THE UNIVERSITY OF HULL

A transtheoretical model intervention

to help Greek students adopt and maintain a physically active lifestyle

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by

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Abstract

Physical activity is positively related to a number of health benefits that influence morbidity and mortality during childhood, adolescence and adulthood. However, an epidemic of physical inactivity is quickly expanding worldwide and particularly affecting the Greek population. Early life periods and especially transitional ones leading to young adulthood are considered critical to intervene to help people adopt and maintain an active lifestyle. Well-designed longitudinal interventions are recommended for these ages.

The main objective of this study was to design, implement and assess an intervention to help students adopt a more active profile according to the Transtheoretical model. This theory was selected due to its practicality and adaptability. The intervention materials consisted of a set of five printed manuals based upon the Transtheoretical model and encouraging physical activity. The study design was quasi-experimental (n=665, mean age=15.8 years, 57% girls) with a stratified assignment of the intervention (n_{Int}=263) and control group (n_{Con}=402). The intervention consisted of the administration of one printed manual to each student according to his/her current stage and its use for the next four months.

Greek secondary students were measured longitudinally in the course of three years extending from two years before their graduation until one year after their graduation. The first two measurements were performed in the second grade of Lyceum (Greek high school) one just before and one just after the intervention. The last two measurements were conducted one year after and two years after the intervention. The research questionnaires measured stages of change, processes of change, decisional balance and self-efficacy, which are the main components of the Transtheoretical

model. These instruments assisted firstly with the implementation and secondly with the assessment of the intervention.

The research hypotheses examined the various intervention effects. The main analysis of the stage data was performed with latent transition analysis, which was considered as appropriate and advantageous. The latent stage results revealed positive intervention effects in the short-term, which were neutralised in the mid- and long-term. A comparison of the observed stage data pre- and post-intervention confirmed that in the short-term the intervention had successfully helped more students to progress and fewer students to regress along the stages of change continuum compared to the control group. Regarding self-efficacy, decisional balance and processes of change, within-group longitudinal comparisons of the observed data disclosed positive comparative short-term effects. In general, these effects were also reversed or neutralised in the mid-term and remained neutral in the long-term. In most cases the above-mentioned trends of the whole sample were also confirmed for each gender separately making the intervention successful only in the short-term.

Several shortcomings identified in the literature were addressed by the current study by implementing a longitudinal design, conducting a long-term investigation of the intervention effects and specifically adapting and validating the research instruments for the studied population. The "less is more" approach encapsulates the philosophy behind this intervention. In fact, the resources used were kept in a minimum regarding students' time and schools' involvement. Together with the easiness of the administration of the intervention contributed to the potential of being easily generalisable to wider populations. Additionally, the development and implementation of the Greek adolescent stages of change manuals was a pioneer work for Greece.

It is recommended that a number of successive interventions be implemented to accomplish a longer duration of positive results. Another recommendation was to expand the public impact of this intervention by attempting it on a larger, even national scale and in different settings. Finally, the positive conclusions of the current study confirmed its success in helping young people adopt and maintain an active lifestyle and also it provided similar future studies with validated tools and added experience to continue in the search for more efficient PA interventions.

Keywords: physical activity, transtheoretical model, intervention, Greece, stages of change, longitudinal, latent transition analysis, adolescents.

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Nomenclature

ACSM	American College of Sports Medicine
AIC	Akaike Information Criterion
ANOVA	ANalysis Of Variance
CDCP	Center for Disease Control and Prevention
CG	Control Group
CHD	Coronary Heart Disease
CI	Confidence Interval
CPRC	Cancer Prevention Research Center
CVD	Cardiovascular Disease
DB	Decisional Balance
df	degrees of freedom
DALY	Disability-Adjusted Life Years
EHBS	European Health and Behaviour Survey
EHHI	European Heart Health Institute
EORG	European Opinion Group
EPIC	European Prospective Investigation into Cancer and Nutrition study
ES	Effect size
EU	European Union
HEPA	Helath Enhancing Physical Activity
HR	Heart Rate
HRM	Heart Rate Monitor(ing)
HRR	Heart Rate Reserve
ICC	Intraclass Correlation Coefficient
IG	Intervention Group
IHBS	International Health and Behaviour Survey
IPAQ	International Physical Activity Questionnaire
LC	Latent Class
LCA	Latent Class Analysis
LS	Latent Status
LTA	Latent Transition Analysis
LTPA	Leisure-Time Physical Activity
MANOVA	Multivariate ANalysis Of Variance

MPA   Moderate Physical Activity

MVPA   Moderate to Vigorous Physical Activity

NASPE   National Association for Sports and Physical Education

NICE   National Institute of Health and Clinical Excellence

NIPO   Netherlands Institute of Public Opinion

OPA   Occupational Physical Activity

PA   Physical Activity

PE   Physical Education

POC   Processes Of Change

RCT   Randomised Controlled Trial

RHR   Resting Heart Rate

SD   Standard Deviation

SE   Self-Efficacy

SOC   Stages Of readiness to Change

TPA   Total Physical Activity

TTM   TransTheoretical Model

USDA   United States Department of Agriculture

USDHHS   United States Department of Health and Human Services

WHO   World Health Organisation

VPA   Vigorous Physical Activity

YLL   Years of Life Lost

Chapter 1. Introduction

1.1. The general problem

The link between physical activity (PA) and health is well documented for all age groups (Hardman & Stensel, 2003; Janssen & LeBlanc, 2010). The health, longevity and quality of life of adults seem to benefit from PA in various ways (US Department for Health and Human Services, 1996). In general, these benefits outweigh any negative side effects (Suitor & Kraak, 2007). Regarding young people, the health benefits are both short- and long-term (European Heart Health Initiative, 2001; Dobbins, De Corby, Husson & Tirilis, 2009) although these associations are not as strong and consistent as with adults (Twisk, 2001). Especially for the global epidemic of childhood and adolescent obesity a physically active lifestyle can both prevent and cure this disease (Strong, Malina, Blimkie, Daniels, Dishman, Gutn, Hergenroeder, Must, Nixon, Pivarnik, Rowland, Trost & Trudeau, 2005). If the above knowledge could be translated to large proportions of the population being physically active it would produce a high public impact. However, the majority of people in all ages seem to be lacking the benefits derived from an active lifestyle (World Health Organisation, 2002; Currie, Roberts, Morgan, Smith, Settertobulte, Samdal & Barnekow-Rasmussen, 2004; Dobbins et al., 2009). Particularly in Greece, the prevalence of PA is remarkably low; in fact, it is one of the lowest in the European Union (Tzormpatzakis & Sleap, 2007). The emergence of this problem originates in early adolescence and is intensified during the transition to young adulthood or adulthood where stability of PA is weak (Telama, 2009).

1.2. The specific problem

In the above-mentioned critical conditions interventions can help people adopt and maintain active lifestyles. Regarding young people, school-based interventions are highly recommended (Dobbins *et al.*, 2009) although, there seems to be a lack of interventions with long-term success (Almond & Harris, 1998). The same applies for Greek interventions since only three could be located (Christodoulidis, Papaioannou & Diggelidis, 2001; Digelidis, Papaioannou, Laparidis & Christodoulidis, 2003; Manios, Kafatos & Kafatos, 2006) and they either contained methodological flaws or experienced limited success. Considering the above facts a decision was made to implement an intervention in secondary school settings in Greece.

The intervention was theoretically based on the Transtheoretical Model (TTM), which was chosen as appropriate to investigate longitudinal changes in the PA levels of young people. Its main competitive advantages were its practicality and adaptability (Ashworth, 1997; Whitehead, 1997), which are essential characteristics of a well-designed intervention. The model proposes that behaviour change is channelled through a series of "stages of readiness to change" (SOCs) (Prochaska & DiClemente, 1983; Prochaska & Velicer, 1997). Also, the change process can be mediated through the processes of change (POCs), which are the strategies and techniques used by an individual to accomplish change, the Pros and Cons, which are part of the decisional balance of an individual in favour or against the change process and finally, self-efficacy (SE), which represents the confidence of the individual that she/he can persist with her/his positive behaviour change in difficult situations (Cancer Prevention Research Center, 2000). The TTM literature indicated a need for longitudinal research projects and interventions with long-term efficiency (Marshall & Biddle, 2001).

Additionally few studies investigated the TTM in its totality (Hutchison, Breckon & Johnston, 2009). Therefore, the intention of this study was to cater for these gaps in the TTM literature.

1.3. Significance and purpose of the study

The significance of the current study lies upon the quality of its longitudinal intervention design and in the efficiency of the TTM intervention. Its purpose was firstly, the initial design and implementation of a PA intervention in Greece based upon the TTM and targeting adolescents. Secondly, it examined the efficiency of this intervention in helping students to adopt and maintain a physically active lifestyle during their final school years and even after their graduation from school.

1.4. Structure of the thesis

The literature review examines in more detail those issues that were mentioned in the introductory section. Chapter 2 establishes the link between PA and health in adults and young people while chapter 3 is concerned with the inability to translate this knowledge into a high prevalence of PA worldwide and especially in Greece. Chapter 4 shows that adolescence and mostly the transitional periods to young adulthod and adulthood are the most problematic in terms of stability of PA. Chapter 5 examines in detail all the necessary elements of a well-designed intervention leading to in chapter 6 a description of the TTM and a justification of its selection. The methods section contains an analytical statement of the aim of this study, the research hypotheses, operational definitions, delimitations, limitations and assumptions that govern this study (Chapter 7). Additionally, it describes in detail its design, implementation and validation of its instruments. Moreover, the non-parametric analysis of the observed

data is presented in chapter 8 and the statistical method of LTA, which was the main method of analysing the SOCs, is outlined in chapter 9. The results section reveals the observed data of the SOCs (Chapter 10), the LTA data (Chapter 11) and the data of the remainder of the TTM components (Chapter 12). Finally, chapter 13 concentrates on the discussion of the results and chapter 14 on the presentation of conclusions and recommendations of this study.

LITERATURE REVIEW

Chapter 2. Establishing the link between physical activity and health

2.1. Introduction

The health effects of PA are well-established. Comprehensive reviews of the available scientific evidence associates PA with a number of health benefits both in adults (Hardman & Stensel, 2003; Dishman, Washburn & Heath, 2004; Roberts & Barnard, 2005; Pedersen & Saltin, 2006; Suitor & Kraak, 2007) and young people (Suitor & Kraak, 2007; Stensel, Gorely & Biddle, 2008; Janssen & LeBlanc, 2010).

