Effects of Exercise and Music on Psychological Well-Being and Exercise Performance

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Effects of Exercise and Music on Psychological Well-Being and Exercise Performance

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…a coloro che hanno condiviso il mio cammino!

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The following thesis is based on the following original publications, which will be referred to in the text as Studies 1, and 2 (See Appendix):

ORIGINAL ARTICLE

1) **MACONE, D.**, BALDARI, C., ZELLI, A., GUIDETTI, L. (2006) Music physical activity in psychological well-being. *Perceptual and Motor Skills*, 103(1), 285-95.
2) BALDARI, C., **MACONE, D.**, BONAVOLONTÀ, V., GUIDETTI, L. (2010) Effect of music during exercise in different Training status. *Journal of Sport Medicine and Physical Fitness*, 2010, 50(3), 281-287.

PROCEEDING

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ABSTRACTS

The present thesis examined the effects of listening to music during treadmill running on mood, state anxiety, and time of running considering gender as well as fitness-level differences. To evaluate these topics the present study was divided in two separate investigations.

1st study aim: Examined how music and exercise together might affect mood and state anxiety, compared to exercise alone. The possible music-plus-exercise effects on time to exhaustion was considered. Possible gender differences was also assessed.

Methods: Fourteen men and 13 women completed the Profile of Mood State and the State Anxiety Inventory before and after treadmill running in Music and No- Music conditions. Participants exercised at 75% of their Heart Rate Reserve until voluntary exhaustion. Music and No-Music condition were randomly assigned, the opposite music condition was administered about one week later.

Results: First study's results indicated participants reported statistically significant mean changes on Tension, Depression, Fatigue, Confusion, and State Anxiety after exercise. However, the findings for emotion yielded no significant effects of music. The analysis also showed that women exercised longer in presence of music compared to no-music condition while men did not.

Discussion: Overall this study showed that exercise can yield psychological benefits both in males and females, even though music did not contribute to enhance this effects. On the other hand, music contribute to prolong exercise in females, suggesting that they may profit more of beneficial effects of music during treadmill running.

2nd study aim: Assessed the effects of listening to music during exercise on state-anxiety and time to exhaustion comparing two groups with different training status namely trained vs. active.

Methods: Each participants completed the Profile of Mood State and/or the State Anxiety Inventory before and after treadmill running in Music and No- Music conditions. Participants exercised at 75% of their Heart Rate Reserve and a RPE on the Borg scale at about 13, until voluntary exhaustion. and Music and No-Music condition were randomly assigned. The opposite music condition was administered about one week later.

Results: Second study's results showed that both trained and active groups significantly reduced their State-Anxiety scores after exercise tasks independently by the presence of music. Finding also revealed that active group reported a higher significant reduction of their state anxiety score after exercise in music condition compared to no-music task , while this effect in trained group was not significant. Moreover, data showed that only active-subjects significantly prolonged their exercise experience in presence of music, while trained group did not.

Discussion: This study supports the general finding that exercise is associated with state-anxiety reduction, and suggests that music during exercise may improve this effect in active but not in trained participants. Further, listening to music during exercise may prolong the participants' exercise experience but different training status seems to qualify differently this response.

Overall Conclusion: In accordance with several international researches, the main finding the current studies revealed that physical activity improve mental health enhancing mood experience, and reducing state anxiety. Also emerged that music improved the time of exercising even though this effect was evident in female and in active participants.

FOREWORD

There has been, in the last decades, a growing interest in research on the contribution of physical exercise to the alleviation of the problem of mental discomfort. (LaFontaine, DiLorenzo, Frensch, Stucky-Ropp, Bargman, & McDonald, 1992; Karageorghis & Terry, 1997 for reviews U.S. Department of Health and Human Service, 1996; Morgan, 1997 for reviews). Findings have indicated that psychological states such as feeling better, having less anxiety, less depression, more self-confidence, and more vigour, are associated with participation in exercise (Martinsen, 1993; Plante, 1993; Landers & Petruzzello, 1994; Craft & Landers, 1998).

Several studies have investigated the influence of the music on affect and state anxiety in healthful and clinical condition (Luccacini & Kreit, 1972; Burns, Labbe, Arke, Capeless, Cooksey, Steadman, & Gonzales, 2002; Chan, Lee, Ng, Ngan, & Wong, 2003; Tornek, Field, Hernandez-Reif, Diego, & Jones, 2003). A general agreement exits on the effect of exposure to music on mood states, namely, that the exposure to music may reduce anxiety and induce positive changes on one’s mood (Karageorghis, et. al., 1997; Sousou, 1997).

Researchers have also evaluated the properties of music to prolong exercise and physical activity. On this concern, music has been recommended as a technique to enhance the psychophysical state of participants during sport and exercise (Karageorghis, & Terry, 1997) by improving exercise performance (Kirby, Murphy, 2003), aerobic endurance (Szmedra, & Bacharach, 1998; Copelan et al., 1991) and enhancing the exercise experiences and adherence (Potteiger 2000). On this issue Brownley, McMurray , and Hackney (1995) claimed that participant's profile, (e.g. fitness status) has emerged as putative determinant of the direction and magnitude of music effects in exercise setting.

Although many studies have examined the effects of either physical activity or music on mood, few studies have evaluated the effects of listening music during exercise (music-plus-exercise) on psychological variables compared to exercise alone (see Karageorghis & Terry, 1997 for a review). Gender differences on this topic has been also rarely investigated and results are yet controversial. Further, the effects of listening to music on state anxiety and time to exhaustion comparing different fitness status is a field less explored yet.

From such above mentioned, the present study was divided in two separate investigations. The 1st study examined how music and exercise together might affect mood and state anxiety, compared to exercise alone. This study also considered the possible music-plus-exercise effects on time to exhaustion during moderate exercise intensity and evaluated the extent to which any experimental effect varied with gender. The 2nd investigation assessed the effects of listening to music during exercise on state-anxiety and time to exhaustion comparing two groups with different training status namely trained vs. active.

***P*REMESSA**

Negli ultimi anni, la comunità scientifica ha guardato con grande interesse al contributo che l'attività fisica e lo sport possono offrire nel mantenere e/o incrementare il benessere psicologico (LaFontaine, DiLorenzo, Frensch, Stucky-Ropp, Bargman, & McDonald, 1992; Karageorghis & Terry, 1997 for reviews U.S. Department of Health and Human Service, 1996; Morgan, 1997 for reviews). I risultati più incoraggianti hanno dimostrato che l'esercizio fisico è positivamente correlato al benessere psicologico potendo, ad esempio, ridurre l'ansia, e la depressione (Martinsen, 1993; Plante, 1993; Landers & Petruzzello, 1994; Craft & Landers, 1998).

Gli effetti dell'ascolto della musica sull'umore a sull'ansia dell'uditore è un'altra tematica che ha richiamato l'attenzione degli studiosi i quali sono pressoché in accordo sul principio generale che l'esposizione alla musica può ridurre i livelli di ansia e può indurre effetti positivi sullo stato dell'umore (Luccacini & Kreit, 1972; Burns, Labbe, Arke, Capeless, Cooksey, Steadman, & Gonzales, 2002; Chan, Lee, Ng, Ngan, & Wong, 2003; Tornek, Field, Hernandez-Reif, Diego, & Jones, 2003).

Ricercatori hanno anche valutato le proprietà e gli effetti dell'ascolto della musica durante l'attività fisica. A riguardo è stato suggerito che ascoltare musica durante l'esercizio fisico può essere d'aiuto al fine di migliorare la condizione psico-fisica dei partecipanti (Karageorghis, & Terry, 1997), può incrementare le prestazioni (Kirby, Murphy, 2003), la resistenza aerobica (Szmedra, Bacharach, 1998; Copelan et al., 1991), e la partecipazione/adesione all'attività fisica e sportiva (Potteiger 2000). Su tale tematica Brownley et al., (1995) hanno sottolineato come il profilo dei partecipanti (ad esempio il livello di fitness) sia un fattore che può condizionare gli effetti dell'ascolto della musica durante l'esercizio fisico.

Sebbene numerosi studi abbiano valutato gli effetti dell'esercizio o della musica su parametri psicologici, pochi di questi hanno considerato gli effetti della musica durante esercizio sul benessere psicologico in comparazione con gli effetti legati esclusivamente all'attività fisica (Karageorghis & Terry, 1997). I possibili effetti legati alla differenza di genere è, inoltre, un fattore raramente preso in considerazione e a riguardo i risultati sono ancore controversi. Inoltre, gli effetti dell'ascolto musicale sull'ansia di stato e la durata della prestazione comparando soggetti con diversi livelli di allenamento è un settore ancora poco esplorato.

Da quanto fino ad ora esposto, il presente lavoro è stato diviso in due studi separati. Nel primo studio viene esaminato come l'esercizio con accompagnamento musicale possa influenzare lo stato dell'umore e l'ansia di stato comparando i dati con quelli relativi all'esercizio senza accompagnamento musicale. Questo primo studio prende in considerazione anche gli effetti della musica sul tempo di esaurimento all'esercizio fisico nelle due condizioni sperimentali (esercizio con e senza musica) e gli eventuali effetti che possono essere legati alla differenza di genere.

Il secondo studio valuta gli effetti della musica durante esercizio fisico sull'ansia di stato e sul tempo di esaurimento all'esercizio fisico comparando due diversi gruppi di soggetti aventi un differente livello di allenamento (Allenati vs. Attivi).

CHAPTER 1

1.1 TRENDS OF PHYSICAL INACTIVITY: RISKS FOR HEALTH

It is widely accepted that physical inactivity and sedentary behaviour dramatically enhance the risk of death and chronic diseases of new generations (ACSM, 2006). In the U.S., it has been estimated that inactivity results in one-third of all deaths from CHD, colon cancer and diabetes (Powell & Blair, 1994). Meta-analyses (Powel, Thompson, Caspersen, and Kendrik, 1987) have further indicated that sedentary life seriously increases disease and premature death. In particular, the World Health Organization (WHO, 2003), estimates that physical inactivity cause 1.9 million deaths globally. Moreover, physical inactivity causes globally, about 10-16% of cases of breast cancer, colon and rectal cancers and diabetes mellitus, and about 22% of ischemic heart disease. The risk of getting a cardiovascular disease increases up to 1.5 times in people who do not follow minimum physical activity recommendations (WHO, 2003). These date dramatically enhance considering that physical inactivity is closely related to other risks factors such as poor diet tobacco and alcohol consumption. "Unless addressed, the mortality and disease burden from these health problems will continue to increase. WHO (2008), projects that, globally, NCD (Non-communicable Diseases) deaths will increase by 17% over the next ten years. The greatest increase will be seen in the African region (27%) and the Eastern Mediterranean region (25%). The highest absolute number of deaths will occur in the Western Pacifi c and South-East Asia regions" (WHO 2008). On the other hand, there is now worldwide acceptance among scientific authorities that physical activity is an important element of healthy living. Scientific evidence (American College of Sport Medicine, 1978, 1990, 2006) has indicated that regular physical activity and sports provide people of all ages and conditions, with a wide range of physical, social, and mental health benefits. Specifically, it has been demonstrated that physical activity and exercise prevent and reduce the incidence of stroke, cardiac events, hypertension, type2 diabetes mellitus, colon and breast cancer osteoporosis, and delay mortality (ACSM, 2006). Additionally to the above mentioned benefits, being physically active also has social and mental health benefits (i.e. depression and anxiety reduction) (WHO, 2004).

Taking into account all different causes of death, moderate to high physical fitness has been associated with lower mortality, whereas low level of fitness with higher mortality. Higher levels of activity and fitness are protective factors in older as well as in younger populations. In recent longitudinal studies, people who become fitter over time reduced their risks of mortality in comparison with those who remain within low levels of fitness (Dubbert, 2002). This holds true from middle age to older age, indicating that “it is never too late to became physically active to achieve health benefit” (ACSM, 2006). Physical activity, also interacts positively with strategies to reduce caloric excess, discourage the use of tobacco, alcohol, help to reduce violence, enhances functional capacity, and promote social interaction and integration (WHO, 2003).

