motivational music in his successful bid to break the indoor 2000m world record (Karageorghis, 1998). The conventional assumption is that music constitutes a dissociative strategy. However, this classification is too simplistic. First, it has been established that emotionally relevant stimuli, such as music, can potentiate the awareness of bodily sensations (White & Potteiger, 1996). Second, music can serve as a temporal cue, to which movement can be synchronised. Gluch (1993) studied the use of music in preparation for sporting competition. He reported that some of the athletes he interviewed used music as an associative strategy, whereas others used it as a dissociative strategy.

The attentional style of experienced or elite participants has been thought to moderate the relationship between music and motor performance. For example, Nelson (1963) reported that music exerted no effect on performance in a maximal cycle ergometer test. He attributed this result to the attentional style of the elite athletes who participated in the study. Further, Crook (as cited in Vogel, 1986) attributed the absence of any effect of music on running performance to the possibility that the experienced runners who participated "had learned to overcome the perception of pain" (p. 12).

Karageorghis and Terry (1997) reported that music has been shown to affect RPE in untrained participants but not in those who are trained. However, definitions of trained and untrained are somewhat inconsistent across different studies; for example, supposedly untrained participants have been obtained from physical education classes (see Karageorghis & Terry, 1997 for exemplars). Further, in some instances, music has been shown to influence the RPE of trained participants (Karageorghis & Terry, 2000; Miller, 1984; Potteiger et al., 2000; Szmedra et al., 1998).

In summary, the findings pertaining to RPE are not entirely conclusive. A tentative conclusion would be that various music conditions lower RPE during submaximal exercise when compared to control conditions. This effect appears to obtain regardless of the music type although the findings of Karageorghis and Terry (2000) indicate that motivational music may prove more distracting than oudeterous music. Despite its theoretical basis, the load-dependent hypothesis has received only partial support. However, few studies have tested the effects of music on RPE at differing exercise intensities and hence, no definitive conclusion is yet warranted. The affective qualities of the musical stimulus may impact upon RPE during physical tasks. Thus, the measure of RPE should be considered in concert with affective responses.

2.7.6.3 *Psychological responses: Mood, affect, and flow.*

Boutcher and Trenske (1990) found that self-selected music improved affect during a 6-min treadmill trial. The other stimulus conditions consisted of sensory deprivation (goggles and ear-plugs) and a control. At a low exercise intensity (60% max. HR), the stimulus conditions did not influence affect. However, at a moderate intensity (75% max. HR) the music condition improved affect when compared to the other two conditions. Whereas, in the high-intensity condition (85% max. HR) affect was more positive in the music condition than in the deprived condition. Hence, as with RPE, the relationship between music and affect during exercise may be load-dependent. Brownley et al. (1995) reported that stimulative (fast) music led to improved affect during a treadmill test when compared with sedative music and a control condition. However, this finding only applied to untrained participants (as opposed to the trained) and only in the case of low or high exercise intensity (not moderate). Thus, as with RPE, the trained status of a participant may impact on their affective response to music during exercise.

Wales (1985) delivered music selections that differed by tempo (fast vs. slow) and disposition (positive vs. negative) during a submaximal, 30-min cycle ergometer test. An interaction effect occurred whereby fast and positive music lowered anger, depression and fatigue during the course of the test. Lee (1987) measured the response to music in terms of mood after a submaximal treadmill test that was accompanied by slow music, fast music, or a control condition. Using an unvalidated inventory, he found that positive mood states were higher and negative mood states were lower in the fast music condition when compared to either the slow music or control conditions. However, Lee's fast and slow music conditions were taken from different music idioms- rock and baroque. Both Lee's and Wales' work indicates that fast-tempo music may induce positive mood states; a perspective also endorsed by researchers outside the sport and exercise domain (see Section 2.1.3).

Hayakawa, Miki, Takada, and Tanaka (2000) investigated the effects of traditional Japanese folk music and aerobic dance music on mood during a 30-min bench-stepping exercise. Both music conditions led to reductions in the POMS subscale of Fatigue over the course of the test when compared to a metronome control condition. Moreover, aerobic dance music led to improvements in Vigour relative to the control condition. A limitation, which affected the study, was that the aerobic dance music was synchronous (120 bpm) with the bench-stepping task as was the metronome control condition, whereas the folk music was asynchronous. Hence, it is not clear to what extent the results may be attributed to the style of music or its synchronicity with the task. Hayakawa et al.'s results also included the finding that RPE was higher in the dance music condition when compared to the control condition, despite the fact that participants experienced greater Vigour and less Confusion under the former condition. Such a result lends support to the proposition of Hardy and Rejeski (1989) that it is more important to appraise *how* an individual feels about exercise than *what* they feel.

Kodzhaspirov et al. (1988) conducted a longitudinal study using a self-report questionnaire to investigate the effects of music on Russian weightlifters during training. The participants stated almost unanimously (95.40%) that music improved their mood during training. Notably, all of the weightlifters reported than they eagerly looked forward to training with music; a possible relationship between exercise compliance and the affective response to music has been suggested by Karageroghis (1998) and Boutcher and Trenske (1990).

Karageorghis and Terry (2000) tested the effects of both motivational and oudeterous music on mood and affective responses before, during, and after a submaximal treadmill test. Affect was measured using Rejeski's feeling scale (1985) and it was found that motivating music led to improved affective responses when compared to oudeterous music and a control condition. The POMS-C subscales (Terry, Lane, Lane, & Keohane, 1999) were administered before and after the test. The motivating music condition led to increases in Vigour during the course of the test when compared to the control condition. Karageorghis and Deeth (2002) investigated the effects of motivational music on flow during a multi-stage fitness test. The multiple dimensions of the flow experience are represented by the factors of the Flow State Scale (FSS) developed by Jackson and Marsh (1996). Motivational music led to increases in several of the FSS factors when compared to oudeterous music and a no-music control condition. This finding corroborated the results obtained by Karageorghis (1998), who found that perceptions of flow were correlated with the rated motivational qualities of music following exercise-to-music classes.

Pates et al. (2003) used a single subject, multiple baseline approach to investigate the effects of a music intervention on netball shooting performance and self-reports of flow. The three collegiate netballers who participated in the study were asked to select music that evoked feelings similar to a state of flow. Following baseline shooting trials, the concept of flow was explained to the 3 participants and they were invited to mentally rehearse sensations of flow and recall their own flow experiences relating to netball. Each participant selected a piece of music that would evoke feelings similar to those they associated with flow. Subsequent shooting trials were accompanied by the chosen music and each of the participants was deemed to have improved their shooting accuracy in relation to the baseline trials. Moreover, two of the participants reported higher estimations of flow-state (combined FSS score) following the intervention.

A criticism that could be levelled at Pates et al.'s study (2003) is that the results in relation to the measure of flow were partly determined by a Hawthorne effect. Namely, the success of the intervention in promoting flow may have been attributable to the fact that the participants were specifically asked to select music that would promote flow. Further, the mental rehearsal and recall of flow-state, which constituted part of the intervention, may have prompted the results rather than the music itself. The participants were required to complete the FSS 10 times during the trials, thus consistently re-enforcing the components of flow, an effect that would have accrued added strength in the latter trials following the introduction of the intervention.

Based on the theoretical work of Norman and Shallice (1986), Pates et al., (2003) offered a cognitive explanation of the effects of music on perceptions of flow during physical activity: The presence of music may inhibit a supervisory, or higher-order, behavioural control system, thus assigning the control of behaviour to an automatic lower-level system. The consequence of this cognitive devolution would be that behaviour is directed in a more autonomous manner and analytical thought processes are annulled. However, Pates et al. do not clarify the exact mechanism whereby music inhibits the supervisory control system.

In summary, there is unilateral evidence that both motivating music and stimulative music elevate mood and improve affective responses during exercise. Similarly, there is accumulating evidence that motivating music promotes perceptions of flow during physical activity.

2.7.7 *The Use of Music in the Context of Competitive Sport*

Karageorghis et al. (1999) posited that one of the two principal outcomes of motivational music, in the contexts of sport and exercise, is a pre-event routine, the other outcome being exercise adherence. The various functions of music in relation to the pre-competitive routines of athletes were detailed by Gluch (1993; see also Figure 2.6). Notably, similar facets of musical response, such as mood, arousal, and attentional mechanisms, are evoked both prior to competition and during training (see Figure 2.5). The prevalence of music in the context of competitive sport was underlined by Thiese and Huddleston (1999), who investigated the use of psychological skills in competition by female collegiate swimmers and found that such individuals almost always use music as part of their competitive routines.

Lanzillo, Burke, Joyner, and Hardy (2001) presented collegiate athletes with a self-selected music intervention prior to performance in inter-collegiate events; a control group was not provided with music. The music heightened self-reports of state Self-confidence as measured by the Competitive State Anxiety Inventory-2 (Martens, Burton, Vealey, Bump, & Smith, 1990). Accordingly, Gluch (1993) found that music enhanced self-confidence and bestowed feelings of ‘power’ in the context of pre-competitive routines.

2.7.8 *Methodological Issues*

Lucaccini and Kreit (1972) concluded that research into the ergogenic effects of music was beset by methodological weakness and the want of coherent theoretical structures; “the lack of control characterising most studies may constitute the most important reason for the inconsistent, largely negative findings reported in this review” (p. 256). Twenty-five years later, Karageorghis and Terry (1997) noted that “findings since 1972 also appear to arise from a questionable theoretical base and numerous methodological limitations” (p. 55). Since the time of the latter review, it could be argued that studies have benefited from a firmer conceptual foundation and greater methodological rigour. Nevertheless, the limitations described in the aforementioned reviews warrant introduction and further elaboration, for they underpin future study.

2.7.8.1 *Music selection.*

Music selection was deemed by both Lucaccini and Kreit (1972) and Karageorghis and Terry (1997) to be the most serious flaw attributable to music research in the context of physical activity. Many researchers fail to report the musical selections that were used; thus, it is impossible to repeat their experiments or apply the results of their research. The method of music delivery and the intensity level of the music should also be fully disclosed. In the ecologically valid setting of the gymnasium, music is obscured by many ambient sounds, a factor which researchers should consider. Notably, Copeland and Franks (1991) increased the volume-level of the music they delivered to account for treadmill noise; such is the sensitivity required to undertake research into the effects of music during physical activity.

The selection of music in an arbitrary fashion by experimenters is the Achillean methodological weakness in this field of study. Socio-cultural factors mediate music preference (Karageorghis & Terry, 1997; Lucaccini & Kreit, 1972). Hence, researchers should be sensitive to the socio-cultural background of participants when selecting music for experimental conditions. For example, Becker et al. (1994) found that the ergogenic effects of music on cycling performance were absent only from the senior (60-80 years) group of participants. The authors reported that the senior participants had complained about the contemporary (1990s) pop music used during the experiment.

Researchers have failed to isolate different musical factors; an investigation into the effects of musical tempo would require the same selection to be delivered at different tempi rather than a contrast between fast, jazz music and slow, classical music (e.g., Potteiger et al., 2000). Further, the confused terminology that is used to describe music conditions renders valid comparison prohibitively difficult. Some music descriptors refer to intensity (loud vs. soft), some to idiom (pop, classical), some to the synchronisation of music with movement (asynchronous), some to tempo (fast vs. slow), some to the mood of the music (positive vs. negative), whereas some refer to the proposed stimulative and sedative properties of the music (mellow vs. frenetic).

The manipulation of tempo is problematic because to distort the tempo of a well-known piece of music also distorts the associations, which were formed when the piece was heard at its original tempo (Mertesdorf, 1994). Hence, to reduce the tempo of a popular song would not be an effective isolation of tempo as a variable. A more valid approach would be to use musical selections that differed in terms of tempo but were similar in terms of their remaining motivational qualities.

Researchers should attempt to control the effects of general music preference, which mediates psychophysical effects. One solution would be to permit the self-selection of music by participants as advocated by Karageorghis et al. (1996). Pujol and Langenfeld (1999) allowed participants to choose from a limited selection of music, which included different musical idioms but with a common tempo of 120 bpm. Despite the advantages of self-selection, the process might well draw undue attention to the experimental conditions or research hypotheses, thus compromising internal validity.

2.7.8.2 *Hawthorne effects.*

Research into the effects of music on physical activity is affected by the tendency of participants to become aware of the experimental hypothesis and for this to influence their behaviour. Lucaccini and Kreit (1972) provided an example of the resultant redirection of effort exhibited by participants in a study by Wokoun (1963). A characteristic of musical response is absorption within a flow-like state, which becomes distorted in laboratory-based investigations of musical effects (Lowis, 1998).

Various strategies may be employed to maintain the integrity of a single-blind experimental design. For example, Karageorghis and Terry (2000) informed participants that feelings would be assessed before, during, and after exercise and that the music was present to alleviate the monotony of the test. Further, the experimenter explained to participants, who passed comment on the music, that it could not be changed because it had to be standardised between trials.

2.7.8.3 *Temporal factors relating to music delivery.*

Lucaccini and Kreit (1972) proposed that clear hypotheses should be formed and stated in respect of when musical selections are delivered in relation to the task. If music is used in an antecedent role (prior to the task) then this procedure should be justified in terms of a proposed effect of the musical stimulus on activation. For example, Becker et al. (1994) tested the effects of music both prior to and during a cycle-ergometer task. Hence, it was concluded that the effects of the music conditions used prior to the task were not attributable to mechanisms of attentional distraction. Thus, varying the point in time at which the music is introduced relative to the task allows researchers to examine the contribution of different psychophysical response mechanisms.

2.7.8.4 *Intrusivity.*

Given that the nature of the response to music in exercise settings is subtle (Karageorghis & Terry, 1997), the proliferation of different measures used by some researchers might negate or overshadow the effect of the musical stimulus. A classic example is that of Mertesdorf (1994), whose measures included HR, pedalling rate, blood lactate, an adapted mood scale, several RPE scales, various subjective rating items, a personality scale, and an instrument to asses attention. The measurement of so many differing physiological and psychological indices presents a significant threat to external validity. Moreover, the use of headphones by researchers to deliver music conditions to participants may decrease comfort and influence dependent measures such as affective response.

2.7.8.5 *Dependent measures.*

Karageorghis and Terry (1997) highlighted issues surrounding the use of inappropriate dependent measures. For example, physiological measures are unlikely to tap the subtle effects of music during physical activity. Further, certain performance measures are unlikely to be affected by music. A good example being Lee's (1987) use of stride rate as a measure of running performance; stride rate is primarily dependent on anthropometric characteristics (Karageorghis & Terry, 1997). Simple motoric patterns that lend themselves to standardisation may prove the most appropriate measures of the ergogenic effects of music. Research should be undertaken to examine the effects of music after the plateau of work output-level (Karageorghis & Terry, 1997). Such effects are obscured because experimental work has typically involved the performance of a single task to the point of exhaustion. The effects of music may become more evident in externally-valid settings where participants are able to exert more control over their physical activity. For example, both Becker et al. (1994) and Matesic and Comartie (2002) found that music conditions led to an increase in work output when exercise intensity was self-selected by participants (see Section 2.7.5.3).

2.7.8.6 *Limitations of RPE.*

The measurement of RPE is problematic for several reasons. First, the process of assessing perceptions of exertion alters the focus of attention thus distorting the measure (Szabo et al., 1999). Thus, an individual's internal perception of exertion might differ from their reported perception of exertion (Rejeski, 1985). Such concerns are heightened when RPE is measured frequently. For example, Tenenbaum et al. (2003) measured RPE at 30-s intervals during a treadmill running task. Second, RPE measurement can be affected by various social presentation concerns and also by personality type (Hardy, Hall, & Prestholdt, 1986). Third, retrospective measures of RPE are unreliable (Szabo et al., 1999). It is questionable whether an individual can recall with accuracy how hard they felt themselves to be working 10 min ago as opposed to 20 min ago. Fourth, responding to an RPE scale is a form of active distraction. Hence, if a comparison is sought between passive and active attentional distractions then the use of RPE as a measure will confound this distinction. Boutcher and Trenske (1990) employed a sensory deprivation condition that consisted of opaque goggles and earplugs, which were worn to eliminate attentional distraction.

However, they bade the participants remove their opaque goggles on request to rate their perceived exertion. Such a procedure may have compromised the internal validity of the sensory deprivation condition.

Perceived exertion is an indicator of fatigue in sustained submaximal work. In such cases, the maintenance of a constant work output is associated with an increasing perception of effort (Borg & Noble, 1974; Noble, Metz, Pandolf, & Cafarelli, 1973). Hence, the efficacy of RPE scales in the assessment of exertion during short-term bouts of activity is questionable. For example, Johnson and Siegel (1987) found that music did not reduce RPE during a 5-min treadmill run; a result that might be attributable to the short duration of the test. Indeed, the exercise intensities chosen by experimenters are sometimes confounded by the duration of the test. For example, if a 5-min test at 85% $\dot{V}O_2$ max. is referred to as *high* intensity then should a test to the point of volitional exhaustion starting at 70% $\dot{V}O_2$ max. be referred to as *moderate*?

2.7.8.7 *Statistical limitations.*

A lack of statistical power in the design of some studies may have led to the effects of music on performance being declared non-significant. For example, Schwartz et al. (1990) found that a music condition increased cycling endurance by over 4 min (M = 25.60 min) when compared to the control condition (M = 21.30 min). The non-significance of this result may be attributable to the unusually low alpha (.01) and the small number of participants in the sample (n = 10 in each sex group), both factors that would conspire to reduce statistical power. Similarly, a music condition improved treadmill endurance by 4 min relative to both ambient sounds and silence (Ciccomascolo et al., 1995). However, the small sample size (N = 12) may have prevented this difference from achieving statistical significance.

2.7.9 *Summary*

Musical stimuli are capable of evoking both emotional and affective responses (Section 2.1) as well as sensations of optimal experience (Section 2.3). The determinants of such responses include physical properties of the music such as tempo and harmony and the extra-musical associations that the music may bear (Section 2.1.7). Music preference is a developmental process that involves a large number of personal, musical, and cultural variables. Music preference is partly determined by the situation. For example, in the physical training setting, stimulative music is typically appropriate because it heightens levels of activation. In various environments (e.g., retail, manufacture, medicine) music alters the perceptions of additional stimuli (e.g., products, visual media) and also influences behaviour.

Within the context of exercise, stimulative music has been shown to enhance performance in explosive, anaerobic tasks. Further, various types of music have been shown to lead to increases in aerobic endurance at moderate exercise intensities. Concerning psychological responses, there is evidence that motivational music promotes positive affective states, improves mood, and increases the likelihood of flow experience during physical activity. Future research is warranted into the various effects of music in sport and exercise settings. However, in order for this research to prove meaningful in theoretical and practical terms, several methodological limitations must continue to be addressed in accordance with the recommendations of Karageorghis and Terry (1997).

CHAPTER 3

A Qualitative Investigation Into the Motivational Qualities of Music and Their Effects in an Exercise Context

The potential effects of music during exercise may influence patterns of exercise adoption and maintenance (Karageorghis et al., 1999; Schwartz et al., 1990). Research into the psychophysical effects of music in a physical activity context has been characterised by methodological weaknesses and the lack of study rationales that were firmly grounded in theory (Karageorghis & Terry, 1997). Consequently, research findings have been largely equivocal, making it difficult to evaluate general trends. However, Karageorghis et al. (1999) developed a conceptual framework that outlines the principal factors contributing to the motivational qualities of music and predicts their effects (see Figure 2.5). The conceptual framework provides practitioners with guidelines, which facilitate the prescription of music that may impact upon exercise adherence. In addition, the framework provides researchers with a conceptual structure that focuses their investigations into the effects of music in sport and exercise settings. Latterly, there is accumulating evidence that carefully selected music improves exercise performance (Atkinson et al., in press; Karageorghis & Jones, 2000; Karageorghis & Lee, 2001; Matesic & Comartie, 2002; Szabo et al., 1999), elevates mood (Hayakawa et al., 2000; Karageorghis 1988), and reduces RPE (Karageorghis, 1998; Potteiger et al., 2000; Nethery, 2002).

3.1 *Rationale*

Research into the psychophysical effects of music has been characterised by an experimental approach (Karageorghis, 1998). Further, the hierarchy of music’s motivational qualities within the revised conceptual model (see Figure 2.5) was derived from the factor structure of a psychometric instrument – the Brunel Music Rating Inventory (BMRI). Whereas an experimental approach may be said to separate the experience of music listening from the external context of a gymnasium, naturalistic inquiry is grounded in the context where the phenomenon in question (i.e., the experience of being motivated by music) occurs. Patton (1990) cited naturalism as one of the ten salient themes of qualitative research. Essentially, qualitative methodologies stem from a *constructionist* perspective; i.e., ‘meaning’ is not inherent and waiting to be discovered but constructed by individuals and inextricably related to context (see Segal, 1986). As such, exercise participants and leaders construct the meaning of music within the context of exercise.

Music is an art from and the subjective nature of music perception and preference appear to require a reciprocally subtle research paradigm (Reimer, 1985). Further, it has been argued that qualitative research methods are particularly beneficial in the development and extension of theory (Hayes, 1997; Miles & Huberman, 1994; Smith, 1995). The positivistic nature of the extant conceptual framework (see Figure 2.5) represents a limitation that should be addressed. Thus, the principal rationale for the present study was to strengthen the conceptual base relating to motivational music through the use of a naturalistic and qualitative methodology. In addition, the descriptive nature of the present study serves as an appropriate starting point for the doctoral programme.

The only prior example of interview-based qualitative research relating to music in the context of sport or exercise was undertaken by Gluch (1993), who interviewed five elite athletes regarding the role of music in their pre-performance routines. Despite the fact that Gluch's work represents a valid precedent for qualitative research in the field of music and physical activity, the framework he elicited from the athletes is open to expansion. First, he focussed exclusively on the pre-competitive routines of elite sport participants. Second, the data collection and analysis were focussed on the psychophysical responses to the music rather than the salient qualities of the music itself. The present study is set predominantly within the context of exercise and the scope of the data collection is broader (see Section 3.3.2).

Although the motivational qualities of music appear to have been identified (see Karageorghis et al., 1999), the consequences of manipulating individual musical components (e.g., rhythm) are not well understood. Notably, qualitative methods are considered to be particularly appropriate for assessing local causality and preserving the narrative flow of phenomena (Miles & Huberman, 1994). The factors that are thought to comprise the motivational qualities of music have been face-validated by exercise leaders (Karageorghis et al., 1999) but not by exercise participants themselves. Hence, part of the rationale for the present study was to determine whether the perspectives of exercise participants would contribute to the extant construction of the motivational qualities and effects of music.

3.2 *Purpose and Hypotheses*

The purpose of the study was to identify the motivational qualities of music and the effects thereof in the context of gymnasium-based exercise using a qualitative methodology. An essential tenet of naturalistic enquiry is that an inductive approach is taken to data collection and analysis, the formation of hypotheses *a priori* is the very antithesis of such an approach (Marshall & Rossman, 1999). Rather, the emphasis lies on mitigating the imposition of prior findings and theory on the procedures of data collection and analysis.

3.3 *Method*

3.3.1 *Participants*

The sample of 13 participants was purposively selected from the population of members and staff of health clubs and sport centres in London and Norwich, United Kingdom. Gluch (1993) outlined the criteria for purposive sampling: "Participants are selected because of their unique value to the study based on certain characteristics that are considered important by the researcher" (p. 34). Each participant had at least two years experience of exercising to music. At the time of the study, all of the participants exercised to asynchronous music (see Section 2.7.3.5) in a gymnasium setting at least three times per week. Four of the participants also had experience as exercise leaders. The sample comprised seven males and six females, whose mean age was 33.23 years (range: 20 – 65 years). The distribution of ethnicity within the sample was as follows: White UK or Irish (n = 9), Black Afro Caribbean (n = 3), and Black Maori Australasian (n = 1).

Principally, the participants were active in exercise as opposed to sport contexts. Nevertheless, the present findings may also have some relevance to sport. It should be emphasized that, in qualitative research, sample size is not the determinant of research significance (Patton, 1990). Instead, the principal consideration when developing a sample is richness of information (Kuzel, 1992).

3.3.2 *Procedure*

Commensurate with the naturalistic emphasis of the study, the participants were interviewed by the researcher at a location in which they reported that they felt comfortable: Either at their place of study (n = 3), their health club (n = 3), or at their home (n = 7). Ten of the participants were interviewed twice, whereas, owing to dropout, the remaining 3 participants were interviewed only once. The duration of the interviews was between 45 and 120 min. The first interview was open-ended in nature and semi-structured. The structure was derived from a 'schedule' of topics that was specified *a priori* (see Côté, Salmela, & Russell, 1995). The general themes of the schedule were drawn from a review of relevant literature (e.g., Gfeller, 1988; Gluch, 1993; Karageorghis & Terry, 1997; Szabo et al., 1999) and consisted of the following aspects: (a) The properties of music that elicit responses in the exercise setting, (b) factors relating to individual perception that moderate the response to music in the exercise setting, (c) contextual factors, (d) responses to music in the exercise setting, and (e) the behavioural outcomes of listening to music during exercise. However, the specific concepts that prevail within the relevant literature, such as the term 'motivational music' were not imposed upon the participants lest their own perspectives should be inhibited (see also Section 3.3.3.1). In order to elucidate a rich description of the subject matter, the participants were also asked to envisage and describe memorable incidents that related to their experience of music in exercise and sport training settings.

Framing questions were used, followed by gentle probing for elaboration. Finally, contrast questions were used to differentiate points of interest raised by the participants (Spradley, 1979). Thus, the approach adopted was largely open-ended (see Marshall & Rossman, 1999). An example of a framing question relating to musical qualities follows: "Which qualities of music, if any, influence you while you are exercising" Stringent efforts were made to avoid 'leading' questions; the interviewer refrained from phrasing questions in such a way that certain answers were prompted. For example, rather than ask a question such as "does rhythm stimulate you during exercise," the researcher would have used a question with less explicit reference such as "why do people exercise to music as opposed to exercising in silence," possibly followed by "please describe that effect from your perspective." During the course of the interview, the researcher recorded in a notebook any new themes as they emerged. This procedure ensured that certain avenues of questioning were fully explored during the present interview and also provided a repertory for future reference and consideration. The schedule for future interviews was amended on the basis of this repertory of emergent information.

An inherent problem associated with the subject matter of the interviews was the semantic difficulties that stem from attempting to describe an aesthetic stimulus such as music and the emotional responses to it (see also Section 2.1.1). These difficulties were compounded by the fact that, with a solitary exception, the participants were not musically trained or conversant with musical terminology. Hence, it was incumbent upon the researcher to make concerted efforts to clarify the intended meaning of what was said. For example, it was necessary to differentiate words such as ‘beat’ and ‘rhythm’ from the perspectives of the interviewees. This aim was achieved by simply asking the participant to clarify a term that they had used (e.g., tempo) and contrast it with similar terms in order to resolve any semantic disparity. Finally, at the close of each interview, the participant was asked if any information had been omitted or if they would like to make additional comments or elaborate on any aspect of what they had said. All interviews were recorded using a dictaphone.

Contingent on the availability of the interviewee, a second interview was arranged. The protocol for the second interview involved the participant and researcher listening to music together. The participant selected music to exemplify their preferred / motivating musical accompaniment for gymnasium-based exercise. The rationale for this was that specific examples might cue detailed and insightful explanations of the function of music in relation to physical activity. The self-selection procedure ensured that the music possessed motivational qualities from the perspectives of the interviewees. Hence, the aim was not to compare the participants’ responses to a standardised musical selection but to prompt pertinent instances of musical response, which would prove insightful and relevant to the overall purpose of the study. In fact, a strength of qualitative research is the inclusion of the “rare experience”, which is often more enlightening than the common response (Prof. V. Krane [see Krane, Andersen, & Strean, 1997], personal communication, July 12, 2002). Even within the more exacting and positivistic climate of experimental research, Karageorghis et al. (1996) have advocated the self-selection of music by participants as a valid means of forming an experimental condition.

Each participant was asked to select three different pieces. The participants chose a variety of music, which they described as follows: ‘dance’ (n = 11), ‘popular’ (n = 4), ‘rhythm and blues’ (n = 4), ‘rap’ (n = 4), ‘soul’ (n = 2) and ‘ethnic’ (n = 2). The pieces of music were delivered by either a high-fidelity music system in the home of the participant or a portable compact-disc player provided by the researcher. During presentation of the music, the participants were able to draw attention to elements of the piece that they felt were salient. Following each piece of music, the researcher inquired as to the aspects of the music that evoked a response for the participant. Hence, the protocol that was adhered to during the second interviews partially circumvented the semantic difficulties relating to musical terminology that were evident during the initial interviews. Apart from the change in protocol, the process of questioning was similar to that of the first interview. The schedules of the second interviews were based on the same broad structure that was used for the first interviews, with the difference that the questions were focused on the specific musical selections that were used. For example, the participants were asked "which aspects of the piece of music that we have just listened to would influence you during exercise."

3.3.3 *Data Analysis*

The inductive analysis of the data was based upon the methods and techniques described by Côté et al. (1995), which were, in turn, derived from the recommendations of authors such as Miles and Huberman (1994), Strauss and Corbin (1990), and Tesch (1990). First, the interviews were transcribed *ad verbatim* by the researcher. In this way, he was able to remain close to the data (Strauss & Corbin, 1990) and begin to appraise the content of the interviews and identify tentative themes. At this point, the researcher screened the data and removed any references to the identity of the participants in order to promote confidentiality. Second, each interview transcript was read in its entirety in order to provide a global appraisal of each participant's perspective. Third, the transcripts were broken down into *meaning units*; bracketed statements from the transcript that are indivisible and contain sufficient information to be interpreted on their own (Tesch, 1990). Fourth, the meaning units were grouped into *properties* according to common features. For example, meaning units that contained reference to the rhythmical elements of the music were grouped into a 'rhythm' property. Fifth, the properties were further grouped into *categories* at a higher level of abstraction. For example, the properties 'rhythm' and 'harmony' were added to the 'music' category, which contained properties that were related to the perceived motivational attributes of the music. At this juncture, it was felt that it was not possible to further group the categories to form categories at a higher level of abstraction. Sixth, the relationships between the properties and categories were assessed. For the purposes of expediency, the data analysis was performed using a personal computer. Microsoft Access 97 served as a platform to develop a database of the transcripts, which permitted all the meaning units from a certain property (e.g., ‘rhythm’) to be filtered and viewed concurrently. The data were coded as they emerged rather than at the conclusion of all data collection. Hence, during the analysis of the data from each interview, the properties were subject to continual readjustment and cross-referencing. Brody (1992) suggested that reflexivity is an essential aspect of qualitative data analysis.