2.2. Health effects of physical activity for adults

The longevity and long-term health of adults seem to benefit from PA in various ways. Lower overall mortality rates (US Department for Health and Human Services, 1996), cardiovascular disease (CVD) mortality rates (Berlin & Colditz, 1990; Thompson, Buchner, Pina, Balady, Williams, Marcus, Berra, Blair, Costa, Franklin, Fletcher, Gordon, Pate, Rodriguez, Yancey & Wenger, 2003; Leon, Franklin, Costa, Balady, Berra, Stewart, Thompson, Williams & Lauer, 2005) and morbidity rates (57th World Health Assembly, 2004; Roberts & Barnard, 2005; Cavill, Kahlmeier, Racioppi & Eds, 2006; Pedersen & Saltin, 2006) were evident for those who were moderately or highly active compared to sedentary people. According to Powell and Blair (1994) around one third of the deaths caused by CVDs, diabetes mellitus and colon cancer could have been avoided through sufficient PA levels of the population. Roberts and Barnard (2005) reviewed numerous clinical trials and intervention studies where the

major role of PA and diet was clearly confirmed in the reduction of coronary heart disease (CHD) risk by positively influencing a plethora of related physiological factors. A causal nature of association has been inferred in all the above health benefits (US Department for Health and Human Services, 1996; Suitor & Kraak, 2007) accompanied with an established dose-response effect (US Department for Health and Human Services, 1996). Thus, physically active people seem to live longer and be more protected against CVDs.

PA also seems to be associated with a number of other healthy conditions. Research evidence strongly suggests that a physically active lifestyle plays a protective role against the overall risk of developing cancer (Thune & Furberg, 2001), especially colon and breast cancer (Colditz, Cannuscio & Frazier, 1997; Roberts & Barnard, 2005; Suitor & Kraak, 2007), and also for non-insulin-dependent diabetes mellitus (Cavill *et al.*, 2006; Pedersen & Saltin, 2006; Suitor & Kraak, 2007). Furthermore, its importance for weight management and weight loss by expending energy and sustaining a high resting metabolism has also been established (57th World Health Assembly, 2004; Roberts & Barnard, 2005). Low PA levels were considered as the key determinant of adult obesity in Britain (Prentice & Jebb, 1995) and in the USA (Heini & Weinsier, 1997). Additionally, aspects of mental health such as depression, anxiety, mood and general well-being seem to benefit from PA (Landers, 1997; Pedersen & Saltin, 2006; Suitor & Kraak, 2007; Conn, 2010). Thus, there appears to be sufficient evidence to accept the positive influence of PA in the maintenance of health.

Body functions may deteriorate with age but movement continues to be of vital importance. In this sense, PA is essential for maintaining the health of joints (US Department for Health and Human Services, 1996; Cavill *et al.*, 2006) and also appears

to be beneficial for the control of osteoarthritis symptoms (Pedersen & Saltin, 2006; Suitor & Kraak, 2007). Furthermore, PA seems to play a protective role against falls and fractures specifically among women (Suitor & Kraak, 2007) and the elderly (Kanis, Johnell, Gullberg, Allander, Elffors, Ranstam, Dequeker, Dilsen, Gennari, Lopes Vaz, Lyritis, Mazzuoli, Miravet, Passeri, Perez Cano, Rapado & Ribot, 1999; Gregg, Pereira & Caspersen, 2000; Cavill et al., 2006). Evidence also supports the notion that through PA osteoporotic women can minimize bone loss and even enhance in some degree their bone mineral content (Cavill *et al.*, 2006; Suitor & Kraak, 2007). Finally, daily living activities can be performed in a better fashion by those who are physically active on a regular basis even if they possess health problems (US Department for Health and Human Services, 1996; Cavill *et al.*, 2006). Thus, the benefits of PA seem to persist in the elderly and enhance their health and quality of life.

Despite the above-mentioned benefits PA should not be considered a panacea against all diseases. Some aspects of health have not been correlated with PA in a convincing manner or not at all; for example the risk of stroke, the risk of specific types of cancer such as endometrial and ovarian cancer in women or testicular and prostate cancer in men (US Department for Health and Human Services, 1996; Cavill *et al.*, 2006). These health aspects highlight the limited applicability of the documented health benefits of PA. In addition, there are some adverse effects caused by engagement in PA. It is generally acknowledged that movement increases the risk for injury (Suitor & Kraak, 2007). Exercisers who walked, run or did other sports were at a higher risk of injury than sedentary individuals in both genders (Hootman, Macera, Ainsworth, Martin, Addy & Blair, 2001). A variety of exercise groups experience this unpleasant effect of PA mainly due to overtraining, but also by falls, collisions or other accidents (Cavill, Biddle & Sallis, 2001). Petridou (2001) examined data from eight EU member

states plus Israel and concluded that each year more than 700 individuals died from a sports injury in these countries, whereas about 700,000 were hospitalised. Additionally, ten million people every year experienced a sports injury requiring medical attention and half of them contacted a hospital (Petridou, 2001). The Greek data showed a higher injury risk than most other European countries despite the lower participation levels (Petridou, 2001); however, the injuries were less severe and the risk of hospitalisation was generally lower. Scientists have managed to estimate thresholds of PA which when exceeded result in increased injury risks with no additional fitness rewards (Suitor & Kraak, 2007). Thus, if carefully followed, participants can decrease the risk of injury without sacrificing fitness rewards. Petridou (2001) also highlighted three adverse effects of sports, namely the acute risks for those with compromised health (for example, the risk of a cardiac arrest), doping and over-concentration on sports. In a stochastic comment Suitor and Kraak (2007) likened PA to surgery since both potentially save and enhance the quality of life, clearly outweighing any possibilities of dangerous side-effects.

2.3. Health effects of physical activity for young people

Regarding young people, consensus statements and reviews argue that a physically active lifestyle has short- and more importantly long-term health benefits (Cavill *et al.*, 2001; European Heart Health Initiative, 2001; Strong *et al.*, 2005; Trost, 2005; US Department for Health and Human Services & US Department of Agriculture, 2005; Suitor & Kraak, 2007; Dobbins *et al.*, 2009), particularly for weight management; building and maintaining a healthy musculoskeletal and cardiovascular system; fostering mental health; and establishing healthy lifestyles early in life. Nevertheless, the strength and consistency of these associations in young people and also any dose-

response association have been questioned by reviewers of the literature (Cavill *et al.*, 2001; Twisk, 2001). These inconsistencies were possibly attributed to the high levels of health among young people that prevented improvements only evident in those suffering from health conditions such as hypertension or overweight (Suitor & Kraak, 2007). However, a more recent analysis of available literature suggested strong associations between PA and numerous health benefits in school-aged children and youth accompanied by a positive dose-response effect (Janssen & LeBlanc, 2010). This recent change in the findings of the literature might be based on the reverse argument of Suitor and Kraak (2007); since the health levels of young people have deteriorated in recent years (Lakdawalla, Bhattacharya & Goldman, 2001) the margins of enhancement are consequently extended. PA seems to play a crucial role in the health and physical development of young people but there are issues that need further clarification.

Both children and adults face the global epidemic of obesity (World Health Organisation, 1998). Overweight and obesity are among the biggest threats for people's health and their magnitude seems to be increasing (Hughes, Li, Chinn & Rona, 1997; Flegal, 1999; World Health Organisation, 2006). Almost 25% of schoolchildren in the EU are overweight and more than 400,000 new cases are being added every year (Lobstein & Baur, 2005). According to Reilly (2005) persistent obesity in childhood increases the risk of developing many serious chronic diseases both in childhood (poor glucose tolerance, hyperinsulinaemia, type 2 diabetes, hypertension and asthma) and later in adulthood (CHD, arteriosclerosis, certain types of cancer). Additionally, childhood obesity can increase the risk of psycho-social problems which can be carried over to adulthood (Edmunds, Waters & Elliott, 2001). These include low levels of self-esteem, psychological well-being, and life satisfaction accompanied by high levels of psychosomatic complaints (Lehrke, Koch, Hubel & Laessle, 2005; Reilly, 2005). PA

seemed to be significantly and inversely associated with undesirable body compositions (overweight and obesity status) in the majority of the 56 reviewed studies by Trost (2005). Furthermore, the lack of PA in 10 to 16 year-olds was robustly associated with overweight in 29 of the 33, primarily European countries, including Greece (Janssen, Katzmarzyk, Boyce, Vereecken, Mulvihill, Roberts, Currie & Pickett, 2005). Additionally, observational studies related lack of moderate to vigorous PA (MVPA) with obesity in a strong and consistent manner with a dose-response effect and also objective measures of PA (pedometers and accelerometers) showed a significant modest to strong relationship between PA and fitness with absence of overweight and obesity (Janssen & LeBlanc, 2010). Although physical inactivity is not the single cause of childhood and adolescent obesity, the preventive and therapeutic role of PA is indisputable (Strong *et al.*, 2005).

PA is regarded as one of primary modifiable factors for atherosclerosis (Fletcher, Blair, Blumenthal, Caspersen, Chaitman, Epstein, Falls, Froelicher, Froelicher & Pina, 1992). In turn, atherosclerosis is generally acknowledged as the single most important contributor to CVD (Wennloff, 2005). Atherosclerosis is caused by a mixture of lifestyle and heredity factors that work progressively from the first decades of life to reveal clinical symptoms much later (McGill, McMahan, Herderick, Malcom, Tracy, Strong & Pathobiological Determinants of Atherosclerosis in Youth (PDAY) Research Group, 2000; Libby, Ridker & Maseri, 2002; Roberts & Barnard, 2005). In that sense, early engagement in PA may reduce the risk of future CVD. Indeed, low levels of PA in Finn adolescents seemed to be predictive of CVD in adulthood (Raitakari, Juonala, Kahonen, Taittonen, Laitinen, Maki-Torkko, Jarvisalo, Uhari, Jokinen, Ronnemaa, Akerblom & Viikari, 2003) but this conclusion were not confirmed by the *Northern Ireland Heart Project* (Boreham, Twisk, Neville, Savage,

Murray & Gallagher, 2002). Additionally, longitudinal studies have shown that childhood PA levels were only weakly associated with CVD risk factors in adulthood (Kemper, Snel, Verschuur & Storm-van Essen, 1990; Lefevre, Philippaerts, Delvaux, Thomis, Claessens, Lysens, Renson, VandenEynde, Vanreusel & Beunen, 2002). Furthermore, PA only seems capable of influencing certain CVD risk factors of healthy young people such as body fatness and cardiopulmonary fitness and not others such as lipid levels, blood pressure and diabetes mellitus (Twisk, 2001). A recent systematic review (Janssen & LeBlanc, 2010) concluded that even low volumes of aerobic MVPA have consistently proven to produce favourable effects in blood lipid or lipoproteins levels in high-risk (mainly obese) children and young people and also in systolic and diastolic blood pressure in hypertensive or obese youngsters but was still inconclusive for the effect on youngsters with a metabolic syndrome. Thus, ambiguous results do not permit certainty regarding the protective role of early PA in current or later CVD risk in healthy youngsters but are more encouraging for those with certain health conditions.