Despite this wealth of evidence, data show that more than 60% of adults do not engage in sufficient levels of physical activity to ensure health benefits (Centers for Disease Control and Prevention, 2005). Physical inactivity is more prevalent among women, older adults, individuals from low socio-economic groups, and the disabled (WHO, 2003). Physical activity also decreases with age during adolescence, and this decline continues throughout the adult years (Pratt, Macera, Blanton, 1999). In many countries, less than one-third of young people are sufficiently active to benefit from their present and future health and female adolescents are less active than male adolescents (Pratt, et al., 1999). This is related in part to lack of physical activity during leisure time, but is even more likely the result of people spending an increasing amount of time in sedentary behaviour such as watching television, using computer, and excessive use of “passive” modes of transport (i.e. cars, buses) (Centers for Disease Control and Prevention, 2005).

Health promotion is, hence, an emerging field of action in public health in developed and developing countries. Given the health, economic, and social benefit of physical activity and the high costs of inactivity, it is time for urgent action to be taken in order to integrate physical activity promotion in health and social development strategies, policies, and programmes world wide (WHO, 2003).

1.2 - HEALTH AND PHYSICAL ACTIVITY: DEFINITIONS AND MODELS

"Health" can refer both to absent and present states. It is often used to mean the absence of disease or disability, but just as often, health may refer to a state of fitness and ability (Naidoo & Wills, 2000). People with different backgrounds and cultures may hold different conceptions of health. When lay people describe what it means to be healthy, their responses reflect often the particular circumstances of their lives. Under some circumstances, they equate health with freedom from disease; in others, they equate health with autonomy or with vitality. Older people, for example, tend to define health as inner strength and the ability to cope with life 's challenges; younger people tend to emphasize the importance of fitness, energy, and strength. People with comfortable living conditions tend to think of health in the context of enjoying life; people not so well-off tend to connect health with managing the essentials of daily living (WHO, 2004).

The World Health Organization defines health as “a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity” (WHO, 2003) and there is now a world-wide acceptance among medical authorities that physical activity is an important element of healthy living (ACSM, 1990, 2006).

In the 1990s, the American College of Sport Medicine published new recommendations that could be realistically achieved: “every U.S. adult should accumulate 30 min. or more of moderate physical activity every day of the week” (Pate, Pratt, Blair, Haskell, Macera, Bouchard, et al., 1995). However, while several investigations have been conducted around the impact of exercise on reducing the risk of *physical health* problems such as CHD, cancer, obesity, diabetes, much less attention has been paid to the contribution of exercise for the prevention and treatment of the increasingly burgeoning problem of mental disorder, illness, and general mental discomfort (Fox, Boutcher, Faulkner, and Biddle, 2001).

1.3 - INCREASING BURDEN OF MENTAL DISORDERS

In the last decades, mental discomforts and poor mental well-being affect populations in considerable ways. On this concern, the WHO (2001) have shown that, today, some 450 million people suffer from a mental or behavioural disorder. Surveys conducted in developed as well as developing countries have shown that, during their entire lifetime, more than 25% of individuals develop one or more mental or behavioural disorders (Almeida-Filho, Mari Jde, Coutinho, Franca, Fernandes et al., 1997; Regier, Boyd, Burke, Rae, Myers, et al., 1988). Klerman & Weissmann (1992), showed that psychiatric disorders, such as depression, affect 5-10% of people in developed countries, with some estimates suggests that 20% of the population will be affected by "depressive disorders" at one time in their lives (Richards, Musser, & Gershon, 1999). In Europe, data suggests that depression causes 6% of the burden of all diseases in terms of disability adjusted life years (DALYs). Specifically, in 28 countries with a population of 466 million, at least 21 million were affected by depression (Sobocki, Jonsson, Angst, Rehnberg, 2006).

Table 1-1. Disease burden by selected illness categories in established market economies, 1990

	Percent of Total DALYs*
All cardiovascular conditions	18.6
All mental illness**	15.4
All malignant diseases (cancer)	15.0
All respiratory conditions	4.8
All alcohol use	4.7
All infectious and parasitic diseases	2.8
All drug use	1.5

*Disability-adjusted life year (DALY) is a measure that expresses years of life lost to premature death and years lived with a disability of specified severity and duration (Murray & Lopez, 1996).
**Disease burden associated with "mental illness" includes suicide.

Source: Murray & Lopez, 1996.

In the United States, mental disorders collectively account for more than 15 percent of the overall burden of disease from all causes and slightly more than the burden associated with all forms of cancer (Murray & Lopez, 1996). In 1999s the U.S. Dept. of Health and Human Service revealed that prevalence of mental disorders is about 21 percent of adults and children (DHHS, 1999). Projections for the year 2020 indicate that Major Depressive Disorder (MDD) will be second only to coronary heart disease as a cause of illness burden worldwide (Murray & Lopez, 1997).

The most prevalent mental disorders are depression, chronic anxiety, low self-esteem (WHO, 2003) and such disorders commonly occur together (World Health Report, 2001). This co-morbidity is found among about half of all the individuals with these disorders (Zimmerman, McDermut, Mattia, 2000). Anxiety, depression, and schizophrenia, particularly, present special problems contribute to the high rates of suicide in this population (U.S. Department of Health and Human Services, 1999).

Hence, mental health problems and illnesses are real and disabling conditions that are experienced by one in five Americans. Left untreated, mental illnesses can result in disability and despair for families, schools, communities, and the workplace. This toll is more than any society can afford. (U.S. Department of Health and Human Services, 1999)

1.4 - Mental Disorders: the Main Pathways

Mental disorders are characterized by abnormalities in cognition, emotion or mood, or the highest integrative aspects of behaviour, such as social interactions or planning of future activities. On the more difficult side of the ledger are the terms disorder, disease, or illness. There can be no doubt that an individual with schizophrenia is seriously ill, but for other mental disorders such as depression or attention-deficit/hyperactivity disorder, the signs and symptoms exist on a continuum and there is no bright line separating health from illness, distress from disease (U.S. Department of Health and Human Services, 1999). Mental and physical health are two vital strands of life that are closely interwoven and deeply interdependent. Advances in neuroscience and behavioural medicine have shown that, like many physical illnesses, mental and behavioural disorders are the result of a complex interaction between biological, psychological and social factors. Scientific evidence from the field of behavioural medicine has demonstrated a fundamental connection between mental and physical health – for instance, that depression may enhance the risk of ischemic heart disease (Pratt, Ford, Crum, Armenian, Gallo, et al., 1996; Anda, Williamson, Jones, Macera, Eaker, et al., 1993). Furthermore, pain and depression lies in the central and peripheral nervous systems. The brain stem serves as an important connection between the higher brain centers and the spinal cord and the neurotransmitters serotonin and norepinephrine modulate pain transmission through ascending and descending neural pathways. Both serotonin and norepinephrine are also key neurotransmitters involved with the pathophysiology of depression (Jann, & Slade, 2007).

Research shows that there are two main pathways through which mental and physical health mutually influence each other. Physiological systems, such as neuro-endocrine and immune functioning, are one such pathway. Anxious and depressed moods, for example, initiate a cascade of adverse changes in endocrine and immune functioning, and create increased susceptibility to a range of physical illnesses (Glaser & Glaser, 2002).

Health behaviour is another pathway and concerns activities such as diet, exercise, sexual practices, smoking and adhering to medical therapies. The health behaviour of an individual is highly dependent on that person’s mental health. For example, recent evidence (Shrier, Harris, Sternberg, & Beardslee, 2001) has shown that young people with psychiatric disorders such as depression and substance dependence are more likely to engage in smoking and high-risk sexual behaviour.

1.5 - MENTAL HEALTH AND WELL-BEING

Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity (WHO, 2001/3). Mental health is clearly an integral part of this definition. Mental health is described by WHO as a state of well-being in which the individual realises his or her own abilities, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to his or her community (WHO, 2003). In other words, mental health is a state of successful performance of mental function, resulting in productive activities, fulfilling relationships with other people, and the ability to adapt to change and to cope with adversity. Mental health is indispensable to personal well-being, family and interpersonal relationships, and contribution to community or society. It is easy to overlook the value of mental health until problems surface. Yet from early childhood until death, mental health is the springboard of thinking and communication skills, learning, emotional growth, resilience, and self-esteem (U.S. Department of Health and Human Services, 1999). In this positive sense, mental health is the foundation for well-being and effective functioning for an individual and for a community.

1.6 - Treatments and Strategies of Intervention

The U.S. Dept. of Health and Human Service (1999), claimed that "the majority of people with diagnosable disorders, regardless of race or ethnicity, do not receive treatment. For those who receive treatment, it is generally given through pharmaceutical products (serotonin-enhancing), and more than half of the population who is affected by mental health problems have no specialized treatment in this area (Richards, et al., 1999). Less common is the use of psychotherapy (Fox, et. al., 2001). Such prevalence is not without great cost. For instance, the Department oh Health of the UK, estimated that more than £5 billion was spent on mental illness in 1992/93. In the same country, the office of Health Economics estimated the cost of treating depression at £333 millions, including drugs, hospitalization, and primary care consultation (Fox, et. al., 2001). The total annual cost of depression in Europe was estimated at Euro 118 billion in 2004, which corresponds to a cost of Euro 253 per inhabitant. Direct costs alone totalled dollar 42 billion, comprised of outpatient care (Euro 22 billion), drug cost (Euro 9 billion) and hospitalization (Euro 10 billion). Indirect costs due to morbidity and mortality were estimated at Euro 76 billion. This makes depression the most costly brain disorder in Europe, accounting for 33% of the total cost (Sobocki, et al., 2006).

In this contest, in order to reduce the burden of distress of the population suffering of mental disorder, it is necessary to find out appropriate strategies of intervention services which include secondary care such us stress management techniques and/or physical activity and sport (Fox, et. al., 2001). Because no single treatment is effective for everyone there has been great interest in the development and evaluation of alternative therapies for mental disorders (i.e. depression) (Blumenthal, Babyak, Doraiswamy, Watkins, Hoffman, Barbour, Herman, Craighead, Brosse, Waugh, Hinderliter, Sherwood, 2007). Physical exercise is one such therapy that has received considerable attention (Brosse, Sheets, Lett, Blumenthal, 2002). Although physical inactivity does not cause poor mental and psychological health, it is known that participation in physical activity can reduce levels of stress, anxiety and symptoms of depression among those individuals with these conditions (LaFontaine, DiLorenzo, Frensch, Stucky-Ropp, Bargman, McDonald, 1992; Karageorghis & Terry, 1997 for reviews). In this contest, Weinberg & Gould (1999), suggests that: “even if millions of Americans suffer from anxiety disorder and depression, not all of them have psychopathological states; many simply have subjective distress, a broader description of unpleasant emotion. For these people, regular exercise appears to have some therapeutic value in reducing feeling of anxiety and depression. And participating in regular exercise for psychological well-being is more than an American phenomenon”.

Accordingly, either in terms of clinical or non-clinical conditions, exercise may offer substantial potential alone or as in combination with other factors in improving the mental well-being of many individuals. There are five important benefits that are associated with the use of exercise (Fox, et. al., 2001): first, exercise is cheap; second, exercise carries negligible deleterious side-effects; third, exercise can be self-sustaining by the individual once the basic skills have been learnt (Martinsen, 1993); fourth, exercise is recommended for individuals who cannot access therapy or would prefer not to use medication; finally, given the inherent physical benefits, exercise should be promoted regardless of any impact on mental health.