3.3.3.1 *Considerations of validity within the data analysis.*

Within the domain of qualitative research, the issue of validity has received much critical attention (e.g., Aldridge & Aldridge, 1996; Denzin & Lincoln, 1994; Koch, 1994; Sparkes, 1998). The appropriateness of rigid, prescriptive validity criteria has been questioned, “reliability, validity, generalizability, and probability, the stalwarts of the positivist tradition, are simply irrelevant to the purpose, assumptions, and methodological problems of qualitative research.” (Bruscia, 1998, p. 177). From a naturalistic perspective, there is no single reality waiting to be discovered, rather there are multiple realities and consequently the very notion of foundational criteria to distinguish between valid and invalid results is an alien one (Sparkes, 1998). Hence, validity represents a flexible concept that is not externally applied by others in a rigid fashion but assessed by the researcher (Bruscia, 1998); guiding principles, which can be applied in accordance with context rather than absolute criteria (Schwandt, 1996).

In qualitative research, the researcher is the instrument and therefore concepts of validity rest largely with the researcher and in particular their conduct in relation to the participants (Marshall & Rossman, 1999). Hence, particular attention was paid by the researcher to the application of interpersonal skills; in particular, his ability to be an active, patient listener and the need to respect and validate the interviewees’ perspectives. It was imperative that the researcher understood the nature of the discourse between interviewer and interviewee and how this might be influenced by the interviewing situation. For example, an interviewee may exhibit “varying rhetorical, persuasive, and defensive stances” (Sherrard, 1997, p. 71). Thus, the researcher sought to nullify any perceptions that he was an expert or somebody who had all the answers. At the commencement of each interview, the researcher emphasised that anything the participant said was valid and of interest; hence, there were no right or wrong answers. Further, it was stated that there was no requirement for the participants to adjust their responses in order to provide the researcher with information that they thought he would value in an effort to assist him in expediting the study.

The participants drew on discourses that relate to music and exercise. Hence, the researcher made conscious efforts to be sensitive to these discourses. According to Gillett (1995), one must “open oneself to the reality of the person one is studying, to share in discourses with them, their constructions of us also, rather than to push them into theoretical boxes” (p. 114). The researcher’s experience of working in a health club environment, exercising to music, playing music, and listening to music was thought to enhance his sensitivity to the perspectives of the interviewees. Moreover, the researcher aimed to employ the language and terms of reference used by the participants and thus project an accurate conceptualisation of their perspectives. In doing so, the researcher aimed to demonstrate his affinity with the participants’ viewpoints and encourage the development of trusting relationships thus increasing his ‘participantness’ or affiliation with the participants (Patton, 1990). Further, it was felt that the researcher’s personal qualities of empathy, attentiveness, sensitivity, and his good communication skills would render him an appropriate interviewer.

Other steps were taken by the researcher to establish his credibility as a qualitative researcher. This process involved extensive reading and thought into the epistemological position that underpins naturalistic paradigms. The epistemological position that underlies the present study is one of multiple realities. Hence, a piece of music is not seen as being motivational *per se*, i.e., in an absolute sense; rather, music is *perceived* as motivational by an individual. In order to further his credibility, the author also entered into consultation with three other researchers (two post-doctoral, one doctoral) who had extensive experience of qualitative methods in order to discuss relevant issues relating to data collection and analysis.

The process of ‘member-checking’ or involving the participants in the process of analysing the data has been frequently advocated within the research literature and has been felt to increase the ‘trustworthiness’ of findings (Côté et al., 1995; Gluch, 1993; Marshall & Rossman, 1999). The participants were all sent a detailed but concise report of the analysis (c. 1,500 words, see Appendix B). A feedback sheet and a stamped addressed envelope were also provided. As a consequence of the member-checking procedure, four feedback sheets were returned, which contained three suggestions relating to properties within the data analysis. These suggestions were incorporated into the second phase of the data analysis (see below). Subsequently, two of the properties were re-defined.

‘Critical challenging’ (searching for alternative explanations) and the exploration of bias (Marshall & Rossman, 1999) were considered to be integral aspects of the analytical process. Thus, it was felt that the analysis would be facilitated by the involvement of a second researcher. The researcher’s first doctoral supervisor is widely published in the area of the psychophysical effects of music and has experience of qualitative methods. Thus, he took part in the analysis of the data as a form of external audit (see Lincoln & Guba, 1985).

Following the analysis of the data by the researcher, there was a series of three meetings between the researcher and his first supervisor, each lasting approximately 90 min. During these meetings, the emergent properties and categories were discussed at length. The first supervisor challenged the researcher’s coding of a number of the properties and the formation of two of the categories (the ‘individual’ category and the ‘environmental’ category that was subsequently replaced by the ‘contextual’ category). In order to reconcile the issues that the first supervisor raised, both parties referred to the data using a personal computer. In some cases, it was agreed to retain a disputed property because it was appropriately qualified by reference to the data. In the case of other properties, a recoding was agreed upon. Subsequently, the researcher reviewed all the meaning units that related to such properties and recoded them as agreed upon during the meetings. Hence, a consensual validation was achieved.

3.4 *Results*

The results will be presented for each category that was elicited from the analysis. In the text, the names of the categories and properties have been italicised. Owing to the nature of the subject matter, some of the properties are inter-related. For example, in order to present findings relating to feelings of stimulation, it was in some instances necessary to outline which musical qualities were felt to promote stimulation. Table 3.1 contains a list of the categories and properties that emanated from the data analysis. The frequency counts are provided for information purposes and to assist in the interpretation of the findings, they do not necessarily imply relative importance (see Krane et al., 1997). In order to illustrate the perspectives of the participants, direct quotations have been used where possible. The inclusion of such quotations contributes to the ‘thick description’, which is an important characteristic of qualitative research (Patton, 1990).

3.4.1 *Music Category*

The music category comprises properties that relate to perceived attributes of the music. The salience of *rhythm* was expressed by all of the participants. It was felt that strong rhythmical features characterise music that is suitable for exercise. The following statement was typical: “It shouldn’t really matter what music is playing, if it’s got a good beat … if it’s rhythmical then you can train to it.” A 24-year-old male exercise leader described the tendency to synchronise one’s movement with a rhythm: “There is a natural human characteristic that if someone has a rhythm and then the desire is to keep up with that and to erm work with that as opposed to pulling against it.” Aside from its role as a temporal pacemaker, rhythm was also felt to initiate a motivational response; “it gives you a jab of enthusiasm when you hear a song with a good beat.” An intense beat was disliked by three of the female recreational exercise participants; “if the beat is too heavy, it pulls me down rather than lifts me up.” This trend was not unilateral, three of the younger male participants from a sport background reported that they responded positively to the strength of the rhythm: “I like the beat to be really driving, hard, a real booming sound.” The participants who expressed a preference for a pronounced beat also referred to the *bass* frequencies of the music as a motivational factor. In particular, the bass-line, was identified as a motivational quality.

The *speed* or tempo of the music was referred to by 11 of the participants. Generally, a fast or ‘upbeat’ tempo was considered to be motivational during exercise: A 20-year-old male exercise participant stated that “when a slow song is replaced by a fast one then you can definitely see a big improvement in effort and speed.” It was also suggested that ideally the musical tempo should coincide with the tempo of movement. For example, a 32-year-old male exercise participant noted that “when you are doing sit-ups you want to keep them slow and controlled, so movement quality is what you’re going for, you wouldn’t then want a fast beat because you’d be moving slowly.”

Table 3.1

Response Frequencies of the Properties that Emerged from the Content Analysis

Category	Property	Interview-1	Interview-2	Participants (*N*)
Music	Rhythm	90	54	13
Speed	50	22	11	
	Lyrics	41	36	13
	Artist	35	40	13
	Style	26	7	11
	Segmentation	3	25	11
	Bass	8	16	6
	Variety	8	0	4
	Harmony	0	8	5
Contextual	Social factors	51	17	13
	Time of day	11	5	3
Individual	Attitude to exercise	53	7	11
	Personality	18	27	8
	Background	30	16	10
	Music preference	32	11	11
	Familiarity	15	12	10
State	Stimulative	65	36	11
	Motivation	73	21	13
	Distracts attention	74	18	13
	Associations	31	26	11
	Mood	46	10	11
	Imagery	10	15	8
	Self-expression	18	4	9
	Altered state of awareness	7	5	4
	Sedative	8	2	5
	Perception of time	6	0	3
Outcomes	Work-rate	13	7	8
	Attendance	5	6	6
	Endurance	9	1	7

The melody, or tune, of a musical piece was typically referred to as a motivational quality. However, two of the participants reported that music with melodic qualities was an inappropriate accompaniment for exercise. Nevertheless, further probing for clarification revealed that the participants in question associated the melodic qualities of music with ballads, which are also characterised by a slow tempo and a less-pronounced rhythm; hence, it was not purely the melodic qualities of music that were deemed to be demotivational.

Five of the participants referred to *harmony* in order to describe a motivational segment of a musical piece. For example, during her second interview, a 35-year-old female recreational exercise participant was able to identify a key-change in the final chorus of a musical piece that inspired her. However, owing to the semantic difficulties noted above (see Section 3.3.2), only one of the participants was able to refer to harmony without the aid of the music as a reference point. Notably, this participant was a music student and a semi-professional musician.

Music is often described in terms of a general *style* or idiom such as rock or jazz: A 27-year-old male participant revealed that "the styles of music really do make a difference for me, there are certain types of music that do not have any erm stimulating factor toward them and thus do nothing for me." The participants typically referred to their preferred music in terms of its style.

On occasion, the participants identified music that they perceived as motivational in terms of the performing *artist(s)*. However, in the majority of cases, the identity of the artist was synonymous with the idiom, which the music was thought to represent, e.g., "*Stone Roses*-type music." Indeed, even in the case of the music that they personally chose, the exercise participants were often unaware of the artist's identity. However, the voice of the artist may express emotional character that is significant to the listener: A 32-year-old male exercise and sport participant stated that "the sound of the voice, the way they articulate the lyrics, it brings a certain attitude to the music that I can relate to." Hence, a piece of music may possess human qualities such as "attitude" or "aggression." Two of the male sport participants reported their preference for rap music that conveyed "attitude": "I feed off what I have distinguished as an attitude and I take this attitude into my exercises." However, perspective is also important: An older female participant interpreted the "attitude" of rap music as "animosity."

A property closely related to both the artist and their voice was *lyrics*. All of the interviewees suggested that lyrics could be highly motivational. A sense of personal meaning can be generated by the lyrics. For example, a 30-year-old participant who had forged a successful career in exercise leadership, reported that, when exercising, she responded to lyrics which reminded her of her own ambitions: “The words are very important to me, especially when it says something like ‘moving on up to your destination’, because I think about my own career.” Lyrics can be literally related to physical activity: A female exercise leader stated that “in the cycling class this morning there’s a song which goes ‘push, push, push, just a little... a little bit further’ and it’s very, very motivating.” In contrast to the positive comments regarding lyrics, there were examples of negatively charged responses to lyrics (see ‘personality’ property). However, lyrics may prove irrelevant in some cases. For example, a 42-year-old, female exercise participant reported that English was her second language; consequently, she said that she did not typically focus on the lyrics.

In terms of the overall programme of music provided in an exercise context, *variety* was cited as an important consideration. For example, a 29-year-old, male participant, who trained at home, was asked which factors contributed to the success of his training programme: “What really drove me was the excellent array of music that I used.” Conversely, repetition of the same type of music can prove demotivational. An experienced aerobics instructor described the negative effects of repetition in a group-exercise setting: “For 45 minutes there was no variation, the same beat, no lyrics, no changes in mood… it was just awful.” Those interviewed made considerable reference to their preferred *segment* of musical pieces, e.g., the introduction, the chorus, or the ending. It was reported that a piece of music has a motivational contour; several of the participants recalled coordinating a burst of increased effort with their preferred segment of a given piece of music. A preferred segment was typically characterised by an emphasised shift towards a more prominent rhythm:

> It drops down a level and there’s quiet... not quietness but it’s less intense, there is just a slight beat, you can take a breather, then the good bit comes and straight away it picks up again and it’s inspirational, inspiration with an immediate effect, it gives you purpose in your exercise to work harder.

Similarly, a 30-year-old exercise leader relayed the manner in which the chorus of *Fame* by *Irene Cara* energised the participants in an aerobics class that she taught; "what gets them going when I teach with this song is this burst of 'fame.' "

3.4.2 *Contextual Category*

The contextual category contains properties that represent aspects of the exercise or training environment that may interact with the music to influence the psychophysical state of the participant. Music can motivate a person indirectly through the medium of a third party. References to this effect were grouped into a property named *social factors*. A 30-year-old exercise leader described this process: "It's not guaranteed that they're gonna like the same music as you do, but I think if you like the music it helps to motivate you which helps you to motivate them." In some cases, a person is highly aware of listening to the music in a social context. "There is an excitement because people are hearing your preferred music ... that is an outside factor that actually is quite stimulating and it adds a sort of a pride or happiness."

Music may have different motivational effects at different *times of the day*. A 36-year-old, recreational exercise participant was able to describe her preferences for music early in the morning: "We're just easing into the day so I would prefer to have easing music, light and uplifting but not heavy beat-beat-beat, something that's sort of waking you up, with a lighter tone." In the evening, such preferences are inverted and music with a strong rhythm is considered appropriate. These diurnal differences in music preference were apparently related to lifestyle factors such as a person's work routine and the different type of clientele that use gymnasia at different times of the day.

3.4.3 *Individual Category*

The properties within the individual category constitute various dispositions and characteristics of the individual. An individual's *personality* may influence their preferred choice of music; for example, a participant who worked as a motivational speaker was asked to elaborate on her preference for what she termed "uplifting" or "positive" music during exercise: "That's my focus in life, I insist on having a positive outlook in life, it's just who I am." Deep-seated personal values can also affect the response to music during physical activity, a 35-year-old female exercise leader reported that:

> Exercise is a very pure activity, it’s almost like religion for me, the exercise experience has to have a form of purity by my values, and any lyrics that are sexually explicit are like a taint or a tinge that I don’t want, that’s not what I want to be reminded of when I’m doing exercise.

One particular characteristic that shaped the participants’ responses to music was their *attitude towards exercise*. The interviewees demonstrated various approaches to their exercise, some were very serious about their physical training and this was reflected by what they said. The following words represent the perspective of a 23-year-old martial artist: “I wanna be as bloody-minded as the next person, if you want to achieve your goal when you’re training you ain’t letting anything stand in your way, and this is the attitude of the music.” Alongside these highly motivated individuals were people who exhibited lower levels of motivation such as a 45-year-old, female participant who stated that: “I’m a bit lazy for exercise, I have to be stimulated.” In such cases, music may be cast in the role of a comfort factor:

> I’m thinking, it’s Friday evening, most people are out partying and here I am looking after my body at the gym… I suppose music’s a comfort factor because it’s something that you like and so it gives you a sense of having fun.

The participants made reference to the role of their *background* in determining preference for music during exercise. The background of the participants included their immediate and extended family, peers, community, and the broader cultural forces to which they were exposed. Although one participant referred to the influence of her father’s music preferences this was not the case for every participant: “Quite simply my background has probably had no influence on those songs I like, not in a parental home way, I suppose it’s more the music of our time.”

A 27-year-old, male exercise participant developed a preference for rap, a musical idiom, which was *antithetical* to his background: “The music form that I like most now I didn’t really have much access to as a child, it just wasn’t available to me.” Rather than develop a preference for the music style that was prevalent within his immediate culture, this individual had sought to become part of the social group that he associated with his preferred music form. This experience was mirrored by a 23-year-old male whose first exposure to rap music had been within the context of exercise. Although rap music was not part of the cultural milieu in the area of north England with social problems where he grew up, the confrontational “attitude” of the rap music did reflect his tough upbringing and his feelings towards exercise.

The cultural affiliations of the participants were partly determined by age. For example, the participants expressed an affinity with the music of their teenage years or their early twenties:

> I prefer songs from when we were at school, associated with teenage years. As people get older, they listen to the same style of music because I guess their youth was when they had time and were most affected by popular culture.

Two of the group exercise leaders emphasized the importance of selecting music from an appropriate era when teaching older exercise participants: “If you taught a 50-plus class and put your latest dance music tape on they would ask you to put some proper music on, they would be very disgruntled.”

It is reasonable to postulate that general *music preference* may have some bearing on a person’s choice of music for exercise. However, it was suggested that a different type of music preference is developed specifically for exercise: A 24-year-old exercise leader asserted that “I wouldn’t want to sit down and listen to gym music at home, it’s just not my music.” This specific type of music preference seems to be developed due to the particular function of music during physical activity: “Gym music is not the sort of thing that you’d sit down of an evening and listen to, I suppose you might say it gets the adrenaline going.” Similarly, a 23-year-old, male martial artist commented that “the majority of times when I’d listen to gym music is when I’m going out, there’s a similar kind of aim as when I listen to music for training which is to get me going, it’s to get me up.”

A male, recreational exercise participant discussed the relationship between general music preferences and favoured musical accompaniment for exercise:

> I train to music that I wouldn’t necessarily buy in the shops, popular culture stuff, even the *Spice Girls*, you wouldn’t catch me dead buying that but you can actually train to it, it opens your mind as well to different music, exercise helps me embrace a lot more music

Hence, it appears that music preference for exercise may be more focussed on music’s stimulative qualities and less on its socio-cultural associations that general music preference.

Familiarity does not breed contempt, in fact, it may add considerably to music’s motivational qualities. It appears that familiarity interacts with music preference: “I would have to admit that even songs that you don’t like in time grow on you if you hear them often enough.” A 30-year-old, exercise leader felt that familiarity was an essential component of music used in the exercise-studio setting: “If the people in my class don’t know the music, they don’t like it, they find it hard to motivate themselves irrespective of what I’m doing to try and motivate them.”

3.4.4 *State Category*

The *state* category contains properties that reflect the psycho-physiological state of the individual. Music typically plays a *stimulative* role during exercise. Music was said to “get me going,” “stimulate me,” “get me up for it,” “kick me up,” “rev me up,” “spur me on,” “excite me,” and “push my buttons.” In particular, it was felt that the rhythmical properties of music lead to an increase in excitement, this tendency was exemplified by a 23-year-old martial artist who discussed the role of music in his intense training: “You need your booming sound, your beats to get you up for it, to stimulate you.” A sense of anticipatory excitement may be generated by the immanence of a musical segment that is perceived to be especially motivational:

> I feel quite nervous when I hear the intro, at first I think yeah! I go through the introduction and then I think oh, here we go, here we go, I can feel her getting ready to start really singing and it starts to make the butterflies come because that’s when I start to work.

In addition to the above descriptions of stimulation, the interviewees reported the following physical sensations of arousal: “butterflies in my stomach”, “warm feeling in my stomach”, “increase in heat in various parts of my body”, “hairs raising on the back of my neck”, “shiver down by whole body from by neck to my toes”, and “my heart pumping faster.”

Music is not always cast in a stimulative role, 5 participants stated that music could also serve in a pacifying or *sedative* capacity: “When I want to stretch down I play something like *Sade* because she’s calmer, more pacifying and I can stretch to it.” Hence, music can facilitate different levels of arousal depending on the activity being undertaken.

Eleven of the participants made reference to the role that music played in improving their *mood* or evoking a positive emotional response (see Section 2.1.1). A 34-year-old exercise leader was able to describe an incidence of strong positive emotion that she had experienced during exercise accompanied by dance music: “You feel so high, almost like you’re flying.” It was found that mood states prior to the initiation of exercise exerted an influence on the response to music during exercise.

For example, a 36-year-old, female exercise participant suggested that activities engaged in prior to exercise (e.g., work) make a substantive difference to the receptivity of an individual to the music in the gymnasium. “I find that when I am feeling good about myself, I don’t really need anything apart from the TV to keep me occupied while I’m training.”

Music may lead to feelings of *motivation* or inspiration. In particular, the music may bring about a change in the cognitive approach to the task: “The music enhances your will to achieve something, but it doesn’t change your perception that it’s tough.” A very experienced recreational exerciser described how music led to a shift in her attitude during a bout of exercise:

> If they put on a piece of music that I really like, I can get positive from that music and all of a sudden my whole attitude towards my work-out has changed, and therefore I leave the gym in an entirely different frame of mind.

Motivational music may also alter the evaluation of the self: “You feel good about yourself, like you could go on for ever and ever.” Hence, music may alter one’s perceived ability to meet the demands of a given task. A 23-year-old, male exercise participant described this effect:

> Music gives you a feeling that you’re capable of working harder and achieving more, it’s that sense of power … in the absence of music you might do six repetitions and think ‘ah! I’ve had enough, there’s no way I could do anymore’, whereas with music you’d do seven or eight.

Such sentiments would suggest that music increases self-confidence. The following contribution, made by a 20-year-old, male martial artist, provides an example of how music may prime motivational cognitive processes: “If I was strength training I’d want music that would make me say to myself ‘come on Darren [not his real name] you can do it, you can lift this weight.’ ”

Typically, the participants suggested that music *distracts attention* away from exercise: An experienced 36-year-old, female exercise leader expressed the view that “if the music is motivating, I’m very distracted by it, I don’t think about my body or ... or the fatigue, I can switch off from my body and get on to that next level.” However, there were contrary examples. A participant, who was a martial artist engaged in intense and frequent training, felt that music did not influence him during very intense activity: “Ten to twenty percent of the time I will be so completely focused on the activity that I’m gonna forget about the music.” Two other male participants, both of whom engaged in relatively intensive training, noted that music had the propensity to increase their awareness of their activity. One of these stated that the intensity of the music heightened his sensation of the martial arts training he was engaged in, the other reported that "I am able to concentrate on the music and still concentrate on what I'm doing, does that make sense? I don't necessarily separate the two."

Music may promote an *altered state of awareness*: "To some extent it's a form of hypnosis I think, it helps you to go into another world so that you're not aware of what you're really doing." A 36-year-old, female exercise leader related her experience of a "trance-like state" characterised by absorption and elation: "It just feels totally effortless and the music is just taking your body wherever it needs to go." There were six references to an altered *perception of time* and these were formed into a property. Music makes time appear to speed up: "Because I love music so much, you can go [exercise] for 45 minutes before you even know it." The participants also spoke of the response to music during exercise as a form of *self-expression* or dis-inhibition:

> If I know a tune, and I hear it, I suddenly think oh wow! I know this tune and I want to show off to it, I want to dance to it and express myself to the full, I suppose in the gym I'm not dancing, but I suddenly run faster.

Music may promote *associations*, which can prove motivating during exercise. The interviewees frequently reported that they associated a certain piece of music with particular life events or memories. Hence, music may function as a conditioned stimulus or trigger: "If a song comes on that I remember having an absolutely great time to in a [night] club, then positive memories will come back, my mood's gonna change completely toward the positive and I'm gonna feel inspired again." However, three of the interviewees remarked that music with negative associations may create the opposite effect. A martial artist detailed the way in which he had harnessed the associative function of music to enhance his preparation for a Tae-Kwan-Do competition:

> You have two gates in your mind, there's a tunnel and you've got two entrances. Whenever I'm in a competitive state, one entrance has got barriers on it, so the only thing that will then enter my brain to give me an effect that I want is the music that goes in the competitive door, the music I like to train to, the music I fight to.

Associations may be mediated by *imagery*, for example, a male participant with a varied background in sport and exercise training referred to the well-known *Rocky* motion picture series: “Rocky’s training through the snow and trying to overcome this obstacle to get to ultimately beating a guy who’s sort of like nearly twice his size, that inspires the way I approach my training.” Rocky is an icon that many people exposed to Western culture will be aware of. However, in some instances, imagery is abstract in its nature. For example, a 20-year-old, male participant used *lyrics* to facilitate motivational imagery:

> If I’m hearing something like ‘unleash the dragon’, I … call me childish in my overactive imagination but I’m thinking… the beast inside, the strength, you’re gonna unleash it, you’re gonna explode and you can pull that weight stack right up.

A further example was provided by a 23-year-old, martial artist who imagined the frenetic percussive movements of a drummer while listening to *Brown Paper Bag* by *Roni Size and Reprazent*. He aimed to replicate the notional drummer’s intense cadences in his own physical movements whilst engaged in circuit training.

3.4.5 *Outcomes Category*

The final category contains properties that describe the outcomes or behavioural consequences of listening to music during exercise. Music may lead to increased *endurance*, a 44-year-old, female exercise participant stated: “If a great song comes on and I’m about to leave, I’ll think ‘oh no, right I’ll work-out to this’ because I love it and I’ll do another 25 minutes on the pure strength of that.” Conversely, two of the participants referred to incidences in which they had curtailed bouts of exercise because they found the music to be demotivational: “If the music tends to irritate you I think you quickly get through the routine and get out.” Eight of the participants referred to the music increasing their *work-rate*: “You could see the transformation as soon as they put the music on for the lesson, everyone was working much more, and you know it was amazing and I would work even more.” However, it was also reported that music might serve to reduce exercise intensity or impair physical co-ordination. Music may influence exercise *attendance*. For example, a 30-year-old, exercise leader described the effect of music on her class-attendance figures:

> Well I’ve noticed that since I’ve deliberately tuned the music to them and them to the music, that my classes have become a lot more popular. It has had

> an effect on participation rates because I haven't consciously changed anything else except the music.

It is also possible that music may prompt a decrease in attendance. A 45-year-old, female, recreational exercise participant remarked that, "if the music is bad and I tried so hard and it didn't work then I am totally annoyed, erm maybe the next day I won't even go, it can put you down." The same participant also stated that demotivational music might lead her to consider leaving an exercise facility on a permanent basis.

3.5 *Discussion and Conclusions*

The participants in the present study emphasised the importance of rhythm in determining the response to music in exercise contexts. The pre-eminence of rhythm as a motivational quality of music is a consistent theme within the literature pertaining to the psychophysical effects of music (Gaston, 1951; Karageorghis & Terry, 1997; Lucaccini & Kreit, 1972). Further, rhythm sits atop the hierarchy of factors that are thought to contribute to the motivational qualities of music (see Figure 2.5). From a musicological perspective, rhythm may be defined as the "periodic accent and duration of notes" (Carroll-Phelan & Hampson, 1996, p. 536). The effects of rhythm are often presented in terms of a synchronisation effect linking the periodic distribution of notes with patterns of physical movement (Karageorghis & Terry, 1997). However, the present findings indicate that a strongly accented rhythm may heighten activation. Hence, the dynamics of a musical piece (the relative intensity of different notes) may prove to be a stimulative quality that warrants future research. Notably, when discussing the stimulative effects of accented rhythm, the participants referred exclusively to the percussive elements of music (e.g., the drumbeats) as opposed to the higher-pitched notes of the singer's vocals or the melodic accompaniment to the music.

Relative to the discourse on rhythm, the participants made few references to the pitch-related qualities of music such as melody and harmony. However, this dearth may have been due to the participants' lack of musical training. All of the references to harmony were made during the second set of interviews, in which the participants were able to use music they had chosen as an audible reference point and thus draw attention to the motivational qualities of music that they were unable to verbalise. For this reason, the technique of using music *in vivo* appears to address semantic difficulties relating to music. It has been suggested that music represents a pre-verbal discourse, one that is fundamentally incongruent with spoken language (Demorest, 1995). A further option would have been to select musically trained participants. The limitation of such an approach would be that those with musical training may respond to music in a substantively different manner when compared to those who are musically naïve (see North & Hargreaves, 1998b).

The participants exhibited a tendency to attach significance to certain segments of musical pieces. This facet of musical response has been reported extensively by researchers investigating the emotional effects of music (e.g., Sloboda, 1991, 1992; Waterman, 1996). Indeed, there is evidence that both emotional responses, such as feelings of elation, and psychophysical responses, such as crying and tachycardia, can be located to exact reference points on a musical score (Sloboda, 1991).

Within the realm of sport and exercise, Szabo et al. (1999) reported that a music condition, which included a switch from a slow tempo to a fast tempo, promoted the accomplishment of greater work in a graded cycle ergometer test than music conditions that consisted purely of either fast or slow music. This finding may have been due to the motivational impact of the increase in tempo. Based on the conclusions of Szabo et al., it may be inferred that the motivational impact of such musical segments (i.e., alteration in tempo) is related to their attention-gaining value. Hence, the effects of a motivational musical segment may not be entirely contingent upon its inherent qualities but upon the degree to which the segment elicits a noticeable contrast with the preceding bars. Notably, in aesthetic research, a contrast effect has been reported whereby a pleasant stimulus induces greater pleasure when preceded by a less pleasant stimulus (Cantor & Zillman, 1973; Martindale, 1984). In a more general sense, several of the participants emphasised the importance of variety in determining the motivational qualities of a musical selection.

North and Hargreaves (1997) proposed that music factors might interact with the time of day, as well as other environmental conditions, in determining music preference. This proposition is concordant with the results of the present study, which indicate that contextual factors influence the response to music in exercise settings. The regulation of bodily function varies diurnally according to *circadian rhythms* (see Wefelmeyer & Kuhs, 1996). Levels of energy, fatigue, and mood have established peaks during the day. For example, energy levels typically peak in the evening and are lower in the morning than the afternoon or evening (see Yoon, May, & Hasher, 1999).

Following a review of relevant research findings, Strutton, Catley, and Davey (2003) concluded that maximum voluntary muscle force varies throughout the day, typically being low in the morning and high in the evening. Correspondingly, in the present study, two participants stated their preference for louder, more energetic music during the evening but not in the morning.

Karageorghis (1998) reported that the motivational qualities of music used during an exercise-to-music class were moderately correlated with post-exercise reports of relatedness, one of the building blocks of intrinsic motivation (see Reeve & Sickenius, 1994). The findings of the present study indicated that music may create a shared experience within a gymnasium setting, particularly in an exercise-to-music class. Further, exercise participants appear to be aware of the motivational effects of music on their co-actors. Relatedness contributes not only to intrinsic motivation but also to the autonomous regulation of extrinsically motivated behaviour; an end that may prove beneficial in the context of exercise (Ryan & Deci, 2000). In addition to relatedness, two other psychological needs are thought to underlie intrinsic motivation: competence and autonomy. Whereas competence may be increased by improved performance resulting from musical accompaniment (Section 3.4.5), autonomy would be increased if an exercise participant were able to exert control over their musical accompaniment during exercise by using a portable music delivery system such as an MP3 player (see also Section 4.5.2).