Reviewers have also pointed out that several studies indicate a beneficial effect of PA on young people's skeletal health (Strong *et al.*, 2005; Suitor & Kraak, 2007; Janssen & LeBlanc, 2010) and consequently to their growth and maturation. Resistance training and weight-bearing activities have been associated with higher bone mineral density in children and adolescents (French, Fulkerson & Story, 2000; McKelvie, Khan & McKay, 2002; Trost, 2005). On the other hand, the evidence relating PA with muscular strength and endurance is equivocal (Suitor & Kraak, 2007), possibly due to the fact that specific resistance training and not habitual PA is needed to produce gains in them (US Department for Health and Human Services & US Department of Agriculture, 2005). Regarding mental health, a wealth of studies confirmed a strong

beneficial influence of PA with anxiety and depression in young ages (Strong *et al.*, 2005; Trost, 2005; Suitor & Kraak, 2007).

In their review of evidence regarding school-aged youth and PA Strong and co-workers (2005) concluded that additional curricular PA was positively associated with academic performance but only to a small degree. Even when the addition of PA was at the expense of other subjects' time the effect in academic performance was neutral (Shephard, 1997). Strong and co-workers (2005) also concluded that PA had positive relationships with indirect markers of academic performance such as concentration, memory, classroom behaviour and intellectual performance.

Participation in any activity incorporates an element of risk especially for children and young people. The risk of musculo-skeletal injuries is particularly increased at young ages, possibly due to their engagement in more dangerous activities. According to Petridou (2001) sports injuries were found to be the most common cause of injury and the second leading cause of hospital emergency department visits and hospital admissions in young people (13 to 19 year-olds) in Massachusetts (Rome, 1995). Furthermore, Janssen and LeBlanc (2010) concluded that physically active children and young people were more injury-prone with a dose-response relation with increased duration and intensity of PA. However, the injury rate for PA in school settings was estimated to be nearly zero during PE classes and very low for extra-curricular supervised activities (Strong *et al.*, 2005).

2.4. Conclusions

Numerous health benefits of PA have been documented for both young people and adults and a causal relationship has been inferred in adults. The primary role of PA in the protection and treatment of CVD seems to benefit active adults with improved health and longevity. Strong evidence suggests its positive association with serious health problems such as colon and breast cancer, type 2 diabetes and weight management. Additionally, there is sufficient evidence to indicate its positive influence on mental health and general well being. Lastly, increased PA can also be marginally benefitial to academic performance. However, there are aspects of health unrelated with PA and also some adverse effects appearing mostly by overuse or injuries. For young people, in particular, a physically active lifestyle seems to help their natural development and also to prevent and treat overweight and obesity. Associations of PA and health benefits are much weaker and more inconsistent than those reported for adults although the strength of these associations seems to have increased according to recent data. Furthermore, early PA has not been documented to decrease current or later CVD risk in healthy young people. Thus, it could be argued that research has provided valuable knowledge of the health effects of PA for all ages. The key issue for those engaged in the field of PA promotion is the level of adoption of this knowledge by the general public and its application in their everyday lifestyle. A translation of this knowledge to active lifestyles by a large proportion of the population would produce a beneficial public impact. Consequently, the next chapter assesses the prevalence of PA among adults and young people globally and, specifically, among the Greek population.

Chapter 3. Prevalence of physical activity

3.1. Introduction

Despite the common knowledge that PA is beneficial to health and the ever-increasing scientific evidence of this notion, the majority of people seem to adopt an inactive lifestyle. The most alarming fact though, is that this pattern emerges early in life. Young people are considered the future of each society and because of their potential they should be treated with extra care. They are considered to be inherently physically active but, as it will be shown next, this behavioural characteristic seems to be lost quite early in childhood. Thus, the worldwide epidemic of physical inactivity is growing in young people, as well.

3.2. Prevalence of physical activity in adults

All around the world, the majority of people do not seem to take advantage of the health benefits derived from the embracement of an active lifestyle. The *2002 World Health Report* (World Health Organisation, 2002) described the above situation in the year 2000 across all 14 sub-regions of the five continents. Seventeen percent of the adult population ($\geq$15 years) was estimated to be physically inactive (doing very little or no PA). Furthermore, 41% was estimated to engage in some but insufficient activity (<2.5 hours per week of moderate activity). The two averages mentioned above produce a global average of 58% of adults not engaging in sufficient PA to promote health. Disappointing figures have also been published recently in relation to European populations. A percentage as high as 69% of EU adults ($\geq$15 years old) did not reach recommended levels of health-enhancing PA (HEPA) in 2002 *(Sjöström, Oja,*

Hagströmer, Smith & Bauman, 2006). Thus, high proportions of the global population seem to be lacking the health benefits of sufficient PA.

There is evidence to support a biological explanation behind the low prevalence of PA. In a review of non-human literature, Ingram (2000) showed that age-related decline in physical activity (after maturation) is spread in a wide range of species and thus it seems to have a strong biological basis. The biological purpose of playful PA across all animals and particularly in the young is considered to be the stimulation of the central nervous system, a mechanism that is lost during maturation, which could possibly explain the decrease in PA (Thorburn & Proietto, 2000). The biological drive to store and maintain body weight might explain the control of PA with age because it is consuming large amounts of energy (Thorburn & Proietto, 2000). The above remarks could partly explain the difficulty of maintaining an active lifestyle.

3.3. Prevalence of physical activity in young people

In accordance with the most recent recommendations of at least an hour of moderate PA five or more days of the week (Cavill *et al.*, 2001; Strong *et al.*, 2005; US Department for Health and Human Services & US Department of Agriculture, 2005) several international and national questionnaire surveys have reported low levels of PA. In most studies the majority of youth populations seemed to be insufficiently active (see: table 3.1). An international survey of health behaviour among young people aged 11, 13 and 15 years revealed low prevalence of PA in numerous countries of the Western world. In particular, in 32 European countries, US and Canada only one third of the youth population was found to be physically active (Currie *et al.*, 2004). The same percentage was also found for an even wider age-range (12-18 year-old

adolescents) in a national representative Finnish sample (Hämäläinen, Nupponen, Rimpelä & Rimpelä, 2000). However, higher activity percentages were reported by the Department of Health (2000) regarding 7 to 18 year-olds in England, with approximately half being physically active for an hour per day. This higher percentage in England could possibly be attributed to the younger age range of the sample. Similar percentages were repeated in Sweden, where almost half of the 14-16 year-olds spent at least an hour per day in moderate PA (Ekelund, Sjostrom, Yngve & Nilsson, 2000), as measured by the more objective method of heart rate monitoring (HRM). Dobbins and colleagues (2009) concluded that international surveys of PA consistently report less than half of the children and adolescents to be physically active in a health-enhancing manner. Thus, the majority of adolescents in the Western-World do not seem to meet current recommendations for PA.

Table 3.1. Studies of participation in physical activity by young people

Study	Sample	Method	Variable	Age (yrs)	Total active	men	Active women
Currie *et al.* (2004) in 32 European Countries US and Canada	162,306	Q	MPA>1hr at least 5 t/wk	11,13,15	34%	-	Mostly less active
Heath *et al.* (1994) in the USA	11,631	Q	VPA>3x20min/wk	15-18	37%	50%	17%-31%
Hämäläinen *et al.* (2000) in Finland	70,351	PQ	VPA≥4 times/week	12-18	34%	40%	27%
NIPO (1999) in the Netherlands	-	-	VPA 1hr/day	16-24	20%	-	Less active
Ferrando (2000) In Spain	-	-	PA≥3t/wk	15-24	60%	-	Less active
Fuchs *et al.* (1988) in Germany	932	LG, Q	VPA 30-120 m/wk	12-14 and 14-16	18%<30min/week 30min/wk<30%<12min/wk		
Department of Health (2000) in England	1,424	7-day AD	PA≥1 hour/day	7-18	50%	61%	42%
Smithers *et al.* (2000) in the UK	1,701	7-day AD	Duration of MPA or VPA	7-18	-	-	Less active
Friel *et al.* (1999) Health behaviour of school-aged children in Ireland	-	Q	Ex≥4 t/week	School-aged	-	62%	45%
Kelleher *et al.* (2003) Health behaviour of school-aged children in Ireland	5,712	Q	Ex≥4 t/week	School-aged	-	58%	38%
Telama and Yang (2000) in Finland	2,309	LG, Q	Index of PA	9, 12, 15, 18	-	-	Mixed results
Wennloff (2005) in Sweden	1,137	AC	PA level	9-10 and 14-15	-	-	Less active
Riddoch *et al.* (2004) in Denmark, Portugal, Estonia, and Norway	2,185	AC	-	9 and 15	-	-	Less active
Ekelund *et al.* (2000) in Sweden	82	HRM	PA≥30min/day	14-16	49%	-	Same
Armstrong *et al.* (1990) in England	266	HRM	VPA 5-, 10-, 20-min bouts	11-16	-	-	Less active

PA= Physical Activity, VPA = Vigorous PA, MPA = Moderate PA, Ex = Exercise, LG=Longitudinal, Q=questionnaire, PQ=postal questionnaire, AD=Activity Diaries, HRM=Heart rate monitors, AC=accelerometers, hr=hour, wk=week, min=minutes, t=times.