CHAPTER 2

2.1 - THE CONTRIBUTION OF PHYSICAL ACTIVITY PRESCRIPTION AND MUSIC FOR THE REDUCTION OF MENTAL DISCOMFORT

There has been, in the last decades, a growing interest in research on the contribution of physical exercise to the alleviation of mental discomfort. Psychological benefits of regular physical activity have been reported by many researchers (i.e. U.S. Department of Health and Human Service, 1996; Morgan, 1997 for reviews). Findings have indicated that psychological states such as feeling better, having less anxiety, less depression, more self-confidence, and more vigour, are associated with participation in exercise (Martinsen, 1993; Plante, 1993; Landers & Petruzzello, 1994; Craft & Landers, 1998). In addition, other researchers demonstrated that regular physical activity contributes to a reduced responsiveness to acute physical stressors (Petruzzello, Jones, & Tate, 1997) or reported reduced susceptibility to the adverse influences of life stressors in physically active people (Steptoe, Edwards, Moses, Mathews, 1989; Throne, Bartholomew, Craig, Farrar, 2000). Stephens (1988), analyzed data from 56,000 subjects and concluded that "the level of physical activity is positively associated with good mental health in the household population of the USA and Canada, when mental health is defined as positive mood, general well-being, and relatively infrequent symptoms of anxiety and depression" (pp. 41-42).

On the other hand, an absence of significant effects of exercise on mood has also been reported. For instance, Mack, Huddleston & Dutler, (2000), studied the effects of physical activity on mood using the Emotional Assessment Scale (EAS). Participants, (74 students enrolled in physical activity classes) completed the happiness and sadness scales of the EAS each week for the 7-week course. In this study, data analysis indicated no-significant change in mean mood state scores.

Among psychological variables, investigators have focused primarily on depression and anxiety. This growing body of epidemiologic research on adults suggests that people that are more active have lower levels of anxiety and depression symptoms (Tuson, Sinyor, & Pelletier, 1995; Toskovic, 2001). In this contest, Guszkowska (2004), published a review on the effects of physical activity on the emotional states - anxiety, depression and mood. The meta-analyses of correlation and experimental studies reveal positive effects of exercise, in healthy people and in clinical populations (also in patients with emotional disorders) regardless of gender and age. Moreover, the author suggests that "the benefits are significant especially in subjects with an elevated level of anxiety and depression because of more room for possible changes". The most improvements are caused by rhythmic, aerobic exercises, using large muscle groups (jogging, swimming, cycling, walking), with moderate and low intensity. They should be conducted for 15 to 30 minutes and performed a minimum of three times a week in programs of 10-weeks or longer (Guszkowska, 2004).

Most prevalent researches have focused on the effects of aerobic exercise on psychological health. For instance, Blumenthal, Babyak, Moore, Craighead, Herman, and colleagues (1999) have published the result of a controlled trial of endurance exercise, antidepressant medication, or their combinations for older adult with depressive disorder. After 16 weeks, all three groups had clinically significant improvements in depression scores. After 10 months, remitted participants in the exercise-only group had significant lower relapse rates than participants in the medication groups. This study suggests that exercise can be an effective alternative to antidepressant medicine.

Further, the effects of anaerobic exercise have been also investigated. For instance, Toshihico et al. (1998), studied the psychological benefits of anaerobic exercise for older adults using self-reported Profile of Mood Scale and self-reported trait anxiety (State Trait Anxiety Inventory). This study showed that both high and moderate anaerobic intensity exercise reduced trait anxiety, improved positive mood (Vigour) and decreased tension.

Studies of the association between exercise and mental well-being have usually focused on acute (single bouts) and chronic (over time) effects separately (Annesi, 2002). Acute effects refer to immediate and possibility, but not necessarily, temporary effect arising from a single bout of exercise (Weinberg & Gold., 1999). It has been suggested that the improved affect associated with a single session exercise appears to be transient and returns to the baseline levels after several hours (Raglin & Morgan, 1987), whereas continued experiences of acute emotional change may have cumulative or “spill-over” emotional benefits over time (Berger & Molt, 2001). However, the relation between emotional changes associated with acute and chronic exercise is not completely revealed. In this contest, Petruzzello, Landers, Hatfield, Kubitz, and Salazar (1991) provided the most comprehensive meta-analysis, with over 100 studies examining the effects of both acute and chronic exercise on psychological self-report measures and psycho-physiological indices of stress. Petruzzello et al, (1991) indicated that chronic exercise reduces trait anxiety especially when: exercise sessions lasted 21-30, or more than 40 minutes (in comparison to < 21’); the training period was more than 15 weeks (in comparison to <10). In terms of acute effects, state anxiety was reduced especially when the exercise was aerobic and it lasted 21-30 minutes (in comparison to< 21); and the effect size (ES) was determined from within-subjects comparisons from pre-to-post exercise as opposed to changes from pre-to-post exercise being compared with other anxiety-reducing treatment.

2.2 - MECHANISMS

Although a number of mechanisms have been proposed, how exercise alleviates depression and anxiety is not completely clear (Dubbert, 2002, Blumental et al., 2007). The changes in anxiety, depression and mood states after exercise are frequently explained by biologic/physiological mechanisms such as hormonal responses levels of endorphins, serotonin and monoamine (Dunn, & Dishman, 1991; Dishman, 1994). Exercise may also increase body temperature, blood circulation in the brain and impact on hypothalamic-pituary-adrenal axis (Droste, Gesing, Ulbricht, Muller, Linthorst, Reul, 2003) and physiological reactivity to stress (Dickerson, & Kemeny, 2004). Further, psychosocial aspects of exercise/sport such as increased social contact, perceived mastery, distracting from daily stressor, a sense of mastery, positive thought, may positively contribute to beneficial effects induced by participation in physical activity (Dubbert, 2002). Moreover the possible psychological mechanisms include improvement of self-efficacy, distraction and cognitive dissonance (Guszkowska, 2004). Recent research indicates that exercise is associated with positive mood changes, even when psychological benefits are not found (Annesi, 2000). There is some evidence of a dose–response relationship between level of physical activity and depressive symptoms; however, evidence of increased depression from studies of overtraining in athletes suggests that the relationship may be curvilinear. The degree to which mental health benefits of exercise are linked to cardiorespiratory fitness is still undetermined (Dubbert, 2002).

In general, studies with individuals without clinically significant mental health problems and studies with other types of mental health problems, such as psychosis, substance abuse, and cognitive impairments, have been inconclusive or too limited to allow conclusions (Dubbert, 2002). As suggested by Berger, and Molt (2001), "there is no conclusive evidence that identifies a single mechanism or group of mechanisms as consistently influencing the exercise-mood relationship. Although knowledge of the relationship between exercise and mood alteration is substantial, much remains to be studied. Promising avenues for future investigation of exercise include mood changes in specific populations, environmental influences on mood alteration, and personal characteristics impacting mood alteration".

2.3 - EFFECTIVENESS OF MUSIC TO REDUCE MENTAL DISCOMFORT

Music is an intentional auditory stimulus with organized elements including melody, rhythm, harmony, timbre, form, and style (Kemper, Danhauer, 2005). Environmental sounds that exist without controls for volume, duration, or cause-effect relations are perceived as noise. Most common adverse effects of exposure to excessive noise are hearing damage, fatigue, insomnia, and decreased appetite. On the other hand, exposure to music (organized form of sound) may produce and enhance positive clinical effects (Kemper, Danhauer, 2005).

Music has been used since ancient times to enhance wellbeing and reduce pain and suffering (Kemper, Danhauer, 2005). Although, music and medical practice was largely forgotten during the 20th century (Munro, Mount, 1978), in the last decades the research showed a growing interest to evaluate the psycho-physiological effects/application of music in different social/behaviours conditions. Music-therapy, which is defined as a therapeutic use of music to affect patient health and well-being (Snyder, 1992), provided a relevant contribution to evaluate the effectiveness of music in reducing discomfort such as pain, anxiety, sadness. (Chlan, 1998; Della Bella, Peretz, Rousseou, Gosselin, 2001; Kenntner-Mabiala, Gorges, Alpers, Lehmann, Pauli, 2006). Music, in fact, is widely used to help people relax and divert their attention from unpleasant and stressful situations (Koch, Kain, Ayoub, Rosenbaum, 1998). From this standpoint, music may be useful as a secondary care in mental stress management as much as other stress management techniques (i.e., relaxation technique, yoga).

Several researchers have documented the positive effects of listening to music in order to manage mental discomfort (i.e. reduces anxiety, improves mood) (i.e. Wong, Lopez-Nahas, Molassiotis, 2001). For instance, Evans (2002), published a systematic review on the effectiveness of music as an intervention for hospital patients and demonstrated that music was effectiveness in the reduction of anxiety during normal care deliver. The author also suggested that given the inexpensive nature of this intervention, and the lack of adverse events, it is recommended as an adjunct to normal care practices. Further, Cooke, Chaboyer, Schluter, Hiratos, (2005) tested the hypothesis that day surgery patients who listened to music during their preoperative wait will have statistically significantly lower levels of anxiety than patients who receive routine care. Results evidenced that experimental-music group reported a lower state anxiety level compared to the control group. In this concern, it has been suggested that music represents a simple and cost-effective intervention to reduce the anxiety experienced in limited time periods, will have enormous impact on clinical practice (Cooke, Chaboyer, Hiratos, 2005).

The positive effects induced by listening to music have been relevant also considering mood, and happiness. For instance, Barnason, Zimmerman, Nieveen, (1995), revealed that subjects who experienced a music intervention during the post-operative period after coronary bypass surgery showed a significant improvement in mood. Recently, Kenntner-Mabiala, and colleagues (2006) reported that higher happiness rating were obtained when fast music was administered (fast major mode music). More over the authors revealed that their “results support the widely known fact that music therapy tend to be more effectively applied to females than to males" (Kenntner-Mabiala, et al., 2006, pp.22). As we can see below, this last statement is relevant for the results reported in this manuscript (see chapt. 3).

Overall, there is substantial evidence showing that music may positively affect the listeners both in clinical and non-clinical condition to enhancing psychological well-being, reducing stress, and distract patients from unpleasant symptoms (Chan, Lee, Ng, Ngan, Wong, 2003; Kemper, Danhauer, 2005).

2.4 - CONTRIBUTION OF MUSIC (DURING EXERCISE) TO ENHANCE MOTOR PERFORMANCE AND PSYCHOLOGICAL WELL-BEING

Music has been widely recommended as a technique to enhance the psychophysical state of participants during sport and exercise activities (Karageorghis, & Terry, 1997). The researchers' interest in the effects of music and rhythm on motor behaviour dates back to the beginning of the 20th century, when it was proposed that music is a stimulus that promotes "natural movement" (Szabo, Small, Leigh, 1999). Current research is primarily aimed at the understanding the facilitatory impact of music on motor performance (Copeland, and Franks, 1991; Karageorghis, Drew, and Terry, 1996; Karageorghis, and Terry, 1997). For instance, Karageorghis, et al. (1996), investigated the effects of stimulative and sedative music on grip strength. In this study data showed that participants evidenced higher grip strength after listening to stimulative music than after sedative music or white noise control conditions.

Selected researches revealed that music have significant psychophysical benefits during physical activity (Boutcher & Trenske, 1990 ; Copeland & Franks, 1991). These studies have showed that listening to music can produce ergogenic effects (Szabo, et al., 1999) in terms of improved motor performance and increased aerobic endurance (Copeland & Frank 1991; Szmedra & Bacharach, 1998) and can also enhance the exercise experiences (Potteiger, et al., 2000). For instance, Anshel & Marisi (1978) examined the effects of synchronous and asynchronous movement to music during exercise (cycle ergometer). The results showed that the synchronous condition elicited significantly better score for endurance than the control condition and, additionally, male participants endured significantly longer than female with music trial. Even if other studies reported that music has no-significant psychophysical benefits during exercise (Schwartz, Fernhall, Ploman, 1990; Potteiger, Schrorder, Goff, 2000) it seems that music may enhance motor performance and increase physical activity participation (see Karageorghis & Terry for review, 1997).