With reference to the findings regarding personality, McCown et al. (1997) found that psychoticism, male gender, and extraversion were all positively related to a preference for exaggerated bass in music. In the present study, the three participants who reported a strong preference for a pronounced rhythm and bass frequencies were male and engaged in relatively intense sport training. It is possible that those who train at a higher intensity level require musical accompaniment that is higher in its simulative qualities that those who exercise at a lower intensity. Accordingly, those who exercise at a purely recreational level may require the presence of music merely as a comfort factor. Factory owners have often used music in an attempt to blur the distinction between work, domesticity, and leisure in the minds of workers, particularly females (Jones & Schumacher, 1992). Further, music serves to relieve the boredom of tasks such as homework, cleaning, and driving (Gantz et al., 1978).

The importance that the participants attached to preferences developed during their youth can be explained with reference to music preference research: Frith (1996) discussed the special role music preferences play in adolescence as different identities are being assimilated. Hence, formative music preferences endure; “working their way through history like the devoured prey that passes through a snake” (Robinson & Fink, 1986, p. 238). The importance of socio-cultural background in determining music preference for sport and exercise has been established (Karageorghis & Terry, 1997). Although the present findings lend partial support to this assertion, a more complex and subtle picture has emerged. For example, 2 participants described how they developed a music preference that was antithetical to their backgrounds. Such a tendency might be explained with reference to Russell (1997) who suggested that people align themselves with musical styles, which they associate with social groups that they aspire to join. It is also conceivable that music preference in exercise settings is less strongly related to socio-cultural factors than music preference *per se*. Indeed, various dimensions of cultural background including ethnic grouping and socio-economic status are thought to exert a strong influence on general music preference (LeBlanc, 1982).

Raul Espinosa, a pioneering practitioner in the field of music and physical activity, stated that adhering to participants’ general music preferences proves limiting when selecting music to accompany exercise (Vogel, 1986). Further, North and Hargreaves (1997) have suggested that context-specific music preferences develop owing to the effects of music on arousal. The findings of the present study corroborate this suggestion in that stimulative music is typically preferred, as stimulation may prove facilitative in certain exercise contexts. North and Hargreaves suggest that music preferences that are specific to a given situation may be self-perpetuating in that people become conditioned to expect a certain type of music in that setting and regard such music as appropriate. Credence is lent this proposal by the fact that the participants frequently referred to “gym music,” indicating that there is a conditioned expectation of what music is appropriate for an exercise environment. Such conditioning could be explained in terms of Martindale and Moore’s (1988) cognitive perspective: The stimulation of a higher-order cognitive unit relating to exercise facilities in turn activates cognitive units relating to “gym music” while inhibiting connections to units that represent other types of music such as jazz or classical.

Music has often been used as a stimulative ergogen in experimental work (e.g., Hall & Erickson, 1995; Karageorghis et al., 1996; Papa, 1990; Pearce, 1981). Indeed, arousal control is one of the three proposed consequences of motivational music (see

Figure 2.5). In the present study, the participants made copious reference to the excitative and stimulative properties of music in the exercise setting. The participants reported both the physiological (somatic) and psychological symptoms of activation. Such descriptions are concurrent with Lacey's (1967) seminal proposition that arousal is a multi-dimensional construct.

Within the domain of sport psychology, Hanin (1997) referred to the concept of psychic or psycho-biological *energy*, which underlies emotion. Music can also be said to consist of energy in the form of sonic vibrations. Notably, one participant touched on the theme of energy: "If I had to give advice on what sort of music to use in your training, I would say find something that's got energy in it for you." A sense of anticipatory excitement is intrinsic to the musical response (Button, 1988). In the present study, it was testified that the mounting expectancy occasioned by music was exacerbated by the anticipation of a motivational segment of music and its effects on exercise intensity.

Karageorghis and Terry (1997) suggested that improved mood is one of the psychophysical consequences of motivational music. The present study has yielded evidence, suggesting that music may elicit a positive mood response during physical activity. Indeed, two of the participants suggested that a positive mood state induced by music might encourage them to remain in the gymnasium for longer. It has been proposed that the affective responses to music might contribute directly to improved exercise adherence (Karageorghis et al., 1999), which is an issue of paramount significance for both exercise leaders and health professionals.

Music can be used to evoke mental imagery that is relevant to physical activity. In a sporting context, Karageorghis and Terry (2001) reported that the Great Britain bobsleigh team owed part of their medal success in the 1998 winter Olympic games to the conditioned effects of music. The Whitney Houston ballad, *One Moment in Time*, was used to trigger powerful event-related imagery. It was played on the team bus each day prior to competition. Within the present study, a martial artist reported his use of a specific musical selection to accompany his pre-fight routine. Outside the context of exercise, music has been used to counter-condition animal phobias (Eifert et al., 1988) and condition the response to a product brand (Blair & Shimp, 1992).

In the present study and in the aforementioned example of the British bobsleigh team, the lyrics that accompanied the music played a particularly significant role in eliciting motivational imagery. However, contrary to the established conceptual position (e.g., Karageorghis & Terry, 1997; Karageorghis et al., 1999), such lyrics need not refer explicitly to physical activity. Examples of such lyrics include *Release the Dragon*, *One Moment in Time*, and *Moving on up to Your Destination*. Through lyrics, a vocalist can enunciate a very specific and tangible message. The title of a song or a memorable segment of the lyrics may specify the feelings evoked by the music and thus create symbolic meaning beyond that which the music itself holds for the listener. Indeed, a posit of the revised conceptual model (Figure 2.5) is that extra-musical associations may contribute to the motivational qualities of a piece. However, such associations are less significant to the overall motivational qualities of the piece than the rhythmical properties of the music. The example above concerning the piece *One Moment in Time* is an exceptional case because the significance of the lyrical content appeared to take precedence over the rhythmical elements of the music, which comprised a relatively slow (ballad) and unpronounced (gentle) rhythm.

A number of the descriptions given of exercising to music pointed toward the experience of flow state (see Csikszentmihalyi, 1990). For example, the property *altered state of awareness* refers to a condition in which movement feels effortless and the participant feels absorbed in a trance-like state. Descriptions of time appearing to speed up, disinhibition, and elation also relate to the flow construct. Music has been shown to affect the perception of time in a laboratory setting (Kellaris & Altsech, 1992), and in the context of a gymnasium (North et al., 1998). In addition, Lowe (1973) reported on the use of stimulative rock music to disinhibit an individual who had a public speaking phobia. Moreover, Szmedra and Bacharach (1998) proposed that music may attenuate anxiety during exercise. Karageorghis and Deeth (2002) found that motivational music led to increases in reported flow state during a multi-stage fitness test, whereas Pates et al. (2003) reported a similar finding in relation to a netball-shooting task.

With regard to attention, Rejeski (1985) postulated that affective information is processed in parallel with sensory information in a pre-conscious filtering phase. Hence, music may inhibit the unpleasant feedback associated with physical fatigue (Karageorghis & Terry, 1997). The findings of the present study indicated that music served to dissociate exercise participants from sensations of fatigue. However, participants involved in high intensity exercise may wish to focus on their physical movements (see Nethery et al., 1991). In such cases, the music is not attended to or the individual is aware of both the music and the physical movement. White and Potteiger (1996) noted that affective stimuli such as music have the propensity to heighten awareness of physical sensations. In the present study, two of those engaged in relatively intense resistance training noted that it is possible to be aware of the activity and the music concurrently; a heightened state of a awareness.

Concerning the consequences of listening to motivational music during physical activity, there is evidence to support the revised model (see Figure 2.5) in that motivational music may increase exercise adherence. However, there is also evidence to suggest that demotivational music may serve to reduce exercise adherence, a consequence not previously countenanced within the literature. It is possible that motivational music may influence individuals on a cognitive level, leading them to more favourably evaluate themselves and their own ability to meet the perceived demands of tasks. It proved challenging to differentiate between descriptions of supposedly discrete responses such as improved mood, heightened activation, and increased motivation. For example, the statement “the music really gets me going” could be construed as heightened activation or increased motivation. Likewise, the observation that “the music really picks me up” could conceivably refer to affective processes as well as activation and / or motivation.

Careful clarification of the participants’ perspectives led to the evolution of a response property referred to as ‘motivation’, which was distinct from the ‘stimulative’ property. The distinction being that the motivation property was related to a favourable evaluation of either the task demands, one’s determination to engage in the task, or one’s ability to perform the task. It has been reported that music may increase the self-esteem and confidence of exercisers (see Lampl, 1996, as cited in Tenenbaum et al., in press) and the self-confidence of inter-collegiate athletes prior to competition (Lanzillo et al., 2001). Such cognitions appeared to be closely allied to both heightened activation and improved mood. For example, a 45-year-old, female exercise participant of long experience said “if they put on a piece of music that I really like, I can get positive from that music and all of a sudden my whole attitude towards my work out has changed.” Further, a 38-year-old, female participant elaborated on what she perceived as a subtle distinction between stimulation and motivation:

> R Kelly's *I Believe I Can Fly* is a very inspirational, moving song, but it doesn't stimulate physically in terms of wanting to get up and move … the arousal is actually internal and it's emotional, it stimulates you into being more confident on the inside, whereas the previous dance song I chose was stimulative… it was energising.

Music may also function as a conditioned stimulus within a sport and exercise environment (Lucaccini & Kreit, 1972). Thus, the motivational effects of music would become amplified over time owing to a gradual reinforcement process. The various motivational effects of music characterise exercise for some individuals and motivational music may positively affect patterns of exercise adherence and compliance. Conversely, music may demotivate individuals and exert ergolytic effects on exercise performance. The demotivational effects of music may negatively affect adherence.

The findings from the present study offer general support for the tenets of the revised conceptual model (see Figure 2.5). However, the restricted scope of the model coupled with its simplicity minimised the possibility that the present findings would prove contradictory. Nevertheless, aspects of the present findings extend beyond the compass of the model. The revised model does not account for the effects of personal variables such as personality and attitude towards exercise or contextual variables such as the time of day. The conceptual framework may also be expanded to reflect the findings that suggest exercise participants enter into a flow state or more favourably assess their ability to overcome the challenges imposed by exercise. Experimental studies have failed to demonstrate consistent improvements in physical performance due to the application of music (see Section 2.7.5 for review). However, the current findings indicate that exercise participants vary the intensity and duration of their physical activity as a result of music listening. This is a phenomenon that is difficult to demonstrate in tightly controlled experimental conditions. When participants are permitted to regulate the intensity of their exercise, music may exert ergogenic effects (e.g., Matesic & Comartie, 2002). The conceptual model may require amendment in order to reflect these ergogenic effects.

It appears that the ubiquitous presence of music within exercise contexts is well justified by the evidence presented herein. Although the present findings emanate from a small sample and should not be too readily generalised, there may be some tentative implications for the use of music in the context of exercise. Music may function as an ergogenic aid, which leads to voluntary increases in exercise intensity and / or exercise endurance. Hence, where work rate is self-determined, particularly at submaximal levels, music is a stimulus that leads exercise participants to drive themselves harder and for longer durations. Such a proposition might be tested most appropriately in externally valid settings with a quasi-experimental design.

The evaluation of a piece of music in a physical activity setting is highly complex, involving an interaction between musical, personal, and contextual factors. Among the music factors, rhythm is the most salient and should be considered to be the main pre-requisite when selecting a piece of music for exercise. The present findings indicate that a specialised form of music preference develops within the context of exercise. Hence, for some individuals, general music preferences do not dictate the preferred choice of music for exercise. Practitioners should be aware of this as many individuals who select music for others within exercise contexts, make the assumption that preferences are shaped principally by the musical choices demonstrated by participants outside of such contexts.

Music is one of many stimuli that an exercise participant is exposed to while engaged in physical activity; hence, the choice of music should not be made irrespective of the context in which the music is heard. Various personal characteristics influence the response to music during exercise. Hence, personality, socio-cultural affiliations, and attitude towards exercise should all be considered when selecting a music programme to accompany exercise. Personal characteristics are of particular importance when prescribing music for an individual as opposed to a group. Managers of gymnasium facilities should be advised to study carefully the demographics of their clientele, their attitudes and exercise-related music preferences, and to use such information in the construction of music programmes. These programmes should vary in accordance with the different time periods of the day (e.g., mornings vs. evenings).

Those interested in promoting the social and health benefits of exercise should regard music prescription as an area of pivotal importance. Similarly, those who are concerned with facilitating the performance and enjoyment of sport should give greater consideration to the potential benefits of carefully selected music. Presently, it could be argued that music is a largely untapped resource within exercise contexts and the responses to music in such contexts are highly individualised. Hence, further research in this domain utilising qualitative and naturalistic designs appears warranted.

CHAPTER 4

Perceived Characteristics of Motivational Music in Exercise Settings: Possible Influence of Sex, Age, Frequency of Attendance, and Time of Attendance

During the past decade, the scope of music psychology has been extended beyond the confines of the laboratory to include research into the effects of music in a wide variety of social contexts (see Hargreaves & North, 1999). Leisure facilities provide one such social context and the potential effects of music on the performance and experience of exercise may influence patterns of exercise adoption and adherence (Karageorghis et al., 1999; Schwartz et al., 1990). Research into the psychophysical effects of music in a physical activity context has been characterised by methodological weaknesses and the lack of study rationales firmly grounded in theory (Karageorghis & Terry, 1997). Consequently, research findings have been largely equivocal.

Four factors are believed to contribute to the motivational qualities of a piece of music: Rhythm response, musicality, cultural impact, and association (see Figure 2.5). Music with a high motivational quotient (see Karageorghis et al., 1999) has been shown to increase endurance in a cycle ergometer task (Karageorghis & Jones, 2000), reduce perceptions of exertion and improve affect in a treadmill task (Karageorghis & Terry, 1999), and promote the experience of flow (Karageorghis & Deeth, 2002). In addition to possessing motivational qualities, music that accompanies exercise should be functional, i.e., well co-ordinated with the task (Karageorghis & Terry, 1995).

4.1 *Rationale*

Prior to the present programme of investigation, a predominantly positivistic approach was assumed towards music research in sport and exercise contexts; the characteristic strengths of qualitative research methods were not brought to bear on the topic in question. Thus, the first study in the research sequence (see chapter 3) was rationalised in terms of the need to clarify and extend the conceptual basis of motivational music research using naturalistic and qualitative methods. The primary rationale for the present study was to extend this process by collecting data from a larger (N = 532) sample of exercise participants that was more representative of the wider population of British gymnasium users. Hence, although retaining a naturalistic and qualitative methodology, the present study represents a shift from an idiographic approach towards a more nomothetic one.

In order to facilitate the collection of data from 532 participants, a questionnaire was developed. Gfeller's (1988) research serves as a precedent for questionnaire-based inquiry relating to music preferences in an exercise context. However, the structure of the questionnaire that she used may have prompted the responses of the participants. For example, questions such as "do you think the music takes your mind off any part of the physical activity" (p. 33) resulted in a 91% positive response (i.e., yes it does). Similarly high percentages were found in response to the other questions. The present study addresses this limitation through the use of open-ended questions. Further, Gfeller's smaller sample of 70 participants consisted of physical education students at the University of Iowa, who were engaged in exercise-to-music classes, whereas the present sample comprised members of 29 private health clubs across the United Kingdom. Consequently, the age range of Gfeller's sample (18-30 years) was smaller than that of the present study (12-79 years).

A conclusion of the previous study was that personal variables may mediate the response to music in the exercise setting. However, this conclusion was tentative owing to the small sample size employed (N = 13). Indeed, a larger sample and a more nomothetic approach may be required to adequately assess the effects of personal variables. The impact of factors such as sex and age on the response to music in sport and exercise settings has not yet been comprehensively investigated. Hence, the secondary rationale for the present study was to investigate the relationship of the personal variables of age, sex, time of attendance (e.g., morning or afternoon), and frequency of attendance, with the perceived motivational qualities of music.

General music preferences become less contingent on prominent rhythm as people age; however, this does not apply in the context of exercise (Gfeller, 1988). The preference for different musical idioms is associated with age. For example, classical music preference has been reported to peak in the 55-64 year-old group (Robinson & Fink, 1986). Further, certain music forms play a key symbolic function in establishing the identity of young people within society (Russell, 1997). The findings presented in chapter 3 indicate that age determines the music that a given exercise participant was exposed to during their youth. Such preferences may be maintained throughout adulthood.

Gfeller (1988) found that the music preferences of males and females in the context of exercise were highly correlated. However, experimental and psychometric researchers have reported sex differences in music preference and response (Kageyama, 1999; Karageorghis et al., 1999; McCown et al., 1997). Female exercise participants reported a greater response than males to the rhythmical elements of music (Karageorghis et al., 1999). Conversely, males exhibited a greater preference than females for music with an exaggerated bass (McCown et al., 1997). Moreover, females selected lower volume levels than males when listening to four different types of music (Kageyama, 1999). Hence, it is possible that males are more responsive to the stimulative qualities of music.

The response to music in gymnasium settings may differ according to the time of day (see Section 3.4.2). Such diurnal variations appear to be determined by the different types of exercise participants (in terms of age and sex) who use gymnasium facilities during the morning, afternoon, and evening. The present study will clarify the diurnal patterns of health club attendance demonstrated by males and females and those of different age groups. Hence, it will be possible to ascertain whether any diurnal differences in reported music response can be explained purely in terms of the different types of exercise participants who frequent gymnasia at particular times of the day. Finally, the frequency of attendance measure may provide an insight into the relationship between an aspect of exercise adherence and the perceptions of music's motivational qualities. For example, are there any substantive differences between frequent and infrequent gymnasium attendees in terms of the preference for certain motivational qualities of music? Such information may provide an opportunity for practitioners to select music that is more likely to motivate exercise participants whose attendance is infrequent and / or sporadic.

4.2 *Purpose and Hypotheses*

The primary purpose of the present study was to investigate the motivational qualities of music in exercise settings using a qualitative and naturalistic mode of inquiry. The secondary purpose was to investigate the association of personal variables (age, sex, time of gymnasium attendance, and frequency of gymnasium attendance) with the perceived motivational qualities of music and the perceived importance of music in the exercise environment. Directional hypotheses were not set for the following reasons: First, the open-ended questions provided no direction for responses that could be used as a basis for hypotheses. Second, the study was of an exploratory and inductive nature (see Section 3.2 also).

4.3 *Method*

4.3.1 *Participants*

The sample comprised 532 volunteers who were members of 29 David Lloyd Leisure health clubs in England and Scotland. There were 307 females (57.90%) and 223 males (42.10%); two of the participants did not indicate their sex. The age of the participants ranged from 12 to 79 years (M = 34.9, SD = 12.3 years); seven of the participants did not report their age. The participants all engaged in gymnasium-based exercise programmes, which comprised of a combination of cardio-vascular and resistance training.

4.3.2 *Measures*

A questionnaire was prepared by the author in consultation with senior managers of David Lloyd Leisure and sport and exercise psychology researchers at Brunel University. Participants were asked to report which David-Lloyd Leisure health club they attended and their age and sex. In addition, the participants reported their frequency of attendance and the time of day that they typically attended the facility. These questions were open-ended with no response set provided.

The participants were asked to assess the importance of music to them while they exercised in the gymnasium. This response was rendered on a 7-point Likert-type scale anchored by 1 (*not at all important*) and 7 (*extremely important*). Two open-ended questions were used to assess the participants’ perceptions of music in the gymnasium setting: “Please comment on the current music programme being delivered at your David Lloyd club” and “Please suggest how the selection of music at your club could be improved”. The questionnaire was purposefully brief so as to render it unobtrusive during administration. This was a requirement stipulated by the managers of the health-club chain who granted access to the researchers.

It was felt that to impose the conceptualisation of ‘motivational music’ onto the participants would inhibit their own perspectives (see also Section 3.3.2). Hence, the wording of the open-ended questions was purposefully non-specific and did not imply the concepts that are prevalent in the research literature regarding the psychophysical effects of music in physical activity settings.

4.3.3 *Procedure*

Confederates of the researchers, who were recruited from among health club staff and thoroughly briefed, administered the questionnaire. Participants were approached while they were in the gymnasium area. However, the research confederates were under instructions to approach the participants at a time when the completion of the questionnaire would not intrude upon their exercise routine. Having obtained informed consent, the research confederates explained to participants that the questionnaire would be used to accumulate feedback, which would be used in formulating a new music policy for the health club. The participants were given an opportunity to question the research confederates. In order to preserve the participants’ anonymity, their names were not recorded. Subsequently, the research confederate withdrew and the participants completed the questionnaire at their convenience before returning it to the gymnasium reception desk.

4.3.4 *Qualitative Data Analysis*

First, the data from the questionnaires were entered onto a Microsoft Excel 2000 spreadsheet to facilitate analysis. The following analytical procedures closely resembled those employed in the previous study, where they are reported in greater detail (see Section 3.3.2). The responses to the open-ended questions were broken down into meaning units, i.e., bracketed statements that are indivisible and contain sufficient information to be interpreted on their own (Tesch, 1990). Following this, the meaning units were grouped into properties according to common features. For example, meaning units referring to the rhythmical elements of music were grouped into a ‘rhythm’ property. Finally, properties were further grouped to form categories at a higher level of abstraction. For example, the ‘rhythm’ and ‘melody’ properties constituted part of the ‘specific music factors’ category. The framework for the analysis of the qualitative data was drawn from a review of relevant texts (e.g., Marshall & Rossman, 1999; Miles & Huberman, 1994).

In order to further the trustworthiness of the qualitative data analysis (see Section 3.3.3.1; also Denzin & Lincoln, 1994) a reliability check, also known as an external audit (Lincoln & Guba, 1985), was undertaken. The researcher’s first doctoral supervisor analysed a subsection of the data containing 300 meaning units (approximately one quarter of the data). The first supervisor classified 94.62% of the property codes in agreement with the analysis conducted by the researcher. The discrepant codes were then highlighted and discussed individually in order to resolve any residual incongruity. At this point, it was deemed unnecessary to re-code any of the data as the researcher had justified his decisions in undertaking the original analysis.

4.3.5 *Quantitative Data Analysis*

In order to ascertain whether the frequencies of the properties, which resulted from the content analysis varied according to the personal variables of age, sex, time, and frequency of attendance, a series of χ^2 tests was undertaken. The sex variable had 2 levels (male and female), whereas the age variable was split into 4 levels (16-26 years, 27-34 years, 35-45 years, > 45 years). These gradations were chosen so that a broadly even number of participants were included in each level. The first 3 levels of the age variable correspond broadly to decades following the cessation of scholastic education. However, there were insufficient numbers of participants in the latter decades to form separate levels; hence, the data relating to older participants were condensed into a single level. The frequency of attendance variable was split into 3 levels (1-2 times per week, 3-4 times per week, > 4 times per week). In order to ensure a sufficient number of participants in each level, the time of attendance variable was split into 3 levels: morning (before 12:00 hrs), afternoon (13:00-16:30 hrs), and evening (after 17:30 hrs). The data provided by those participants who attended their respective health clubs at more than one particular time of day were excluded from the analyses that related to the time of attendance variable.

Chi-square tests were only undertaken when the total frequencies numbered at least 20 (Vincent, 1999). Preliminary chi-square analyses were also performed in order to ascertain whether the frequency of attendance and time of attendance variables differed according to age or sex. Consequently, when the pattern of results suggested that the influence of either time or frequency of attendance was attributable to age or sex, double classification χ^2 tests were carried out. To ensure adequate cases in each cell for the double classification tests (Thomas & Nelson, 2001; Vincent, 1999) the age variable was condensed into young (16-34 years) and old (> 34 years) participants.

A total of 18 chi-square tests were computed; hence, the probability of committing a Type I error was increased. In the case of such a high number of tests, the Bonferroni adjustment of alpha is considered too conservative owing to the fact that power is greatly reduced by the procedure (see Rom, 1990; Wilcox, 1996). In order to control the risk of committing a Type I error while guarding against the occurrence of a Type II error due to reduced power, the level of α was set at .01 instead of .05 (Huck, 1999; Noel & Cohen, 1997). It should be noted that the chosen level of α (.01) applied separately to each group of chi-square tests (i.e., age & sex), which were considered as separate *families* of tests (see Huck, p. 422). For example, it was considered acceptable that there be a .01 probability of a Type I error in respect of one of the chi-square tests relating to sex.

The response data pertaining to the participants' ratings of the perceived importance of music during exercise displayed minor deviations from normality (Std. Kurt. = 2.24). However, due to the minor nature of these deviations (see Vincent, 1999) a four-way ANOVA was undertaken to investigate the extent to which the perceived importance of music during exercise differed according to the independent variables (Sex x Age x Frequency of attendance x Time of attendance). Post-hoc comparisons using Tukey's method with Bonferroni adjustments ($\alpha = .008$) were made to determine the effects of the four age groups (16-26 years, 27-34 years, 35-45 years, > 45 years) on the rated importance of music during exercise.

4.4 *Results*

4.4.1 *Results of the Content Analysis of Qualitative Data*

The results of the content analysis are presented in Table 4.1. Specific music factors relate to structural components of music such as rhythm, which was referred to by 7.89% of the sample. A clear preference was demonstrated for up-beat music; for example, a 26-year-old female exerciser stated that "music tempo has a significant impact on how hard I push myself. Up-beat music is best." There was a general trend for the preference for louder volume (9.77%) as opposed to quieter volume (4.70%). A 23-year-old female explained that "the louder it is the more motivated you are to do more." The foregoing statement would suggest that the stimulation provided by louder music contributes to its motivational qualities. Indeed, 34.62% of those who expressed a preference for louder music ($n = 52$) also reported that they felt motivated to exercise by music. Conversely, only 15.45% of those who did not express a preference for louder music ($n = 479$) reported feelings of motivation in response to music. Of those who expressed a preference for quieter music ($n = 25$), only 8.00% also reported feelings of motivation.

Table 4.1

Frequency Count of Properties Arising from the Content Analysis

Category	Property	Frequency and % of sample
General music factors	Preference for dance music	52 (9.77%)
	Preference for popular / chart music	28 (5.26%)
	Aversion to dull or bland (or similar terms) music	20 (3.76%)
	Aversion to popular / chart music	18 (3.38%)
	Preference for classical music	18 (3.38%)
	Preference for energetic (or similar term) music	15 (2.82%)
	Preference for rock music	15 (2.82%)
	Preference for type of music used in classes	12 (2.26%)
	Preference for jazz music	9 (1.69%)
	Aversion to dance music	9 (1.69%)
	Preference for rap music	6 (1.13%)
	Preference for easy listening music	5 (0.94%)
	Aversion to rap music	5 (0.94%)
	Aversion to type of music used in classes	3 (0.56%)
Specific music factors	Preference for upbeat music	76 (14.29%)
	Preference for current music	56 (10.53%)
	Preference for loud volume	52 (9.77%)
	Preference for rhythmical elements of music	42 (7.89%)
	Preference for non-current music	32 (6.02%)
	Preference for quiet volume	25 (4.70%)
	Preference for less prominent beat	7 (1.32%)
	Preference for downbeat music	4 (0.75%)
	Preference for prominent beat	4 (0.75%)
Music programme factors	Preference for varied music selection	146 (27.44%)
	Aversion to repetitive music selection	100 (18.80%)
	Aversion to radio programming	20 (3.76%)
	Preference for radio programming	11 (2.07%)

(*table continues)*

Table 4.1 (*continued*)

Category	Property	Frequency and % of sample
Music Programme Factors	Aversion to talking (i.e., news broadcasts, advertisements)	8 (1.50%)
Delivery factors	Preference for the provision of Cardio-Theatre ™	23 (4.32%)
	Request of provision of choice in music selection	14 (2.63%)
	Inadequate acoustics (poor sound quality) in gymnasium facility	8 (1.50%)
Tele-visual factors	Preference for music television	35 (6.58%)
	Preference for provision of television in general	7 (1.32%)
	Aversion to music television	7 (1.32%)
	Preference for televised sport	3 (0.56%)
Personal factors	Influence of age on music preference	26 (4.89%)
Contextual factors	Differing music preferences depending on the time of day	26 (4.89%)
	Synchronisation of movement with music	23 (4.32%)
	Interaction between music and type of exercise activity being undertaken	22 (4.14%)
Psychophysical response factors	Increased motivation	91 (17.11%)
	Enhanced mood	19 (3.57%)
	Stimulative effects of music	13 (2.44%)
	Distraction from physical sensations	11 (2.07%)
	Sedative effects of music	5 (0.94%)

With reference to musical idioms, various types of dance music were touted as especially motivational (9.77%). Although 28 individuals preferred listening to popular or chart music (5.26%), 18 individuals expressed an aversion to this type of music (3.38%). Hence, despite the fact that the popularity of music was felt by some to contribute to its motivational qualities, others felt that too much popular music was delivered to the exclusion of other types.

Subjective assessments of the overall character of music were resolved around two poles: Aversion to music that was considered to be bland or boring (3.76%) and preference for music that was considered to be “lively” or “energetic” (2.82%). A 20-year-old female wrote “I find it improves my motivation to carry on with my workout when the music is lively.” Similarly, a 32-year-old female, who exercised frequently, wrote “the livelier the music the better the workout.” In terms of the overall music programme, by far the most important concern among the participants was variety (27.44%). In concordance with the marked preference for variety was an aversion to repetitive music selections (18.80%). It was suggested that variety could be manifested by either utilising music of different eras or different styles. Further, many of the negative references to the repetition of music suggested that gymnasia provide literally the same musical selections over a long period of time. The following statement, made by a 16-year-old male, was typical: “I’ve been coming [to the gymnasium] for nearly a year now and I hear all the same songs every time I come in.”

In terms of the delivery of music programmes, 14 individuals proposed the provision of choice for members of gymnasium facilities. More specifically, positive judgements were passed regarding Cardio-Theatre™, a system that enables users to choose from a variety of channels that are delivered through personal headphone units. Thirty-five individuals felt that music television was motivational: “I would rather have MTV than just music as you have something to watch and keep you interested.” A specific consideration, which was advanced by nine of the participants was that the music delivery should be synchronised with the televisual pictures. Indeed, 3 participants felt annoyed or irritated by incongruity between the music and video content.

Concerning the personal variable of age, it was felt that the currently available music selection catered for young gymnasium users but not their older counterparts. Contextual factors also influenced the type of music that was preferred. A number of the participants (4.14%) stated that they preferred different music depending on which activity they were partaking of. The motivational effects of music were considered particularly relevant during cardio-vascular as opposed to resistance exercise. It was particularly the temporal aspects of the music such as tempo and rhythm that were felt to facilitate performance on cardio-vascular equipment; “a good rhythm helps to maintain pace on cardio equipment." Indeed, references were made on 23 occasions to the conscious synchronisation of movement with music.

Twenty-six of the participants (4.89%) wrote that music should be altered in accordance with the time of day. The reason for this proposed alteration was to account for the different clientele that were thought to attend the gymnasium at different times. The general trend of responses suggested that stimulating music (described variously as "dance music," "loud music," "fast music," or "rhythmical music") should be played during the evening, busy, or peak times and that music delivered during the daytime should comprise a less stimulative (but not sedative) selection.