Intensity is another aspect of PA that can account for measurement variations of participation. The *Pan-American Health Organisation* (2002) argued that vigorous exercise performed three times a week has equivalent health effects as PA of moderate intensity practised daily or at least five days a week. Additionally, for health aspects dependent on expended energy, such as weight management, vigorous PA (VPA) can be quite energy-consuming (Kesaniemi, Danforth, Jensen, Kopelman, Lefevre & Reeder, 2001; Shephard, 2001). As it will be shown next, there seem to be plenty of different interpretations of the amount of VPA needed to be physically active. The *US National Youth Risk Behaviour Survey* (Heath et al., 1994) estimated 37% of 14-18 year-old US students were vigorously active at least three times per week, 20 minutes at a time. In the *Berlin-Bremen Study of Health Behaviour in Childhood and Adolescence* (Fuchs et al., 1988), approximately 30% of 12-14 year-old students spent 30 to 120 minutes per week in vigorous PA. In the Netherlands, 20% of young people aged 16-24 years were active for an hour of 'intensive' activity per day (Netherlands Institute of Public Opinion, 1999). Thus, despite the application of several different activity criteria for VPA low participation is evident among the youth population.

Gender also seems to play an important differentiating role in PA participation. Several reviews have concluded that both children and adolescent boys are active in higher proportions than girls (Sallis, Prochaska & Taylor, 2000; Dobbins et al., 2009). Moreover, Currie and co-workers (2004) confirmed that in most of the 32 countries across Europe, US and Canada boys were more active than girls. Other surveys from several countries like England (Armstrong *et al.*, 1990; Department of Health, 2000), the UK (Smithers *et al.*, 2000), the USA (Heath *et al.*, 1994), the Netherlands (Netherlands Institute of Public Opinion, 1999), Spain (Ferrando, 2000), Finland (Hämäläinen *et al.*, 2000) and Sweden (Wennloff, 2005) have reported higher levels of

activity among boys (see: table 3.1). The above studies were mostly dependent on self-report measures but some of them confirmed these findings by utilising more objective measures such as HRMs and accelerometers (see: table 3.1). Apparent gender differences were evident in most studies using several criteria such as type, intensity and frequency of PA and also in several age groups (see: table 3.1). However, exceptions of the previous canon do exist. Such is the study by Ekelund and colleagues (2000) in Sweden, which used HRM and found no gender differences in PA level or time spent in PA. To make the issue even more intriguing, a longitudinal study of young Finns (Telama & Yang, 2000) that covered the ages from 9 to 27 years, revealed one interesting result. In particular, boys were more active than girls until the age of 15 years when girls became more frequent participants. To conclude, in most cases girls seem to be more at risk of physical inactivity and thus, should be treated with extra care and attention.

There seems to be a decline in PA as young people grow from childhood to adolescence and to young adulthood (Telama & Yang, 2000; Tammelin, 2005; Dobbins *et al.*, 2009). This has been repeatedly shown in a series of cross-sectional and longitudinal studies, using various methods of PA assessment. However, the most appropriate design for investigating this issue is considered to be the longitudinal one since it follows the same participants through time and compares their evolutionary differences. In contrast, a cross-sectional design compares different participants of various ages at the same time point and thus, any differentiation might not be due to true variability between ages but to sources of bias.

A longitudinal study of West-German 12-14 year-old students (Fuchs *et al.*, 1988) concluded that weekly engagement in LTPA seemed to decline by 10% during a

2-year period. Cross-sectional data confirmed the above findings in a wide range of countries and by using both self-report (questionnaires, activity diaries) and more objective measures of PA such as accelerometers. An international survey of health behaviour among young people aged 11, 13 and 15 years (Currie *et al.*, 2004) in 2001–2002, found that in most investigated countries, PA declined with age in both sexes. In a different study of four European countries a substantial decline in PA levels was found between the ages of 9 and 15 years using accelerometers (Riddoch *et al.*, 2004). The same measurement method found PA levels of 14-15 year-olds in Sweden to be lower compared to 9-10 year-old fellow-students (Wennloff, 2005). In several other countries such as England (Department of Health, 2000) and the Netherlands (Netherlands Institute of Public Opinion, 1999) participation in PA seemed to decline between the age ranges of 7-18 years and 16-24 years, respectively. Additionally, time devoted to MPA or VPA seemed to decline with age among 7-18 year-olds in the UK as measured by 7-day diaries (Smithers *et al.*, 2000). Thus, the age decline of PA is confirmed in different countries, ages and facets of PA and by using different methods of assessment.

Although the starting age of the decline cannot be easily detected (Dobbins *et al.*, 2009), the critical point seems to be in early or middle adolescence (Malina, 2001), as confirmed by several studies. An international cross-sectional study (Riddoch *et al.*, 2004) found that at the age of 9 years, the great majority of boys and girls (97%) achieved current health-related PA recommendations while at the age of 15 years, fewer achieved these guidelines. Hence, it seems that the decline starts between the ages of 9 to 15 years. Additionally, a longitudinal study of 9 to 18 year-old Finns (Telama & Yang, 2000) showed a remarkable decline after the age of 12 years in frequency of PA and sport participation. Several other cross-sectional studies supported this decline. In Ireland exercise levels decreased from 63% in 9-11 year-olds to 58% in 12-14 year-olds,

and more sharply to 40% for 15-17 year-olds (Friel *et al.*, 1999). Participation in one to six sessions per week of VPA outside of school in Austria, England, Finland, and Norway dropped from 61% in 11 year-olds to 50% at the age of 15 years (Cale & Almond, 1992). Furthermore, the decline seems to continue into young adulthood. A survey in Spain (Ferrando, 2000) revealed that 67% of 15-17 year-olds were physically active at least three times per week, dropping to 49% among 18-24 year-olds. Thus, the decline of PA seems to start in early adolescence and continue at least until early youth.

To conclude, the prevalence of PA appears low even among young people, who are considered potentially the most active part of the population. Another general finding is that girls are less active than boys and thus at greater risk. Finally, the proportion of active youth seems to decline with age and the onset could be traced to early adolescence.

3.4. Participation in physical activity and exercise in Greece

The prevalence of PA in Greece is of paramount concern for this thesis since it is the location of the research project. Most of the information in this section is drawn from a recently published narrative review of research relevant to participation in PA and exercise in Greece (Tzormpatzakis & Sleap, 2007). It was claimed to be the first of its kind for Greece including 36 papers concerning 15 studies published between 1993 and 2006. A methodological limitation of the available studies was the absence of published longitudinal data, which are considered to possess higher methodological quality (Biddle, Gorely & Stensel, 2004). Another shortcoming was that all studies relied on self-report measures of PA. Notably, all associations were two-tailed and set at a 95% confidence interval. In order to be able to evaluate the significance of the Greek

studies their key characteristics are presented in table 3.2 and a short description of each one can be found in Appendix A.

3.4.1. Discussion for Greece

A systematic review of literature provided sufficient data regarding participation in PA and exercise in Greece. However, care needs to be taken in interpreting these results due to the following limitations. None of the studies used an objective method of measuring PA. Most of the results were self-reported estimates of PA. However, this limitation is a common finding in the field, especially in large-scale studies (Pols, Peeters, Kemper & Grobbee, 1998; Trost, Owen, Bauman, Sallis & Brown, 2002). Also, different self-report measures of PA were utilised, which complicates comparisons. Furthermore, none of the instruments were validated in Greece and therefore there is reasonable concern as to whether they possessed satisfactory levels of validity and reliability for the Greek population.

Many different aspects of PA were investigated, namely; TPA, HEPA, LTPA, OPA, household PA, activity for transportation, exercise and sports. Many earlier studies seemed to confuse the terms PA and exercise or use them interchangeably. The same problem was recognised by Caspersen and co-workers (1985) and the US Department for Health and Human Services (1996). The majority of studies focused on exercise and sports, LTPA and OPA. Few studies provided data for household PA and TPA. However, when investigating PA for health purposes total lifestyle needs to be estimated since according to US Department for Health and Human Services (1996) and Margetts and co-workers (1999) all forms of PA contribute to total energy expenditure. It is noticeable that the recent trend focuses more on TPA or HEPA.

Table 3.2. Characteristics of selected studies examining participation in physical activity and exercise in Greece

Study/paper	Greek sample			Type	Scale	variable
	n	Men	Age (yrs)			
Eurobarometers						
Eurobarometer 58.2 (2003)	1,000	49%	15+	EU 15	Nationally R	TPA
Rütten and Abu-Omar (2004)	1,000	49%	15+	EU 15	Nationally R	TPA
Sjöström *et al.* (2006)	1,000	49%	15+	EU 15	Nationally R	TPA
Eurobarometer 64.3 (2006)	1,000	49%	15+	EU 25	Nationally R	TPA
Eurobarometer 52.1 (2000)	1,000	49%	15+	EU 15	Nationally R	Exercise
Eurobarometer 60.0 (2003)	1,000	49%	15+	EU 15	Nationally R	E and S
Eurobarometer 62.0 (2004)	1,000	49%	15+	EU 25	Nationally R	E and S
Pan-EU study						
Kearney *et al.* (1999a)	1,011	44 %	15-65+	EU 15	Nationally R	LTPA
Margetts *et al.* (1999)	1,011	44 %	15-65+	EU 15	Nationally R	LTPA
De Almeida *et al.* (1999)	1,011	44 %	15-65+	EU 15	Nationally R	LTPA
Zunft *et al.* (1999)	1,011	44 %	15-65+	EU 15	Nationally R	LTPA
Varo *et al.* (2003)	1,011	44 %	15-65+	EU 15	Nationally R	Sedentariness
EPIC study						
Haftenberger *et al.* (2002)	9,669	38 %	50-64	International	Large scale	LTPA+O
EHBS study						
Steptoe *et al.* (1997)	639	46 %	18-30	International	Large scale	Exercise
IHBS study						
Steptoe *et al.* (2002)	1,468	46 %	17-30	International	Large scale	Exercise
ATTICA study						
Pitsavos *et al.* (2005b)	3,042	50 %	18-89	Regional	Large scale	LTPA
Pitsavos *et al.* (2003b)	3,042	50 %	18-89	Regional	Large scale	LTPA
Panagiotakos *et al.* (2005a)	3,042	50 %	18-89	Regional	Large scale	LTPA
Panagiotakos *et al.* (2006)	3,042	50 %	18-89	Regional	Large scale	LTPA

Table 3.2 continued						
Pitsavos *et al.* (2005a)	3,042	50 %	18-89	Regional	Large scale	LTPA
Panagiotakos *et al* (2005b)	3,042	50 %	18-89	Regional	Large scale	LTPA
Manios *et al.* (2005)	3,042	50 %	18-89	Regional	Large scale	LTPA
Skoumas *et al.* (2003)	2,772	50 %	18-89	Regional	Large scale	LTPA
Panagiotakos *et al.* (2003)	2,772	50 %	18-89	Regional	Large scale	LTPA
Panagiotakos *et al.* (2004a)	2,282	49 %	18-89	Regional	Large scale	LTPA
Panagiotakos *et al.* (2004b)	2,266	48 %	18-89	Regional	Large scale	LTPA
Pitsavos *et al.* (2003a)	1,856	48 %	18-89	Regional	Large scale	LTPA
Skoumas *et al.* (2002b)	1,480	44 %	18-89	Regional	Large scale	LTPA
Skoumas *et al.* (2002a)	1,480	44 %	18-89	Regional	Large scale	LTPA
Pitsavos *et al.* (2006)	853	53 %	18-89	Regional	Large scale	LTPA
Panagiotakos *et al.* (2004c)	853	53 %	18-89	Regional	Large scale	LTPA
Other important studies						
Papaioannou *et al.* (2004)	6,091	49 %	11,13,16	Stratified	National	E and S
Milias *et al.* (2006)	5,003	49 %	18-74	National	Nationally R	LTPA+W
Athyros *et al.* (2005)	4,153	49 %	18+	National	Nationally R	LTPA+W
Pitsavos *et al.* (1998)	2,009	100 %	18-24	Worksite	Large scale	Exercise
Adamopoulos *et al.* (1993)	1,205			Regional	Large scale	LTPA+OPA
Trigonis *et al.* (2002)	171	54 %	18-65	Worksite	Small scale	Exercise

Notes: Nationally R = nationally representative, TPA = Total physical activity, LTPA = leisure time physical activity,

OPA = occupational physical activity, E and S = Exercise and Sports, W = work type, EU 15 or 25 = 15 or 25

European Union member states.