It has also been proposed that music can influence mood (Sousou, 1997). Recently, Hayakawa, Miky, Takada, & Tanaka, (2000) studied the effect of music (aerobic dance music, Japanese traditional folk song) on mood states (Tension, Depression, Anger, Vigor, Fatigue, Confusion) in 16 middle-aged women during a bench-stepping exercise. In this study, music induced significantly less fatigue than no-music condition; moreover, aerobic dance music induced more vigor and less confusion than no-music condition. Similar findings were also reported by Boutcher and Trenske (1990) who examined the effects of sensory deprivation and music on perceived exertion and affect during exercise. Those analyses showed that subjects (24 untrained females) were feeling better during moderate and heavy exercise when accompanied by music than when exercising in the deprived condition, suggesting that music during exercise may enhance the participants' affective states. In this contest, Karagerghis and Terry (1997) suggest that: "there is strong evidence to suggest that the use of music enhance affective states during exercise and that such improvements (Boutcher & Trenske, 1990) are not necessarily dependent on workload.

There has been also some controversy, as non-significant effects of music during moderate intensity exercise on mood and state-anxiety were reported. For instance, Macone and colleagues (2006) studied the effects of listening to music during treadmill running on mood and state anxiety in 27 physical active undergraduate students. Authors reported that exercise was associated with positive mood and anxiety dimension but they also revealed that music did no add any significant effect on psychological dimension.

2.5 - PERFORMANCE AND STRESS REDUCTION: POSSIBLE MECHANISM

The literature suggests four ways in which music may enhance exercise performance: a) it reduces one's sensation of fatigue; b) it increases arousal; c) it encourages motor co-ordination and/or synchronisation; d) it increases relaxation. (Karageorghis, Terry, 1997 – review). Despite support for the performance enhancing properties of music during exercise, the mechanisms remain unclear even though *dissociation* and *physiological arousal* seems particularly involved in these processes (Elliott, 2007; Karageorghis, 2008). The music's ability to induce a state of *dissociation* occurs when an individual focuses upon external stimuli thereby reducing the perception of internal bodily cues (Elliott, 2007). As defined by Morgan and Pollock (1977), *dissociation* referred to any thought that served to divert attention away from internal sensations and toward external distracting stimulation. Through the application of Rejeski's parallel attentional processing model (Rejeski, 1985) researchers have verified this process and claimed that music may divert the performers' fatigue away from internal sensation to external stimulus; a technique knows as *dissociation* (Boutcher & Trenske, 1990; Karageorghis, 2008). However, this process seems to exert this effect at low-to-moderate exercise intensities; at higher intensity internal cues predominate the psychophysical response due to the higher fatigue/effort perceived by performer (Lim, Atkinson, Karageorghis, Eubank, 2009).

Arousal is a construct that represent the intensity dimension of behaviour (Landers, 1980) and thus an increase of arousal correspond to an increase of behaviour intensity (Elliott, 2007). In exercise setting, one music component that has been correlated to the “arousal effect” is *tempo* (see Karageorghis, 2006), with authors that suggest that *music tempo* and *arousal* are positively related (Husain, Thompson, & Schellenberg, 2002) that is, the faster the tempo the greater the intensity of arousal response (Elliott, 2007). In this sense, tempo is considered the most determinant factor in determining the response to a piece of music (Simpson, Karageorghis, 2006). Specifically, authors (Terry, Karageorghis, 2006) suggested four factors that contribute to the motivational qualities of music: rhythm response (most notably tempo – speed of music measured in beat per minute), musicality (harmony and melody), cultural impact, and association. On this concern, music tempo is considered a key determinant of one’s response to music. (Karageorghis, Terry, & Lane, 1999; Karageorghis, Priest, Terry, Chatzisarantis, and Lane, 2006).

2.6 - MUSIC SELECTION IN EXERCISE SETTING

A large body of research focused on the effects of both synchronous and asynchronous music during physical tasks.

Asynchronous use of music occurs when music is played in the background and there is no conscious synchronisation between movement and music tempo (Terry, & Karegoerghis, 2006). With asynchronous applications, tempo, which is related to the rhythm, is postulated to be the most important determinant of response to music (Brown, 1979; Karageorghis et al., 1999, Simpson and Karageorghis, 2006). Karageorghis and Terry (1999) reported that asynchronous music was more effective in influencing how participants felt (affect) rather than what they felt (exertion). This conclusion was corroborated in a subsequent study (Tenenbaum, Lidor, Lavyan, Morrow, Tonnell, et al., 2004) using a hill running task at 90% VO2 max which showed that although motivational asynchronous music did not influence perceptions of effort, it did shape participants' interpretations of fatigue symptoms.

The synchronous use of music involves performing repetitive movements in time with its rhythmical elements such as the beat or tempo. Research has consistently demonstrated the efficacy of synchronous music as an ergogenic aid in aerobic activities such as cycle ergometry (e.g., Anshel & Marisi, 1978; Karageorghis & Jones, 2000). Typically, synchronous music has been used to extend exercise duration among non-highly trained participants. Until very recently, however, there was no research into the effects of synchronous music on anaerobic endurance. Simpson and Karageorghis (2006), addressed this gap in the literature by testing the effects of synchronous music during 400m track running. Their results showed that both motivational and oudeterous music (from the Greek word meaning neutral – to denote music that is neither motivating nor demotivating) elicited faster times than no music, but times associated with the two music conditions did not differ, suggesting that the motivational qualities of music are not of critical importance when it is being used synchronously. Moreover, researchers (Karageorghis et al., 2009) examined the impact of motivational synchronous music and oudeterous music on psychophysical variables and point out that endurance was increased in both music condition and that motivational synchronous music had a greater ergogenic effects. The authors also revealed that in-task affects was enhanced by motivational music compared to no-music task. Previously, Hayakawa, Miki, Takada, and Tanaka (2000), tested the effects of music on mood during step-aerobics classes using synchronous, asynchronous, and control conditions. Participants reported more positive moods when classes were conducted to synchronous music, although it was unclear whether effects were associated with the music or the physiological demands of the class (e.g., thermoregulation, oxygen uptake). It appears that synchronous music can be applied to aerobic and anaerobic endurance performance among non-elite athletes and exercise participants with considerable effect. However, there is limited research and specific theory underlying the use of synchronous music, rendering this a particularly fruitful area for further investigation.

2.6.1- TOOL TO SELECT MUSIC IN EXERCISE SETTING

Karageorghis and Terry (1997) noted that methodological limitations of previously researches included lack of criteria for the music selection for experimental conditions in exercise and sport setting. On this issue, Karageorghis, Terry, & Lane, (1999) developed the Bruner Music Rating Inventory (BMRI) to assess the motivational quality of music in exercise/sport setting. In the original BMRI, a number of limitations were evident (i.e., limitation of applicability to non-experts in music selection - Karageorghis, 2006; relatively lengthy of procedure - Elliott, 2007) and some of these limitations were reported in the original publication (Karageorghis, Priest, Terry, Chatzisarantis, and Lane, 2006) Although Karageorghis and colleagues offered theoretically grounded justifications in retaining weak items, reservations about the psychometric integrity of the BMRI remain. The authors concluded that further validation and development should be an imperative. In 2006s, Karageorghis, Priest, Terry, Chatzisarantis, and Lane redesigned the BMRI-2 to consistent tool by which music can be selected in sport and exercise program (notably, the BMRI-2 is less than half the length of its predecessor: 6 items as opposed to 13).

BMRI-1/2 was also criticized. For instance, Elliott (2007) argued that " in the studies of Elliott and colleagues (Elliott, Carr, Savage, 2004; Elliott, Carr, Orme, 2005) music was selected using the BMRI, however, the results suggested that music may not need to be choose in this manner to induce ergogenic responses". Specifically, Elliott et al., (2005) evaluated the effects of 3 music conditions (motivational, oudeterous, and no-music - selected by BMRI) during sub-maximal exercise and their results did not differ comparing the two music experimental selections. In further investigation, Elliott (2007) avoided to use the BMRI (relative lengthy procedure), and he decided to consider limited criteria to select music.

Notable that the author of the present thesis and the investigators that supported for the following investigations (see capt. 3, and 4) were aware of the work of Karageorghis et al., 1999. However, we observed similar consideration argued by Elliott et al., (2005), and Elliott (2007) namely, lengthy procedure, and limitation of applicability to non-experts. On this concern, 3 main criteria were used for the following investigation (see music selection – chapter 3).

2.7 - EXERCISE AND PSYCHOLOGICAL WELL-BEING: GENDER DIFFERENCES

Relatively few researchers have focused on gender differences in the relation between exercise and mood. O'Connors, Morgan, and Raglin, (1991) investigated psychobiological effects of 3 days (72 hours) of increased training in female and male swimmers. This study showed that the main effect for gender and the gender by trial interaction were not significant for each variable tested and it was concluded that female and male college swimmers did not differ in their psychological or physiological responses to a rapid increase in training volume. Previously, Berger & Owen (1983) examined the relation between exercise and mood in swimmers. In that study, subjects reported significantly less tension, depression, anger, confusion, and more vigour after exercising than did the control group (lecture-control classes). However, there were no gender differences in the amount of mood change associated with swimming. Recently, Toskovic (2001) reported that Taekwondo practice may produce acute benefits on mood state. Specifically, his study was designed to examine the acute alteration in selected measures of mood profile in novice Taekwondo practitioner using the Profile of Mood States. Results showed a significant improvement in score of all six sub-scale of POMS, but in this study affective benefit were independent of gender. Further, Aşçi (2002) examined the effects of step dance on Physical Self-Perception (PSPP) of female and male university students and considered the possible gender differences. Results of the study showed that experimental group (step dance participants) improved their PSPP compared to control group (no-exercise) but this effect did not change across gender. Similarly, Elliot, et al., (2005) evaluated the effects of varied music condition (no-music, motivational, non-motivational) on 20-min of sub-maximal exercise and used the Feeling Scale (Rejeski, 1985) to assess in-task affect. The Authors found out that in both the music conditions participants significantly increased their traveled distance. Moreover they noted that motivational music, elicited the higher level of positive affects compared to the others two exercise conditions (no-music, oudeterous music) but/and no-gender x trial interaction was identified for any dependent measures.

On the other hand, Bhui and Fletcher (2000) examined the impact of the duration and intensity of physical activity on common anxiety and depressive states. Anxiety and depressive states were measured by the General Health Questionnaire, and physical activity variables were defined from a detailed activity schedule. The findings suggest that, compared to men who reported 0-44 min of daily physical activity, there is some benefit for those men who exercised for at least 92 min a day, but not for women in a similar exercise condition. In their conclusions, they reported that physical activity of long duration confers protection against negative mood states and anxiety and that this protective factor only characterizes men. Recently, Rocheleau, Webster, Bryan, (2004) examined the effect of gender, type of exercise, level of exertion, and duration of workout on the exercise-mood relation in a naturalistic setting. Participants reported improved mood after exercise in both weight training and cardiovascular domains. Workout duration and level of exertion significantly moderated the relation of exercise to mood improvement (i.e., an increase in either corresponded to greater improved mood). Overall, women showed more improved mood than men in the domain of exhaustion.

On this issue, Priest, Karageorghis, & Sharp (2004) studied the characteristics and effects of music during exercise considering the possible influence of different variables such as gender. The Authors reported that females rated the importance of music more highly than the males, so music appears a more integral aspect of their workout experience. These authors also suggests that “ females may require a greater degree of extrinsic motivation to exercise, or they may be more responsive than males to music in exercise environment”. In the same study Priest and colleagues (2004), also reported that females were more likely to experience enhanced (more positive) affective state as a result of listening to music during exercise. Moreover it has been noted (Crust, 2008) that women rated the importance of melody significantly higher than did men, whereas men gave more importance to music associated with sport.

In sum, although there is substantial reports that seems suggest that gender could influence mood responses in exercise setting, however, the results have been inconclusive and other contribute should be encouraged.