Although the questionnaire was focussed on the characteristics of the music and the way in which it was delivered, participants also included descriptions of the psychophysical outcomes of listening to music during exercise. Ninety-one participants referred to feeling motivated in response to the music. Seventeen of these respondents used similar related terms such "inspiring," "incentivising," or "encouraging" to describe the music in question. For example, a 38-year-old female stated that "the more I like the music, the more effort I put into my training." Hence, music may affect the conscious distribution of effort during exercise. Individual characteristics of the music may directly influence motivation; "I find the rhythm very motivating." Similarly, fast or energetic music was described as motivating. For example, a 20-year-old female, who exercised infrequently suggested that: "I find it improves my motivation to carry on with my workout when the music is lively and up-beat,"

Music can also exert a negative impact on motivation; "music is one of the prime motivators when actually using the gym, music can make you keep going or give up." Indeed, in responding to the question regarding the current provision of music, 5 participants stated that the selection was "not motivating," whereas four others described the music as "demotivating." A 26-year-old female reported that demotivational music had negatively impacted upon her exercise adherence: "I have stopped exercising in the gym because the music is so slow, repetitive, boring and does not encourage you to work out effectively."

4.4.2 *Results of the Chi-square Analyses and ANOVA*

Time of attendance differed by sex ($\chi^2 = 8.97$, $p < .01$) in that males attended gymnasia more than females in the evening when compared to the morning or afternoon. Further, the time of attendance differed by sex ($\chi^2 = 18.50$, $p < .01$) in that younger participants attended less in the morning and more in the evening relative to older participants (> 34 years). The frequency of attendance differed by sex ($\chi^2 = 6.61$, $p < .01$); a greater number of males than females attended the gym at a high frequency (5 or more sessions per week) as opposed to a moderate frequency (3-4 sessions per week). The frequency of attendance did not differ by age ($\chi^2 = 1.06$, $p > .01$).

The results of the ANOVA computed to assess the effects of sex, age, time, and frequency of attendance on the rated importance of music during exercise are presented in Table 4.2. Females rated the importance of music more highly than the males ($F_{1,389} = 5.89$, $p < .05$, $\eta^2 = .02$). Further, the rated importance of music differed according to age ($F_{3,387} = 18.80$, $p < .01$, $\eta^2 = .15$). Although there was a trend whereby the importance of music during exercise was rated increasingly lower with age, it was the oldest participants (> 45 years), whose ratings were significantly lower than each of the younger groups.

The rated importance of music during exercise did not differ according to the frequency of attendance ($F_{2,388} = 1.52$, $p > .05$, $\eta^2 = .01$) or the time of attendance ($F_{2,388} = 1.40$, $p > .05$, $\eta^2 = .01$). However, a non-significant trend revealed increased ratings of importance for those attending the gymnasium facility more than twice per week.

The incidence of the properties from the content analysis according to sex is presented in Table 4.3. Sex did not affect the preference for current music ($\chi^2 = 3.15$, $p > .01$), preference for non-current music ($\chi^2 = 0.83$, $p > .01$), preference for dance music ($\chi^2 = 0.77$, $p > .01$), preference for rhythm ($\chi^2 = 1.31$, $p > .01$), preference for faster music ($\chi^2 = 1.69$, $p > .01$), preference for a varied musical selection ($\chi^2 = 0.07$, $p > .01$), preference for quieter music, ($\chi^2 = 0.65$, $p > .01$), preference for louder music ($\chi^2 = 1.19$, $p > .01$), or the propensity to feel motivated in response to music ($\chi^2 = 4.77$, $p > .01$).

Table 4.2

Analysis of Variance to Assess the Effects of Sex, Age, Frequency of Attendance, and Time of Attendance on the Perceived Importance of Music During Exercise

Group	*N*	*M*	*SD*	F^{df}	Source of diff.	η^2
Sex						
Male	174	5.52	1.63			
Female	217	6.05	1.32			
Age						
16-26 years (Group 1)	107	6.19	1.13			
17-34 years (Group 2)	98	6.22	1.04			
35-45 years (Group 3)	106	5.92	1.34			
> 45 years (Group 4)	80	4.65	1.92			
Time of attendance						
Morning	116	5.56	1.73			
Afternoon	55	5.80	1.52			
Evening	220	5.95	1.32			
Frequency of attendance						
1-2 times per week	79	5.56	1.58			
3-4 times per week	227	5.87	1.43			
> 4 times per week	85	5.89	1.55			
Sex x Age x Time of attendance x Frequency of attendance				$1.68^{6, 319}$	——	.03
Sex x Age x Time of attendance				$0.39^{6, 367}$	——	.01
Sex x Age x Frequency of attendance				$1.34^{6, 367}$	——	.02
Sex x Time of attendance x Frequency of attendance				$1.82^{4, 379}$	——	.02
Age x Time of attendance x Frequency of attendance				$1.42^{10, 355}$	——	.04
Sex x Age				$0.05^{3, 383}$	——	.00
Sex x Time of attendance				$0.58^{2, 385}$	——	.04
Sex x Frequency of attendance				$1.68^{2, 385}$	——	.01
Age x Time of attendance				$0.79^{6, 379}$	——	.01
Age x Frequency of attendance				$1.30^{6, 379}$	——	.02
Time x Frequency of attendance				$0.72^{4, 382}$	——	.01
Sex				$5.89^{*\ 1, 389}$	F > M	.02
Age				$18.80^{**\ 3, 387}$	4 < 1, 2, 3	.15
Time of attendance				$1.40^{2, 388}$	——	.01
Frequency of attendance				$1.52^{2, 388}$	——	.01

* $p < .05$, ** $p < .01$.

Table 4.3

Chi-square Analysis of the Incidence of Properties from the Content Analysis According to Sex

Property	Frequency	Sex		χ^2_{df}
		Female	Male	
Preference for current music	Expected	32.44	23.56	3.15_1
	Observed	39	17	
Preference for non-current music	Expected	18.54	13.46	0.83_1
	Observed	16	16	
Preference for dance music	Expected	30.12	21.88	0.77_1
	Observed	27	25	
Preference for rhythmical music	Expected	24.33	17.67	1.31_1
	Observed	28	14	
Preference for upbeat music	Expected	43.44	31.56	1.69_1
	Observed	49	26	
Preference for varied musical selection	Expected	83.41	60.59	0.07_1
	Observed	85	59	
Preference for loud volume	Expected	30.12	21.88	1.19_1
	Observed	34	18	
Preference for quiet volume	Expected	13.90	10.10	0.65_1
	Observed	15	9	
Increased motivation in response to music	Expected	52.71	38.29	4.77_1
	Observed	63	28	

* $p < .01$.

Table 4.4

Chi-square Analysis of the Incidence of Properties from the Content Analysis According to Age

Property	Frequency	Age				χ^2_{df}
		17-26	27-35	36-45	> 45	
Preference for current music	Expected	14.93	14.30	14.51	10.26	20.67 $_3$*
	Observed	28	16	7	3	
Preference for non-current music	Expected	8.84	8.48	8.60	6.08	9.04 $_3$
	Observed	7	6	13	3	
Preference for dance music	Expected	13.82	13.25	13.44	9.50	23.74 $_3$*
	Observed	28	12	9	1	
Preference for rhythmical music	Expected	11.61	11.13	11.29	7.98	0.99 $_3$
	Observed	12	11	9	10	
Preference for upbeat music	Expected	20.73	19.87	20.15	14.25	11.31 $_3$*
	Observed	27	27	16	5	
Preference for varied musical selection	Expected	39.53	37.89	38.42	27.17	2.75 $_3$
	Observed	47	33	40	23	
Preference for loud volume	Expected	14.37	13.77	13.97	9.88	11.60 $_3$*
	Observed	21	19	9	3	
Preference for quiet volume	Expected	6.63	6.36	6.45	4.56	50.16 $_3$*
	Observed	0	2	4	18	
Increased motivation in response to music	Expected	24.60	23.58	23.91	16.61	8.80 $_3$
	Observed	33	29	16	11	

* $p < .05$.

The incidence of the properties from the content analysis according to age is presented in Table 4.4. Preferences for current music decreased with age ($\chi^2 = 20.67$, $p < .01$), as did preferences for dance music ($\chi^2 = 23.74$, $p < .01$). Additionally, older participants exhibited a marked preference for quieter music ($\chi^2 = 50.16$, $p < .01$), whereas younger participants exhibit a marked preference for louder music (χ^2 = 11.60, $p < .01$). Younger participants preferred upbeat music (χ^2 = 11.31, $p < .01$). However, a preference for the rhythmical elements of music was expressed regardless of age (χ^2 = 0.99, $p > .01$). The preference for a varied music selection was reported irrespective of age (χ^2 = 2.75, $p > .01$), as was the experience of feeling motivated in response to music (χ^2 = 8.80, $p > .01$).

Frequent attendees were more likely to report an aversion to repetitive music selections (χ^2 = 7.88, $p < .05$) and a preference for upbeat music (χ^2 = 15.31, $p < .05$). However, frequency of attendance did not affect the incidence of any other properties. When the sexes and age groups were tested separately, the preference for dance music did not differ by time of attendance; this result held for males (χ^2 = 1.70, $p > .05$), females (χ^2 = 0.73, $p > .05$), older participants (χ^2 = 1.29, $p > .05$), and younger participants (χ^2 = 3.059, $p > .05$). The motivation response to music was reported to increase throughout the course of the day (χ^2 = 8.62, $p < .05$). However, this result appeared to be moderated by age; neither younger (χ^2 = 1.51, $p > .05$) nor older (χ^2 = 0.71, $p > .05$) participants reported greater motivation in the evening than they did in the morning or afternoon.

Those who attended the gymnasium in the evening reported a greater preference for the rhythmical elements of music (χ^2 = 22.47, $p < .05$). Further, those who attended the gymnasium in the afternoon were particularly averse to the repetition of the music programme (χ^2 = 10.65, $p < .05$). However, time of attendance did not affect preference for upbeat music (χ^2 = 2.45, $p > .05$), preference for a varied music selection (χ^2 = 1.23, $p > .05$), preference for louder volume (χ^2 = 0.51, $p > .05$), or preference for quieter volume (χ^2 = 1.65, $p > .05$).

4.5 *Discussion and Conclusions*

The primary purpose of the present study was to investigate the characteristics of motivational music in exercise settings. The secondary purpose was to investigate the possible influence of personal variables on perceptions of the motivational qualities of music and the importance of music in the exercise environment. The mean rating of the importance of music during exercise was 5.84 on a 7-point scale. Hence, it appears that the ubiquitous presence of music in exercise facilities is, to some extent, justified. However, it is plausible that exercise participants have been conditioned to regard the music as an important characteristic of the exercise environment (see North & Hargreaves, 1997; also Section 3.5).

4.5.1 *The Motivational Characteristics of Music*

By far the strongest finding in terms of the frequency of response was the preference for a varied music programme. This result suggests that exercise participants are sensitive to the effects of a musical programme as a whole. Hence, an all-encompassing approach should be taken to the selection of music in physical activity environments; one that has, as yet, not been countenanced within the literature. For example, five of the participants made the suggestion that music should be selected according to thematic principles, e.g., a “disco night” etc.

One approach towards manipulating an entire programme of musical selections is to gradually increase the stimulative qualities of each successive piece of music. When used within the context of a factory, such an approach yielded greater production than an entirely random selection of music (Jones & Schumacher, 1992). Similar results have been reported within an exercise context; participants undergoing a cycle ergometer test to voluntary exhaustion produced the highest workload when accompanied by a music condition that comprised a selection, which began slowly but subsequently doubled in tempo (Szabo et al., 1999). Hence, when the tempo of the music was increased in concert with the intensity level of the task, this resulted in greater work output.

Idiomatic descriptions of music provide an excellent framework for the selection of balanced programmes that are grounded in the symbolic categories, which lay people (non musically-trained) use to categorise music. However, musical pieces should be selected on an individual basis rather than purely because they are thought to be representative of a desirable idiom (North & Hargreaves, 1998a).

The importance that the participants attributed to the rhythmical elements of music underlines the theoretical importance of rhythm response (see Karageorghis & Terry, 1997). Indeed, the tendency to synchronise movement with musical rhythm was reported by 23 participants. However, numerous participants suggested that rhythm in itself is motivating or stimulating without referring to a synchronisation effect. The preference demonstrated by the participants for upbeat music may be related to the findings of psycho-physiological research into the effects of HR on music preference. LeBlanc (1995) theorised that there is a positive relationship between HR and preference for musical tempo; hence, as HR increases during exercise, an individual should prefer an equivalent increase in musical tempo. LeBlanc's predictions have been partially confirmed by Iwanaga (1995) who detected a monotonic relationship between participants' HR and their preferences for various musical tempi.

The participants did not refer to the pitch-related musical qualities of harmony and melody that may also contribute to the motivational qualities of music (see Figure 2.5). A tenet of Rejeski's (1985) parallel processing model is that musical cues compete with work-related internal feedback in order to reach focal awareness. This competition might explain why participants are less able to attend to the more subtle components of musical structure such as melody and harmony during exercise. The rhythmical aspects of music are typically associated with prominent bass and percussion instruments. Hence, the rhythmic qualities of music may prove pre-eminent over the melodic and harmonic qualities during exercise because of the reduced attentional capacity that results from work-related feedback. Alternatively, it is plausible that the response format of the questionnaires did not encourage the participants to provide verbose or subtle descriptions of their preferences. Further, the sample may have consisted of participants who were naïve to musical terminology.

The present findings indicate that a greater number of participants exhibited a preference for music delivered at a high volume (9.77%) than music delivered at a low volume (4.70%). The definition of motivational music draws its lineage from the terms used to describe stimulative music (see Karageorghis et al., 1999). Hence, if increased volume contributes to the stimulative qualities of music then it should also enhance its motivational qualities. In addition to enhancing motivation, music of a louder volume level may also distract exercise participants. From the perspective of information processing models (e.g., Rejeski, 1985), stimulus strength is an important consideration. Because the sensory cues relating to music must compete with internal feedback, the strength of each stimulus becomes paramount owing to the fact that channel capacity is limited. Hence, the stronger stimulus of louder music should facilitate greater dissociation from the internal sensations of fatigue than softer music. In the case of Tenenbaum's (2001) social-cognitive model of perceived exertion, there is a threshold at which an increasing intensity of internal feedback predominates processing at the expense of external stimuli (such as music). It is probable that, as the volume level of music is increased, the threshold of exercise intensity at which physiological cues predominate is raised.

Researchers examining the effects of loud music on annoyance levels have found that, when delivered at high intensities (> 100 dB), music is a more potent distractor than noise because it possesses momentary peak levels (Ayres & Hughes, 1986). Further, a contrast effect occurs whereby an annoying sound becomes less annoying when juxtaposed with a markedly louder sound (Harder, 1997). Hence, the degree to which a particular sound is interpreted as annoying depends on its loudness relative to other sounds present. In the gymnasium environment, the loudness of the music would be partially masked by machine noise and other extraneous sounds. Vaestfjaell (2002) found that individuals are less distressed by loud sounds when they are in a positive mood state. Hence, loud music may be less likely to create annoyance in the gymnasium than in other contexts. The issue of volume is key to the provision of music within gymnasia; practitioners must achieve a balance between allowing the music to become obscured by environmental noise (Karageorghis & Terry, 1995) and causing short-term hearing loss (Vittitow, Windmill, Yates, & Cunningham, 1994).

4.5.2 *Contextual Factors*

The finding that gymnasium members advocated the provision of musical choice can be interpreted in the context of self-determination theory (Deci & Ryan, 1985, 1991). Specifically, the provision of choice may enhance one’s sense of autonomy (Ryan & Deci, 2000), which is one of the needs underlying intrinsic motivation. Autonomy may also be enhanced by the provision of Cardio-Theatre™ and other advanced music selection technologies such as Tracktones™ that permit the exercise participant to make their own decisions regarding musical accompaniment. Ryan and Deci (2000) proposed that a sense of autonomy facilitates intrinsic motivation and promotes the self-integrated regulation of extrinsic motivation (i.e., integrated or identified regulation). Any agent that increases intrinsic motivation may have a consequent effect on exercise adherence (e.g., Wankel, 1993).

The combination of audio and visual stimulation may prove to be more highly motivating than music alone. Two studies have examined the effects of music accompanied by video pictures on ratings of perceived exertion during exercise (Abadie, Chance, O’Nan, & Lay, 1996; Nethery et al., 1991). However, there is no published work regarding the motivational effects of music television in sport or exercise settings. In the context of Rejeski’s (1985) parallel processing model, it would be anticipated that music television is liable to exert a greater dissociative effect than music alone. This is because the capacity of the afferent channels depicted in Rejeski's model is limited and hence, the additional televisual stimulus would occupy unique space in competition with the sensations of internal fatigue promoted by physical work.

Music appears to serve a particular function in relation to specific activities. Typically, the participants reported that the rhythmical elements of music facilitated their performance on cardio-vascular ergometers such as the treadmill or cycle. Exercise participants may require additional motivation to endure the unpleasant physical sensations they associate with certain pieces of equipment. At equivalent exercise intensity, ratings of perceived exertion have been found to be higher for certain pieces of cardio-vascular equipment than others (Thomas, Ziogas, Smith, Zhang, & Londeree, 1995). For example, RPE was higher during cycling than jogging owing to the higher demand on local muscular endurance of the former. Hence, the utility of motivational music may prove greater in cycling than jogging.

4.5.3 *The Response to Motivational Music*

The cognitive responses to music in the exercise environment have not received a great deal of attention from researchers; hence, the present findings serve to illuminate the thought processes that are induced by motivational music. At sub-maximal exercise intensities, music may tip the balance in favour of a heightened or continued effort. The participants in the present study demonstrated a preference for certain aspects of the music (in particular the rhythm), which they found motivating. Nevertheless, music may also demotivate individuals, i.e., exert debilitative effects on their exercise performance; hence, it may prove as important for music providers to avoid delivering demotivational music as it is for them to deliver motivational music. A further consideration is that not all exercise participants will wish to be 'motivated'. For some individuals, music may serve as a pleasant distraction and this function may not be synonymous with heightened motivation.

4.5.4 *Sex Differences*

Females rated the importance of music more highly than the males, so it appears that music is a more integral aspect of their workout experience. Although females were more likely than males to report that they felt motivated by music during exercise, this result narrowly failed to achieve significance (p = .03). When the moderating effects of exercise intensity are controlled, there are no sex differences in RPE (Robertson et al., 2000). Further, sex does not affect the mood response to either cardio-vascular or resistance exercise (Rosenfeld, 1998). Hence, it is probable that females demonstrate a heightened response to the motivational qualities of music rather than simply requiring additional motivation because they perceive exercise to be more strenuous or less uplifting than males. An alternative explanation is that, when compared with males, females may engage in a greater proportion of cardiovascular as opposed to resistance-based exercise. The motivational attributes of music may prove more facilitative during aerobic exercise (see above); hence, females would report a heightened response to motivational music when compared to males.

The higher incidence of motivation in response to music among females may be due to sex differences in the affective response to music. Although there was an insufficient number of responses to test the difference in affective response between males and females, the prevailing trend indicated that females were more likely to experience enhanced (more positive) affective states as a result of listening to music during exercise. It has been suggested that females are more aware of and affected by their mood states (Rothkpof & Blaney, 1991). Sex did not affect the preference for music volume, a result that may be related to the exercise context, as other researchers have reported a general sensitivity of females to louder volume music (Wansink, 1992) or a male preference for loud volumes (Kageyama, 1999). In contrast to previous findings (Karageorghis et al., 1999), preference for the rhythmical component of music did not differ between males and females, indicating that there may not be an imbalance in rhythm response between the sexes.

4.5.5 *Age Differences*

Concerning patterns of attendance, the propensity for older individuals to attend gymnasia in the morning but not in the evening can be explained in terms of two factors. First, retired people may have a greater freedom of choice in respect of when they attend the gymnasium; younger individuals are more likely to be compelled to engage in exercise outside the hours of working and studying. Second, there are individual differences in circadian rhythms that may explain age-related patterns of gymnasium attendance. Specifically, the energy levels of older individuals reach a peak in the morning and then decline throughout the day whereas those of younger individuals improve throughout the day and reach a peak in the evening (Yoon et al., 1999). The results of the present study indicate that preferences for musical idioms during exercise display a similar pattern to those reported in the general music preference literature. Fourteen of those 17 participants who reported a preference for classical music fell into the 46-year-old and over group; a result which is analogous to findings in the mainstream music preference literature (Robinson & Fink, 1986). The introduction of unconventional musical idioms such as classical music into the gymnasium environment would be problematic due to acoustic factors. There is a possibility that the dynamic range and diversity of timbre in classical recordings would be obscured by the gymnasium noise pollution.

Older participants displayed a clear preference for quieter and slower music. The preference of younger participants for music with a fast tempo may relate to the intensity of the exercise that they undertake; those who exercise at higher intensities may prefer music of a faster tempo (Karageorghis, 1998; LeBlanc, 1995). However, the present findings concur with those of Gfeller (1988) in that preference for the rhythmical elements of music endured with age.

The number of participants reporting a motivation response to the music receded with age, although this result narrowly failed to achieve significance (p = .03). This may have been because the music provided in the chosen gymnasia was selected primarily for younger exercise participants. Hence, music that is selected specifically for older age groups may promote increased motivation. An alternative explanation is that older individuals do not seek to be motivated by the music to the same degree as younger individuals. The older participants felt that music was less important during exercise. The increased importance attached to music by the young may result from a conditioning process: The ubiquitous presence of music in exercise facilities is a recent development within the lives of older individuals whereas the young may have only experienced exercise in association with loud and stimulating music.

4.5.6 *The Time and Frequency of Attendance*

The findings relating to the frequency and time of attendance also have implications for the proprietors of exercise facilities. In the case of males, frequent attendees rated the importance of music more highly than infrequent attendees. It is probable that no such result was reported in the case of females because they rated the importance of the music very highly (M = 6.07) regardless of frequency of attendance.

Higher frequency attendees reported a greater preference for music with faster tempi. However, it is probable that those who attend exercise facilities on a frequent basis exercise at higher intensity levels and thus prefer music with a fast tempo that matches their exercise HR (Karageorghis, 1998; LeBlanc, 1995). There were some instances in which the responses differed according to the time of attendance irrespective of age or sex. For example, the rhythmical elements of music were preferred by those using gymnasia in the evening as opposed to the morning or the afternoon. Prominent rhythmical features characterise stimulative music (Gaston, 1951). Thus, diurnal differences in preference for the rhythmical properties of music may reflect larger changes in fatigue and energy levels during the course of the day (Karageorghis, Dimitrou, & Terry, 1999; Shephard & Shek, 1996).

4.5.7 *Conclusions*

Health-club operators may have underestimated the importance of music to those exercising in gymnasia. Indeed, the tenor of the participants' responses invites the conclusion that the present music content in gymnasia is deficient in numerous aspects and requires more careful selection. The results of the present study are characterised by opposing preferences, underlining the problems facing those who select music in gymnasia. In addressing these problems, two solutions may be proposed. First, the music programme should demonstrate great variety. This aim can most easily be achieved by systematically varying the age (date of release) and musical idiom of the selections in order to cater for different tastes. However, the volume, tempo, and rhythmical components of the music should not be varied to the same extent as they influence the perceived motivational qualities of musical pieces in a more exacting way. Second, an effort should be made to carefully account for the preferences of the exercise participants that attend facilities at different times of the day. The most important personal variable in any such consideration should be age. For example, slower, quieter, musical selections that coincide with the idiomatic preferences of older gymnasium attendees may be appropriate during the morning.

The sex of exercise participants may also have a bearing on their music preferences during exercise. Females appear to find music more important during exercise in addition to exhibiting a heightened response to its motivational qualities. However, the question of whether females are more responsive to the rhythmical elements of music appears to warrant further investigation. The present findings suggest that volume level may influence the perceived motivational qualities of music. The majority of participants in the present study did not refer to the volume level of the musical output Nevertheless, a tentative conclusion would be that a louder volume level is likely to enhance motivation during exercise. The nature of tasks being undertaken should receive careful attention when music is prescribed for exercise; the motivational effects of music appear to be particularly evident in the case of cardio-vascular exercise.

Future research utilising idiographic and qualitative designs may better mitigate the semantic difficulties, which impede researchers from accounting for the effects of musical variables that are not understood by lay individuals. Several avenues for future research follow from the present findings. Researchers may wish to examine whether the rhythmical components of music lead to increased arousal, using an experimental manipulation of the rhythmic properties of a musical selection. The motivational effects of music volume have received scant attention in the exercise-related music literature. Hence, the possible effects of volume level on the motivational responses to music during exercise may also be tested experimentally. However, any such design should include age and possibly sex as independent variables. In addition, the effects of motivational music when used to accompany different exercise modalities (e.g., resistance training, cardio-vascular work) are ripe for investigation.

In externally valid contexts such as health clubs, musical pieces are delivered in a series rather than in isolation. Hence, it is important for researchers to evaluate the impact of systematic variation on the motivational effects of a music programme as a whole; prior research has typically been focussed on the responses to a single piece of music. Finally, one of the most promising directions for new research in this field is the motivational effects of music television; a stimulus that has received very limited attention from researchers. The research literature should reflect the prevalence of music television in gymnasia so that the efficacy of this medium in motivational terms may be assessed. In particular, the addition of televisual pictures to musical output may create further stimulation and contribute significantly to the motivational qualities of the music. Moreover, when combined with visual images, music may be more likely to elicit a distraction effect.

The present study has highlighted the importance of personal variables in determining the motivational response to music, possibly providing a rationale for including such variables in future conceptual frameworks. Greater understanding of the ways in which personal factors, such as age and sex, influence the response to motivational music will allow practitioners to prescribe the most appropriate music selections for different groups. The evidence presented herein supports the conclusion that the current state of music provision in gymnasia requires considerable attention.

CHAPTER 5

Development and Validation of an Instrument to Assess the Motivational Qualities of Music in Exercise Settings: The Brunel Music Rating Inventory-2

Much of the research into the psychophysical effects of music in physical activity settings has risen from a questionable theoretical base (Karageorghis & Terry, 1997). Nevertheless, since the inception of a conceptual framework to predict the effects of asynchronous music in sport and exercise settings (see Figure 2.5), there is accumulating evidence that *motivational* music promotes both ergogenic effects and psychophysical consequences (see Sections 2.7.5 & 2.7.6) during physical activity.

Karageorghis et al. (1999) developed and validated a psychometric instrument that can be used to rate the motivational qualities of music in exercise and sport settings; the Brunel Music Rating Inventory (see Appendix C). This inventory has provided exercise leaders, sport coaches, and researchers with a standardized method through which to prescribe music that is intended to have a motivational effect. Karageorghis et al. defined motivational music as that which stimulates or inspires physical activity. Moreover, motivational music was defined with reference to measurable psychophysical consequences; improved mood, reduced perceptions of exertion, and arousal control. The four-factor structure of the BMRI was derived from exploratory and confirmatory factor analysis (CFA) techniques and is depicted in the revised conceptual model (see Figure 2.5).

5.1 *Rationale*

The implications of the revised conceptual model are that motivational music might impact upon exercise adherence and consequently public health. At present, it appears that the music, which is provided in gymnasia, is selected on a somewhat arbitrary basis without due consideration of its motivational qualities (see Section 4.5.7). Consequently, there is a requirement for a standardised means of selecting music according to its motivational properties (Karageorghis & Terry, 1999). Such a method will enable practitioners to more fully harness the effects of motivational music. Hence, the primary rationale underlying the present study was to provide a means by which to facilitate the selection of motivational music in exercise settings.

The biggest limitation pertaining to music research in sport and exercise contexts is the haphazard selection of music conditions (Karageorghis & Terry, 1997).

Indeed, the equivocal findings associated with such research may stem from the unstandardised selection of music conditions (see Section 2.7.8.1). Hence, the secondary rationale underlying the present study was to provide researchers with a means of selecting motivational music conditions according to established standards. Greater consistency in the selection of music for experimental conditions will considerably strengthen the coherence of research into the effects of motivational music in exercise settings. In summary, the development of the BMRI-2 will guide both researchers and practitioners in the effective application of music in exercise contexts.

Despite the acceptable fit (according to Bentler’s 1995 criteria) of the four-factor model to the data, there were several residual issues and limitations associated with the BMRI that will be addressed in the present study. Some of these issues were reported in the original publication, whereas others were revealed through the application of the BMRI in exercise, sport, and research contexts by Karageorghis and his associates (Costas Karageorghis, personal communication, January 2002). First, Karageorghis et al. (1999) reported a degree of invariance in the rhythm response factor across the two samples used in their multi-sample CFA (aerobic dance exercise instructors vs. exercise participants). Second, the items in the cultural impact factor yielded low internal consistency ($\alpha = .57$). Third, the variance of the melody item was entirely accounted for by the musicality factor in which it sat (Measurement Error = .00). Fourth, the familiarity item demonstrated a relatively weak relationship with the cultural impact factor that it was intended to tap (Factor Loading = .35; Measurement Error = .94) but was included owing to the notion that it was theoretically meaningful. Fifth, there were similar weaknesses in items tapping stimulative qualities and danceability in the rhythm response factor among exercise participants. Although theoretically grounded justifications were offered by Karageorghis et al. (1999) in respect of the decision to retain weak items, reservations regarding the psychometric integrity of the BMRI remained. Indeed, the authors concluded that further validation and development would be an imperative. The psychometric limitations of the BMRI strengthen the rationale underlying its redevelopment.

A further concern regarding the validation process of the BMRI relates to the fact that a panel of five qualified aerobics instructors assessed face validity (the extent to which the items appear valid; American Psychological Association, 1974). Thus, the BMRI was developed for use by experts in musical selection rather than by exercise participants. It would be incumbent upon the exercise leaders who responded to the inventory to *infer* that the music, which was being rated, would be appropriate for exercise participants. Such inferences are unlikely to be as reliable as the responses of a representative sample of exercise participants. Indeed, Karageorghis and Terry (1997) asserted the importance of an individual's interpretation of music in determining psychophysical response. Despite the acknowledged limitations of the instrument, the BMRI did provide researchers and practitioners with a valuable resource that enabled motivational music to be selected in a time-efficient and standardised manner.

5.2 Purpose and Hypotheses

The purpose of the present study was to redevelop the BMRI in order to account for the acknowledged weaknesses of the instrument. As the present study is organised in a series of methodological stages, specific hypotheses will be set where appropriate (see Section 5.7.4).