The criterion for participants to be considered physically active was usually participation in some kind of PA once per week or per two weeks, which is less demanding than the internationally established guidelines which have set the criteria of at least 30 minutes of moderate intensity PA, three to five times per week (US Department for Health and Human Services, 1996). In most cases the less demanding criteria would have led to overestimation of the active proportion of the sample. On the other hand, these criteria led to a more valid categorisation of sedentary participants. Consequently, sedentary rather than active behaviour has been reported where meaningful.

Another issue that should be addressed is the seasonality effect, since seasonal variation exists in PA participation (Tucker & Gilliland, 2007). Data collection in most studies was usually completed in one to two months and thus, seasonal participation was estimated, which might be different from that of the whole year. Most studies collected data during autumn or spring. This is done to avoid the extreme differences that have been observed between winter and summer participation (US Department for Health and Human Services, 1996). However, in the *EPIC* study (Haftenberger, Schuit, Tormo, Boeing, Wareham, Bueno-de-Mesquita, Kumle, Hjartaker, Chirlaque, Ardanaz, Andren, Lindahl, Peeters, Allen, Overvad, Tjonneland, Clavel-Chapelon, Linseisen, Bergmann, Trichopoulou, Lagiou, Salvini, Panico, Riboli, Ferrari & Slimani, 2002) where seasonality was investigated total time devoted to recreational activity in the summer was higher than in the winter in all European centres. Thus, the seasonality effect adds another complicating factor in the assessment of PA and the comparison between studies.

Taking the above limitations into account it could be concluded that participation in PA and exercise in Greece has been generally low, both in absolute and comparable terms (see: table 3.3). In comparative terms, the prevalence of PA and exercise in Greece during the 1990s and 2000s seemed to be one of the lowest in the EU (Kearney, de Graaf, Damjkaer & Engstrom, 1999b; European Opinion Research Group, 2000; Varo, Martínez-González, De Irala-Estévez, Kearney, Gibney & Martínez, 2003), especially in university students (Steptoe, Wardle, Fuller, Holte, Justo, Sanderman & Wichstrom, 1997; Steptoe, Wardle, Cui, Bellisle, Zotti, Baranyai & Sanderman, 2002). In absolute terms, Eurobarometers that examined total PA found the majority of Greeks (50%-82%) to participate in little or no OPA and LTPA (European Opinion Research Group, 2003a; 2006; Sjöström *et al.*, 2006). In the household a minority (24%-44%) seemed to participate in little or no PA. The studies that examined LTPA found that prevalence of sedentariness ranged from 50% to 69% in samples taken from the capital of Athens (see: *ATTICA* studies in table 3.3.) and from 70% to 81% in national samples (Varo et al., 2003; Athyros, Bouloukos, Pehlivanidis, Papageorgiou, Dionysopoulou, Symeonidis, Petridis, Kapousouzi, Satsoglou & Mikhailidis, 2005; Milias, Panagiotakos, Pitsavos, Xenaki, Panagopoulos & Stefanadis, 2006). The two studies that examined both work-type and LTPA found 75%-81% nationwide to be sedentary. These extended ranges mentioned above were common in other countries, such as the USA where, depending upon definition, 25%-60% of US adults have been considered sedentary (Dishman & Buckworth, 1996). Moreover, the Eurobarometers that examined exercise and sports found a large proportion of the Greek population (81%) participating less than twice per week in 1999 and a declining trend of non-participants from 2002 to 2005 (75% vs. 57%). In addition, recent studies have shown a promising upward trend for participation in sports and exercise (European Opinion Research Group, 2004) and also PA (European Opinion Research Group, 2006). Possible explanations might be the

organisation of the Olympic Games in Greece during 2004 and also the winning of Euro 2004 by the Greek national football team and first and second places of the Greek national basketball team in the European and World championships. This link is clearly evident in the comparison between Eurobarometer 60.0 and Eurobarometer 62.0 (Exercise and Sports), which were conducted respectively just before and after the above events (see: table 3.3).

Exceptionally low levels of sedentary behaviour were shown by Greek army recruits and army personnel (Pitsavos, Skoumas, Dernellis, Toutouza, Doulalas, Stefanadis & Toutouzas, 1998; Athyros et al., 2005). This could be attributed to the combination of demands of their occupation and their young age and should not be considered as representative of the wider population. In another young cohort of university students an inactive lifestyle was evident in great proportions (Steptoe *et al.*, 1997; Steptoe *et al.*, 2002), which is in accordance with the following international findings. In a review, Irwin (2004) concluded that more than half of university students in the US, Canada, China and 40% in Australia were insufficiently active to derive health benefits. Thus, it could be argued that occupational status might be more influential than age with regard to participation in PA.

Table 3.3. Results of selected studies examining participation in physical activity and exercise in Greece

Study / paper	variable	sedentary	men	women	p (sex)
Eurobarometers					
Eurobarometer 58.2 (2003)	TPA	51%/50%/24%[a] 61%/50%/24%[b]			
Rütten and Abu-Omar (2004)	TPA	1.98/3.06/ 4.18/38.57 [c]	2.37/2.91/ 4.27/42.12[c]	1.56/3.22/ 4.07/35.12[c]	SS/SNS/ SNS/SS [c]
Sjöström et al. (2006)	TPA	32%/37%/ 37%/35% [d]	28%/38%/ 43%/39% [d]	37%/35%/ 31%/31% [d]	SS/SNS/ SS/SNS [d]
Eurobarometer 64.3 (2006)	TPA	67%/82%/44%[a] 28%/5%/3%[b]			
Eurobarometer 52.1 (2000)	Exercise	81 %			
Eurobarometer 60.0 (2003)	E and S	75 %			
Eurobarometer 62.0 (2004)	E and S	57 %			
Pan-EU study					
De Almeida et al. (1999)	LTPA		33 %	48 %	SS
Varo et al. (2003)	Sedent.	70 %			
EHBS study					
Steptoe et al. (1997)	Exercise	54 %	45 %	71 %	SS
IHBS study					
Steptoe et al. (2002)	Exercise	41 %			
ATTICA study					
Pitsavos et al. (2005b)	LTPA	50 %	47 %	52 %	<0.05
Pitsavos et al. (2003b)	LTPA	58 %	57 %	59 %	SNS
Panagiotakos et al. (2005b)	LTPA	58 %	57 %	59 %	SNS
Panagiotakos et al. (2006)	LTPA	58 %	57 %	59 %	<0.01
Pitsavos et al. (2005a)	LTPA	57 %	56 %	58 %	
Panagiotakos et al. (2005a)	LTPA	59 %	58 %	61 %	

Table 3.3. continued					
Skoumas *et al.* (2003)	LTPA	59 %	58 %	60 %	0.06
Panagiotakos *et al.* (2003)	LTPA	59 %	58 %	60 %	
Panagiotakos *et al.* (2004a)	LTPA	61 %	59 %	63 %	<0.01
Pitsavos *et al.* (2003a)	LTPA	62 %	64 %	60 %	
Skoumas *et al.* (2002b)	LTPA	57 %			
Skoumas *et al.* (2002a)	LTPA	57 %			
Pitsavos *et al.* (2006)	LTPA	55 %	50 %	60 %	0.58
Panagiotakos *et al.* (2004b)	LTPA	55 %	50 %	60 %	0.58
Other important studies					
Papaioannou *et al.* (2004)	E and S	14%/11%/26%[f]	57%/69%/59%	31%/44%/25%	<0.01
Milias *et al.* (2006)	LTPA+W	75 %	68 %	82 %	<0.01
Athyros *et al.* (2005)	LTPA+W	81 %			
Adamopoulos *et al.* (1993)	Walking	63 %[e]	53 %[e]	73 %[e]	SS
Pitsavos *et al.* (1998)	Exercise	24 %			

Notes: TPA = Total physical activity, LTPA = leisure time physical activity, E and S = Exercise and Sports, Sedent. = Sedentariness,

W = work type, SS = Statistically significant at 95% CI, SNS = statistically non-significant at 95% CI

[a] little or no physical activity at work / little or no recreation, sport and leisure-time activities / little or no household physical activity

[b] vigorous physical activity / moderate physical activity / walking at least 10 minutes at a time

[c] mean energy expended in TPA (MET·h/week) / frequency of (days per week): vigorous physical activity / moderate physical activity /

walking at least 10 minutes at a time

[d] sedentariness / sitting / sufficient total physical activity / walking at least 5 x 30 min / week

[e] walked less than 7 km/week [f] no exercise at all

Cross-sectional data (Papaioannou *et al.*, 2004) indicate that Greek senior high school students were significantly more sedentary than their younger school mates from elementary or high school, a trend evident in both genders (see: table 3.4). Within-gender comparisons were performed for different facets of PA between different school levels. Regarding no exercise at all, a small decrease (5%) was found from elementary to junior high school only in girls. Furthermore, both genders revealed a higher percentage of inactivity in senior high school compared to junior high school. For both genders, frequent vigorous sport or exercise increased in junior high school compared to elementary school and then dropped in senior high school. Lastly, regular vigorous out-of-school exercise increased only in junior high school. Regarding gender differences significantly more girls had no exercise at all in Greek elementary and senior high school (see: table 3.4), while boys revealed higher proportions of frequent vigorous sport or exercise in all school levels. Regular vigorous out-of-school exercise was not significantly different between genders in all school levels. However, these results should be considered only indicative of between-ages trends since the data were cross-sectional.