2.8 - Psychophysical responses to exercise in different fitness level

Physiological adaptations, both at rest and during physical work, distinguish trained from the untrained. In response to a standard work load, the trained, relative to the untrained, show the following: (a) less heart rate increase coupled with more rapid return to baseline after the exercise, (b) less increase of cortisol, (c) and less accumulation and faster elimination of lactic acid from the bloodstream. The question arises whether the physiological adaptations associated with training might influence psychological reactivity to stress comparing different fitness status (Sinyor, Schwartz, Peronnet, Brisson, Seraganian, 1983). Sinyor et al. (1983) found aerobically fit subjects to exhibit lower state anxiety following a psychological stressor. It appears that being physically active may differentially influence an individual's reactivity to psychosocial stress depending on the kind and intensity of physical activity, the level of physical fitness, the age and gender of the subjects, the method of measurement, the time of day of stress induction, and the type of stressor (Rimmele, Zellweger, Marti, Seiler, Mohiyeddini, Ehlert, Heinrichs, 2007). Recently, it has been reported that, trained men exhibited significantly lower cortisol and heart rate responses to the stressor compared with untrained men (Rimmele et al., 2007). In addition, trained men showed significantly higher calmness and better mood, and a trend toward lower state anxiety during the stress protocol. The Authors concluded that “on the whole, elite sportsmen showed reduced reactivity to the psychosocial stressor, characterized by lower adrenocortical, autonomic, and psychological stress responses” (Rimmele et al., 2007, pp 627). Further, results above indicated were consistent with Rimmele, Seiler, Marti, Wirtz, Zellweger, Ehlert, Heinrichs, (2009) who investigated whether different level of fitness (elite sportsmen, amateur, untrained) were associated with different adrenal, cardiovascular, and psychological responses to psychosocial stress. Main finding of this study revealed that different level of physical activity was associated to different stress-related neuro-physiological system in response to psychological stress.

Listening to music during exercise or sports may be beneficial by improving exercise performance and may influence emotions; on this topic it has been demonstrated music during exercise induced physiological and affective responses; however it seems that this responses may vary regarding the participants’ fitness level considered . Specifically, Brownley et al. (1995) demonstrated that listening to fast, upbeat music during exercise was beneficial for untrained runners but counterproductive for trained runners. In this concern Brownley et al., (1995) claimed that exercise, music mode and participant profile have emerged as putative determinants of the direction and magnitude of music effects during exercise and questions regarding potential music and training status interactions have not been adequately addressed. Thus, the prescriptive value of previous data has remained undefined, especially with respect to different fitness groups. Furthermore, given that elite and novice athletes employ different cognitive coping strategies to meet exercise demand (Morgan, 1971) the possibility that training history might regulate or buffer the potential effects of music on performance warrants additional investigation. The present study was designed to address some of these issues more directly.

2.9 - USE OF RPE AND HR TO ESTABLISH EXERCISE INTENSITY

Various indicators can be used for exercise intensity (e.g., % VO2peak, energy expenditure, oxygen uptake), but relative heart rate reserve (% HRReserve) is practical and is the most widely used approach (Dishman, 1994). HR target prescription presents some problem especially when the more common procedure of age-predicted HRmax (220bpm – age) is used. (Dishman R.K. 1994.). It has been noted that “when age-predict maximum heart rate (MHR) is used, error exceeding 10-15 bpm above or below a true maximum can be expected in about 30% of the adult population (Dishman R.K. 1994). For these reasons, exclusive reliance on HR for testing and prescription can lead to overestimate and underestimate of % VO2peak for some individuals (Dishman, Patton, Smith, Weinberg, Jackson, 1987).

Rating Perceived Exertion (RPE) can be considered an alternative indicator of exercise intensity (Myles, MacLean, 1986). On this concern, RPE is used in conjunction with physiological measures to prescribe training intensity levels in both adult fitness and cardiac rehabilitation program (Noble, 1982; ACSM, 1990) and empirical literature provided several data concerning the correlation of RPE and physiological parameters to establish the exercise intensity target. For instance, it has been shown the high degree of correlation between RPE and VT (Hetzler, Seip, Boutcher, Pierce, Snesd, Weltman, 1991) and LT (Haskvitz, Seip, Weltamn, Rogol, Weltman, 1992) and such relationship seems persist in despite of the physiological changes induced by training (Haskvitz et al., 1992). Dishman (1994) reinforce this concept when reported that perceived exertion at both LT and VT has not been changes by training despite the fact that lactate and ventilatory threshold after training occur at a higher power output and a higher absolute and relative oxygen uptake.

DeMello et al.1987 found that the mean RPE at LT was about 13 or 14 independently by training status and gender. Hetzler, et al., (1991), emphasize the relationship between blood lactate concentration and RPE at LT and fixed blood lactate concentration (FBLC), regardless of exercise mode (i.e., cycling, running). Authors (Dishman, Patton, Smith, Weinberg, Jackson, 1987), claimed that RPE may be used as adjuvant to HR prescription and suggest that using HR and RPE to predict voluntary working capacity is more accurate than using either measure alone. On this topic, Feriche, Chicharro, Vaquero, Perez, Lucia (1998) examined the fixed value of RPE (12-13) as a method for determination of the workload corresponding to the ventilatory threshold (VT) during a ramp protocol on a cycle-ergometer. They concluded that 12-13 RPEs value might be used to detect the exercise intensity corresponding to VT and therefore may be used in substitution to more sophisticated methodologies.

Regarding the relationship between HR and RPE, Burke (1984) reported that RPE of 11-16 corresponded to Heart Rates ranging from 144 to 174 during jogging in healthy adults from 18-50 yr of age. An early study (Smutok, Skrinarg, Pandolf, 1980) showed that subjects could reproduce a treadmill pace using RPE when HR was 150 beats x min-1 or above and RPE was 12 or higher. Similarly, RPE of 10-15 usually correspond to 50% to 70% of METmax, or 50-85% of HRReserve during walking/jogging. (ACSM, 1990). Glass, Knowlton, Becque, (1992) examined the accuracy of using RPE values from a graded exercise test to prescribe steady state treadmill exercise. The Authors reported that subjects were highly successful in reproducing the appropriate exercise intensity and thus RPE was an effective technique for prescribing and monitoring exercise intensity. Similar finding was also reported by Eston et al. (1987) who evaluated the use of RPE as a means of regulating the intensity of exercise during running. The Authors revealed that RPE can be used to regulate exercise intensity when those using such a scale are healthy and fit. Further they also reported that an RPE of 13 is a practically useful index of appropriate exercise intensity for active individuals.

In the following studies, the Karvonen's formula was used to determine the target heart rate zone and RPE was used monitoring this exercise intensity. (Karvonen formula at 75% of HRreserve : TargetHR= (HRmax-Hrrest) x 0.75 + HR_{rest}. This intensity was chosen because it falls within a frequently used training range of 60-80% $HR_{reserve}$ for an individual beginning an exercise program. (ACSM, 1991- suggested by Glass et al. 1992).

AIMS OF THE STUDY

The aims of the present study was twofold. First one, to examine the effects of physical activity and music on mood, state anxiety, and time to exhaustion and also to evaluate the extent to which any experimental effect varied with gender differences. The second, to investigate the effects of listening to music during exercise on state-anxiety and time to exhaustion including two study groups with different training status (trained vs. active). Psychological responses were assessed by repeated measurement of state anxiety, mood, and time of running.

CHAPTER 3

1ST Experimental Study

MUSIC AND PHYSICAL ACTIVITY IN PSYCHOLOGICAL WELL-BEING

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3.1 - AIMS OF THE FIRST STUDY

As we have seen, several studies have focused on physical activity and psychological well being, and researchers agree on the positive effects of exercise on mood and affect. Effects of music on mood have also been investigated and the results of studies seem to suggest that music with positive disposition has positive effects on mood than does music with a negative disposition (Karageorghis, et. al., 1997; Sousou, 1997). Although many studies have examined the effects of either physical activity or music on mood, few studies have evaluated the effects of listening music during exercise (music-plus-exercise) on mood and/or state anxiety (see Karageorghis & Terry, 1997 for a review).

For these reasons, the first focus of the study was the investigation of how music and exercise together affected mood and state anxiety when compared to the effects of exercise alone. Furthermore, the study also investigated the possible music-plus-exercise effects on time to exhaustion.

Additionally, to date, no experimental studies on the exercise-mood relation have involved Italian samples or participants. Another purpose of the study was then to obtain Italian data that could possibly confirm or qualify international findings. For this purpose, this study covered 27 Italian university students. Finally, since several studies have also investigated gender differences on the exercise-mood relation, a final goal of the present study was to examine the possible interaction of experimental effects with gender differences.

3.2 - Methods

3.2.1 – Participants

Thirty-two science undergraduate students (16 male and 16 females) from the University of Motor Sciences in Rome of moderate fitness level were recruited for this study. During the study, five subjects (2 males and three females) dropped due to ill, injuries or for not having completed all the measurements. Therefore, the study relied on data from only fourteen male and thirteen female subjects. Participants, ranged in age from 20 to 30 years-old (mean age 22±2.9 yr.), and were homogenous in terms of socio-cultural status.

The selection criteria for participating in the study consisted of (a) age ranging between 20 and 30 years, (b) previous experience of treadmill running, (c) no injury in the last six months, (d) no cardio-vascular impairment, (e) no auditory impairment, and (f) no medical counter-indications for exercise. The physical characteristics of female participants were: 57.5±5.7 kg for weight, and 168±5.1 cm height, whereas 66.8±4.5 kg and 175.2±4.5 cm were the characteristics for male participants.

3.2.2 - Materials

A Technogym Treadmill (model Runrace HC 1200) was used to perform the running test. A portable Sony stereo (model No. CFD222L) with Sennheiser headphone (model No. HD 433) was used to play music for the subjects during the test condition. A Polar Heart Rate Monitor (model S610, Polar Electro Oy, Kempele, Finland) was used to assess Rest Heart Rate and monitor Heart Rate (HR) during exercise.

3.2.3 - Measures

The Profile of Mood States (POMS), developed by McNair, Lorr, & Droppleman (1992), was used to assess six self-reported emotional states (i.e., Tension, Depression, Aggression, Vigor, Fatigue, and

Confusion). The instrument presented the participants with 58 separate adjectives, each of which belonged to one of the six emotional dimensions tapped by the instrument. For each adjective, participants were asked to indicate on a four-point response scale ” (i.e., 0 = “not at all” and 4 = “extremely”) to what extent the adjective characterized their emotional state at that moment (“right now”). For each dimension, the use of a software program permitted to compute a T-score that represented the data used in the analysis, and higher T-scores indicated a greater level of the emotional experience.

State Anxiety test (STAI-S), developed by Spielberger (1966), was used to assess the participants’ state anxiety before and after the running performance. At each occasion, the instrument presented the participants with 20 items describing positive (10 items, e.g., “I feel relaxed”) or negative (10 items, e.g., “I feel tense”) emotional statements. For each item, subjects responded on a four-point sale ranging from 1 (“non at all”) to 4 (“extremely”) to express their emotional state at that moment. The scale score was calculated by summing the negative items’ scores and the positive items’ scores (after being reversed). Higher scores thus indicated higher anxiety levels. This tool has been extensively used to assess the anxiety level in exercise research (Khan, Marlow, Head, 2008).

3.2.4 - Music selection

The music track was chosen according to two main criteria. First, to enhance possible positive effects of music on mood, an "up-beat' music within the range of 140-160bpm (see Karageorghis & Terry, 1997 for review) was chosen. Second, to avoid possible influence of semantic content on participants' mood, the track did not contain lyrics. Moreover, participants were familiar with the selected music because it was widely used during an ad campaign aired through both television and radio. The music track that was selected according to these criteria was "Struggle for pleasure" (piano, trumpet), by Wim Mertens' (duration=230 s, tempo=140 bpm).