5.3 *Qualitative Appraisal of the BMRI*

A limitation of the BMRI was that exercise participants were not involved in the process of demonstrating face validity (see Section 5.1). Hence, in order to comprehensively re-develop the instrument, it was deemed beneficial to appraise the structure of the BMRI from the perspectives of exercise participants. Eight such individuals were interviewed regarding the process of response in order to highlight any issues relating to the comprehension and interpretation of the items, instructions, and response set. The information gleaned from this process was used to inform the subsequent development of the BMRI-2, in particular, the development of the item pool. The interview procedure and qualitative analysis were based on those employed during the first study of the programme. Hence, refer to Section 3.3.2 for a more exacting description.

5.3.1 *Participants*

A sample of eight exercise participants with at least two years experience of exercising to music was purposively selected (see Mason, 2002; also Section 3.3.1). The sample ranged in age from 20-46 years (M = 31.86 years; SD = 8.86 years) and comprised four males and four females. The population from which the participants were selected comprised members of health clubs in London, United Kingdom. The participants were recruited by the researcher, who contacted those who had participated in the first study of the programme. Hence, the researcher had already had the opportunity to cultivate trusting relationships with the participants (see Patton, 1990; also Section 3.3.3.1).

5.3.2 *Procedure*

The researcher interviewed the participants, either at their place of study (*n* = 1), their health and fitness club (*n* = 3), or their home (*n* = 4). The interviews lasted between 45 and 60 minutes and were recorded using a Dictaphone. The researcher initiated each interview by presenting the BMRI to the participants, who were given an opportunity to peruse its items and instructions. During the course of each interview, three musical pieces chosen by the participant were delivered using a portable compact disc player. The participants were asked to select music that they considered appropriate as an accompaniment for exercise in a gymnasium context (i.e., submaximal exercise utilising cardio-vascular and resistance machines). This music was typically fast (> 120 bpm), with a pronounced rhythmical component; described by the interviewees as either “dance” or “pop” music.

Following exposure to each piece of music, the participant was invited to rate the motivational qualities of the piece using the BMRI. Subsequently, the participant shared their responses with the interviewer and answered questions thereon. The interviewer used a simple schedule to provide a structure to guide his questioning of the participant (see Ĉoté et al., 1995; also Section 3.3.2). The schedule consisted of four themes: First, the relevance of each item to the motivational qualities of music. Second, the degree to which the participant felt that she was able to comprehend the meaning of each item. Third, the extent to which the participant’s interpretation of each item corresponded with its intended meaning. Fourth, the elicitation of additional items that would contribute to the new item pool (see Section 5.4).

Participants were invited to describe their thoughts and responses during the rating procedure in order to elucidate their interpretation of the wording of each item. Such a procedure resembles protocol analysis, a technique used to infer thought processes during tasks based on concurrent verbal reports (Green, 1995). Indeed, protocol analysis has been used to qualify test-based quantitative data and highlight inconsistencies and erroneous reasoning on the part of respondents (see Barber & Wesson, 1998). Verbatim transcripts were made of the interview data. Data pertaining to each item of the BMRI were grouped together and content analysed (see Section

3.3.3) according to the three components of the interview schedule. Common themes that applied across the different items were categorized at a higher level of abstraction.

5.3.3 *Results*

The respondents reported that they comprehended the items well with the exception of those items that pertained to musical terms. Owing to the wording of the items, the participants could not differentiate between tempo and rhythm without further qualification from the interviewer. Moreover, the only participant who was able to distinguish between harmony and melody was a music student. With the exception of this individual, none of the participants claimed to understand the term harmony. Such semantic difficulties mirrored those reported in chapter 3. The respondents expressed concerns regarding the relevance of a number of the items to the motivational qualities of music. In particular, Items 6 (chart success) and 13 (date of release) were felt to be irrelevant. Further, the scope of Items 4, 5, and 7, which related to association, was felt to be too narrow. The point was made that only a tiny percentage of the pieces of music used in exercise contexts would carry associations that related specifically to sport or physical activity. Due to this, it was proposed that a wider frame of reference should be used.

With regard to Item 5 (association of music with sport), a respondent suggested that many of those who participate in recreational exercise feel intimidated by the notion of competitive sport. In addition to the aforementioned concerns regarding the items that leant on musical terminology, the participants encountered difficulties in responding to other items. The participants found that the chart success (Item 6) of the music they selected was difficult to recall. Further, several of the participants stated that they were unaware of the identity of the artist(s) (Item 8) who performed the majority of the musical pieces that they heard during exercise. Hence, the response to Item 8 was determined by the style of music that the artist in question was thought to represent. Two participants asserted that attitudes toward dancing might taint the response to Item 12 (danceability). Item 13 (date of release) proved the most difficult for the participants to interpret. It was unclear whether the item implied that current music is motivational and older music is not.

Finally, certain erroneous response trends were observed, which were not specific to individual items. First, the respondents typically failed to rate the music for a notional group as instructed (see Appendix C). Rather, the respondents rated the motivational qualities of music from their own perspectives. Second, the responses were impaired by the inherent complexity of the rating process. For example, in order to respond to Item 9 (harmony), a respondent was required to assess the type of harmony evident in the small segment of music to which they had listened, decide to what extent that harmony contributed to the motivational qualities of the piece, and infer that this contribution would still be applicable from the perspective of a third party. Lastly, the respondents demonstrated a tendency to ignore the piece of music that they were listening to and report generic responses that related their estimations of the contribution of certain items (e.g., rhythm) to the motivational qualities of music.

5.4 *Development of the Item Pool*

Following the consideration of the qualitative data presented above, a new item pool was developed, and attached to a 7-point Likert-type scale. The scale was anchored by 1 (*strongly disagree*) and 7 (*strongly agree*). The development of the item pool was based upon recent recommendations in the psychometric test literature (e.g., Anastasi & Urbina, 1997; Mulaik & Millsap, 2000). Several pertinent issues were identified that bore consideration when forming the initial pool of items. First, efforts were made to ensure that the items were worded in a uniform fashion. Specifically, it has been suggested that a question should refer to an action, a time, a context, and a target (Azjen & Fishbein, 1977). Further, each item should refer to these four parameters at the same level of generality. Hence, the items were reworded so that they conformed to the following specification. The target would be a property of the musical stimulus, e.g., rhythm or tempo, the context would be exercise, and the action would concern motivation. For example, “the melody of this piece of music would motivate me to exercise” or “the rhythm of this piece of music would motivate me to exercise.”

The second issue that underwent consideration was the operationalisation of the term motivation, which was not thought to be sufficiently precise. Specifically, the wording of the BMRI’s items lead to the implication that music motivates individuals to *initiate* exercise. The available evidence supports the conclusion that musical accompaniment precipitates increased exercise intensity or endurance (seeAtkinson et al., in press; Karageorghis & Jones, 2000; Szabo et al., 1999). However, there is no evidence to support the contention that music affects the initiation and persistence components of motivation. Thus, the instructions of the BMRI-2 were additionally specified in that respondents were required to assess the extent to which music motivated them to exercise harder and / or longer (see Appendix E). This amendment was deemed sufficient owing to the fact that no extant theoretical work or research findings were obtained to support the illogical suggestion that music would exert differential effects on exercise intensity and duration. Hereafter, the new instrument, which comprised an initial pool of eight items, was referred to as the BMRI-2.

5.5 *Content and Face Validity Analysis of the Item Pool*

The degree to which items represent the construct that they are purported to measure is referred to as content validity whereas face validity refers to the extent to which the items appear to be valid (APA, 1974). In order to assess content and face validity, the first version of the BMRI-2 was distributed to a sample of 78 qualified fitness instructors who were employed in 31 health clubs across the United Kingdom (M = 24.86 years; SD = 5.86 years). Participants were asked to evaluate the importance of each item in relation to the assessment of the motivational qualities of music in exercise. The responses were measured on a 7-point Likert-type scale anchored by 1 (*not at all important*) and 7 (*very important*). Further, the participants were asked to re-write any items that they did not understand and to provide any feedback that they deemed relevant regarding the items.

The only feedback that related specifically to the items themselves was the observation, made by two participants, that not all music is accompanied by a lyric / vocal element. The researcher decided to retain the two items in question (3 & 7) pending the results of factor analysis; at this juncture, a more informed decision could be taken regarding their inclusion. In terms of additional items, two of the participants suggested an item relating to music volume. However, the volume level of music is a contextual factor, i.e., it would vary between a music-rating session and the actual gymnasium environment due to a variety of factors including differences in music delivery equipment, ambient noise, and the acoustic properties of the interior spaces concerned. All other suggested items diverged from the format established for the item stems or extended beyond the scope of the instrument, e.g., “what sort of music would you listen to at home?”

In addition to commentary related to the pilot BMRI-2, the participants chose to submit general observations pertaining to the motivational qualities of music (*n* = 8). These expert observations were retained as a point of reference; indeed, they are referred to in the following chapter (see Section 6.7). All eight items yielded a mean response above four on the 7-point scale, which represented an endorsement.

5.6 *Music Selection*

In order to test the factorial validity of the BMRI-2, music was required that could be used during subsequent rating sessions. For the purpose of providing a comprehensive test of the BMRI-2's factorial validity, it was deemed necessary to select three pieces that varied according to their motivational quotients (highly motivational, moderately motivational, and oudeteorus). This procedure enabled the researcher to demonstrate the tenability of the factor structure across three different pieces of music. Prior to the copying and delivery of the music selections that were used, permission was sought from each of the record companies concerned. A compilation of fast (> 120 bpm) musical selections (*n* = 24) from the dance and rock idioms was edited onto a compact disc by the researcher. The motivational quotient of these musical pieces was determined using the BMRI. Psycho-musicology researchers working in the field of exercise and sport (*n* = 6) were invited to attend a music listening and rating session that was administered by the researcher. Researchers were chosen to rate the music as they were deemed to be more likely to comprehend the instrument than exercise participants (see Section 5.3.3).

Prior to the rating, the participants were introduced to the BMRI-2 and afforded an opportunity to question the researcher and clarify its meaning and the procedure of responding. Although the ratings were not being used to form experimental conditions, the instructions of the BMRI required that the respondents envisage a group for whom they were selecting music. Thus, the respondents were asked to select music for a group of students in their late teens and early twenties, mixed in terms of sex, and mostly White U.K. or Irish in terms of their socio-cultural background. Such characteristics closely approximated those of the samples subsequently used to validate the BMRI-2. At this juncture, the researcher asked the participants whether there were any ambiguities regarding which they would require further elaboration. All participants indicated that the instructions were clear.

The tracks were edited onto two compact discs by the researcher. A 1-min segment of each track was selected in order to demonstrate at least one chorus and verse (see chapter 3; also Gluch, 1993). The music was delivered using a portable compact disc player situated upon a table equidistant from the seven raters, who were seated in a semi-circular formation. Following each track, the respondents were allotted a period of approximately 30 s to rate the piece of music using the BMRI. The next track was delivered by the researcher only when it was clear to him that all of the participants had completed their ratings and that they were ready to attend to the following piece of music.

The motivational quotients assigned to each piece using the BMRI ranged from 11.99 to 26.18. These quotients do not merely constitute a sum of the item scores but include weightings assigned to each factor to reflect its relative importance in the hierarchy (see Figure 2.5). Hence, the possible range of scores reported by Karageorghis et al. (1999) was 3.33-33.33. Scores below the middle range (18.33) represent *oudeterous* rather than demotivational music (see Section 2.7.4.1). Three pieces were selected in order to reflect the desired difference in terms of motivational quotient. The first piece, *Only Love Can Set You Free* by *N-Tyce,* was considered to be highly motivational (Motivational Quotient = 26.18). The second piece, *Back In My Life* by *Alice Deejay*, was moderately motivational (Quotient = 22.15). The third piece, *Outta Space* by *The Prodigy*, was oudeterous (Quotient = 16.95). Hereafter, the tracks will be referred to by number (1, 2, & 3) in the order presented above.

5.7 *Method*

5.7.1 *Participants*

The first version of the BMRI-2, which comprised eight items (see Appendix D), was administered to 151 sport science undergraduates (*M* = 19.38, *SD* = 2.77 years). The sample comprised 48 females and 74 males while 29 participants did not report their sex. Sport-science undergraduates were chosen owing to their broad experience of physical activity with musical accompaniment. Asynchronous music was present in all of the student training facilities on the testing site.

Subsequent to the first administration of the BMRI-2, data were collected from a second sample that consisted of a different group of 99 sport science undergraduates (*M* = 19.92 years, *SD* = 1.44 years) that comprised 30 females, 58 males, and 11 participants who did not report their sex. The purpose of the second sample was to provide data for a multisample CFA (see Section 5.7.3). Hereafter, the samples will be referred to as Samples 1 and 2 respectively. The same data collection procedure was adhered to for both of the samples.

5.7.2 *Procedure*

Prior to a lecture, the participants were each given three copies of the BMRI-2 and directed to read the instructions and address any queries regarding the instrument to the researcher. Henceforth, the participants were instructed to listen to the three pieces of music that had been selected for the validation (see Section 5.6). Each selection was delivered for 90 s using a portable compact disc player. Hence, at least one verse and chorus of each selection was heard (see Section 3.4.1; also Gluch, 1993). Following the delivery of each piece, the participants were given adequate time to complete their responses to the BMRI-2.

The participants were required to complete the Concentration Grid (Harris & Harris, 1984) for a period of 1 min prior to rating each track. The purpose of using the concentration grid was to distract participants from cognitions induced by the music that they had just heard, and to induce cognitive fatigue so that responses to one track would not impact upon responses to the following track; a procedure known as a *filler* (Bargh & Chatrand, 2000).

5.7.3 *Data Analysis*

One multivariate outlier was identified and subsequently deleted from the first sample using the Mahalanobis distance method ($p < .001$). In addition, a single univariate outlier was identified and deleted from Sample 1 ($z > \pm 3.29$; Tabachnick & Fidell, 2001). In the case of Sample 2, there were no univariate or multivariate outliers. Thereafter, the distributional properties of each item were examined separately for each sample. None of the items exhibited a leptokurtic (Std. Kurt. > 1.96), platykurtic (Std. Kurt. < -1.96), positively skewed (Std. Skew. < -1.96), or negatively skewed (Std. Skew. > 1.96) distribution for any of the three tracks.

A repeated measures ANOVA was computed using the total scores reported by each participant for the three tracks. The purpose of this test was to ascertain whether the BMRI-2 successfully discriminated between the three tracks, which were selected using the BMRI on the basis of their differential motivational quotients (see Section 5.6). Post hoc comparisons using Tukey’s method with Bonferroni adjustments (α = .017) were made in order to determine between which tracks the differences lay.

The items and orientation of the BMRI-2 differed markedly from the BMRI; hence, the factor structure of the former instrument was irrelevant to present data. There are two reasons for the difference in scope between the two instruments. First, the interviews with BMRI respondents revealed that the psychometric measurement of personal factors (i.e., association and cultural impact) is somewhat problematic. Hence, such items were not included in the BMRI-2. Second, a more rigorous approach was applied to the development of the item pool in the case of the latter instrument (see Section 5.4).

Because only two of the items (4 & 6) related specifically to musicality (see Figure 2.5) as opposed to rhythm response, and only a single item bore any distinct relation to extra-musical association (Item 7) there was no conceptual justification to test multiple-factor models. Indeed, the recommendation of psychometricians is that, preferably, a factor should consist of at least six items (Lowenthal, 2001). Hence, the fit of a single factor model was tested on the data pertaining to each musical track from Sample 1 using CFA.

According to Hu and Bentler (1999), the cut-off value required before one can assert a relatively good fit between the hypothesised and observed models should be close to .95 for the robust comparative fit index (CFI), and close to .08 for the standardised root mean residual (SRMR). These indices were used to evaluate the adequacy of model fit. In order to assess the extent, to which the derived factor structure was invariant across different samples, a multisample CFA was computed using data from both samples. The invariance of the factor structure across sex was tested by dividing the two samples further to yield four separate groups. A multisample CFA, with factor loadings constrained to be equal across all four groups was undertaken. No simulation studies have been performed using multisample CFA (Marcoulides & Hershberger, 1997), hence, the CFI criterion of .90 is applicable in this instance (Bentler & Wu, 1995).

5.7.4 *Hypotheses*

H_1. The single-factor model will demonstrate an adequate fit to the data in the case of each of the three musical tracks.

H_2. The single-factor model will demonstrate an adequate fit across four groups (Sample x Sex).

5.8 *Results*

The results of the repeated measures ANOVA computed to determine the difference in BMRI-2 scores between each track are presented in Table 5.1. The BMRI-2 successfully discriminated between the three tracks ($F = 72.50$, $p < .01$, $\eta^2 = .37$). Specifically, Track 1 (highly motivational) was rated above Tracks 2 ($t = 5.34$, $p < .017$, 95% CI = 1.44 – 3.13) and 3 ($t = 11.36$, $p < .017$, 95% CI = 5.59 – 7.93). Further, Track 2 (moderately motivational) was rated above Track 3, which was oudeterous ($t = 6.46$, $p < .017$, 95% CI = 3.11 – 5.84). Hence, the overall scores derived from the BMRI-2 regarding each track were concurrent with expectations. The single-factor model failed to produce an acceptable fit to the data in the case of each track (see Table 5.2). The largest standardised residuals related to Items 3 and 7 (pertaining to vocals and lyrics respectively). Following the deletion of these problematic items, an acceptable fit to the data was attained (CFI > .95) in the case of each of the three tracks (see Table 5.2). Thus, the finalised inventory consisted of six items (see Appendix E).

Table 5.1

ANOVA, Descriptive Statistics, and Post-hoc Analyses for BMRI-2 Motivational Quotients of Tracks 1, 2, and 3 (N = 250)

Track	*M*	*SD*	F ratio $_{df}$	η^2	Source of difference
1	31.64	6.89	$72.50^{*}_{2,248}$	.37	1 > 2 > 3
2	29.35	8.03			
3	24.88	8.41			

* $p < .01$.

Table 5.2

BMRI-2 Fit Indexes Following CFA and Multi-sample CFA (Single-factor Model)

Model and sample	$\chi^{2\ (df)}$	CFI	SRMR	AIC
8-item version (Sample 1)				
Track 1	155.59* (20)	.82	.09	115.59
Track 2	120.04* (20)	.90	.06	80.04
Track 3	200.36* (20)	.86	.08	160.35
Following deletion of problematic items (3 & 7)				
Track 1	30.19* (9)	.95	.05	12.18
Track 2	22.35* (9)	.97	.03	4.34
Track 3	22.70* (9)	.98	.03	4.69
Multisample CFA with data from Track 1				
Sample 1 (Male)	22.37* (9)	.93	.07	4.37
Sample 1 (Female)	31.73* (9)	.94	.06	13.72
Sample 2 (Male)	28.18* (9)	.91	.06	10.18
Sample 2 (Female)	21.04* (9)	.88	.08	3.04
Constrained multisample	122.43* (54)	.91	.23	14.43
Multisample CFA with data from Track 2				
Sample 1 (Male)	32.47* (9)	.93	.06	14.47
Sample 1 (Female)	25.31* (9)	.93	.05	7.31
Sample 2 (Male)	15.50* (9)	.97	.04	2.50
Sample 2 (Female)	7.45* (9)	1.00	.05	10.55
Constrained multisample	96.20* (54)	.96	.17	11.80
Multisample CFA with data from Track 3				
Sample 1 (Male)	22.86* (9)	.96	.04	4.86
Sample 1 (Female)	33.98* (9)	.86	.07	15.97
Sample 2 (Male)	9.85* (9)	1.00	.03	8.15
Sample 2 (Female)	12.67* (9)	.98	.05	5.33
Constrained multisample	90.67* (54)	.96	.11	17.33

Note. CFI = Comparative Fit Index; SRMR = Standardised Root Mean Residual; AIC = Akaike's Information Criterion; df = Degrees of Freedom. * $p < 0.001$.

Table 5.3

Standardised Factor Loadings (FL) and Measurement Errors (ME) Resulting from the CFA of the Responses to the Final Version of the BMRI-2

	Sample 1				Sample 2			
	Male		Female		Male		Female	
Item	FL	ME	FL	ME	FL	ME	FL	ME
Rhythm	.88	.48	.87	.49	.81	.58	.78	.62
Style	.90	.44	.88	.48	.82	.58	.91	.42
Melody	.76	.65	.64	.77	.41	.91	.71	.71
Tempo	.85	.52	.86	.51	.88	.48	.69	.72
Instruments	.79	.62	.80	.60	.76	.65	.69	.72
Beat	.76	.65	.78	.62	.84	.55	.80	.61

Multisample CFA indicated CFIs of between .91 and .96, which exceeded the accepted cutoff value of .90. The marginally low CFI of .88 in respect of the females in Sample 2 (Track 1) is attributable to the limited sample size (n = 30); such fit-indices are highly sensitive to sample size (Tabachnick & Fidell, 2001). However, the SRMR was inside the .08 criterion, which indicated an adequate fit between the observed and hypothesised (single factor) models. A similar trend may have applied to the responses of the females in Sample 1 (Track 3). The internal consistency estimates for the single factor of the BMRI-2 across the four multisample groups using Cronbach’s (1951) alpha coefficient were as follows: Sample 1 (male) = .86, Sample 1 (female) = .92, Sample 2 (male) = .88, and Sample 2 (female) = .90. These figures exceed the criterion value of .70 specified by Nunnally (1978).

The standardised solutions for each item were examined in order to assess the amount of unique variance accounted for by the single factor (see Table 5.3). Only in the case of the females in Sample 2, was the error variance for Item 3 marginally high (.91). However, the factor loadings for Item 3 in all of the samples were in excess of the .40 criterion (Ford, MacCallum, & Tait, 1986). In summary, each item demonstrated a sufficiently strong relationship with the single factor of the BMRI-2.

5.9 *Discussion and Conclusions*

The present study has yielded a valid instrument with which to rate the motivational qualities of music in exercise settings. The single-factor model attained an adequate level of fit with the data in the case of all three tracks, hence, H_1. was accepted. Further, the factor structure generalized well across different samples and both sexes. Consequently, H_2. was accepted. The standardized solutions indicated that each item bears a distinct relationship to the single factor. The prevailing single-factor model demonstrated higher psychometric integrity than the factor structure of the original BMRI. Indeed, the residual concerns relating to the structure and items of the BMRI have been almost entirely resolved.

The limitations of psychometric instruments in the field of motivational music research have also been exemplified. For example, despite the acceptable fit indices that the original BMRI demonstrated, respondents experienced notable difficulties in comprehending the items (see Section 5.3). Specifically, the personal response to motivating music proved an inappropriate subject for objective measurement. The interview data revealed that the subjective bias evident in the scoring of such items rendered them unsuitable for inclusion in the BMRI-2. Hence, the single factor of the BMRI-2 consists of items that relate to the musical stimulus itself and not one's personal interpretation of the music. This outcome is concurrent with the revised conceptual model (see Figure 2.5), in that music factors were regarded as more salient than personal factors.

Notably, the BMRI-2 is less than half the length of its predecessor (6 items as opposed to 13). This characteristic renders the newer instrument particularly suitable for rating a large number of musical selections; a purpose for which it was specifically designed. The relative importance of the rhythmic qualities of music over melodic qualities (see Karageorghis et al., 1999) has been underlined; the rhythm, tempo, and beat items demonstrated a stronger relationship with the BMRI-2's single factor than the melody item (see Table 5.3). Atkinson et al. (in press) asked those who participated in a simulated cycle time-trial to rate the motivational qualities of the music that had accompanied the trial. The rhythmical components of the music were reported to have made a greater contribution to its motivational qualities than the melodic or harmonic components.

The items pertaining to lyrics and vocals impaired the fit of the single factor model. This result can be attributed to the fact that these items did not fit logically in to the single factor. The decision to exclude these two items was reinforced by a consideration that was raised by two of the participants in the content and face validity procedure; namely, not all pieces of music used in an exercise context are accompanied by a lyrical and vocal element. Further, the essential nature of music is extra-verbal (Critchley & Henson, 1977; Demorest, 1995). Hence, the items pertaining to lyrics and vocals may not have tessellated with the single factor because the participants did not interpret them as musical properties in the same sense as the remaining items. Indeed, the single factor was characterised by items that referred to musical properties.

There are two principal reasons that explain the absence of the distinction between rhythm response and musicality that was reported by Karageorghis et al. (1999). First, the BMRI was developed for expert respondents (qualified exercise-to-music teachers), whereas the BMRI-2 was developed for the use of non-expert respondents who may not have been able to distinguish between the rhythm- and pitch-related qualities of music. Second, the results of the interviews undertaken during the present study support the conclusion that musical terms such as harmony are poorly understood by those lacking a music education (see Section 3.5). Hence, it would be incorrect to cite the present results as evidence that the pitch- and rhythm-based components of music do not exert different psychophysical effects. Specifically, the pitch-related elements of music are thought to determine affective responses whereas the rhythm-related components of music elicit a physical response (Lucaccini & Kreit, 1972).

Unlike the original BMRI, which was developed with reference to exercise and sport contexts, the BMRI-2 has been developed to enable the selection of music for exercise settings. Despite this limitation, practitioners may wish to amend the instructions of the instrument so that music can be selected for a physical training context that relates to sport, such as weight training or circuit training. Although such a minor amendment is unlikely to weaken the psychometric properties of the instrument, further research in the sport context is warranted. Notably, the BMRI-2 was validated by samples of participants, who engaged in a broad range of physical activity, including both sport training and exercise (see Section 5.7.1), thus increasing the likelihood that the instrument will generalise well in sport settings.

An issue raised during the course of the present study is the appropriateness of the term *motivational* music. Such terminology has intuitive appeal and is favoured by exercise participants themselves (see Section 4.5.3). However, it is conceivable that different musical properties may separately influence mood, arousal, and attention. Hence, mood-enhancing music may not necessarily prove to be arousing music. Thus, to subsume these different effects under the banner of 'motivating' music may represent an over-simplification.

The operational definition that Karageorghis et al. (1999) offered of motivational music is practically synonymous with Gaston's definition of stimulative music (1951): "Motivational music tends to have a fast tempo (>120 bpm) and a strong rhythm, and is proposed to enhance energy and induce bodily action" (p. 2). Hence, the differentiation between motivating and stimulative music may be regarded as insufficient. Indeed, the concept of stimulative music may prove to be the more parsimonious one.

Although the psychophysical effects of music may invoke a state that contributes to an individual's decision to increase the intensity and / or the duration of a bout of exercise (see Sections 3.5 & 4.5.3), these effects are not easily reconciled with extant theoretical frameworks relating to motivation (e.g., Bandura, 1986; Ryan & Deci, 2000). However, within the framework of Vallerand's (1997) HMIEM (See Figure 2.3), the role of music would be to increase intrinsic motivation at the situational level (see Section 2.7.3.6). One of the tenets of Vallerand's conception is that motivation at the situational level affects motivation at the contextual level. Hence, HMIEM accounts for the possibility that the effects of music on situational motivation may increase contextual motivation to engage in exercise with musical accompaniment. This proposition is certainly congruent with the suggestion that music may lead to increased exercise adherence under certain conditions (see Karageorghis et al., 1999).

The limitations of the psychometric measurement technique preclude the development of an inventory that accounts for the multitudinous facets of musical response. However, the brevity and simplicity of the BMRI-2 mean that large quantities of music can be rated on a scale that permits comparisons between the responses of different subgroups. In order to elicit the optimum selection of music in exercise settings, it may be necessary to use the BMRI-2 in tandem with qualitative methods that enable more subtle aspects of musical response to be assessed. For example, the BMRI-2 may be used as a wide filter to identify musical pieces that can then be considered on additional grounds. Subsequently, an exercise-leader may wish to employ the following framework of criteria when selecting music:

1) Music with clear associations to sport or physical activity may prove motivating (Karageorghis & Terry, 1997). It should be noted that not all exercise participants are motivated by music that is associated with sport.
2) Associations that are unrelated to sport or physical activity may also prove motivating. For example, the theme to a popular television adventure series may promote the desire to engage in physical activity. Further, lyrics that are related to determination and strength may also conceivably enhance motivation to exercise more intensely and / or for a longer duration.
3) The musical idiom, date of release, and artist of the music in question must be allied to the age and socio-cultural background of the exercise participants. When a very diverse group is being considered, a systematic attempt must be made to vary these factors (see Section 4.5.7).
4) When selecting music for an individual, the effects of personal associations should be considered. For example, a boxer may have conditioned him or herself by listening to a certain piece of music prior to fighting. Where possible, practitioners should attempt to encourage the formation of such personal associations and harness their power.

Although extra-musical associations are an important determinant of musical response, music with certain structural qualities can pre-dispose listeners to form such associations (Trehub & Schellenberg, 1995). Hence, it is conceivable that music, which is high in motivating qualities as measured by the BMRI-2, may predispose exercise participants to form extra-musical associations that relate the music to physical activity.

The criterion validity of the BMRI-2 has yet to be established. Criterion validity refers to the relationship of test scores to a recognized standard or criterion and consists of two dimensions: Concurrent validity and predictive validity (Thomas & Nelson, 2001). Concurrent validity refers to the accordance of test scores with a measure that is delivered at the same time and reflects a similar construct. Predictive validity pertains to the correlation of test scores with a subsequently administered behavioural or psychometric criterion. The concurrent validity of the BMRI-2 may be assessed by relating the motivational quotient of music to the affective and psychophysical responses to such music in physical activity settings using such measures as the Brunel University Mood Scale, formerly known as the POMS-A (Terry et al., 1999), or the Flow State Scale-2 (Jackson & Eklund, 2002).

The predictive validity of the BMRI-2 may be demonstrated by testing the effects of music with different motivational quotients on physical performance. In particular, there is a need for quasi-experimental designs that test the effects of motivational music in an externally valid setting. For example, researchers may wish to investigate the effects of motivating and oudeterous music on exercise behavior in a health club environment. Qualitative research paradigms may also be used to elaborate the precise contingencies and temporal flow of the effects that music exerts on physical performance and the experience of that performance.

CHAPTER 6

Effects of Motivational and Oudeterous Music on Affective Response and Time Spent in a Gymnasium Setting

In an attempt to address the absence of a conceptual framework to predict the effects of music in sport and exercise settings, Karageorghis et al. (1999) developed a model that represented the motivational qualities of music and their psychophysical and behavioural consequences (see Figure 2.5). Support has been derived for the tenets of the model and accumulating evidence has been found to support the assertion that music promotes ergogenic and psychophysical effects (see Sections 2.7.5 & 2.7.6). However, whereas such findings stem from work, which demonstrates a high degree of internal validity, there is a dearth of externally valid research (Pates et al., 2003). This imbalance is a consequence of the need to first assess the motivational effects of music in tightly controlled settings. Hence, there is now an appropriate basis for naturalistic work. Indeed, the rationale for the present programme of research was, in part, to introduce study methodologies that are ecologically valid.