Table 3.4. Percentage of Greek secondary students adopting activity behaviours

	Elementary school		Junior high school		Senior high school	
	Aged 11–12		Aged 13–14		Aged 16–17	
	Boys	Girls	Boys	Girls	Boys	Girls
Vigorous Sport or Exercise more than ten times per month	**57%**	**31%**	**69%**	**44%**	**59%**	**25%**
Regular vigorous out-of-school exercise	61%	57%	67%	67%	65%	61%
No exercise at all	**11%**	**17%**	9%	12%	**21%**	**30%**

Note: Percentage differences larger than 5.0 (in bold) are significant at p<0.01

Most of the studies that examined gender differences revealed Greek women to be sedentary in higher proportions than men (see: table 3.3). In a review, Trost and co-workers (2002) found the same trend in a large number of studies from different countries. Greek females and female students also seemed to exercise less frequently than males (Steptoe *et al.*, 1997; European Opinion Research Group, 2000; 2003b; 2004), a feature also identified by Irwin (2004) in his review of university students from different countries.

In the Attica region (inside and nearby Athens, the capital of Greece) single people were more likely to be physically active compared to those who were married or divorced/widowed (Pitsavos *et al.*, 2005b), and people living in rural areas were more likely to be physically active than those living in urban areas (Skoumas *et al.*, 2003; Pitsavos *et al.*, 2005b). The findings of nationally representative data highlight higher non-participation rates among lower educated cohorts in the EU, including Greece (Zunft, Friebe, Seppelt, Wildhalm, Remout de Winter, Vaz de Almeida, Kearney & Gibney, 1999; European Opinion Research Group, 2000; 2003b; 2004). In accordance, Trost and colleagues (2002) found that in a large number of studies socioeconomic, occupational and educational status were associated with PA. The above conclusions were also confirmed by national US surveys (US Department for Health and Human Services, 1996). On the contrary, no statistically significant associations were found between PA levels and educational level, annual income or socio-economic status in the Attica region (Pitsavos *et al.*, 2003a; Panagiotakos *et al.*, 2004b; Manios *et al.*, 2005; Panagiotakos *et al.*, 2005a; Pitsavos *et al.*, 2005b). Lastly, Eurobarometers of Sport and Exercise (European Opinion Research Group, 2000; 2003b; 2004) identified increased age as a negative factor for participation.

People in physically demanding occupations seemed to refrain from PA during their leisure time (Margetts *et al.*, 1999; European Opinion Research Group, 2000; 2003b; 2004; Pitsavos *et al.*, 2005b). A possible explanation might be that those who get physically tired by their work might not wish to engage in more PA in their leisure time. Greece had the highest proportion of workers in physically demanding occupations (Haftenberger *et al.*, 2002), possibly due to the large numbers of manual workers and farmers in the country. Nevertheless, it would be misleading to attribute the low levels of physical recreations in Greece only to the high prevalence of manual work, since inactivity is also common among university students (Steptoe *et al.*, 1997; Steptoe *et al.*, 2002) who are mainly involved in a sedentary type of work/study.

3.4.2. Conclusions for Greece

A number of limitations were identified for the examined studies. Firstly, lack of objective methods of measuring PA and lack of validation of research instruments in Greek samples weakened their validity. Secondly, many different aspects of PA were investigated, which complicated comparisons, since most did not focus on TPA or HEPA. Furthermore, the criterion to be considered physically active was usually less demanding than the internationally established one, which probably resulted in overestimation of the active part of the population. Lastly, in most studies seasonality was not taken into consideration in data collection, which could have biased the results.

Despite the above limitations, which are not unknown in PA epidemiology, a general picture could be drawn. Prevalence of PA and exercise in Greece were found to be low in the 1990s and 2000s, both in absolute and comparable terms. More recent data revealed the development of a more active profile of the Greeks regarding PA, sports

and exercise. Influencing factors such as age, gender, type of work, marital status, residence and educational background were identified.

A clear outcome could be derived from the above results regarding implications for public health. There are major parts of the Greek population in various age cohorts that are under serious threat regarding their present or future health as a consequence of a sedentary lifestyle. A recent trend towards increased PA should be sustained and reinforced in order to achieve long-term results. High-risk populations need interventions to change their lifestyles both in the short- and long-term.

3.5. Consequences of low physical activity prevalence

As a result of low PA levels the health and longevity of Greek people seem to be seriously affected. On a global level in the year 2000 physical inactivity was estimated to cause 1.9 million deaths, 15.8 million years of life lost (YLL) and 19 million disability-adjusted life years (DALYs) (World Health Organisation, 2002). One DALY is a measure of population health accounting for one lost year of "healthy" life due to premature mortality or disability (Murray, Salomon & Mathers, 2000). Furthermore, physical inactivity is recognized as a major independent risk factor for morbidity (3.5% of total) and mortality (up to 10% of deaths) in the European Region (World Health Organisation, 2007). Physical inactivity is estimated to cause 600,000 deaths per year in the EU (5–10% of total mortality across countries) and leads to a loss of 5.3 million DALYs (Health-Enhancing Physical Activity Europe, 2005). The *2002 World Health Report* estimated physical inactivity to be the cause of 10–16% of cases world-wide of breast cancer, colon cancer, rectal cancer and diabetes mellitus, independently, and

about 22% of ischaemic heart disease (World Health Organisation, 2002). It is clear that a physically inactive lifestyle is a major health burden worldwide and, in particular, in Greece needing serious consideration and actions. However, in order for efforts to be as effective as possible the starting age of the problem and those in greater risk need to be identified. Tracking of PA is a way of examining this kind of trends longitudinally and thus research concerning tracking is analysed in the following chapter.

Chapter 4. Tracking of physical activity

4.1. Introduction

A physically active lifestyle while young assists sound growth and development and helps to prevent the onset of major lifestyle diseases like CHD and obesity. However, the greater value of PA may lie in the establishment of lifelong habits of participation since any short-term benefits in fitness or cardiac risk profile would not persist for long if the lifestyle is changed to an inactive one (Shephard & Trudeau, 2000). Thus, it is critical to examine physically active behaviour over the short and long term.

The lifespan could be considered as a series of interrelated transitional periods that create patterns of consistency (Malina, 1996). PA habits, skills and attitudes developed during childhood and adolescence have been assumed to continue into adulthood (Yang, Telama, Leino & Viikari, 1999; Twisk, Kemper & van Mechelen, 2000; Aarnio, Winter, Peltonen, Kujala & Kaprio, 2002). In order to test this hypothesis researchers examine the tracking or stability of PA, which refers to the preservation of a variable's relative rank within a group over time (Beunen, Malina, Renson, Simons, Ostyn & Lefevre, 1992), or equally the predictability of an earlier measurement for the value of the same variable in a later measurement (Twisk *et al.*, 2000). Based on the above definitions at least two longitudinal measurements of a variable are required to identify its tracking. However, it should be stressed that tracking is examined only between these two points in time and not for the whole time period in-between. Especially when the time interval is very extensive a number of changes back and forth from inactivity to activity might have occurred and not be detected and considered.

Furthermore, since tracking refers to the preservation of the relative positions within a group if most individuals alter their PA levels the sample would show high tracking even though their absolute PA levels might have altered (Twisk *et al.*, 2000). Thus, if PA tracking is high then prevention or intervention at a certain age could have more influence on future behaviour but, if it is low, then earlier events would be less influential to later behaviour. The most common method used for estimating tracking is correlation analysis between repeated measurements. Correlation coefficients (r) are considered low if found below 0.30, moderate if found between 0.30 and 0.60 and strong if found above 0.60 (Malina, 1996; 2001).

4.2. Tracking in different life-periods

In the following analysis childhood, adolescence, young adulthood and adulthood were chosen as the most suitable time periods to study tracking of PA, as has been done in past reviews (Malina, 1996; 2001). Only longitudinal studies were included because their methodology is the only appropriate one for the measurement of stability (see: appendix A.1 for a description of tracking studies). There was no exception to the method of data collection by self-report, which is the most common method of estimating PA (Thomas & Nelson, 2001; Trost *et al.*, 2002; Armstrong & Welsman, 2006) and is also considered as the only feasible measurement method of PA in large-scale surveys (Booth, 2000). However, the limitations of this approach such as potential for self-report bias, errors in recall, difficulty in gaining an accurate picture of habitual activity (Snel & Twisk, 2001) could lead to overestimation or underestimation of involvement in PA (Ainslie, Reilly & Westerterp, 2003). Lastly, it should be noted that the self-report measures of PA differed from study to study, since there is no

international agreed measure of PA (Booth, 2000), and thus comparisons across studies should be approached with caution.

4.2.1. Tracking during childhood and adolescence

The investigated literature revealed research projects from Finland, USA, Canada, Holland, Belgium, Portugal and Estonia (see: appendix B; table AB.1) that studied stability of PA during childhood (3-12 years) and adolescence (13-18 years). One-year intervals produced moderate to high correlation coefficients. Regarding the 2-year intervals tracking was low to moderate for boys and low to high for girls. In accordance with a recent review (Malina, 2001), moderate tracking was found for 3- and 4-year intervals for both genders. Low to moderate tracking was found for 5-year intervals in boys and low in girls. The 6-year intervals produced low to moderate tracking for boys and low for girls. Non-significant correlations were found for 7-year intervals in both genders. Lastly, low correlations for both genders were found for 9-year intervals.

4.2.2. Tracking from childhood and adolescence into young adulthood

The examined literature revealed research projects from Finland, Canada, Holland, Belgium, Denmark and New Zealand (see: Appendix B, table AB.2) that studied stability of PA from childhood and adolescence to young adulthood (19-29 years). Three-year intervals produced mostly moderate to high tracking coefficients. In accordance with an earlier review (Malina, 2001), the 6-, 7-, 8-, 9-, 12- and 14-year intervals tracking were mostly low to moderate.