3.2.5 - Procedure

After written consent was obtained, participants were randomly assigned to the Music or No-music exercise condition in the first testing session. The opposite condition was assigned in the second testing session approximately at the same time (9.00-12.00 am) a week or two weeks later. After the procedure was explained, each participant entered the experimental room (soundproof and visually sterile room), and Rest HR was evaluated (Polar Heart Rate Monitor) with subject quietly sitting. Rest HR was used to calculate HR corresponding to the 75% of HR reserve (HRR) utilizing Karvonen's formula (Karvonen, Kentala, &

Mustalo, 1957). Then, each subject responded to the POMS and the STAI-S to evaluate pre-exercise mood and state anxiety.

3.2.6 – Experimental Task

Participants performed treadmill running trial to volitional exhaustion at 75% of HRR in both experimental sessions (i.e., with or without music). Volitional exhaustion was operationalized as the subject's voluntary interruption of the running trial. A secondary criterion of moderate exercise intensity was the Rating of Perceived Exertion (RPE) at a level of about 13 (Glass, Knowlton, & Becque, 1992) on the Borg's RPE scale from 6 to 20 point (Borg, 1998). As suggested by Dishman, Patton, Smith, Weinberg, & Jackson (1987) target HR plus RPE feedback are more accurate to produce the target intensity. RPE was measured every 5 minutes from the 5th. As expected, imposing the same relative workload (75% HRR) between gender, produced a significant ($p<0.01$) different workload expressed as running speed between female and male subjects (10.9 ± 0.7 km/h and 12.8 ± 0.7 km/h respectively). During the experimental condition, the music was started at the beginning of the running exercise and was repeated until subjects voluntarily interrupted the exercise. Music was played by using a CD-player through headphones, and the intensity (volume) was self-selected by the subject. Headphones were also used in the no-music session. At the end of the exercise, subject seated on a chair and answered the POMS and STAI-S again.

3.3.1 – RESULTS FOR 1ST STUDY

For both baseline and post-task experimental sessions, the means and standard deviations for the POMS scores (Tension, Depression, Anger, Vigor, Fatigue, and Confusion), state anxiety, and time of physical performance on the treadmill are summarized in Table1.

POMS variables, State Anxiety, and Time Exhaustion	Baseline		Exercise in No-Music condition		Exercise with Music condition	
	mean	sd ±	mean	sd ±	mean	sd ±
Tension	**45.11**	**1.56**	**40.43**	**0.91**	**40.36**	**0.83**
Depression	**46.76**	**1.07**	**43.19**	**0.54**	**44.65**	**1.11**
Anger	**45.53**	**1.04**	**58.13**	**14.99**	**43.46**	**1.12**
Vigor	**53.16**	**1.89**	**55.00**	**2.12**	**54.79**	**2.21**
Fatigue	**49.87**	**1.50**	**46.10**	**1.24**	**47.68**	**1.21**
Confusion	**50.06**	**1.55**	**46.48**	**1.64**	**45.24**	**1.45**
State Anxiety	**37.08**	**1.73**	**33.18**	**1.54**	**32.41**	**1.37**
Time Exhaustion			**30.26**	**2.65**	**34.00**	**2.51**

TABLE 1. MEANS AND STANDARD DEVIATIONS FOR POMS EMOTIONAL VARIABLES, STATE ANXIETY AND TIME TO EXHAUSTION FOR BASELINE LEVELS AND POST-EXERCISE IN THE MUSIC AND NO-MUSIC CONDITION.

For the emotional variables only, the table reports a baseline score obtained by averaging the two pre-test scores measured prior to the two physical exercise sessions. These data were analyzed in two separate series of repeated-measure analysis of variance.

The first analysis was performed to examine whether emotional scores obtained after the two physical exercise tasks (i.e., with or without music) changed significantly with respect to participants' initial baseline scores. In other words, this analysis examined the effects of physical exercise in the two experimental conditions on changes across several mood and emotional dimensions. In this analysis, gender was included as a between-subject factor to examine whether any detected effect also varied with gender.

The second series of repeated-measure analysis of variance was instead performed to examine whether any possible pre-post changes in emotional scores obtained in the no-music condition was significantly different from the changes obtained in the music condition. For each experimental condition, separate emotional change scores were computed by subtracting post-test scores from the participants' baseline scores. Again, this analysis included gender as a between-subject factor to examine possible gender differences.

Finally, a similar analysis was performed to see whether gender also qualified any possible difference in subjects' time of treadmill exercise across the music and no-music experimental sessions.

3.3.2 - *Comparison between Baseline and Post-Test Emotional Scores*

The first series of analyses yielded significant main effects for the within-subject factor for five of the emotional variables considered in the study, namely, tension, depression, fatigue, confusion, and state anxiety. There were instead no statistically significant effects for anger or vigor, nor did gender qualified any of the main effects detected for the five emotional variables reported above.

Figure 1. graphically shows the averaged score changes with respect to tension, depression, fatigue, confusion, and state anxiety.

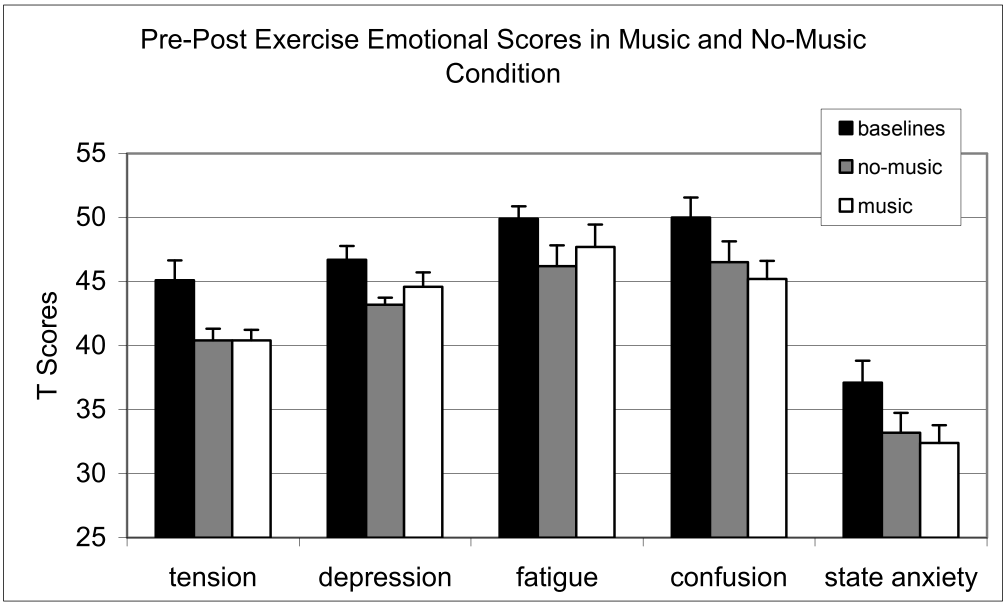

Figure 1. Means and Standard Deviation for Pre Post-Exercise Significant Emotional Scores in Music and No-Music Condition.

Overall, compared to subjects' initial emotional baseline, the physical exercise tasks, both in presence of and without music, led to a significant change in subjects' reported emotional experience. In particular, they experienced a significant decline in tension, depression-related mood, fatigue, confusion, and state anxiety. All these effects were highly significant statistically ($p. <.01$) with the only exception of fatigue, for which the effect was only marginally significant ($p. <.07$). Accordingly, when baseline scores were statistically contrasted with the post-task scores, the former scores were statistically higher than their respective post-test scores, with the only exception of fatigue, for which baseline was only significantly different from the post-test score obtained in the no-music condition.

In sum, exercise led to a decline in emotional experiences both in presence and without music.

3.3.3 - Emotional Changes in Relation to Music

The second series of analysis yielded no statistically significant differences between the change score obtained in presence of music compared to the change score obtained without music. The only exception to this pattern of null results was for fatigue, for which the analysis yielded a marginally significant interaction between gender and the within-subject factor ($p. <.07$). In particular, as Figure 2 shows, while for female participants the change in fatigue was significantly more pronounced in the no-music condition (compared to the change in the music condition), for males the fatigue change scores were statistically equivalent across the two experimental conditions.

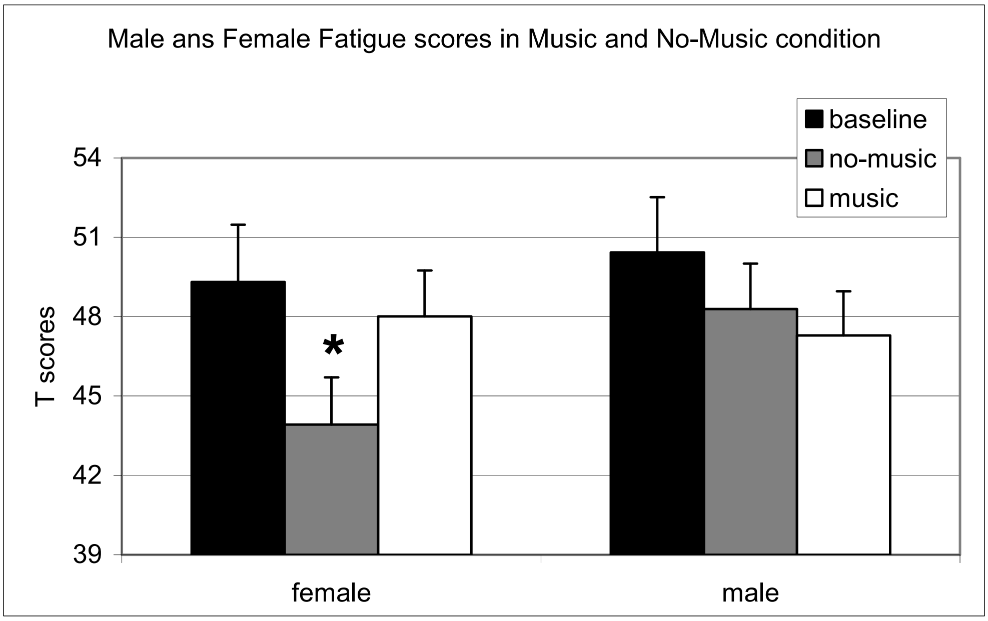

FIGURE 2. MEANS AND STANDARD DEVIATION FOR FATIGUE IN MALE AND FEMALES AFTER EXERCISE IN MUSIC AND NO-MUSIC CONDITION.

3.3.4 - TIME OF EXHAUSTION IN RELATION TO MUSIC

A final repeated–measure analysis of variance compared the two experimental (music and no-music) conditions in terms of subjects' time spent on the treadmill. This analysis yielded significant main effects for time of treadmill's physical exercise and gender, as well as a significant interaction between physical exercise and gender. In particular, as to the gender effect, male subjects, on average, spent nearly 40 minutes on the treadmill in both experimental conditions, whereas female subjects, on average, spent about 25 minutes on the treadmill. Likewise, as to the main effect for physical activity, subjects spent relatively more time on the treadmill when they also listened to music (nearly 34 minutes compared to about 30 minutes in the no-music condition). However, as Figure 3 also shows, the gender by physical activity interaction indicated that the music effect on time of exhaustion just described was particularly and only pronounced among female participants, whereas music had no effect on time of exhaustion among male subjects.