There are very few studies that establish a precedent for naturalistic music research in the gymnasium environment. One exception is provided by the work of North et al. (1998), who investigated the effects of musical tempo on the accuracy of exercise participants' estimations of the time they had spent in a university gymnasium. Hence, aspects of North et al.'s design served as a methodological template for the present study. North et al. found that the tempo of the music used (either < 80 bpm or > 120 bpm) did not influence the time spent in the gymnasium (A. C. North, personal communication, May 6, 2003, see Appendix F).

In retail contexts, music has been shown to exert a marked influence on behaviour. The tempo of music has been linked to both shopping and eating behaviour: When compared to slow music, fast music has led to reduced time spent in retail contexts (Milliman, 1982, 1986). For example, patrons walk slower in supermarkets when shopping is accompanied by slow music as opposed to fast music. In retail contexts, the aim of proprietors is typically to encourage patrons to spend more time in a facility and thus expose themselves to more purchasing opportunities; ends which may not necessarily apply in the context of exercise.

6.1 *Rationale*

Research into the effects of music in sport and exercise settings has been characterised by microscopic and experimental approaches (Karageorghis, 1998). In a laboratory setting, motivational music has been shown to increase positive affect (Karageorghis & Terry, 2000), aerobic endurance (Karageorghis & Jones, 2000), and isometric strength (Karageorghis & Lee, 2001) when compared to oudeterous music. However, Hargreaves and North (1999) emphasised the importance of the social context in which music is heard. Further, Konecni (1982) criticised laboratory-centred research designs that appear to be predicated on the belief that music consumption occurs in a ‘social vacuum’. In order for the findings of music research in the domain of physical activity to be fruitfully applied, naturalistic work is required to bridge the gap between the laboratory and the complex social micro-climate of the gymnasium. Hence, the next logical step was to investigate the possible effects of motivational music in an externally valid setting.

The findings presented in chapter 3 indicated that, whereas music may not necessarily increase exercise endurance under tightly controlled conditions (e.g., Tenenbaum et al., in press), an exercise participant may voluntarily decide to lengthen the time spent on a piece of equipment (e.g., treadmill or cycle ergometer) or even the length of their bout of exercise. The ecologically valid design selected for the present study precluded the measurement of in-task affect, mood, and RPE; the putative responses to motivational music (see Figure 2.5). Rather, a broader perspective was taken in that a behavioural response was assessed, which applied to the entire bout of exercise. There is a precedent for assessing the effects of different types of music on the time spent in various externally valid environments (Milliman, 1982, 1986). Further, should music influence the time that an individual is willing to spend in an exercise setting, there may be greater cause to propose a link between music and exercise adherence. Hence, the present study represents a shift away from snapshot measures of psychophysical effects (e.g., Karageorghis, 1998) towards behavioural measures that indicate the broader consequences of exposure to motivational music.

It has been proposed that improved mood states elicited by music might influence both an individual’s voluntary decision to increase the length of their exercise session (see Section 3.5) and the relationship between music and exercise adherence itself (Karageorghis et al., 1999). Hence, an affective measure was chosen to clarify the relationship between music and the duration of time spent in the gymnasium. In addition, the measure of affect may illuminate the manner in which music shapes the experience of exercise; a consideration that has relevance to gymnasium proprietors whose aims include the development of customer relations.

6.2 *Purpose*

The purpose of the study was to examine the effects of motivational and oudeterous music on affective responses and the self-determined duration of an exercise session in a gymnasium setting.

6.3 *Hypotheses*

The following research hypotheses were tested in the present study:

H_1. Participants will spend significantly longer in the gymnasium in the motivating condition when compared to the oudeterous condition.

H_2. Participants will experience a significantly greater improvement in affect (pre- vs. post- exercise) in the motivating condition when compared to the oudeterous condition.

6.4 *Music Selection*

The most pervasive methodological weakness afflicting work in the domain of music and physical activity is the lack of standardisation in music selection for experimental conditions (Karageorghis & Terry, 1997). This shortcoming has been addressed through the development of an inventory to rate the motivational qualities of music (Karageorghis et al., 1999) and its subsequent refinement and redevelopment through multiple stages (see chapter 5). Hence, the Brunel Music Rating Invetory-2 (BMRI-2) was used as a tool to rate a pool of musical selections and identify suitable music for a motivational condition. Prior to the copying and delivery of the music selections that were used, permission was sought from each of the record companies concerned (see Appendix G). The rating panel consisted of four males and three females (*M* = 28.85, *SD* = 3.30 years) who were invited to attend a music listening and rating session that was administered by the researcher.

In order to assemble the rating panel, electronic mail messages were sent to twelve individuals who had previously participated in the research programme. These individuals all had experience of regularly using a gymnasium, exercising to music, using psychometric questionnaires, and conducting psychological research. Four of the participants were experienced in exercise leadership and had selected music for exercise participants on a professional basis. The characteristics of the sample in terms of age and sex resembled those of the exercise participants for whom the music was selected (see paragraph below). However, the small size of the rating panel is acknowledged as a limitation. The participants were each offered £10 to cover any travelling expenses they may have incurred in attending the rating session.

Prior to the rating, the participants were introduced to the BMRI-2 and afforded an opportunity to question the researcher and clarify its meaning and the procedure of responding. In particular, the respondents were instructed to select music for the members of a large health club in West London who would be engaged in gymnasium-based exercise including a mixture of cardio-vascular (e.g., treadmill, rowing ergometer, stairmill) and resistance exercise (both free weights and machine weights). The respondents were informed that the membership of the health club was equally mixed in terms of sex, predominantly under 40 years-of-age, and from a White, UK or Irish background. The above details were gleaned from an interview with the general manager of the health club prior to the commencement of the study. At this juncture, the researcher asked the participants whether there were any ambiguities regarding which they would require further elaboration. All participants indicated that the instructions were clear.

Sixty-six musical pieces were pre-selected by the author (see Table 6.1) on the basis of the definition of motivational music offered by Karageorghis et al. (1999), "motivational music tends to have a fast tempo (>120 bpm) and a strong rhythm" (p. 2). The tracks that did not meet the requirements in terms of tempo were selected due to their association with physical activity (see Karageorghis & Terry, 1997), these included *Eye of the Tiger* by *Survivor* and *Chariots of Fire* by *Vangelis*. The age (i.e., release date) of the tracks was purposively varied to include music dating from the late 1960s until 2003. A variety of musical idioms were drawn from including dance, rock, disco, classical (symphonic), and rap. Thus, a conscious effort was made by the researcher not to orient the selection towards music of a particular style or era; such considerations were left to the panel who rated the music.

The majority of the selections had achieved a high placing in the popular music charts or were well known for other reasons (e.g., a motion picture such as *Chariots of Fire*). The rationale for selecting music with proven popularity was to increase the likelihood that the participants were familiar with it (see Karageorghis et al., 1999). The 66 selections were drawn from a large library (over 1000 tracks) of potentially motivational music that was purchased during the prior stages of the research programme. The tracks were edited onto two compact discs by the researcher. A 1-min segment of each track was selected in order to demonstrate at least one chorus and verse (see Gluch, 1993; also Section 3.4.1). The music was delivered using a portable compact disc player situated upon a table equidistant from the seven raters, who were seated in a semi-circular formation. Following each track, the respondents were allotted a period of approximately 30 s to rate the piece of music using the BMRI-2. The next track was delivered by the researcher only when it was clear to him that all of the participants had completed their ratings and were ready to attend to the following piece of music. The potential limitations of the rating procedure included the fact that order effects were not controlled for, i.e., the order of tracks was not counterbalanced over multiple trials. Further, although there was minimal interaction between the raters, there is a possibility that group dynamics may have influenced the ratings. Finally, the acoustic environment of the psychology laboratory may have differed from that of the gymnasium in which the selected music was subsequently delivered. Hence, the ratings may have been affected by the rating context. It was acknowledged in the previous chapter (see Section 5.9) that not all of the motivational qualities of music lend themselves to psychometric measurement and that other subjective criteria should be taken into account by those selecting music to accompany physical activity. These criteria include extra-musical associations, lyrics, and factors such as the artist and the musical idiom, which relate to the socio-cultural affiliations of listeners. Thus, in order to reflect these criteria in the selection procedure, an additional rating item was used. Using this item, the participants were required to assess the motivational qualities of each piece based on criteria, which were not comprised within the inventory (see above). The *subjective* item was expressed along the same seven-point Likert-type scale used in the BMRI-2. Hence, a score of 7 indicated strong agreement with the statement that the piece of music in question would motivate the respondent during exercise.

The musical pieces were ranked in terms of their motivational qualities in the following manner. First, the scores relating to the six items of the BMRI-2 were aggregated to yield an overall score for the inventory, which was subsequently divided by six so that it was expressed along the original 7-point scale. This overall score was added to the subjective score to create a combined score on a 14-point scale, according to which the musical pieces were ranked from 1 to 66 (see Table 6.1). The 20 pieces with the highest scores comprised the selection of motivational music that was used in the subsequent quasi-experiment. The licensing issues associated with delivering the music in a health-club context were raised with the general manager and she confirmed that the company, of which the club was part, was indemnified by a blanket license from the MCPS-PRS Alliance (Mechanical Copyright Protection Society & the Performing Rights Society).

A selection of oudeterous music, which consistently lacked discernible motivational qualities, would have been noticeably different to that which the health club typically delivered; hence, such a condition would have lacked external validity. Further, in the opinion of the health-club manager who permitted the data collection, such a selection would have precipitated vociferous complaints from the membership and drawn undue attention to the experimental hypothesis. Thus, the selection of music normally delivered in the health club comprised the oudeterous condition. This selection contained a variety of current, popular (commercially successful) music including some fast and rhythmical pieces but also some ballads and a high frequency of slow, rhythm and blues tracks with irregular rhythmical properties. Consequently, a limitation of the present study was that the oudeterous condition had not been rated in apposition to the motivational condition. Nevertheless, the nature of the oudeterous condition promoted a higher degree of external validity in the design of the study. In essence, the two conditions represented a comparison between the music that is typically delivered in gymnasium settings and music that has been carefully selected according to its motivational qualities. A control condition that did not consist of music would have been impractical and externally invalid.

6.5 *Method*

6.5.1 *Participants*

The participants were members of a large private health club (floor area approximately 2,000 m^2) in West London, United Kingdom with a membership of approximately 2,000 at the time of the study. Membership subscriptions at the club ranged from between £25 and £45 per month. Hence, the club was not among the more expensive facilities available in the immediate locale and the membership consisted of those from the lower and middle socio-economic brackets. The sample constituted 78 males and 34 females whose mean age was 31.46 years (SD = 10.88). The distribution of ethnicity within the sample was as follows: White, UK or Irish (n = 81), Asian (Indian, Pakistani, Sri-Lankan; n = 18), Black Afro Caribbean (n = 4), Latin South American (*n* = 4), Asian (Chinese, Japanese; *n* = 2), White European (*n* = 3).

Table 6.1

Music Selections Used and Rank-order Based on Subjective Ratings and BMRI-2 Ratings

Rank	Artist	Track	BMRI2	SUBJ	COM
1	Kylie Minogue	Can't Get You Out of my Head	6.21	6.43	12.64
2	Urban Cookie Collective	The Key, the Secret	6.17	6.43	12.60
3	Culture Beat	Mr Vain	6.00	6.43	12.43
4	Darude	Feel the Heat	5.88	5.86	11.74
5	N-Trance	Only Love Can Set you Free	5.74	6.00	11.74
6	Kool and the Gang	Celebration	5.67	6.00	11.67
7	2 Unlimited	Ready for This	5.88	5.71	11.60
8	The Jacksons	Can you Feel It	6.02	5.57	11.60
9	DB Boulevard	Point of View	5.71	5.86	11.57
10	Underworld	Born Slippy	5.40	6.00	11.40
11	Architects feat. Nana	Body Groove	5.33	6.00	11.33
12	St. Etienne	He's on the Phone	5.69	5.43	11.12
13	Robbie Williams	Let me Entertain you	5.38	5.71	11.10
14	Shakedown	At Night	5.52	5.57	11.10
15	Aurora feat. Naimee Coleman	Ordinary World	5.79	5.29	11.07
16	Survivor	Eye of the Tiger	5.60	5.29	10.88
17	Funkstar Deluxe feat. Bob Marley	Sun is Shining	5.43	5.43	10.86
18	Irene Cara	Fame	5.14	5.71	10.86
19	Madonna	Music	5.43	5.43	10.86
20	Queen	A Kind of Magic	5.57	5.29	10.86
21	Wham	I'm Your Man	5.38	5.29	10.67
22	SuReal	Take my Breath Away	5.50	5.14	10.64
23	Booker T	Soul Limbo	4.98	5.57	10.55
24	The Pet Shop Boys	Go West	5.26	5.14	10.40
25	Lightening Seeds	Life of Riley	5.21	5.14	10.36
26	Weather Girls	It's Raining Men	5.33	5.00	10.33
27	Rocky Orchestra	Gonna Fly Now	4.88	5.43	10.31
28	Spencer Davis Group	Keep on Running	4.95	5.29	10.24
29	Glen Frey	The Heat is on	5.05	5.14	10.19
30	Irene Cara	Flashdance…What a Feeling	5.29	4.86	10.14
31	England New Order	World in Motion	5.14	5.00	10.14
32	SL2	On a Ragga Tip	5.00	5.14	10.14
33	Queen	I Want to Break Free	4.79	5.29	10.07

Note. SUBJ = Subjective Rating; COM = Combined BMRI-2 and Subjective Rating.

(table continues)

Table 6.1 (*continued*)

Rank	Artist	Track	BMRI2	SUBJ	COM
34	Chumbawumba	Tubthumping	5.21	4.71	9.93
35	The Beach Boys	I Get Around	4.86	5.00	9.86
36	Snap	Exterminate	5.24	4.57	9.81
37	Artful Dodger feat. Romina Johnson	Moving Too Fast	5.17	4.57	9.74
38	The Prodigy	Firestarter	4.86	4.86	9.71
39	Amii Stewart	Knock on Wood	5.12	4.57	9.69
40	James Brown	I got you (I Feel Good)	4.81	4.86	9.67
41	Alena	Turn it Around (Step-2 Remake Vocal)	4.43	5.14	9.57
42	Carl Douglas	Kung Fu Fighting	4.55	5.00	9.55
43	Jungle Brothers	Jungle Brother	4.69	4.86	9.55
44	Dream Warriors	My Definition of a Boombastic Jazz Style	4.67	4.86	9.52
45	Busta Rhymes	Fire it up (burn it up)	4.31	5.14	9.45
46	Iggy Pop	Wild One	5.02	4.43	9.45
47	Steve Harley and Cockney Rebel	Come up and see me (Make me Smile)	4.86	4.57	9.43
48	Europe	The Final Countdown	4.57	4.71	9.29
49	The Grid	Swamp Thing	5.07	4.00	9.07
50	Whitney Houston	I Wanna Dance With Somebody (Who Loves Me)	4.74	4.29	9.02
51	Brian May	Driven by you	4.29	4.71	9.00
52	Project-D	Chariots of Fire	3.55	5.43	8.98
53	Republica	Drop Dead Gorgeous	4.33	4.29	8.62
54	The Charlatans	The Only one I Know	4.07	4.43	8.50
55	Erasure	A Little Respect	4.57	3.86	8.43
56	Pulp	Common People	4.12	4.14	8.26
57	The Undertones	Teenage Kicks	4.10	4.00	8.10
58	Shanks and Bigfoot	Singalong	4.19	3.86	8.05
59	David Bowie	Rebel Rebel	3.88	4.14	8.02
60	The Stone Roses	Fools Gold	3.81	4.14	7.95
61	David Bowie	Queen Bitch	4.12	3.71	7.83
62	Thin Lizzy	Twentieth Century Boy	4.12	3.71	7.83
63	Steppenwolf	Born to be Wild	3.67	4.14	7.81
64	Rolling Stones	Saint of me	3.90	3.86	7.76
65	808 State feat MC Tunes	The Only Rhyme That Bites	3.48	3.14	6.62
66	Chemical Brothers feat. Liam Gallagher	You're the Devil in me	3.86	2.57	6.43

Note. SUBJ = Subjective Rating; COM = Combined BMRI-2 and Subjective Rating.

6.5.2 *Measures*

6.5.2.1 *Pre- and post-task affect.*

Pre- and post-task affect were measured using an 11-point, single-item scale that was developed by Rejeski, Best, Griffith, and Kenney (1987) for assessing affect during exercise. The bipolar scale ranges from +5 (*very good*) to –5 (*very bad*) with a mid-point of 0 (*neutral*) and intermediate points of –3 (*bad*), –1 (*fairly bad*), +1 (*fairly good*), and +3 (*good*). The Feeling Scale measures the bipolar distinction between pleasure and displeasure that underlies all emotion (Frijda, 1988). Hardy and Rejeski (1989) undertook three studies, which demonstrated the validity and merit of the Feeling Scale in measuring in-task affect.

Following consultation with the management of the gymnasium, it was decided to implement measurement techniques that would incur the minimum of intrusion to the participants, who typically hurried through the narrow reception area where the data were collected. Under such circumstances, relatively copious measures relating to mood such as the Brunel University Mood Scale (Terry et al., 1999) may have constituted a degree of inconvenience to some of the participants, thus affecting their mood and confounding the measure somewhat. One of the characteristics of the Feeling Scale is its unobtrusiveness (Karageorghis, 1998). Hence, the simplicity of the scale rendered it highly suitable for the measurement of affect in the context of the present study. In addition, a comprehensive literature search and inquiries to senior academics in the sphere of sport and exercise science yielded no comparable measure that had been specifically developed and validated to measure affect before or after an exercise task (specimen inquiry is included as Appendix H).

6.5.2.2 *Time spent in gymnasium*.

The time that each participant spent in the gymnasium area was calculated by recording the time of his or her entry to and exit from the gymnasium area.

6.5.3 *Procedure*

The data were collected on four consecutive Mondays. In chapter 4, it was ascertained that the demographics of those attending gymnasia differed throughout the day. Hence, data were collected during the following periods: Morning (09:30-11:45 hrs), afternoon (13:00-15:15 hrs), and evening (17:00-19:15 hrs). These time periods were agreed in consultation with the manager of the health club who informed the researcher of the typical diurnal attendance patterns. Initially, a repeated measures design was considered whereby the responses of the same individuals would be assessed over several visits to the gymnasium. However, examination of the health club's computerised records revealed that the pattern of attendance was sporadic; in order to obtain a hypothetical sample of 35 individuals (see Power Analysis; Section 6.5.5), who had visited the gym on four occasions (two under each music condition), several months of data collection would have been required. Available resources did not permit such a strategy and, from the perspective of the health club manager, it would have proved unfeasible. Hence, an independent samples design was used.

In order to increase the sample size and partially equalise factors that may have affected responses on a single day (e.g., the weather or traffic problems), each of the two music conditions was delivered on two separate days. Nevertheless, the day of the week was a constant factor in that all data collection occurred on Mondays. Oudeterous music was delivered on Days 1 and 3 whereas motivational music was delivered on Days 2 and 4.

Under the motivational music condition, the researcher altered the music environment of the gymnasium at the beginning of each testing period (i.e., morning, afternoon, evening). The selected motivational music was delivered via a compact disc player (DENON DCM-280) attached to the health club's audio amplifier (INKEL Public Address Amp PA-4000) and speakers (TURBOSOUND Impact-80). The volume level of the music was adjusted to correspond with the maximum level permissible under the club's operating procedures. This adjustment was determined by an L.E.D. readout situated on the amplifier itself. Using a decibel meter (YSE-YU FONG YF-20) it was established that the chosen volume level of the music varied within the range of 71-82 dB across the six points that were tested in the gymnasium. This volume level was selected so that the music output was not obscured by the noise of the exercise machines. Further, the chosen level was within the range permissible under the club's operating procedures (see above). The compact disc comprising the motivational music selection was 77 min in length. Hence, it was necessary for the disc to be played twice during each session of data collection.

A confederate of the researcher who was a uniformed staff member at the health club collected the data. For the first hour of each data collection period, the confederate stood at the entrance to the gymnasium area of the health club and was thus in a position to collect data from any member entering the facility. Each entrant was approached by the confederate and informed that a customer care survey was taking place. At this point, the name of the participant (which in most cases was previously known to the confederate) was recorded in addition to the time of entry. Subsequently, the participant was asked to respond to the Feeling Scale, which was demonstrated with the use of a laminate card. The confederate recorded the response and primed the participant to expect a similar inquiry upon their exit of the gymnasium. In order to maintain the independence of the samples, any participant who had previously provided data on a different day was disregarded and responses were not sought.

For the remaining 75 min of each data collection period, the research confederate approached members leaving the gymnasium area. Those who had been questioned upon entry were required to respond to the Feeling Scale for a second time. In addition, the research confederate recorded the time of exit. At this juncture, the participant was thanked for their assistance.

6.5.4 *Data Analysis*

Three multivariate outliers ($p < .001$) were identified using the Malhanobis distance test (see Tabachnick & Fidell, 2001) and these cases were removed from the dataset. No univariate outliers were identified ($Z > \pm 3.29$; Tabachnick & Fidell, 2001). It was established that the data relating to each variable were distributed normally in that they were neither skewed, leptokurtic, nor platykurtic (Std. Skew. and Kurt. $< \pm 1.96$). The data pertaining to both the affect variable (change in affect during the bout of exercise) and the duration variable (time spent in gymnasium) were subjected to a 3-way independent samples ANOVA (Music x Sex x Session of data collection). Post-hoc comparisons using Tukey's method with Bonferroni adjustments ($\alpha = .017$) were made to determine the effects of the time of data collection (morning / afternoon / evening) on both the duration and affect variables.

6.5.5 *Power Analysis*

The following power analysis was undertaken using FPOWER, a personal computer application written to perform power calculations for ANOVA designs. Further details regarding the software including the author and the programming code itself can be found in Appendix I. The parameters that were specified included the desired level of α (.05), the desired level of β (.80), the number of levels relating to the factor used for the power calculation (2- the motivational and oudeterous music conditions), the total number of levels relating to the additional crossed factors (5-

male, female, morning, afternoon, evening), and the estimated effect size (Δ = .30). The effect size (Δ) generated by music conditions in similar research (e.g., Karageorghis et al., 1996; Karageorghis & Terry, 2000) has typically been moderate. Consequently, a conservative estimate of .30 was made. The power analysis determined that a sample of at least 35 individuals would be required in each music condition in order to achieve the desired level of power (β = .80); hence, a minimum of 70 participants was required.

6.6 *Results*

The descriptive statistics regarding the influence of the music conditions on affect and duration grouped by sex and time of session are presented in Tables 6.2 and 6.3 respectively. The ANOVA relating to the affect variable indicated that the music conditions did not influence affect ($F_{1,110}$ = 1.83, p > .05, η^2 = .02). However, a non-significant trend indicated that the participants experienced a greater improvement in affect when exposed to the oudeterous condition. Females experienced a greater improvement in affect than males ($F_{1,110}$ = 6.35, p < .01, η^2 = .06). Further, the participants experienced a greater improvement in affect during the afternoon than they did during the morning (t = 2.59, p < .017, 95% CI = 0.23 – 1.79). None of the interaction effects involving the music condition were significant. ,

The ANOVA relating to the duration variable indicated that the music conditions had a significant effect on the time spent in the gymnasium ($F_{1,110}$ = 4.27, p < .05, η^2 = .04). The duration of the participants' sessions was longer in the motivational condition as opposed to the oudeterous condition (Δ = 0.61). However, the interaction between music and sex was non-significant ($F_{1,108}$ = 0.33, p > .05, η^2 = .00), as was the interaction between music and the time of day ($F_{1,106}$ = 0.35, p > .05, η^2 = .01). Nevertheless, the effects of the intervention were greater during the afternoon (+ 31 mins) than the morning (+ 7 mins) or the evening (+ 7 mins). Also, participants remained longer in the gymnasium area during the afternoon as opposed to the morning (t = 2.03, p < .017, 95% CI = 0.20 – 29.07 mins) or the evening (t = 2.90, p < .017, 95% CI = 5.87 – 31.59 mins).

Table 6.2

Independent Samples Analysis of Variance to Assess the Influence of Music Condition, Sex, and Session Time on Affect (Post-task Affect Minus Pre-task Affect)

Group	Music Condition						F^{df}	Source of diff.	η^2
	Motivational (M)			Oudeterous (O)					
	N	*M*	*SD*	*N*	*M*	*SD*			
Sex									
Male	37	1.07	1.43	41	1.26	1.74			
Female	17	1.62	1.14	17	1.82	2.52			
Session									
Morning	13	1.00	1.47	17	0.65	1.31			
Afternoon	20	1.35	1.47	12	2.58	1.78			
Evening	21	1.29	1.23	29	1.40	2.23			
Sex x Music x Session							$0.36^{2, 100}$	——	.01
Sex x Music							$0.53^{1, 108}$	——	.01
Sex x Session							$2.32^{2, 106}$	——	.04
Music x Session							$2.61^{2, 106}$	——	.05
Music							$1.83^{1, 110}$	——	.02
Sex							$6.35^{**\ 1,110}$	F > M	.06
Session							$3.72^{*\ 2, 109}$	M < A	.07

* $p < .05$, ** $p < .01$.

Table 6.3

Independent Samples Analysis of Variance to Assess the Effects of Music Condition, Sex, and Session Time on Time Spent in Gymnasium

Group	Music Condition						F^{df}	Source of diff.	η^2
	Motivational (M)			Oudeterous (O)					
	N	*M*	*SD*	*N*	*M*	*SD*			
Sex									
Male	37	95.70	27.16	41	79.32	30.16			
Female	17	90.88	22.22	17	74.06	22.25			
Session									
Morning	13	87.38	22.01	17	80.24	22.96			
Afternoon	20	109.60	28.86	12	78.58	31.18			
Evening	21	83.71	16.49	29	76.00	30.06			
Music x Sex x Session							$1.34^{2, 100}$		.03
Sex x Session							$0.90^{2, 106}$		.02
Music x Sex							$0.33^{1, 108}$		.00
Music x Session							$0.35^{2, 106}$		.01
Sex							$0.00^{1, 110}$		.00
Music							$4.27^{*\ 1, 110}$	M > O	.04
Session							$3.77^{*\ 2, 109}$	A > M,E	.07

Note. A = Afternoon; M = Morning; E = Evening.
* $p < .05$.

6.7 *Discussion and Conclusions*

The purpose of the study was to examine the effects of motivational and oudeterous music on affective responses and the self-determined duration of an exercise session in a gymnasium setting. The first research hypothesis, H_1., stated that the participants would remain in the gymnasium longer in the motivating condition than the oudeterous condition; this hypothesis was accepted. However, none of the interaction effects involving music proved significant, indicating that the effect of motivational music on the time spent in the gymnasium was similar for males and females, and at different times of the day. Nevertheless, a non-significant trend indicated that the motivational music may have had a greater impact on the time spent in the gymnasium during the afternoon as opposed to the morning or the evening; a proposition that will be discussed shortly. The present findings would suggest that carefully chosen music affects the behaviour of individuals in complex social micro-climates such as that of the gymnasium.

Extant research into the effects of music on physical activity is predicated on the strict experimental control of the task, either in terms of intensity or duration. Under such circumstances, music has been shown to increase the length of exercise bouts consisting of a single task (Copeland & Franks, 1991; Karageorghis & Jones, 2000). However, in an externally valid setting, decisions regarding the duration and intensity of a physical task are made in a spontaneous manner rather than being imposed by an experimenter. Thus, whereas music may not be shown to increase endurance or improve performance when participants are subjected to maximal tests (e.g., Ciccomascolo et al., 1995; Scott et al., 1999; Tenenbaum et al., in press), its effects may be evident over the course of a bout of activity such as a gymnasium workout.

It has been proposed that motivational music may ultimately increase exercise adherence (Karageorghis et al., 1999). If music leads exercise participants to spend more time in a gymnasium then it is plausible that it may also encourage them to attend the facility more often. Research outside of the exercise context has shown that faster music increases the speed with which patrons shop in supermarkets (Milliman, 1982) and eat in restaurants (Milliman, 1986). However, in the differing context of exercise, faster music (the oudeterous condition was generally slower than the motivational condition in that it contained a mix of upbeat tracks with many ballads and slower pieces) actually encouraged the participants to remain in the gymnasium for longer. Hence, it is probable that the motivational condition encouraged the participants to undertake a greater amount of work rather than merely stretching their exercise bout over a longer period of time. North et al. (1998) found that music tempo did not affect the time spent in a university gymnasium. Hence, it may be inferred that motivational qualities of the music other than tempo exerted an influence on the present findings.

Notably, the effects of the intervention were greater during the afternoon (+ 31 mins) than in the morning (+ 7 mins) or the evening (+ 7 mins). The relatively low number of participants who attended the gymnasium during the afternoon under the oudeterous condition and the somewhat larger *SD*s in respect of the afternoon scores may point to an anomalous finding. However, the gymnasium was far busier during the evening session. Hence, the participants may have been less able to increase the duration of their bouts of exercise due to a lack of space. The difference between the morning and afternoon sessions in terms of time spent in the gymnasium may be explained by the types of participants that attended the facility at theses times. Older individuals are more likely to attend gymnasia in the morning (as opposed to later in the day) when compared to younger individuals (Section 4.4.2). Further, the researcher noted that a large proportion of those who attended the gymnasium in the afternoon were students. It is a possibility that the music, which constituted the motivational condition, appealed more to the younger participants who attended the gymnasium in the afternoon than the older participants who attended in the morning.

Motivational music has been shown to improve affect during exercise when compared to oudeterous music (Karageorghis & Terry, 2000). However, the present findings reveal that music exerted no such influence: The change in affect over the duration of exercise was not influenced by the music conditions and hence H_2. was not supported. This result may be explained by considering the nature of the BMRI-2, which was used as a means to select the pieces of music that comprised the motivational condition. Of the items, which constitute the revised instrument, only the melody item bears any relationship to affect; the melodic qualities of music have been linked to affective responses whereas music's rhythmical qualities have been linked to physiological responses (Lucaccini & Kreit, 1972). Thus, the affective qualities of the music were not fully considered during the rating process.