4.2.3. Tracking from childhood and adolescence into adulthood

The investigated literature revealed only three longitudinal research projects from Finland, Belgium and the UK (see: Appendix B, Table AB.3) that studied stability of PA from childhood and adolescence to adulthood (≥30 years). They are considered as important studies due to their scarcity and difficulties raised by the long period between measurements (Trost, 2005). Studies indicated mostly low to moderate tracking of PA from adolescence to adulthood. Obviously, only preliminary conclusions can be drawn and additional studies are needed to investigate the important transition between these two life periods further. However, a clear pattern that can be drawn from the Belgian samples is that for both genders late adolescence seems to be more critical upon adult tracking of sports participation than early adolescence.

4.2.4. Tracking during adulthood

The examined literature revealed several longitudinal research projects from Finland, USA, Canada, Belgium and UK that studied stability of PA during adulthood (see: appendix A, table AA.4). Two- and 3-year intervals produced high tracking coefficients. Regarding the 5-, and 7-year intervals tracking was moderate. Low to moderate tracking was found for 9-, 10-, 12-, 15- and 18-year intervals. Lastly low tracking was revealed for the most extended time period of 28-years.

4.2.5. Discussion of findings of tracking studies

Several longitudinal research projects were reviewed that studied stability of PA during and between childhood, adolescence, young adulthood and adulthood. They were

located mainly in Europe and North America. In all the investigated life periods most of the time there was significant tracking of PA. This conclusion was in accordance with an earlier review by Malina (2001). However, there were differences in the magnitude of tracking (see: table 4.1). Low to moderate tracking coefficients were found in most studies (see: Appendix B, tables AB.1, AB.2, AB.3, AB.4), which is in accordance with the findings of an earlier review by Malina (1996). The only exceptions were the shorter time intervals within childhood, adolescence or adulthood where high tracking was discovered.

Table 4.1. Tracking characteristics of investigated time periods

Time period		Magnitude	Gender	Baseline age	Shorter vs. longer TIs
Childhood and Adolescence	SS	M-H for shorter TI, L-M for longer TI	No Clear Pattern	No Clear Pattern	Higher Tracking Coefficients
Childhood and Adolescence to Young Adulthood	SS	M-H for shorter TI, L-M for longer TI	Males more stable	No Clear Pattern	Higher Tracking Coefficients
Childhood and Adolescence to Adulthood	SS	L-M	No Clear Pattern	No Clear Pattern	No Clear Pattern
Adulthood	SS	H for shorter TI, L-M for longer TI	Males more stable	No Clear Pattern	Higher Tracking Coefficients

Note: SS=Statistically significant, TI=Time interval, L=Low, M=Medium, H=High.

Allowing for differences in the definition and measurement of PA, adulthood seemed to be the more stable period compared to childhood and adolescence and also compared to the transitions from childhood and adolescence to young adulthood or adulthood. It may be that this life-period involves a more routine lifestyle with fewer changes, which helps adherence of behaviours such as PA. The instability of PA during the above transitional periods was confirmed by a recent tracking review (Telama,

2009). Several influencing factors that contribute to the low tracking of PA mostly during the transitional life periods have been identified by researchers including changing schools, entering the workforce, leaving home, moving to a new house, biological and psychological development (especially timing and tempo of puberty and adolescence), illness, marriage and having children (Calfas, Sallis, Lovato & Campbell, 1994; Riddoch & Boreham, 2000; Malina, 2001; Allender, Hutchinson & Foster, 2008). In general, the above factors seem to have a negative effect on PA participation and tracking. However, only two of the investigated studies (Campbell, Katzmarzyk, Malina, Rao, Perusse & Bouchard, 2001; Scheerder, Thomis, Vanreusel, Lefevre, Renson, Vanden Eynde & Beunen, 2006) attempted to control for potential confounders by utilising partial correlations. Conclusively, interventions should be guided towards the early life periods of childhood and adolescence and especially the transitional ones leading to adulthood because they are the most problematic in terms of tracking. The importance of these transitional periods was also acknowledged by Vanreusel and co-workers (1997, p.384), who characterised them as serving a "crucial linking role".

Correlation coefficients tend to underestimate tracking of PA because they cannot differentiate between measurement error and changes in real behaviour (Telama, Leskinen & Yang, 1996). Additionally, measurement inaccuracies of self-report data, which are typically used in PA studies, also tend to underestimate tracking coefficients (Twisk *et al.*, 2000). This has led to the view that "…the true stability of PA level is probably higher than is typically reported in tracking studies." (Fortier, Katzmarzyk, Malina & Bouchard, 2001 p.1910). Actually, one study (Telama *et al.*, 1996) that used a more accurate estimation of true stability of PA accounting for measurement error due to reliability produced higher tracking coefficients.

As has been argued by Guerra and co-workers (2003) the literature seems to suggest that PA tracking is higher for shorter intervals and at older ages. However, the above conclusions were not always confirmed by the investigated studies. As illustrated in table 4.1, in studies with different time intervals the prevalent tendency of stability was to weaken as the time interval increased. Nevertheless, a few studies produced mixed results. Moreover, table 4.1 shows that the effect of baseline age during the investigated life periods revealed no clear tracking patterns. At least during adulthood it was indicated that tracking is more dependent upon the time interval between measurements than the age of the baseline measurement.

The comparison of tracking between genders showed either mixed results or more stability on behalf of the males (see: table 4.1), which was confirmed by a recent review (Telama, 2009). One other characteristic during childhood, adolescence and adulthood was the evident persistence in the extreme categories of inactive and most active participants, with inactive groups showing the highest levels in both genders (Raitakari, Porkka, Taimela, Telama, Rasanen & Viikari, 1994; Van Mechelen & Kemper, 1995).

In conclusion, PA prevalence is not high but it does seem to track to a considerable extent in the short-term but at a reasonably less extent in the long term. Consequently, there appears to be a need to intervene in order to increase prevalence and assist adherence and tracking. Furthermore, the literature revealed the transitional period from childhood and adolescence to young adulthood and adulthood as the most critical ones to intervene.

Chapter 5. Interventions to promote physical activity

5.1. Introduction

Since PA prevalence is not high but the behaviour seems to track reasonably well through time there appears to be a necessity to intervene and make continuous efforts to increase prevalence and assist adherence. As will be shown in this chapter, the above task has proven challenging, especially for long-term adherence of PA. Two questions of high importance arise in the design and implementation of interventions: when to intervene and how? The how can also be divided into three sections: what settings would prove more effective, what method would be more efficient and influential and to whom should the interventions be addressed? These issues will be discussed in the remainder of this chapter.

5.2. Target age of interventions

The selection of when refers mainly to the most appropriate age to intervene in order to gain optimum results. A common notion is that "the earlier the better" in order to prevent the onset of lifestyle-related morbidity (Sirard & Pate, 2001) and to teach long-lasting habits (Sallis, Simons-Morton & Stone, 1992). This might be the reason why elementary school interventions (age ≥ 6 years) were the most common type of studies in a series of reviews (Stone, McKenzie, Welk & Booth, 1998; Marcus, Dubbert, Forsyth, McKenzie, Stone, Dunn & Blair, 2000; Kahn, Ramsey, Brownson, Heath, Howze, Powell, Stone, Rajab, Corso & Task Force on Community Preventive Services, 2002; Sharma, 2006; Connelly, Duaso & Butler, 2007). Another preventive strategy might be to place the intervention around the age period when the decline in PA

begins, which is close to early adolescence. This approach deals with the problem at its emergence and does not allow it to expand and become routine (Cardinal, Engels & Zhu, 1998). As an alternative to the two preventive strategies mentioned above, Sallis (2000) proposed that a high priority should be given at the age when the greatest rate of decline in PA is identified, that is adolescence. This counter-active approach assumes that the problem is inevitable and thus, should be treated after its appearance or during its peak. Finally, an intervention could be placed according to each study's aims. The transitional period from late adolescence to young adulthood has been identified as a critical age for the adoption and maintenance of an active lifestyle (Dishman & Sallis, 1994). In this vein, in order to influence lifelong PA after graduation from school, an intervention should be placed just before or just after school graduation. However, Kahn (2002) identified ineffectiveness of tertiary PE interventions or health education interventions aiming to increase PA. Moreover, interventions in young people implemented after school graduation seem to have a limited reach since they are commonly applied in settings such as university campuses, or worksites and thus fail to reach a proportion of this age cohort who do not attend these specific settings. In contrast, school settings are capable of reaching the vast majority of the school-aged population. Thus, placing the intervention just before graduation might be the best decision in this dichotomous dilemma but it needs to be supported by applied research.

5.3. Settings of interventions

Successful interventions have been implemented in several settings. However, certain environments have proven more challenging and their interventions less successful. In their review Kahn and co-workers (2002) concluded that certain types of environmental interventions, such as community-wide interventions and social support

interventions in community settings were highly successful in increasing PA levels. Furthermore, Sallis and colleagues (1998) have supported the potential of environmental and policy interventions for promoting PA due to their extended reach to populations. On the contrary, the effectiveness of worksite interventions was questioned by Dishman and co-workers (1998). In their review of 26 worksite projects they concluded that they did not generate statistical significant increases in PA. Adult primary care counselling towards behaviour change seems to be effective in the short-term (Petrella & Lattanzio, 2002) but no such studies for young people were identified. Moreover, the effectiveness of mass media campaigns, health education programmes (school- and college-based), and family-based interventions were not consistently supported for young people (Kahn *et al.*, 2002).

5.3.1. School settings

Specifically for young people, the promotion of PA during the school years can be channeled through in-school PE interventions (Pate & Hohn, 1994; World Health Organisation, 2004). Through peer-imitation and social reinforcement (Wold & Hendry, 1998), school settings seem to be most influential in adolescence (Eccles, 1999) and the majority of PA promotion interventions targeting child and adolescent populations have been school-based (Stone *et al.*, 1998; Marcus *et al.*, 2000). An inherent advantage of school-based PA interventions is their generalisation potential since schools cover most locations, service millions of students from the whole spectrum of the society, occupy almost half of students' waking time and have the staff, the infrastructure and the related curricula to support such programmes (Sallis *et al.*, 1992; Almond & Harris, 1998; Stone *et al.*, 1998; Fox & Harris, 2003). Thus, they are considered ideal for PA interventions in young people (Dobbins *et al.*, 2009). However, they are not without problems since the school environment is not easily accessible (in Greece an official

permit must be awarded from the Ministry of Education) and agreement and co-operation from the school staff, the guardians of the students and finally the students themselves have to be ensured in order to proceed with the field research.