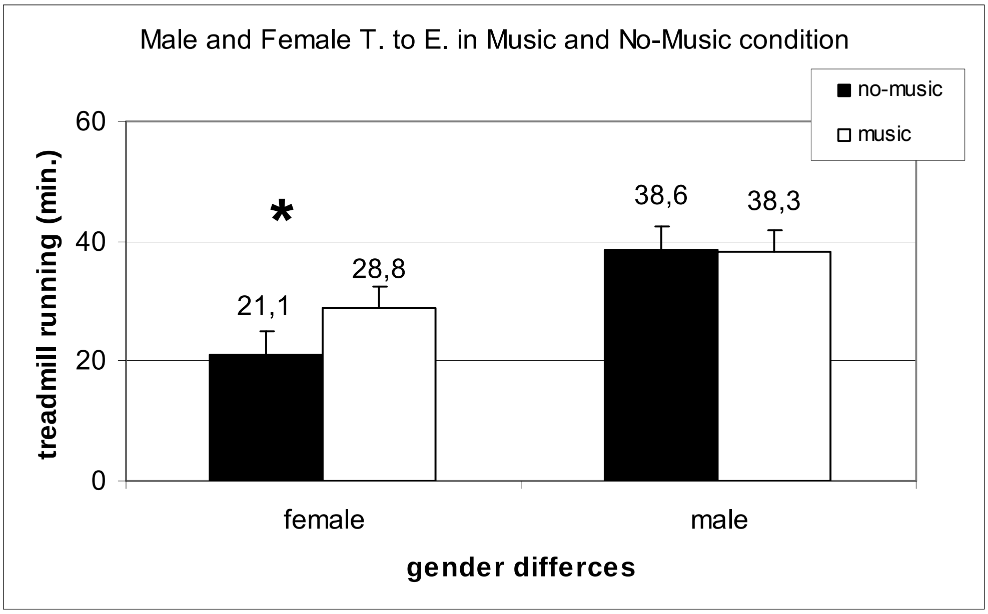

FIGURE 3. MEANS AND STANDARD DEVIATION FOR TIME OF EXHAUSTION OF EXERCISE PERFORMED BY FEMALES AND MALES IN MUSIC AND NO-MUSIC CONDITION.

3.4 - Discussion

The purpose of this study was to evaluate the effects on mood, state anxiety, and time to exhaustion of moderate intensity treadmill running with music and no-music exposure in a group of Italian university students. Furthermore, there was an interest in examining whether experimental effects would vary with gender.

The results of the present study support the general finding that psychological states are associated with participation in physical activity at moderate intensity. In particular, the main finding of the investigation was that participants, compared to their mood and anxiety baseline levels, reported less tension, depression, confusion and state anxiety after exercising on the treadmill both in presence or without the possible aid of music. Additionally, similar effects were also found for participants' self-reported fatigue. Finally, there instead were no significant physical exercise effects on the dimensions of anger and vigor. In agreement with several international studies and reports (U.S. Department of Health and Human Service, 1996; Morgan, 1997, LaFontaine, 1992; Weinberg, & Gould, 1999; Guszkowska, 2004), the present findings suggest that exercise and physical activity contribute to an improvement of positive mood experiences. As to the additional possible contribution of music to any effect due to physical exercise, the present findings did not support such a claim. In fact, the direct comparison of emotional change scores calculated for the two (music and no music) exercise conditions revealed that music did not significantly contribute to a greater improvement in mood states above and beyond the effects accrued by the treadmill running. As to the question of whether gender interacted with any experimental effect of physical exercise and music on mood and anxiety states, the effects reported above characterized both male and female participants. The only exception to this pattern of results was represented by the fact that music seemed to hinder or counteract the effects of physical exercise on females' self-reported fatigue, whereas this effect was not present among males.

The findings of the present study can be integrated with international research quite well. For instance, as to the general effects of physical exercise on mood states, the present findings replicate closely those reported by Berger and colleagues (1997). In these authors' study, changes on mood states were measured by the POMS in competitive swimmers who trained according to either a normal or an abbreviated training schedule. The findings suggested that, after a short-term swimming session, athletes reported a reduction in scores on tension, depression, and confusion, whereas reported no evidence of effects concerning anger, vigor, and fatigue. Berger (1997) and colleagues' findings thus replicated quite well those of the present research.

Despite the original expectations, the present study did not support the hypothesis that music exerts positive effects on mood changes above and beyond physical exercise effects. This null finding is in contrast with other international research. For instance, Hayakawa and colleagues (2000) found that subjects reported more vigor and less fatigue after exercising with music than they did after exercising with no music. It is important to note that Hayakawa and colleagues did not find music effects on many of the POMS emotional dimensions, with the only exception of vigor and fatigue. Thus, their study and the present study are similar in this regard. As to the differences found on the dimensions of vigor and fatigue, there are at least two reasons for such a difference. The first is that the Hayakawa and colleagues' study was conducted only with female participants, thus precluding the possibility of examining how male participants would replicate or hinder their findings on vigor and fatigue. The second reason was that Hayakawa and colleagues applied a bench stepping exercise (HR between 60-90% maximum) of *a fixed duration* (30 min), whereas the present investigation tested effects associated with a treadmill running (75% HRR) performed until exhaustion. Thus, it is plausible that the present study's lack of any music effect on vigor and fatigue is due to the fact that the subjects in all conditions were asked to exercise on the treadmill as long as they wanted, thus precluding the possibility of registering any difference between those who listened to music compared to those who did not. In other words, the difference between the present study and Hayakawa and colleagues' study may be due to the choice of an open duration exercise task performed to volitional exhaustion in the present study. This latter conclusion seems particularly plausible if one considers what the present study revealed in the analysis concerning time to exhaustion. With no surprise, male participants exercised longer, on average, than did female participants. However, the findings also indicated that music contributed to a longer exercise time on the treadmill running, but only among females. Thus, despite the present study could not replicate the Hayakawa and colleagues' finding on the music effects on self-reported fatigue, it confirmed such a music effect on female participants when time to exhaustion was considered.

This seems to suggest that female participants may profit more than males from the positive effects of music during exercise to prolong their physical activity. In other words, it could indicate that males and females might have different reactions to music during exercise. Some authors (Copeland & Franks, 1991; Karageorghis & Terry, 1997; Potteiger, Schroeder, & Goff, 2000) suggested that music narrows the performers' attention and, as a consequence, divert attention away from sensations of fatigue during exercise. Instead, performers may devote themselves to the movement (Hayakawa, et al., 2000). This process may increase duration and/or intensity of work output (Szabo, et al., 1999) and tend to promote a more positive mood state. In accordance with White and Potteiger (1996), music may have distracted the present study's subjects from discomfort associated with fatigue with the net result of prolonging their time of exercise, even though this can only be said for female participants. Finally, the present findings also suggested that physical exercise has an impact on self-reported state anxiety. In particular, participants reported a lower state anxiety after physical activity in both experimental conditions (music, no-music) compared to their baseline levels. This general finding agrees with findings of other international research, which has also shown that exercise and physical activity can yield psychological benefits and acute decrements in self-reported state-trait anxiety (Raglin & Morgan, 1987; Berger & Molt, 2001; Guszkowska, 2004). Again, this general finding applied to both males and females. As a final commentary, although this investigation should be regarded as a preliminary study and taken with caution due to its characteristics (e.g., small sample size, only sport-related university students), it seems appropriate to consider the present study an important replication of some of the international experimental research on the effects of physical exercise on mood and anxiety states.

The study demonstrated the beneficial effects of physical exercise on mood and anxiety and in part replicated what the literature suggests on the additional effects that music may have on these domains, namely, that music does not necessarily “spill over” the effects due to physical exercise, at least when these effects are measured with respect to what people may verbalize about their emotional states. It also is important to note, however, that music contributed to physical exercise, at least in females, when one considers the length of time people choose to exercise. As already mentioned, this is quite in accordance with what White and Potteiger (1996) suggested, that is, that music may have distracted subjects from discomfort associated with fatigue with the result of prolonging exercise. In other words, the present study is consistent with the common view that music helps exercising, even though this contribution may not be immediately evident when people are asked to report how they feel.

CHAPTER 4

2ND Experimental Study

EFFECT OF MUSIC DURING EXERCISE IN DIFFERENT TRAINING STATUS

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4.1 - AIMS OF THE SECOND STUDY

As we have previously reported in the first part of present thesis, several researchers have demonstrated the properties of music during exercise and sport. On this concern, music has been recommended as a technique to enhance the psychophysical state of participants during sport and exercise (Karageorghis, Terry, 1997). In particular, listening to music during exercise can produce ergogenic effects (Szabo, et al., 1999; Elliott, Carr, Orme, 2005) by improving exercise performance, (Kirby, Murphy, 2003) aerobic endurance, (Copeland, et al., 1991; , Szmedra, et al., 1998) and enhancing the exercise experiences and adherence (Potteiger, et al., 2000). Moreover scientific evidence shows that regular physical activity and exercise besides improving physical capacities and health, enhance psychological well-being, (ACSM, 2006; LaFontaine, et al., 1992) and reduce mental discomfort (i.e. reduce anxiety) (Guszkowska, 2004). However it has been demonstrated that these benefits were related to the participants' level of psychological discomfort, (Guszkowska, 2004) and participants' fitness levels (Berger, 1997).

For instance Brownley et al. (1995) investigated the effects of music on affective responses in trained and untrained runner and concluded that listening to fast (up-beat) music during exercise may be beneficial for untrained runners but counterproductive for trained runners. On this issue Brownley and colleagues (1995) claimed that participant's profile, (e.g. fitness status) has emerged as putative determinant of the direction and magnitude of music effects in exercise setting. Further, responsible mechanisms remain unclear even though dissociation and physiological arousal seems involved in these processes (Elliott, 2007).

Hence, this study examined the interaction of exercise and music to establish the impact of these factors on state-anxiety. In particular, this investigation focuses on the interaction of physical activity in two different conditions (with and without music) on state of anxiety comparing two different fitness status such as trained and active. This study also assessed the effect of listening to music during sub-maximal exercise on time to exhaustion of both the considered groups. Finally, a final goal of the present study was to examine the possible interaction of experimental effects with gender differences.

4.2 - METHODS

4.2.1 – Participants

Thirty-two science undergraduate students (16 male and 16 females) from the University of Motor Sciences in Rome of moderate fitness level were recruited for this study. During the study, five subjects (2 males and three females) dropped due to ill, injuries or for not having completed all the measurements. Therefore, the study relied on data from only fourteen male and thirteen female subjects. Participants, ranged in age from 20 to 30 years-old (mean age 22±2.9 yr.), and were homogenous in terms of socio-cultural status.

The selection criteria for participating in the study consisted of (a) age ranging between 20 and 30 years, (b) previous experience of treadmill running, (c) no injury in the last six months, (d) no cardio-vascular impairment, (e) no auditory impairment, and (f) no medical counter-indications for exercise. The physical characteristics of female participants were: 57.5±5.7 kg for weight, and 168±5.1 cm height, whereas 66.8±4.5 kg and 175.2±4.5 cm were the characteristics for male participants.

4.2.2 - Materials (see 1st study)

4.2.3 - STATISTICAL ANALYSIS

Data are presented as mean and standard error. SPSS 15.0 for Windows software was used to perform on State-Anxiety score a 2×2×2

ANOVA with the between-groups factor Fitness Level (trained/active) and repeated measures factors Exercise (pre/post) and Music Condition (Music/No-music). Then, state-anxiety percentage change across events (pre-post exercise) was also compared by a 2×2 ANOVA the between-groups Fitness Level and Music Condition as within factor. A 2×2 ANOVA was also performed to assess running Time-to-Exhaustion between the two groups (trained/active) with Music Condition (Music/No-music) as repeated measure factor. Post-hoc analysis was performed when appropriate. Effect Size was also calculated using Cohen's definition of small, medium, and large effect size (as partial $\eta^2 = 0.01$, 0.06, 0.14 and as $d = 0.20$, 0.50, 0.80, respectively). 36 Statistical significance was accepted at the $p < 0.05$ level.

4.3 - RESULTS

4.3.1 State-Anxiety

A three-way ANOVA for State-Anxiety resulted in a significant exercise main effect ($F_{1,24} = 8.46$, $P < 0.01$, partial $\eta^2 = 0.26$). Anxiety reduced significantly following exercise (from 37.4 ± 3.0 to 32.7 ± 1.2 respectively). A significant exercise by music interaction effect ($F_{1,24} = 8.27$, $P < 0.01$, partial $\eta^2 = 0.26$) showed that, when controlling for the effect of training status, post-exercise anxiety score in music condition was more reduced than in post-exercise in no-music condition (from

39.7 ± 1.8 to 32.1 ± 2.0 and from 35.2 ± 2.5 to 33.3 ±2.2 in Music and No-Music conditions respectively). Further assessing state-anxiety as percentage of variation between post and pre-exercise scores (Figure 1), data revealed that this decline after the exercise-music task was more pronounced ($F_{1,24} = 6.94$, $P < 0.05$, partial $\eta^2 = 0.22$).