The oudeterous music condition contained a high frequency of popular music which, although not necessarily stimulative, possessed uplifting qualities. Notably, although the difference was not significant, a greater improvement in affect was noted in the oudeterous condition. Arguably, the original BMRI instrument that was used as a tool to select music in previous studies (e.g., Karageorghis & Deeth, 2002; Karageorghis & Terry, 2000) contained more items that relate to the affective qualities of the musical stimulus than the newer instrument, which is focussed almost entirely on the stimulative properties of music. From the perspective of self-determination theory (Ryan & Deci, 2000) and the Hierarchical Model of Intrinsic and Extrinsic Motivation (Vallerand, 1997), an intervention that prompts increased intrinsic motivation (to exercise) should also lead to an improvement in affect. Both music conditions led to increases in affect of over 1 point on the Feeling Scale. Hence, it is possible that both music conditions promoted affective responses that were unrelated to increased intrinsic motivation.

In the previous chapter (see Section 5.9), the synonymy of motivational qualities and stimulative qualities was discussed at length. It was argued that music might be stimulative without being uplifting. Indeed, theories of emotion contain affect and arousal as separate dimensions (see Terry, 2004 for review). The wording of the items in the BMRI-2 instrument and the definition that Karageorghis et al. (1999) offered in relation to motivational music appear to lean heavily on the definition of stimulative music (see Gaston, 1951). Consequently, the motivational music selected by the rating panel in the present study appears to have motivated the participants without influencing affect.

The fitness instructors who participated in the face and content validation of the BMRI-2 (see Section 5.5) provided general qualitative feedback on their response forms that is pertinent to the above discussion of the relationship between affect and motivation. For example, one particular group-exercise leader admonished the researcher to:

> Differentiate between what people enjoy and what people work harder to, in my aqua-class the ladies always ask for fifties and sixties music but don't work as hard when I play it, when I play other music they don't seem to enjoy the class as much but they work harder.

Although the foregoing statement is merely anecdotal, it does appear to shed some light on the present findings. However, even if motivating music is not necessarily uplifting, there would still be an onus on practitioners to select music that promotes a positive affective response as enjoyment facilitates exercise adherence (Cervone, Kopp, Schaumann, & Scott, 1994; Wankel, 1993).

Both Rejeski’s (1985) parallel processing model and Tenenbaum’s (2001) social cognitive model of perceived exertion are consistent with the proposition that music distracts attention from the internal sensory cues resulting from fatigue. The present results may be explained in terms of attentional processes. Rather than facilitate situational intrinsic motivation (see Section 2.7.3.6), the motivational music condition may have served as a distraction. Such a distraction effect might have explained the longer time spent in the gymnasium under the motivational music condition. Although a distraction effect may partly explain the findings, the music that comprised the motivational condition was specifically chosen on account of its motivational qualities. Hence, it is probable that this music heightened intrinsic situational motivation as opposed to merely distracting the participants.

An alternative explanation for the failure of the music conditions to differentially influence affect may lie in the manner in which the Feeling Scale measure was used. It is possible that by the time the participants had completed their workouts and were leaving the gymnasium area, any improvements in affect resulting from the music selection would have attenuated somewhat. A related finding was that females experienced a larger improvement in affect during exercise than males regardless of the music condition ($\Delta = .28$). This finding contrasts with that of Rosenfeld (1998), who found that sex did not influence the mood response to exercise in an experimental setting. However, Rosenfeld did report that aerobic exercise prompted a larger improvement in mood (pre- vs. post- exercise) than resistance exercise. Hence, if the female participants in the present study engaged in a greater proportion of aerobic as opposed to resistance exercise when compared to the males, then this imbalance might have explained the improved affective response that they demonstrated. An alternative explanation is that an aspect of the externally valid gymnasium environment other than exercise, such as social interaction, caused the improvement in affect demonstrated by the female participants.

The challenges associated with undertaking externally valid research of this type may explain the dearth of similar work in the area of music and physical activity. The present study was affected by numerous limitations that may have influenced the findings. With hindsight, the rationale for employing an additional item (in addition to those of the BMRI-2) during the music rating procedure was questionable. Indeed, the music selection would have been extremely similar if it has been based on the BMRI-2 scores alone. This assertion is substantiated by the high correlation between the overall BMRI-2 scores and those of the subjective item ($r = .78$, $p < 0.05$).

A further limitation relates to the fact that the motivational qualities of the oudeterous music condition were not rated. Hence, it is not possible to confirm whether the pieces selected were more or less motivational than those that comprised the motivational condition. There is a possibility that changes to the dependent variables may have been partly due to variations in the music output, irrespective of the content of the conditions. However, it was noted that the music selection in the gymnasium was subject to continual change and hence it is unlikely that the participants were aware that the selection had been altered. The volume level was liable to minor adjustments during the course of the day by the gymnasium management. The reason for this was that music is typically delivered at a lower volume during the daytime when a gymnasium is normally emptier and quieter. At such times, the gym is more likely to contain older individuals who prefer the music at a lower volume level (see Section 4.4.2). This limitation was partly mitigated by the fact that when the gym was less busy, ambient noise was lower, thus offsetting the slightly quieter music volume level that was selected on occasion. Also, it was incumbent upon the researcher to respect the operational requirements of the health club as stipulated by the general manager. Nevertheless, an amicable compromise was reached whereby every effort was made by the gymnasium staff members to maintain a similar volume level throughout the course of the quasi-experiment. The results indicated that motivational music increased the time spent in the gymnasium relative to oudeterous music regardless of the time of day; hence, it appears is unlikely that any minor diurnal variations in music volume influenced the findings.

A further limitation was that many extraneous factors such as social interaction, the staff on duty, and the daily routines of the participants might have influenced the time that was spent in the gymnasium area. However, if music is to exert a motivational effect on exercise participants in externally-valid settings then it must do so in spite of the aforementioned extraneous factors. When viewed in this light, the results of the present study are encouraging for those who wish to harness the motivational effects of music in order to promote exercise adherence. It is hoped that the relatively large sample size and the collection of data over four weeks mitigated the above limitations within the design of the study. Indeed, a quasi-experimental design often provides a greater opportunity to generate a large sample than a tightly controlled experimental approach, thus increasing statistical power. The number of the measures used is a further limitation of the present study. However, in defense of the decision to use only two dependant measures must be weighed the benefits of minimal intrusion upon the participants' routines; a factor that enhances the naturalistic properties of the present study design.

A final limitation was the fact that participants, who attended the gymnasium infrequently or not at all, were less likely to have been represented within the sample than those who attended on frequent basis. The extent to which the results generalise to less frequent attenders has yet to be determined. Intrinsic motivation is associated with exercise compliance (Brustad, 1996; Kimiciek & Harris, 1996). Hence, the motivational effects of music may prove even more pivotal for individuals who exhibit low compliance because such individuals are more likely to demonstrate lower levels of intrinsic motivation. An inevitable consequence of the quasi-experimental design that was chosen for the present study was that certain aspects of internal validity were compromised in order to maintain a relatively high degree of external validity. Owing to the exploratory nature of the present work, it is hoped that the present study will serve as a pathfinder for future naturalistic work in this field.

Notably, unsolicited verbal feedback issued by the participants as they exited the gymnasium demonstrated the importance of music provision. Several comments were passed indicating that the motivational music condition had made a substantive positive difference to the exercise experience. Conversely, when musical pieces were delivered under either condition that seemed too slow or too old (from the perspective of younger participants), pointedly negative comments were made. The essence of the negative feedback was that inappropriate music rendered exercise very difficult and necessitated deliberate acts of dissociation from the unfavoured musical stimulus.

In conclusion, systematically selected motivational music appears to exert a behavioural impact upon exercise participants in the complex social environment of the gymnasium. Future researchers should attempt to further elucidate the effects of music in the gymnasium or sport training environment. The following questions should be addressed: Does motivational music increase the intensity of work, the overall amount of work undertaken, or does it merely encourage exercise participants to remain longer in the gymnasium area? Does motivational music affect the time spent on individual pieces of equipment? Does motivational music promote observable behavioural consequences in the gymnasium environment such as social interaction amongst exercise participants? Karageorghis (1998) proposed that motivational music should promote relatedness, one of the building blocks of intrinsic motivation. A question of arguably greater significance is the contribution of motivational music to exercise adherence or the overall benefit derived from physical activity. There is also scope to reconsider the role of affect and its relation to the motivational states that music can promote. To what extent is it beneficial to select music that is both stimulating (heightens activation) and uplifting (improves affect)? In addition, further studies should be conducted to comprehensively establish the criterion validity (see Thomas & Nelson, 2001; also Section 5.9) of the BMRI-2.

CHAPTER 7

Revision of Existing Conceptual Framework and General Discussion

The extant conceptual framework (see Figure 2.5) was developed in 1998, since which time, many additional empirical studies have been published. Both the findings that have arisen from the present programme of research and those emanating from the empirical literature are concurrent with the revision of the existing conceptual framework. Since the inception of the revised conceptual model (Figure 2.5) a number of additional variables have been identified in relation to the response to music in exercise settings. The extension of the conceptual framework at a similar level of generality would have precipitated a model that was sprawling and complex (e.g., Figure 2.1). The inherent complexity of such a model would have rendered it unsuitable for graphic representation in the form a flow diagram. Hence, the new framework has been reset at a higher level of abstraction befitting its status as a *conceptual* model; i.e., a representation of the causal relationships between concepts such as *mood* and *exercise adherence*.

The individual variables that constitute the various stages of the new model will be presented in the following text. A similar approach was favoured on a lesser scale by Karageorghis and Terry (1995) who developed a model to predict the responses to asynchronous music during submaximal exercise according to the *functionality* of the music (see Figure 2.4). The variables that were considered to determine the functionality of the music were not depicted in the model but were instead described textually. Although it is highly improbable that the entire model can be tested empirically, parts of the model may be tested in isolation. Moreover, researchers and practitioners will be afforded an overview of the processes whereby music delivered in the context of physical activity may impact upon public health.

7.1 *Overview of the New Model*

Several issues have been considered during the development of the new model (see Figure 7.1). First, the general framework of the original model has been retained as it has received both empirical (Karageorghis 1998) and qualitative support (see Sections 3.5 & 4.5.1). However, the new model departs from the prior framework in that it is anchored to physiological processes such as afferent neural pathways and is thus complicit with Rejeski's (1985) parallel processing model, which has received strong support (e.g., Karageorghis & Terry, 1997; Nethery et al., 1991; Tenenbaum et al., in press). Parncutt (1998) proposed that models of musical response should adhere to a principle of ‘physiological realism’, thereby anchoring them to actual physical structures. In accordance with this perspective, the starting point for the new model is simply *musical sound*. Music is not motivational in an objective sense but is perceived as such by the listener (see Section 3.3.3.1). Thus, the new model is less positivistic than its forbears (see Figures 2.4 & 2.5) in that the subjective reality of the exercise participant is acknowledged. In sum, the model is logically defined in terms of input (physical stimulus), throughput (psychophysical state), and outputs (immediate and longitudinal behavioural consequences).

7.2 *Music Variables*

In the context of physical activity, the most salient component of musical sound is rhythm. For the purposes of the new model, the term rhythm is inclusive of tempo, the accented main beat, and the temporal displacement of the percussive, instrumental, and vocal elements that may be present within a given musical piece. Pitch-related components of music such as harmony and melody are less significant than rhythm but also contribute to the motivational effects of music (see Section 3.4.1; also Tenenbaum et al., in press). Researchers should be aware that the pitch-related elements of music and, to a lesser extent, the rhythm-related components, are difficult to describe verbally, especially for musically-naïve participants. Possible stratagems to circumvent these semantic challenges are mooted in Section 4.5.7. At present, there is little evidence to support the proposition that the timbral components of music such as instrumentation (see Karageorghis et al., 1999) and vocal elements significantly affect the psycho-physical state of exercise participants. However, the lyrical component of music may influence those engaged in physical activity, but not to the same extent as the rhythm- and pitch-related elements (see Karageorghis et al., 1999; Tenenbaum et al., in press).

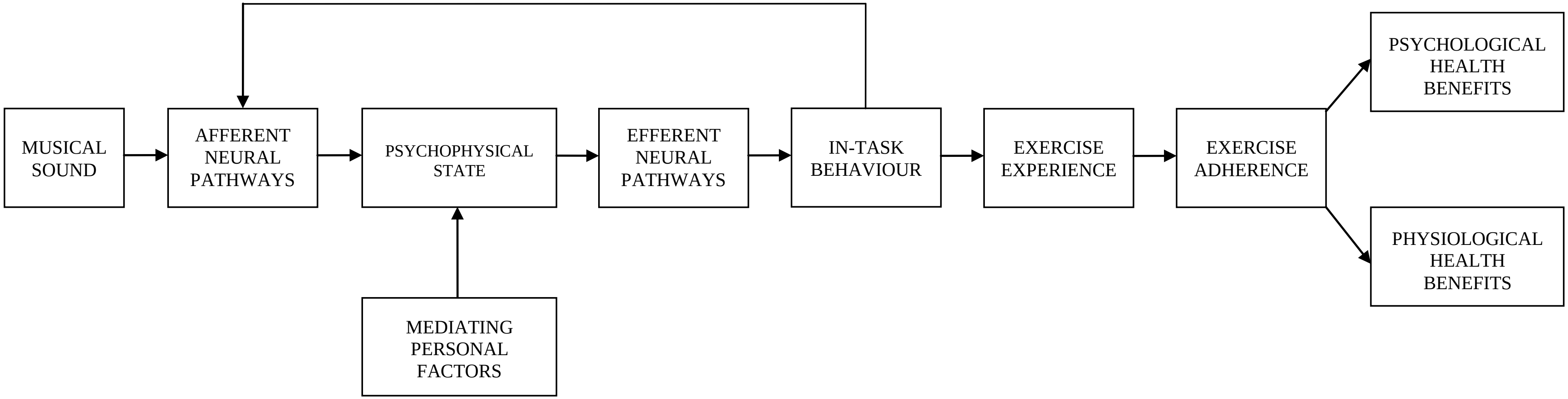

Figure 7.1. A conceptual framework to depict the psychophysical and behavioural effects of music in the context of exercise.

The volume-level of the music and the sound quality of the amplification equipment moderate the effects of the musical variables on exercise participants. In addition, musical output may become obscured by ambient noise in the gymnasium environment (see Copeland & Franks, 1991). Further, a tenet of information processing models such as that of Rejeski (1985) is that a stimulus of greater intensity (e.g., louder music) is more likely to distract an individual from the physical sensations of fatigue than a stimulus of lesser intensity. This is because a stronger stimulus occupies a greater degree of the limited channel capacity. Finally, exercise participants are sensitive to the overall music programme and concerns such as variety are paramount (see Section 4.5.7). For example, the same piece of motivational music may become irritating and demotivating if delivered on a constant loop. A cognitive explanation of musical response may be invoked to elucidate the importance of a *varied* musical accompaniment to exercise (see Martindale, 1988; Section 2.3.3). In response to a certain piece of motivational music, a higher-order cognitive unit representing the piece would be activated. However, following repetition of the piece, the activation of the relevant cognitive unit would become attenuated (Schubert, 1996). Indeed, a contrast effect has been reported whereby the judgement of one aesthetic stimulus affects the reception of a subsequent stimulus (e.g., Martindale).

The individual components of music are thought to exert specific psychophysical and behavioural effects. For example, a prominent musical rhythm may heighten levels of activation (Lucaccini & Kreit, 1972; Sections 3.4.1. & 4.5.1) and prompt a synchronisation effect (Karageorghis & Terry, 1997), whereas the melodic component of music is thought to influence affective responses (Lucaccini & Kreit, 1972). The findings emanating from the two qualitative studies of the present programme (chapters 3 & 4) support the tentative conclusion that increased musical volume and the bass-line melodic component of music heighten levels of activation. Berlyne (1971) theorised that the response to a piece of music in terms of arousal is partly determined by the psychophysical properties of the stimulus, which include its intensity (i.e., music volume). Exercise participants described the manner in which they co-ordinated bursts of heightened activity with musical segments that they regarded as particularly motivational (see Section 3.4.1). Accordingly, localised emotional responses to music have been reported in the experimental music psychology literature (e.g., Sloboda, 1992; Waterman, 1996). The lyrical components of music are particularly evocative of extra-musical associations and imagery (see Section 3.4.4).

7.3 *Psychophysical State Variables*

The psychophysical responses detailed by Karageorghis et al. (1999) included arousal control, lowered RPE, and improved mood. Presently, numerous additional responses will be elucidated. Several psychophysical responses precipitated by music are thought to contribute to a decision (whether conscious or unconscious) to alter in-task behaviour (see Section 7.5). Rather than arousal, the term *activation* is preferred as it describes the state of the organism, whereas arousal refers specifically to the response elicited by a newly introduced stimulus (see Section 2.7.3.2). Hence, arousal may alter the state of activation. Activation has cognitive and physiological components (Hardy et al., 1996). Hence, it is acknowledged that music may influence levels of either physiological and / or cognitive activation in physical activity settings; however, these effects are not synonymous (see Lacey, 1967, for discussion).

Music has been shown to influence affect and mood during physical activity (see Section 2.7.6.3). However, there is a dearth of research into the *emotional* effects of music in sport and exercise settings, which can be attributed, in part, to the semantic confusion surrounding the term emotion (see Section 2.1.1). Although, the aim of practitioners is typically to select music that positively influences affect and mood, there are exceptions. It is conceivable that negative emotional states such as anger or fury would facilitate the performance of explosive athletes such as powerlifters (see Hanin, 1997, for a discussion of the facilitative effects of negative emotional states in sport). A martial artist, who participated in the initial study of the research programme, reported that he specifically chose music that would engender an “aggressive” and “angry” state prior to training. Hence, researchers and practitioners should be aware that, in certain contexts, the negative mood states evoked by music may facilitate performance.

The incidence of flow in response to music during physical activity has been established (Karageorghis & Deeth, 2002; Pates et al., 2003). Hence, flow is included within the model as a psychological state variable. In addition to flow, music promotes several psychological consequences that comprise a cognitive element. Such responses include extra-musical association (Karageorghis & Terry, 1997), imagery (Karageorghis & Lee, 2001; Section 3.4.4; Tham, 1994), increased self-confidence (see Lampl, 1996, as cited in Tenenbaum et al., in press; Lanzillo et al., 2001; Section 3.4.1), and reduced anxiety (see discussion in Szmedra & Bacharach, 1998). In exercise settings, music may prompt participants to more favourably evaluate their ability to meet the demands of the task (see Section 3.4.1); the inverse of cognitive anxiety (Martens et al., 1990). According to Vallerand's (1997) hierarchical model of intrinsic and extrinsic motivation, one of the consequences of heightened motivation is a cognitive response. Hence, the motivational response to music may promote related cognitions such as those described above. The rhythm response (Karageorghis & Terry, 1997) that occurs when physical movements become synchronised to the rhythmical components of music may be thought of as a psychophysical response. Indeed, Wilson (1986) referred to a *pacemaker* in the brain that is thought to regulate temporal functioning. Such a mechanism may serve to co-ordinate the afferent neural stimulus of music with a reciprocally-distributed efferent stimulus (i.e., physical movement).

The previous conceptual model (see Figure 2.5) represented psychophysical consequences as independent and did not account for a possible interaction between them. However, the processes described above are thought to be mutually influencing; several examples follow: Mood, emotion, and affect are reciprocal processes (see Terry, 2004, for review). Activation levels and attentional foci are inversely proportional (see Section 2.7.3.2). For example, narrowed attention is a consequence of heightened activation (Parfitt et al., 1990). Ekkekakis and Petruzzello (2002) proposed that affect is determined by the interaction of valence (positive vs. negative) and activation (high vs. low). Further, the positive mood states evoked by music during exercise may serve as an antecedent to flow (Karageorghis, 1998). The flow experience, in turn, leads to an alteration in the attentional state (Jackson & Marsh, 1996) and thus may influence perceived exertion. Moreover, Rejeski (1985) implicated the role of affective information in determining perceptions of exertion.

Affect may influence cognitive functioning in a generic sense. For example, Isen (1993) theorised that, when mood is elevated, motivation to process information and cognitive performance are improved (see Section 2.5.2). Finally, Szmedra and Bacharach (1998) proposed that emotional responses such as the attenuation of anxiety might influence physiological processes such as vasodilation thereby assisting in the removal of lactic acid from working muscle cells. In summary, researchers should be aware that the various psychophysical responses to music during physical activity are potentially interactive. Further, it is unlikely that all of the responses listed above would occur concurrently. For example, music might lead to improvements in exercise performance without leading to distraction (see Section 4.5.3) or improving affect (see Section 6.7).

7.4 *Personal Factors*

Personal factors, included in the original conceptual model (see Figure 2.4) but excluded from the revised conceptual model (see Figure 2.5), have been introduced as mediators that determine, in part, the psychophysical response to musical sound. In this respect, the new model resembles LeBlanc's (1982) interactive theory of music preference, in which personal factors mediate the response of the organism to the physical properties of sound. In addition, Tenenbaum (2001) theorised that perceptions of exertion are mediated by such personal factors as socio-cultural background and personality. The principal personal factor is age, which is discussed in Section 4.5.5. The trained or untrained status of an exercise participant may also influence their response to music (Karageorghis & Terry, 1997; Section 7.9). The influence of sex on the psychophysical response to music is not yet clear and further research is warranted to elucidate this issue. However, it is premature to state that sex has no influence on the response to music in sport and exercise settings, as there are findings to the contrary (see Section 4.5.4).

A tentative conclusion arising from the review of literature (chapter 2) and the results of the first study (see Section 3.4.2) is that personality variables such as extraversion and sensation seeking may influence the response to music (see Section 2.3.6) and an individual's attentional style (see Section 2.7.3.1). The role of personality dimensions in determining the response to music in the context of sport and exercise has yet to be investigated. Conversely, it is acknowledged that socio-cultural factors influence the preference for certain types of music in the exercise and sport domains (Karageorghis & Terry, 1997). Indeed, findings from the present programme support the proposition that current socio-cultural affiliations may partly determine the preferred musical choice to accompany physical activity (see Section 3.4.3). Nevertheless, it was also concluded that musical preferences in the context of exercise are more contingent upon rhythmical components and less on socio-cultural factors than is the case for general music preference (see also Gfeller, 1988). The particular characteristics of a given piece of music that define it in socio-cultural terms include the identity of the artist(s) and the idiom.

Each sport (or exercise) participant has a unique relationship with the music that accompanies their physical activity (see Gluch, 1993, for discussion). This uniqueness is determined, in part, by the prior exposure that an individual has had to a given piece of music and the extra-musical associations that have been formed in relation to it. Such associations may be either personal or cultural in nature (Meyer, 1956). Personal associations are typically autobiographical and thus relate to the specific experiences that define the course of an individual's life. Thus, personal associations depend on the contingencies that determine when an individual first hears a piece of music and in what context. It is conceivable that personal associations may develop in the context of exercise (see Section 3.4.4) and become reinforced over successive bouts of exposure to the favoured musical piece within that context. Martindale (1988) explained the formation of extra-musical associations in terms of connections between the higher-order cognitive units that represent musical pieces and those that represent remembered experiences and abstract themes. Such an approach explains the development of situational music preference (North & Hargreaves, 1997); a connection may be formed between the cognitive the units that represent loud, fast music and those that represent the exercise setting. Hence, a prototype is formed based upon the expectations of what music should be in the context of exercise.

Cultural associations are determined by the pervasion of a given piece of music in society; for example, a musical piece may become collectively associated with a film, political movement, or particular sport. Cultural associations may still be considered in the context of 'personal factors' because an individual's unique characteristics and socio-cultural affiliations determine the extent to which they assimilate a culturally-held association. Hence, the individual is the conduit through which the influence of cultural factors is relayed into the conceptual model. A factor that determines the associations, which a piece of music carries, is the date of release. Associations are typically formed in young adulthood (Holbrook & Schindler, 1989) and formative music preferences developed during the teenage years endure throughout the life span (Robinson & Fink, 1996).

7.5 *In-task Behaviour*

The immediate (as opposed to longitudinal) behavioural consequences of musical accompaniment during physical activity include increased training intensity (Becker et al., 1994; Hall & Erickson, 1995; Matesic & Comartie, 2002; Section 3.4.5), increased exercise endurance (Karageorghis & Jones, 2000; Section 3.4.5), and improved co-ordination and task performance (Pates et al., 2003). There is currently no evidence to suggest that these behavioural consequences are individually associated with specific musical properties or psychophysical responses in a differential manner. From the perspective of Vallerand's (1997) hierarchical model of intrinsic and extrinsic motivation, the immediate behavioural consequences listed above relate to the effects of *situational* motivation. Indeed, behaviour was theorised by Vallerand to be one of the outcomes of increased motivation alongside affect and cognition.

Karageorghis (1998) proposed that motivational music may promote feelings of relatedness during physical activity; a proposition that was tentatively supported by the qualitative findings presented in Section 3.4.2. Accordingly, music should promote behaviours that reflect such feelings of relatedness including heightened social interaction. In accordance with the posits of self-determination theory (Deci & Ryan, 1985), relatedness should facilitate intrinsic motivation and thus affect behaviour. Social behaviour in exercise settings that is influenced by the musical output may not be considered *task-related behaviour*. However, for the purposes of simplicity, such a distinction was not drawn.

The feedback loop that connects the 'in-task behaviour' box with the 'afferent neural pathways' box reflects the fact that physiological feedback (e.g., kinaesthesia, sensations of heat etc.) will be processed in parallel with affective stimulation (i.e., music) as theorised by Rejeski (1985). Moreover, the effects of the music will also depend on its level of functionality (i.e., appropriateness; see Karageorghis et al., 1999) in relation to the task. Hence, during high-intensity activity, music of a relatively high intensity may prove functional; the strength of the stimulus is an important consideration in active filtering processes (Nethery et al., 1991). Further, it has been proposed that the tempo of functional music should approximate the HR of the exerciser (Iwanaga, 1995; Karageorghis & Terry, 1995).

Those prescribing music should consider the mode of exercise, which the music accompanies. Music may prove to be of greater utility during repetitious aerobic tasks such as treadmill running or cycling (see Section 4.5.2). The discomfort that exercise participants experience varies according to the piece of equipment being used (Thomas et al., 1995). Hence, research into the functionality of music when used to accompany different modes of exercise is a pertinent subject for future investigations. For example, researchers may wish to investigate which characteristics of music facilitate performance during intuitively different tasks such as heavy resistance exercise and aerobic endurance work. For the purposes of the model, the concept of 'in-task behaviour' includes the nature of the task (i.e., intensity, rhythmical component, mode of exercise). The feedback loop that connects 'in-task behaviour' with the 'afferent neural pathways' box also allows for exercise performance to cyclically affect the psychophysical state of the individual. For example, it has been shown that different modes of exercise exert an influence on mood states regardless of the presence of music (see Section 2.7.3.4).

7.6 *Exercise Adherence and Health Consequences*

Music may promote immediate behavioural consequences that relate to the situational level of Vallerand's (1997) HMIEM. However, at the *contextual* level of physical activity settings, music may increase contextual motivation that leads to such behaviours as increased exercise adherence. It is proposed that two mechanisms lead to an improvement in the exercise experience and subsequently to an increase in exercise adherence. The concept of the *exercise experience* is a gestalt perception relating to a bout of exercise. The first means by which music can impact upon the exercise experience is by eliciting a positive affective state, which is thought to facilitate exercise adherence by virtue of a conditioning effect (see Cervone et al., 1994; Wankel, 1993). Hence, music may positively influence exercise adherence without necessarily having led to a performance increment. Second, music may improve several aspects of exercise performance (see Section 7.5); an effect that would increase a participant's sense of competence, achievement, and self-efficacy. The implication is that knowledge of heightened performance and fitness levels may impact positively upon the exercise experience. According to self-determination theory (Deci & Ryan, 1985), a sense of *competence* (i.e., mastery in relation to one's environment) is an antecedent of intrinsic motivation. Hence, if music promotes improvements in exercise performance, these improvements should lead to a greater sense of competence; a perception that would facilitate intrinsic motivation to engage in exercise.

The two paths through which music is proposed to influence exercise adherence, psychophysical state and in-task behaviour, may cohere to some extent. For example, improvements in exercise performance may influence the affective state of the individual (expressed in the model by the feedback loop). Increments in exercise adherence would lead to various physiological and psychological benefits that are listed by Hillsdon and Thorogood (1996). Such health benefits are associated with greater personal fulfilment, well-being, capacity, and functionality throughout life; goals that benefit both the individual and the collective society.

7.7 *The Scope of the Model*

In developing the model, a balance was struck between simplicity and complexity; hence, the new framework (see Figure 7.1) is delimited in several respects. For example, ambient noise, the presence of co-actors, and televisual images might have been added as inputs but were omitted. In terms of information processing, the introduction of additional stimuli is significant because the channel capacity of attention is limited (see Rejeski, 1985). Consequently, music would have to compete with televisual pictures in addition to the physical sensations of fatigue.

A feedback loop between exercise adherence and personal factors would have indicated that increased exercise adherence influences personal characteristics such as the trained status of the participant. Further, the model does not account for the possibility of non task-related behaviour (see Section 7.5), the *direct* influence of personal factors upon exercise adherence, and other extensions and relationships that might have been depicted within the model. Nevertheless, the model is intended to specify the most salient concepts at hand much like a map that details only geographical features of note rather than insignificant minutiae.

7.8 *Terminological Issues*

The usage of the term ‘motivational’ music may be questioned on two counts. First, motivational music is defined as having three psychophysical consequences (i.e., improved mood, reduced RPE, arousal control). However, these responses may operate independently of each other. For example, Tenenbaum et al. (in press) and Mann (1979) have discussed the distraction and motivation functions of music during physical activity as discrete responses. Further, the possibility has arisen that music may motivate without improving affect (see Section 6.7) or distracting (see Section 4.5.3). Second, the definition of motivational music offered by Karageorghis et al. (1999) leans heavily on Gaston's (1951) definition of stimulative music (see Section 5.9).

Despite the concerns acknowledged above, exercise participants favour and readily comprehend the term 'motivational', when applied to music (see Section 4.5.3); hence, such terminology possesses external validity. Nevertheless, the terminological issues outlined in the previous paragraph need to be addressed. The new model does not predict the effects of motivational music owing to the fact that the precise psychophysical consequences of motivational music have yet to be clearly established. *Motivational music* is defined as that which induces a psychophysical state, which contributes to an individual's decision to increase the intensity and / or the duration of their physical effort. From a theoretical standpoint (e.g., Vallerand, 1997), music promotes situational intrinsic motivation. However, music may exert additional effects that are not necessarily synonymous with heightened motivation, such as the elevation of mood, a synchronisation effect, and the reduction of RPE. Nevertheless, it appears that motivational music typically heightens levels of physiological and / or psychological activation.