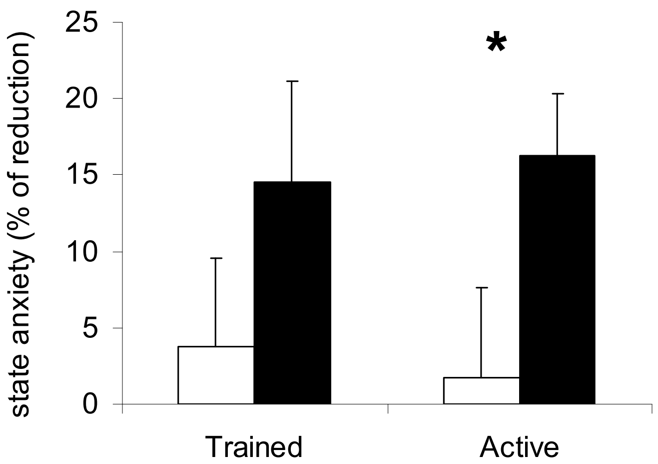

FIGURE 1. STATE ANXIETY DECLINE AFTER BOTH EXERCISE CONDITIONS (NO-MUSIC □, MUSIC ■)

Specifically, a statistically significant decline in Active-subjects' anxiety rating after exercise in music environment emerged ($P < 0.05$, $d = 0.80$), while a similar but not significant trend in Trained participants was observed ($P = 0.08$, $d = 0.47$) (Figure 1).

4.3.2 - Time-to-Exhaustion

A second series of analysis examined whether participants' Time-to-Exhaustion on treadmill varied across music conditions and training participants' status. This analysis yielded significant main effects for Music ($F_{1,24} = 8.76$, $P < 0.01$, partial $\eta^2 = 0.27$), and for Training Status ($F_{1,24} = 4.70$, $P < 0.05$, partial $\eta^2 = 0.16$). On average, trained group spent significantly more time on treadmill comparing to active-group in both exercise conditions (Music, No-Music). Moreover, data showed that both the groups (Trained, Active) experienced a longer time on the treadmill when music was present compared to the quite condition. Specifically, data revealed that this change was statistically significant for Active-participants ($P < 0.01$, $d = 0.47$) while for Trained-participants the effect was not significant (Figure 2).

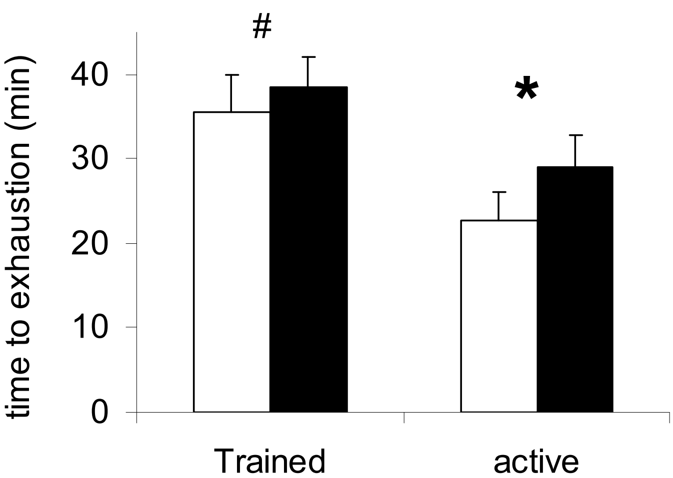

FIGURE 2. TEX. FOR THE TWO MUSIC CONDITIONS

(NO-MUSIC □, MUSIC ■)

4.4 - Discussion

This study examined the effects of listening to music during exercise on state-anxiety and time-to-exhaustion in trained and active participants. The main findings revealed that both trained and active participants decreased their state-anxiety level after the exercise, independently by the presence of music. From the data emerged that exercise was associated with a state-anxiety reduction in active as well as in trained participants, suggesting that different fitness status does not appear to have a different effect on emotional response (i.e., anxiety) to exercise. This first result supports and extends those studies which emphasized the role that physical activity may offer to protect and reduce psychological discomfort such as state-anxiety (Petruzzello, et al., 1991; Scully, Kremer, Meade, Graham, Dudgeon, 1998; Fox, et al., 2001).

Considering the effects of music during exercise on state anxiety, our study revealed that active-participants exhibited a more pronounced reduction of their anxiety level after exercising in presence of music than in its absence, whereas the trained-group demonstrated only a trend in the same direction. This result contrasts with previous investigation (Macone, et al., 2006) who reported that music during exercise was not associated with state-anxiety reduction. The discrepancy of the results could partly be due to the different groups considered in the two studies. In the present study, participants were classified according to their fitness status while Macone et al. (2006) investigated on gender differences. Thus, these different results could reflect differences of the investigation design. The present data support the hypothesis that music during exercise may enhance the anxiolytic effect induced by participation in physical activity (compared to silence) even though it seems that different fitness status may differently qualified this outcome. This is in line with findings by Brownley et al. (1995) who reported different result on affective dimension comparing trained and untrained subjects. Specifically, the Authors evidenced that at low and high intensity exercise with music accompaniment, untrained reported more positive effects compared to trained suggesting that fast/up-beat music tempo during exercise may be beneficial for untrained subjects but counterproductive for trained runners. In other investigations, elite sportsmen, compared with untrained controls showed higher levels of self-efficacy (Rimmele, et al., 2007) and self-efficacy has been associated with lower anxiety and physiological stress reactivity (Bandura, 1997; Butki, Rudolph, Jacobsen, 2001). This might mean that active-subjects may have a higher psychological discomfort compared to trained-subjects and thus the benefit induced by listening to music during exercise was more evident because of more room for possible change, as suggested by Guszkowska (2004). Obviously this point awaits further research, but could have important implications for exercise prescription.

With respect to time-to-exhaustion, our finding indicated that trained and active participants have been differently affected by listening to music during exercise. Specifically, active-subjects substantially prolonged their treadmill running performance in presence of music whereas in trained participants this effect was absent. This result partially contrast with Brownley et al. 1995 and Mohammadzadeh, Tartibiyan, Ahmadi (2008). In particular, Mohammadzadeh et al. (2008) assessed the effects of music on RPE and Time to Exhaustion, measured during the Bruce test (incremental exhaustion trial) in trained and untrained subjects. The authors revealed that both trained and untrained groups increased their time of performance even though untrained participants reported a higher reduction in the RPE scores in presence of music compared to the trained group. On the other hand Brownley et al. (1995) assessed the Total Time to Exhaustion (TTE) in trained and untrained subjects measured after three successive 10-min stages of low, moderate and high exercise intensity in different music conditions (no-music, sedative, and fast). On this concern Brownley et. al. (1995) revealed no-group or music effects on TTE. However the authors collected these data at the conclusion of the high intensity stage, asking the participants if they were able to continue exercising. Moreover during this voluntary fourth stage treadmill grade was increased 2% every 2 min increasing the participants' workload. On this concern researchers claimed that the cognitive strategies in exercise and physical effort were “load dependent” (Boutcher, et al., 1990). Psychological factors may be salient at light and moderate exercise intensities, but during exercise of high intensity and long duration it is likely that attention is focused on overwhelming physiological sensations, which dominate focal awareness (Hutchinson, Tenenbaum, 2007). Hence, it could be plausible that the results reported by Brownley et. al. (1995) was related to the higher participants’ exercise intensity and physical effort.

In the present investigation time-to-exhaustion was measured at constant exercise intensity and grade (respectively moderate and 0 degree) and music was associated with longer running time even though this effect was present only in active participants, while in trained was not. Researchers argued that music may narrow the performers’ attention and, consequently, diverts attention away from sensations of fatigue during exercise so that duration and/or intensity of work output are increased (Copeland, et al., 1991; Potteiger, et al., 2000). This effect was also revealed by Elliott et al. (2005) who found that untrained students significantly increased in distance traveled (exercise intensity) when they were listening to music during a 20 min cycling trial compared to the no-music condition task. The music’s ability to induce a state of dissociation occurs when an individual focuses upon external stimuli thereby reducing the perception of internal bodily cues (Morgan, Pollock, 1977; Elliott, 2007). As defined by Morgan and Pollock, (1977) dissociation referred to any thought that served to divert attention away from internal sensations and toward external distracting stimulation. Collectively these data suggests that active participant have been positively affect by music during exercise whereas trained seems less sensible to this effects. In this context, it could be suggested that active participants may profit more from external cues while trained would focus on internal cues during exercise and therefore would not be responsive to the music stimuli.

These evidences suggest at least two considerations. First, it seems that different fitness status (i.e., active and trained) may have different responsiveness to music stimuli during exercise. In particular, low-to-moderate fitness level participants (active/untrained) may profit more of the effects induced by music during exercise, prolonging their physical exercise experiences; instead higher fitness level (trained) participants seem to be less sensible to this effect and therefore less responsive to the music benefits in exercise setting. Secondly, considering the listening to music effect on exercise, it may be reasonable to suggest that active subjects in their reaction to music stimuli during exercise are more similar to untrained than to trained-subjects (see Elliott, et al., 2005).

Overall, it seems appropriate to consider the present study as an important confirmation of previous experimental researches on the positive effects of physical exercise in the reduction of state-anxiety, thus supporting the general notion that physical activity participation is positively associated with psychological well-being. Moreover, the study confirmed what the literature suggests about the additional effects that music may have on these domains, at least when physically active participants are considered. Finally, the present findings suggest that music exposure may prolong the physical exercise experience, even though this contribution may not be generalized to of all fitness levels and it could be speculated that training status may differently qualify this exercise performance enhancement.

4.5 - CONCLUSIONS

From the obtained data the following conclusions can be established:

1. Participation in moderate physical activity can reduce anxiety level.
2. Listening to music during exercise may enhance the positive effect linked to participation in physical activity on state anxiety dimension in moderate fit subjects.
3. Asynchronous music stimuli may prolong time to exhaustion in active subjects.

Extension of the present investigation is needed analyzing a larger samples, exercising under different music selections (including self-selected music) and workloads, and to establish the further overall quantitative and qualitative accuracy of these findings.

CONCLUSION

The present thesis examined the effects of listening to music during treadmill running on mood, state anxiety, and time of running considering gender as well as fitness-level differences. In accordance with several international researches, the main finding the current studies revealed that physical activity improve mental health enhancing mood experience, and reducing state anxiety. It could have important practical implications.

For instance, physicians, sport trainers and other well-being-promoters prescribe people to be engaged in sport and exercise physical activity to improve physical capacities and health. Moreover it has been largely demonstrated that exercise and sport may reduce mental discomfort. Hence, it could be plausible that physician and colleagues recommend to be active not merely to improve physiological parameters but also to reduce mental disorder and emotional discomfort in order to “globally” enhance the health status of community. Moreover, the positive psychological responses during exercise may increase participation physical activity, and may have positive behavior change.

From our investigations, also emerged that music improved the time of exercising even though this effects was evident in female and in active participants. Whilst remains ambiguity regarding the mechanism involved in this process, the finding, nevertheless, may have practical implication. For instance, this findings may have implication in cardiorespiratory exercise program as well as in obesity one's at least when these kind of participants are involved to prolong the time of exercise experiences. It should be noted that the results of the present studies do not mean that these results could be transferable to other category of participants. Moreover, the positive music effects on this domain could improve adherence to physical activity and it could be integrated in the strategies used to avoide/reduce the dropout from exercise program. Obviously, these points need further researches.

Further investigation are required using larger samples of participants, exercising under different music selections (including self-selected music), and workloads to examine the possible mechanisms and the impact these factors on psychological well-being.

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APPENDIX