7.9 *General Discussion and Conclusions*

The various findings and conclusions that have permeated the review of literature and research programme were synthesised through the development of the new conceptual framework. However, further reconciliation of these themes is warranted. The qualitative methods utilised in the first two studies of the programme yielded novel information pertaining to the characteristics and effects of motivational music from the perspectives of exercise participants. The role of musical rhythm in increasing activation was emphasised in apposition to its function in terms of eliciting a synchronisation effect. In addition, the volume-level of the music was identified as a stimulative property. The significance of factors relating to the music programme as a whole, such as variety and choice, was underlined. Further, music television was identified as a previously under-researched topic of conceptual interest.

Music was found to serve varying purposes across different modes of exercise (e.g., cardio-vascular and resistance training). In relation to personal factors, the importance of age in determining reactivity to music in exercise settings was established. However, further research is warranted to clarify the importance of sex in determining the motivational response to music during physical activity. Concerning the trained status of exercise participants, those who exercise at high intensities may exhibit a tendency to utilise music for a motivational purpose, whereas individuals who exercise recreationally at a low intensity may merely seek a pleasant distraction from the monotony of their training tasks. Hence, a pertinent future avenue of qualitative investigation would be the differences in the response to music during exercise between those demonstrating high and low adherence. The findings emanating from such research would assist practitioners in maximising the benefits of motivational music in the interests of public health.

The cognitive effects of motivational music have not received extensive attention from researchers. The subtlety of the qualitative approaches that were utilised during the inaugural study of the present programme precipitated information relating to the experience of the motivational response to music during exercise. Specifically, music was found to promote increases in self-confidence and the belief that the demands of the task were surmountable, thereby empowering exercise participants. Notably, participants reported co-ordinating bouts of heightened effort with segments of musical pieces that they perceived as especially motivational. Thus, the response to motivational music may be localised. In concordance with Karageorghis’ (1998) proposition, the interview data included information pertaining to the propensity of music to act as a unifier in exercise environments thereby fulfilling a socialising purpose as noted by Martin (1997) in the context of aerobics classes. Moreover, the responses to music in a physical activity setting may become conditioned over time in that the motivational response elicited by a certain piece of music is liable to intensify over repeated listenings. This tendency may prove particularly beneficial for exercise-to-music leaders such as aerobics teachers.

The programme contributed a psychometric instrument that can be used to rate the motivational qualities of music for exercise – the BMRI-2. This instrument represents a considerable improvement on its predecessor, the BMRI, in terms of its psychometric properties. In particular, several issues pertaining to the face validity of the original instrument were resolved. The BMRI-2 will serve both exercise leaders and researchers as a resource to facilitate the standardised rating of musical selections. The item-structure of the BMRI-2 emphasised the salience of rhythm response, thus underlining the findings that arose from the first two studies of the research programme.

Music is more likely to elicit motivational effects in externally-valid settings, in which exercise participants regulate the intensity and duration of their own exercise (see Sections 3.5 & 4.5.7), as opposed to experimental settings, where exercise intensity is typically standardised (e.g., Tenenbaum et al., in press). Indeed, the effects of music are typically too subtle to be meaningfully investigated under tightly controlled laboratory conditions. In order to exert the proposed benefits on exercise adherence and public health, motivational music must be shown to yield effects in gymnasium settings, where a plethora of confounding variables obtain, rather than in laboratories. The dearth of naturalistic music research in physical activity contexts (see Pates et al., 2003) was addressed in the final study of the research programme. This study demonstrated that carefully selected motivational music increased the time spent in a gymnasium setting when compared to the typical musical output provided by the facility. Contrary to expectations, the music conditions failed to differentially influence affective responses. This finding lent credence to an argument that was developed in the discussion sections of the precedent chapters; namely, that the motivation, distraction, stimulation (activation), and affective functions of music during physical activity may operate differentially rather than in a unitary fashion. Hence, music may motivate exercise participants without necessarily improving their affective states.

In terms of motivation theory, music may promote situational motivation and thus lead to an increase in contextual motivation within the exercise setting (see Vallerand, 1997). Further, the effects of music on motivation appear to be particularly relevant to intrinsic motivation (see Deci & Ryan, 1985). Indeed, there is accumulating evidence to support the assertion that music facilitates the experience of flow during exercise (see Section 2.7.6.3); a state that is considered to be the apotheosis of intrinsic motivation (Pates et al., 2003). Whereas exercise behaviour may be motivated by various extrinsic factors such as health benefits and social desirability, the role of music in exercise settings does not appear to relate to extrinsic motivation.

Although the present thesis is set within the context of exercise rather than sport, the findings herein may generalise to sport environments. The boundary between sport training and exercise is indistinct. Indeed, in the context of the motivational effects of music, sport training may serve as a special case akin to intense, goal-orientated exercise. For example, what differentiates the *sports* of bodybuilding and powerlifting from the programmes of resistance exercise that males have traditionally engaged in for the purposes of increasing muscle mass?

Numerous directions for future research have been proposed throughout the thesis; however, several of these bear repeated emphasis. First, further research utilising qualitative methods may yield additional findings of conceptual interest and bolster those generated by experimenters. The suitability of qualitative modes of inquiry for the investigation of motivational music has been demonstrated. Second, naturalistic and applied research represents a particularly valid avenue for future investigations. The precedent for such research was established in the final study of the research programme. In particular, observational measures may be used to elucidate the precise effects of motivational music on the behaviour of exercise participants. Third, in deference to the ubiquity of music television in contemporary health clubs and gymnasia, research is warranted into the motivational impact of music when combined with televisual images. Fourth, as incipient technological advances alter the manner in which music is delivered, researchers should investigate equipment that facilitates the provision of musical choice for exercise participants. Fifth, research should be undertaken to establish the key differences (should they exist) between the motivational effects of music in sport and exercise settings. Sixth, musical properties may be manipulated in a precise manner to form experimental conditions. Global descriptors such as *motivational* music possess external validity; however, carefully controlled research to identify the effects of musical components such as tempo, rhythm, melody, and the presence of vocals is needed.

In summary, this programme of research has contributed a valid psychometric instrument to assess the motivational qualities of music in exercise settings, a re-developed conceptual framework to underpin future research, and inaugural evidence to suggest that music exerts motivational effects in applied exercise settings. Despite the original and significant contribution to knowledge made by the research programme, further research into the motivational effects of music in exercise and sport settings is warranted. The findings arising from such research may significantly impact upon the culture of both exercise and sport, thus furthering the immense benefit that these institutions bestow on humanity.

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9. APPENDICES

APPENDIX A

The Author's Publications During the Research Programme

Books

Priest, D. L. (2003). *Against the odds: A comprehensive guide to betting on horseracing*. Newbury, UK: Raceform.

Refereed Journal Articles

Priest, D. L., Karageorghis, C. I., & Sharp, N. C. C. (in press). The characteristics and effects of motivational music in exercise settings: The possible influence of gender, age, frequency of attendance, and time of attendance. *Journal of Sports Medicine and Physical Fitness*.

APPENDIX B

Member-check Document Delivered to Those who Participated (N = 13) in the First Study of the Research Programme

Dear Montgomery,

Many thanks for taking the time to share with me your perspectives on the use of music in exercise, I am very grateful. To complete the study I would like to feed-back the results and give everyone the opportunity to comment on the way I have analysed what was said during the interviews. The following is a brief summation of the main findings. There is a response sheet and an SAE for you to feedback any comments if you wish to. If you are interested to see the results in more detail then please let me know and I will send you more information.

Yours truly,

David-Lee Priest

Results

The transcripts of the interviews were broken down into meaningful quotes. I then grouped these quotes together with similar quotes to form *categories*, i.e., comments about rhythm were put into a ‘rhythm’ category. These categories were then amalgamated to form ‘groups’ of categories, for example, the ‘rhythm’ and ‘melody’ categories were put into the ‘music’ group, which contains categories that are to do with the music itself. Doing this enabled me to look at the relationships (similarities and differences) between the categories and groups. Here are the groups and categories with brief explanations:

The **MUSIC** group contains categories that relate to the music itself

Rhythm was considered to be the most important component of the music. Not only do people synchronise their gym activities with musical rhythm but it is also a highly stimulating factor in itself.

Generally speaking, the people I interviewed felt that ***tempo*** (the speed of the music) was an important factor. A fast tempo was considered motivating in a general sense, but ideally the tempo of the music should match the speed of the activity itself, i.e., a slow tempo is ideal if one is doing slow sit-ups with an emphasis on control.

Lyrics represented another important category; lyrics can prove highly motivating and were thought to be an important aspect of the music that I asked people to choose during the interviews. However, lyrics can also prove de-motivational for some, especially if they contain a message, which is offensive to that person's system of values, such as too much aggression or sexual references. Weighed against the above were several comments that, most of the time, lyrics did not matter or were superfluous.

There was a tendency for people to use *global* terms to refer to music they liked, for example, music of a particular ***style*** or ***idiom*** such as rock or house music. People also referred to the ***character*** of the music, its attitude or message.

The ***harmony*** and ***melody*** of the music were mentioned by some of the people that I spoke to. The fairly low number of comments about musical factors may have been due to confusion regarding the meaning of musical terms such as 'harmony' and 'melody' etc.

Familiarity with the music in question was felt to be a motivating factor, although it can operate in reverse, i.e., familiarity with a song you dislike can make it seem very annoying.

The ***artist*** performing the song was seen as another factor that can contribute to music's motivational qualities. Artists carry with them certain images and associations that can inspire. The ***voice*** of the artist was also highlighted by some of the people I interviewed. It was felt that the vocal element of a song can convey much in terms of 'attitude' or feeling and that this can prove motivational.

A piece of music consists of separate sections or ***segments*** (e.g., chorus, intro). Exercisers are aware of the ‘build-up’ inherent in a piece of music and may refer to favourite sections of the song that they find particularly motivational.

A particular song may become associated with a specific ***date or time*** (such as when a person was at college or leaving home) and this associations renders the song more motivating.

A music programme delivered in a gym should be characterised by ***Variety***. Furthermore, it was strongly emphasised, by one person in particular, that output such as MTV with more advertising and chat than music could prove highly de-motivating.

The ***bass*** aspect of the music attracted comments from several people. Generally, the ‘bass-line’ (a low-pitched melody) was suggested to be motivational. A pronounced bass seems to cause strong reactions. Some revelled in a strong, resonant beat whereas others found it oppressive. This was one of the clearest points of difference between the people that I talked to.

The **PERSON** group features categories that relate to the person themselves rather than the music, such as age, gender etc.

One of the most frequently referred to categories was a person’s general ***music preferences***. There was a difference of opinion in that some felt that it was motivational to listen to one’s favourite music whilst training whereas others preferred music especially for the gym, i.e., they liked to listen to music during exercise that they wouldn’t normally listen to outside of the gym. Another key category in the person group was the ***attitude to exercise***, a person’s goals and motivation to train appeared to affect their attitude to the music. For instance, a highly motivated sportsperson might look to certain types of music (loud music with a very pronounced beat) to stimulate them whereas people that undertake recreational exercise needed the music to make their workouts more interesting and help them to maintain their attendance.

Culture and upbringing also influenced the choice of music during exercise, but not always in a predictable fashion. Sometimes people reject the music of their cultural background and affiliate themselves with a completely different type of music. Socio-cultural factors associated with the music can also prove de-motivating and some individuals can be readily antagonised by a style of music that they feel no affiliation for, 'rap' and 'house' music were given as examples of this by a couple of the people I spoke to. Several individuals spoke of a preference for music, which reminded them of a particular time in their lives, normally when they were young. So, in this respect, ***age*** was a factor.

The **ENVIRONMENT** group consists of factors other than music which those who participated in the study felt affected them while they were exercising.

In general, the people I spoke to found it motivating to see ***television pictures*** as well as hear sounds, especially if the two were co-ordinated. However, others also felt that the lack of music present on some MTV output could be very de-motivating. An additional category, was the ***time of day***. There were several comments to suggest that music output should reflect people's moods and exercise goals at different times of the day and week. It was also suggested that different types of people attend gyms at different times of the day and hence the music output should vary accordingly. However, there were some contradictions; one individual suggested talk-radio in the mornings as a gentle start to the day, whereas another person preferred loud, strongly rhythmical music to accompany her morning workouts- the sort of music output that is generally found in the evenings.

The **STATE OF MIND AND BODY** group of categories refers to what is happening to the person listening to music during exercise; both mentally and physically.

There are several prominent categories within this group. A high number of comments were made about music affecting one's state of ***attention*** during exercise. For the majority of people, this means that music diverts attention away from exercise. However, some people said that music actually heightened their awareness of their physical endeavours, this was especially the case in resistance or sports training. Music can also affect ***perceptions of time***, making it appear to go faster. Music that is disliked can focus one's attention back on to the uncomfortable aspects of the exercise itself. The point was also raised that if music is too much of a distraction, then it might prove dangerous because one needs to pay a certain amount of attention to the exercise.

There were comments about reaching a ***higher mental state*** through exercising to music, this entailed 'flying', 'losing oneself' or 'floating'. Music certainly seems to have inspirational qualities, which can leave people more ***motivated*** to exercise. This inspiration was frequently found in the lyrics or the rhythm (beat) of the music. In this way, something about the music changes a person's attitude to the task they are attempting, they perceive it as less threatening and their own abilities as greater.

Music may improve ***mood*** during exercise as well; the whole experience of working out to music can lift one. To a certain extent, the exercise itself improves mood, but it was suggested to me that music is often the key to this. Music can also make you feel worse, normally through the frustration of having to listen to music you don't like. The knock-on effect of this is that if you are in a bad mood, you are likely to *perceive* other aspects of the exercise experience in a negative way, i.e., you are more likely to be dissatisfied with your workout and the facilities in the gym. Your mood state prior to working-out also affects your response to the music, i.e., if you are already feeling depressed or a bit flat then you might respond better to a different type of music than when you were feeling euphoric.

Music can increase ***arousal***, that is to say, music can stimulate you or 'psych' you up. It seems that this effect is closely allied to increased motivation. Music can also be used as a pacifier, to relax you whilst stretching for example.

There were a great many comments about music evoking ***associations***, normally of an event in one's life or a motivational image that has special personal significance. Several people remarked that music, which reminds you of socialising or having a good time, brings back those positive outgoing feelings, which are then translated into your approach to exercise. In fact, this type of response can become ***conditioned***, i.e., a particular song can become associated with certain feelings and just hearing the intro of that song stirs up a kind of excitement. There can also be a sort of ***expectancy*** that occurs when you anticipate your favourite section of the song- for example, a chorus or a rhythm that you really like. Often, such associations are accompanied by inspiring ***imagery***; various pictures in your head. Sometimes this imagery can relate to an event in one's life, whereas on other occasions it is abstract and fantastical.

Lastly, music can lead to ***physical sensations*** such as warmth, shivers in one's spine, or just the feeling of being stimulated and aroused (i.e., higher heart rate etc.)

The **CONSEQUENCES** group of categories refers to the behavioural outcomes of using music during exercise.

There were many comments suggesting that music can make you work ***harder*** or encourage you to exercise for ***longer***. Music can also have negative effects and it was suggested on a couple of occasions that the wrong music can lead to a person leaving the gym early. In terms of the larger picture of gym attendance and exercise adherence, it appears that the presence of music *might* encourage people to adhere to an exercise programme and one person told me that the wrong type of music might lead her to leave a gym.

IN GENERAL, the people I spoke to told me that music is very important when one is exercising. However, there were also several comments to the effect that you can make do without it. For some, music is a vital part of the exercise experience that they love, while others emphasised that you should come to the gym because you want to exercise, regardless of the music, "music is the icing on the cake". However, everyone felt that a lot could be done to improve music output in gyms and research like mine is therefore needed.

Responses

Maybe you disagree with the findings or have something to add……

APPENDIX C

The Brunel Music Rating Inventory (BMRI)

Direction: Very soon you will hear a series of musical selections. Imagine that you are selecting music for ………… (state activity; e.g. treadmill running) and the participants will be .... (state musical background; e.g. British pop music listeners) in the age range.......... (e.g. 20-25 years). [*Play the music now*]. Rate the piece of music you have just heard by indicating the extent each of the items below contributes to its motivational qualities. The term 'motivational qualities' refers to the extent to which the music inspires or stimulates physical activity. Rate each item on a scale from 1 (not at all motivating) to 10 (extremely motivating).

	Not at all motivating									*Extremely motivating*
1. Familiarity	1	2	3	4	5	6	7	8	9	10
2. Tempo (beat)	1	2	3	4	5	6	7	8	9	10
3. Rhythm	1	2	3	4	5	6	7	8	9	10
4. Lyrics related to physical activity	1	2	3	4	5	6	7	8	9	10
5. Association of music with sport	1	2	3	4	5	6	7	8	9	10
6. Chart success	1	2	3	4	5	6	7	8	9	10
7. Association of music with a film or video	1	2	3	4	5	6	7	8	9	10
8. The artist/s	1	2	3	4	5	6	7	8	9	10
9. Harmony	1	2	3	4	5	6	7	8	9	10
10. Melody	1	2	3	4	5	6	7	8	9	10
11. Stimulative qualities of music	1	2	3	4	5	6	7	8	9	10
12. Danceability	1	2	3	4	5	6	7	8	9	10
13. Date of release	1	2	3	4	5	6	7	8	9	10

Please use a separate sheet for each musical selection

APPENDIX D

The Brunel Music Rating Inventory-2 (BMRI-2): Initial 8-Item Version

Brunel Music Rating Inventory-2

Age: ________ years Gender: MALE FEMALE (please circle)

Ethnic background: ___________ (e.g., White UK/Irish, Afro-Caribbean, Asian etc.)

Title of musical selection: ______________________________________

The purpose of this questionnaire is to assess the extent to which the piece of music you are about to hear would motivate you during exercise. For our purposes, the word 'motivate' means music that would make you want to exercise harder and/or longer. As you listen to the piece of music, indicate the extent of your agreement with the statements listed below by circling one of the numbers to the right of each statement. We would like you to provide an honest response to each statement. Give the response that best represents your opinion and avoid dwelling for too long on any single statement.

Thank you for your assistance in our research.

Dr. Costas Karageorghis
Senior Lecturer, Department of Sport Sciences, Brunel University

Strongly disagree In-between Strongly agree

1	The rhythm of this music would motivate me during exercise	**1**	**2**	**3**	**4**	**5**	**6**	**7**
2	The style of this music (i.e., rock, dance, jazz, hip-hop, etc.) would motivate me during exercise	**1**	**2**	**3**	**4**	**5**	**6**	**7**
3	The vocals (singing) of this music would motivate me to exercise	**1**	**2**	**3**	**4**	**5**	**6**	**7**
4	The melody (tune) of this music would motivate during exercise	**1**	**2**	**3**	**4**	**5**	**6**	**7**
5	The tempo (speed) of this music would motivate during exercise	**1**	**2**	**3**	**4**	**5**	**6**	**7**
6	The sound of the instruments used (i.e., guitar, synthesizer, saxophone, etc.) would motivate me during exercise	**1**	**2**	**3**	**4**	**5**	**6**	**7**
7	The lyrics (words) accompanying this music would motivate me to exercise	**1**	**2**	**3**	**4**	**5**	**6**	**7**
8	The beat of this music would motivate me during exercise	**1**	**2**	**3**	**4**	**5**	**6**	**7**

APPENDIX E

The Brunel Music Rating Inventory-2 (BMRI): Final 6-Item Version [1]

Age: ________ years Gender: MALE FEMALE (please circle)

Ethnic background: ___________ (e.g., White UK/Irish, Afro-Caribbean, Asian etc.)

Brunel Music Rating Inventory-2

Title of musical selection: _______________________________________

The purpose of this questionnaire is to assess the extent to which the piece of music you are about to hear would motivate you during exercise. For our purposes, the word 'motivate' means music that would make you want to exercise harder and/or longer. As you listen to the piece of music, indicate the extent of your agreement with the statements listed below by circling one of the numbers to the right of each statement. We would like you to provide an honest response to each statement. Give the response that best represents your opinion and avoid dwelling for too long on any single statement.

Thank you for your assistance in our research.

Dr. Costas Karageorghis
Senior Lecturer, Department of Sport Sciences, Brunel University

Strongly disagree In-between Strongly agree

1	The rhythm of this music would motivate me during exercise	**1**	**2**	**3**	**4**	**5**	**6**	**7**
2	The style of this music (i.e., rock, dance, jazz, hip-hop, etc.) would motivate me during exercise	**1**	**2**	**3**	**4**	**5**	**6**	**7**
3	The melody (tune) of this music would motivate during exercise	**1**	**2**	**3**	**4**	**5**	**6**	**7**
4	The tempo (speed) of this music would motivate during exercise	**1**	**2**	**3**	**4**	**5**	**6**	**7**
5	The sound of the instruments used (i.e., guitar, synthesizer, saxophone, etc.) would motivate me during exercise	**1**	**2**	**3**	**4**	**5**	**6**	**7**
6	The beat of this music would motivate me during exercise	**1**	**2**	**3**	**4**	**5**	**6**	**7**

[1] This inventory is not to be used or reproduced without the written permission of David-Lee Priest or his first supervisor, Dr. Costas Karageorghis, Brunel University, West London, UK.

APPENDIX F

Personal E-mail Communication With Dr. Adrian North;

Received 06 May 2003, 10:22

Hi,

No, the fast music did not lead to people spending longer in the gym. Indeed this was one of the things we looked but found nothing. Hope this helps.

All the best,

Adrian

Adrian North
School of Psychology
University of Leicester
University Road
Leicester LE1 7RH
United Kingdom
Tel: +44 (0)116 252 2175
Fax: +44 (0)116 252 2067
Email: ACN5@LE.AC.UK
Internet: http://www.le.ac.uk/psychology/acn5/acn.html

-----Original Message-----
From: David-Lee Priest [mailto:davidlee.priest@btinternet.com]
Sent: 03 May 2003 20:05
To: acn5@leicester.ac.uk
Subject: Paper with David Hargreaves and Sarah Heath

Dear Adrian,

I am PhD Psych. Student from Brunel Uni.

You authored a paper in 98 with David Hargreaves and Sarah Heath regarding music tempo and time perception in a gymnasium

Although the information is not in the paper, I wondered if the fast-music condition actually led the participants to spend longer in the gym than the slow-music condition and whether the difference (if there was any) was significant.

If you have this info I would be extremely interested, if not I will assume that you are very busy (I know how it is!)

Many thanks

David-Lee Priest

APPENDIX G

Specimen Letter to a Music Publisher to Obtain Permission for the Editing and Delivery of the Music Used in the Final Study of the Research Programme

David-Lee Priest
c/o Dr. C. Karageorghis
Brunel University
Uxbridge
Middlesex
UB8 3PH

August 17, 2002

Dear Sir or Madam,

I am a final-year sport sciences postgraduate at Brunel University. My thesis relates to the motivational effects of music in exercise settings. As part of the research that I will undertake to fulfil the requirements of my degree, I intend to develop a questionnaire to rate the motivational qualities of music. In order to do this, I will need to organise a rating session in which a small group of six researchers will listen to 60-second segments of several pieces of music and then rate them according to their motivational qualities. Hence, **I am writing for permission to copy a segment of the recording 'Fame' by *Irene Cara* onto a compact-disc** that will be used during the rating session. I already own a recording of 'Fame', which I have purchased myself. Furthermore, the copied CD will be destroyed following the rating session and hence not used in any public performance, lent, hired, sold, or disseminated in any other way. As I am sure that you are very busy, I will take it, should no response be forthcoming, that you have ascended to my request. However, should this *not* be the case then please respond using the contact details that I have provided. Thank-you kindly for your attention in this matter.

Yours in music,

David-Lee Priest, B.Sc. (Hons.)
Email: davidlee.priest@btinternet.com

APPENDIX H

Specimen E-mail Enquiry Relating to the Pre- and Post-task Measurement of Affect Using a Single Item

Dear Apu,

I hope that you are well. I am currently running a research project in which the effects of motivational music will be tested in vivo within a chain of large health clubs. I am searching for ideally a single-item measure that we can use to assess affect both pre- and post-exercise (not immediately post). In this way, we will be able to determine the relative effects of the motivational music condition and the control condition on the affective state of the participants in the study.

Clearly, Rejeski's (1989) scale was not designed for this exact purpose although it does give a Gestalt measure. I would be extremely grateful if you could suggest an appropriate item or small number of items that would be suitable for the assessment of affect in this context. The PANAS would take too long as I have no more than 30 seconds with each customer and want to eventually publish the work - this is the essence of the problem! It would be particularly helpful if there was a published study which we could make reference to when reporting our decision to select the item(s) in question. I have contacted you because I am aware of your excellent track record in this area. Thank you for your kind attention to this matter.

Sincerely,

David-Lee Priest

APPENDIX I

Programming Code (Macro) Used to Calculate Power for the ANOVA Design Used in the Final Study of the Research Programme

Programme Name: FPOWER.SAS
Title: Power computations for ANOVA designs
Web: http://www.math.yorku.ca/SCS/sasmac/fpower.html
Retrieved: 27 May 2003 22:54
Author: Michael Friendly
Created: 14 March 1990 11:16
Revised: 24 March 1995 21:06
Version: 1.2

This MACRO computes power of an F-test for main effects for one- or two-way layouts with or without repeated measures, assuming main effects are fixed. The alternative used is a minimum power alternative. Actually, the program can be used for ANY fixed effect in ANY crossed factorial design, by designating the levels of the effect of interest as A, and the levels of all other crossed factors as B.

The "effect size" is specified by DELTA. Assuming that only the extreme factor levels have NON-ZERO effects, and

T1 = GM - DELTA/2
Tk = GM + DELTA/2

where DELTA is specified in units of SIGMA = SQRT(MSE)

The intraclass correlation (RHO) is assumed to be positive and constant across all repeated measures. The macro variable N provides:

DO-list of sample sizes to calculate power for.

An output dataset named PWRTABLE is created for plotting or saving, and it contains an observation for each entry.

MACRO CODE:

```
options nonotes;
* Define output format for small & and large probabilities;
Proc format;
  picture PROBS  /*  .99901 - 1.0000  ='  >.999'
                 0.0000 - 0.00089 ='  <.001'  */
                    other   ='  9.999';


%MACRO FPOWER(
    A=,         /* Levels of factor for power calculation */
    B=1,        /* Levels of crossed factor B (default=1) */
    C=1,        /* Levels of crossed factor C (default=1) */
             /* For >3 factors, make C=product of # of */
             /*  levels of factors D, E, etc.          */
    R=1,        /* Levels of repeated measure factor      */
    ALPHA=.05,  /* Significance level of test of factor A */
    N =%str( 2 to 10 by 1, 12 to 18 by 2,  20 to 40 by 5, 50),
    DELTA=.50 to 2.5 by 0.25,  /* DO list of DELTA values */
    RHO=0,      /* Intraclass correlation for repeated    */
             /*   measures (DO list of values)         */
    PTABLE=YES, /* Print a power table?                   */
    PLOT=NO,    /* Plot power*delta=N ?                   */
    NTABLE=NO,  /* Print a sample-size table ?            */
    OUT=PWRTABLE
             );
```

```
%if &A=%str() %then %do;
   %put ERROR : You must specify a value for A= in the macro call;
   %goto DONE;
   %end;

%let pfile = print;
%if %upcase(&PTABLE) ^=YES %then %do;
          %if &sysscp = WIN
                    %then %str(filename ptable DUMMY 'nul:';);
                    %else %str(filename ptable DUMMY '/dev/null';);
          %let pfile = ptable;
          %end;

data &out;;
    length A B C R N TRTDF 3;
    drop fcrit ncol nalpha;

    A = &A;
    B = &B;
    C = &C;
    R = &R;

    do ALPHA = &ALPHA;
    nalpha+1;
    file &pfile;

    TRTDF = (A-1);         *-- Treatment degrees of freedom--;

        *-- Iterate thru RHO values supplied in RHOs    --;
        *   If not repeated measures design, stop after   ;
        *   one iteration.                                ;

    do RHO = &RHO;                  *-- Get macro values;
        put _PAGE_;
        put @5 A 2. 'x' B 2. @;
        if C>1 then put 'x' C 2. @;
        put +2 ' layout Ha: T1=GM-Delta/2, T2=T3=...=T(k-1)'
           '=GM,  Tk=GM+Delta/2'  +3 'tested at Alpha=' ALPHA 6.3;

        if R>1 then put @10 'with' R 2.0
           ' Repeated measures and intraclass RHO = ' RHO 4.2 ;
        else put ;
        put @20 'DELTA (in units of sigma=Std. Dev.)'// @7 'N' @;

        do DELTA = &DELTA;           *-- Get macro values;

            put DELTA 7.3 @;
            end;
        put;
        ncol = 0;
        do DELTA = &DELTA;
          ncol = ncol+1;
          put '-------' @;
          end;
        put '-------';

        *-- Iterate through sample sizes --;

        do N = &N;            *-- Get macro values;
```

```
            put / N 7.0 @;

            *-- Compute error degrees of freedom & F crit --;
            errdf = (a * b * c * (n-1));
            fcrit = finv (1-alpha, trtdf, errdf, 0);

            *-- Iterate through values of DELTA --;
            do DELTA = &DELTA;

               *-- Compute non-centrality parameter, & power --;

               NC = N * B * C * R * DELTA**2/ (2*(1+(R-1)*RHO));
               if NC > 140 then POWER = 1;
               else POWER = 1 - probf(FCRIT, TRTDF, ERRDF, NC);

               put POWER PROBS. @;
               output;
               end;    *-- Do DELTA;
             end;   *-- Do N;

             *-- Exit loop if not repeated measures;
             if R=1 then STOP;
          end;   *-- do RHO;
        end;  *-- do ALPHA;
  call symput(nalpha,put(nalpha,2.));
run;
  %if %upcase(&PLOT)=YES %then %do;
  proc plot data=&out;
    plot POWER * DELTA = N /vaxis = 0 to 1 by .1 vref=1;
    title2 'Power as a function of Effect Size (DELTA) and N';
    run;
  %end;

  %if %upcase(&NTABLE)=YES %then %do;
  data _ntable_;
    set &out;
    drop a b c r rho errdf nc trtdf;
    where (power>=.5);
    power = min(power,.9999);
*     pwr = round(power,.05);
                 pwr = .1 * floor(10*power);
  proc sort;
    by alpha pwr delta n;
  *-- Find the smallest n for given power, delta;
  data _ntable_;
    set _ntable_;
    by alpha pwr delta n;
    if first.delta then output;
  /*
  proc print data=_ntable_;
    id pwr;
    by pwr;
    var delta alpha n power;
  */
  proc tabulate;
    class pwr delta;
    var n;
    table pwr='Power',
        delta*n=' '*f=5.*sum=' ' / rts=9;
```

```
   format n 3.;
   title2 "Sample size to achive a given power, alpha= &alpha";
   run;
   %end;
%DONE:
options notes;
%mend FPOWER;
```