School PA interventions have been extensively and successfully tested for increasing PA in school hours (Sallis, 2003). Their focus has been on increasing PA in PE classes either by lengthening the available hours of PE (Sallis, 2003) or by using PE time more efficiently (Kahn *et al.*, 2002). A proposed alternative strategy was the promotion of PA during the entire school day (Dobbins *et al.*, 2009). Despite their consistent success in increasing time spent in PA during school-hours, they have had little success in increasing out-of-school LTPA (Dobbins *et al.*, 2009), which is a more important aim. An exception came from the *Trois-Rivieres Study* (Trudeau, Laurencelle, Tremblay, Rajic & Shephard, 1998) which managed to increase PA significantly during the weekends in the experimental group but on weekdays there appeared a small decrease in out-of-school PA, possibly due to the extended time allocated to PE in school-hours. The mixed results of the above study are indicative of the complicated nature of PA. The aim of enhancing out-of-school PA holds a serious challenge for youth interventions in the short-term but more importantly in the long-term. Regarding school-based interventions, a review by Almond and Harris (1998) highlighted the lack of longitudinal designs and long-term efficiency estimations which are essential to evaluate the above aim. Consequently, school-based PA interventions seem to be a fruitful and recommended approach, but still more work should be done with longitudinal designs that aim to examine and enhance long-term adherence to PA from a young age to adulthood.

5.4. Methodology of interventions

According to Kahn and co-workers (2002) interventions in PA behaviour can be accomplished by providing information and knowledge of a subject, by teaching behavioural management skills, by building social support and by introducing or enhancing policies and/or the environment. Additionally, they strongly supported the effectiveness of tailored interventions based upon behavioural change strategies and also simple interventions such as prompts at points-of-decision (for example stairs). In their review Dishman and Buckworth (1996) acknowledged the theoretical and practical superiority of cognitive-behaviour modification in increasing PA compared to health education, health risk appraisal, and exercise prescription. Finally, according to Sallis (2003), in order to re-establish active patterns of living for young people, interventions should combine methods and strategies. This combined approach was a common feature in most interventions reviewed by Stone and colleagues (1998). Hence, there is support for tailored rather than "one size fits all" interventions, based upon cognitive and behavioural change strategies, with emphasis on combinations of methods and strategies.

5.5. Target groups of interventions

Another serious question is to whom the interventions should be addressed. Is it more appropriate to address the whole population or those in most need? The proportion of the target population that participate in an intervention is known as its reach (Estabrooks, Carron & Hausenblas, 2002) and it is a measure of effectiveness of the public health impact of interventions. Thus, in a widespread problem, such as physical inactivity, the higher possible reach is considered the most appropriate strategy. Another approach could be to address only the part of the population at higher risk, for example

chronic inactive, overweight or obese people. Hence, if a problem is concentrated in high-risk groups then they should be targeted specifically. Based on a review by Sallis and colleagues (2000) girls, adolescents and those from lower-income families and ethnic minorities were considered high-risk inactive youth cohorts and should be given higher priority in interventions. The dilemma of whether to target the whole population or only those at high risk might be solved with a combined approach aiming to maximise efficacy and reach by addressing the whole population with emphasis on high-risk groups.

5.6. Effectiveness of interventions

Effectiveness of interventions could be based on physiological, cognitive, affective or behavioural changes (Biddle *et al.*, 2004), but according to reviewers of the literature greater emphasis should be placed upon short- and long-term behavioural changes (Sallis et al., 1992; Pate, Trost, Mullis, Sallis, Wechsler & Brown, 2000; Richter, Harris, Paine-Andrews, Fawcett, Schmid, Lankenau & Johnston, 2000). Furthermore, the differentiation between short- and long-term effects is of paramount importance in the field of PA. As it will be shown next, numerous studies and reviews provide sufficient evidence that the implementation of a well-designed and sound theoretical-based intervention has positive short-term effects on PA. However, the long-term effects seem to be a more difficult task to accomplish.

Dishman and Buckworth (1996) conducted a quantitative meta-analysis of PA interventions and concluded that typically they were successful with large effect sizes (ES). The estimated population effect size after adjustment for reliability among the measures of PA (ES = 0.80) represented a potential increase in success rates from 50%

(control group) to 64% (after intervention), or to 76% if weighted by sample size. In both cases, after weighing or ignoring sample size, the most effective interventions were those based upon behaviour modification, involving low intensity LTPA regardless of the duration or frequency of PA. They reported that only about 25% of the reviewed studies included a follow-up measurement and, where this occurred, intervention effects decreased in the long-term. This was particularly the case in community studies where the immediate effects were rather large but yet they disappeared after a few weeks.

Eakin and colleagues (2007) reviewed PA interventions that used telephone counselling as their main component but usually in combination with other tools such as face-to-face counselling or print materials. Sixteen studies were retrieved, the majority targeting moderate PA of healthy adult participants. Most of the studies (70%) had positive immediate outcomes but with small to medium effect size, on average. One interesting finding was that the more efficient interventions were those with longer implementation periods. Only one third of the interventions that were implemented in a time frame of less than three months showed positive results. When the implementation period was more extended (3-6 months) the percentage rose to 56%. Eventually for those implemented for more than six months absolute efficacy (100%) was achieved. Hence, one key element for intervention success seems to be its duration. All the above-mentioned effects should be considered as direct intervention effects because they were measured at the end of their implementation. Only seven of the 16 studies reported on the maintenance of treatment effects after the end of the intervention period (ranging from one to six months after). The majority (71%) showed non-significant short- (< 3 months after), medium- (3-6 months after) or long-term effects (> 6 months after). Only two (29%) showed significant long-term effects. One other weakness of most

studies was the lack of information as to whether study participants were representative of the larger populations from which they were drawn, making it difficult to determine whether study findings could be generalised to the broader population.

The above weakness of long-term effectiveness was also evident in the review of 18 randomised controlled trials with at least a six-month follow-up by Hillsdon and co-workers (2005). They concluded that PA interventions have a positive moderate effect on increasing self-reported PA in the short-term (pooled standardised mean difference 0.31). Nevertheless, none of the four studies examining long-term effects revealed any significant results one and two years after the intervention. In a systematic review of the latest randomized trials of computer-tailored interventions for PA Kroeze and co-workers (2006) found 30% of the studies to be effective.

Conceptual PE programs have been created to encourage a physically active lifestyle for students (Dale & Corbin, 2000). They included theoretical lessons about health and fitness and practical sessions that taught lifetime skills necessary for PA (Dale, Corbin & Cuddihy, 1998). Project Active Teens (Dale *et al.*, 1998) implemented this model in two classes per week in US ninth grade high school students for one year. However, it did not show any long-term results in meeting national PA goals for moderate or vigorous PA one to three years after. The intervention group showed significant differences from the control group only once in sixteen comparisons. After their graduation they were re-surveyed and the same conclusions were drawn regarding PA (Dale & Corbin, 2000). The intervention group showed significant differences from the control group only once in eight comparisons. This lack of long-term effectiveness was also reported by Calfas and colleagues (2000) in a sample of university students (n=338). Despite the theoretical soundness and high participation of the 18-month

intervention programme designed to promote PA it did not produce any long-term effects on PA or its mediators two years after.

In the Trois-Rivieres quasi-experimental study (Trudeau *et al.*, 1998) 272 Canadian students received five hours of quality PE per week throughout their six primary school-years compared to 40 minutes of standard PE per week for the control group. The immediate result was a significant increase in out-of-school PA for the intervention group. Twenty years later they were assessed by a mailed questionnaire. Of those that exercised, women in the experimental group reported being engaged significantly more than the control group, but only in vigorous PA of at least three times per week (42% vs. 26%; x^2=9.4, *df*=2, *p*<0.01). In men there were no significant inter-group differences. Thus, daily quality PE in the primary school years seemed to be related to certain positive long-term effects only for females.

5.7. Interventions in Greece

Interventions implemented in Greek populations are very limited. Only three were retrieved all were school-based and contained some methodological flaws. The Cretan Health and Nutrition Education Programme was initiated in 1992 and claimed to be the first intervention of its kind in Greece. Manios and colleagues (1998; 1998; 1999; 1999; 1999; 2002; 2006; 2006) drew from the Know Your Body disease prevention programme developed in the US (Walter & Wynder, 1989) and from Social Cognitive Theory (Bandura, 1986). This school-based programme (n=4,171) covered the whole elementary school (six successive years) and was implemented in Crete at an intensity of around 50 hours per year. After the two follow-ups (six and ten years after the commencement of the intervention) 238 participants remained in the intervention group

and 187 in the control group, with a retention rate of 6% and 12%, respectively. These low retention rates impose considerable bias for the final sample. Students were measured three times; at the ages of six (baseline), 12 and 15 years. A questionnaire-based interview measured out-of–school MVPA (> 4 METS) with duration longer than 30 minutes. The extended duration criterion might have caused an underestimation of the baseline PA levels since shorter bouts of activity (five to ten minutes) are characteristic for these ages as opposed to longer periods of 20 minutes or more (Sleap & Warburton, 1992; Sleap & Tolfrey, 2001; Trost, 2005). The questionnaire was completed by the parents at baseline and by the pupils at the post-intervention measurements. The above anacoluthia between the pre- vs. post- intervention methods, which is not common among school-based interventions (Dobbins *et al.*, 2009), holds a serious threat to the validity of the follow-up comparisons. In the first two measurements students were considered physically active if they had accumulated at least 60 minutes of MVPA daily (National Association for Sport & Physical Education, 2004), while in the last follow-up the age-specific criterion was appropriately set to at least 30 min of daily MVPA (Sallis & Patrick, 1994). The above limitations mean that cautiousness is needed in the interpretation of the results of this ambitious project. The between-group comparisons revealed non-significant differences in the baseline measurement in both genders. However, the boys of the intervention group were physically active in significantly higher proportions than those in the control group post-intervention (52% vs. 38%, $p=0.04$) and four years after (24% vs. 12%, $p=0.03$). The same comparisons regarding girls were non-significant. Additionally, boys in the intervention group were 2.3 ($p=0.01$) and 2.1 ($p=0.04$) times more likely to meet recommendations for PA post-intervention and at follow-up, respectively. Girls on the other hand revealed no such differences. Thus, the intervention seemed to have quite positive short- and long-term effects only for boys.

Diggelidis and co-workers (2003) conducted a quasi-experimental intervention in first-grade high school students (n_{Int}=262; n_{Con}=521; Mean age=12 years; 50% girls). At least 87 appropriately designed PE lessons were administered to each class during one school year (9 months). Regular exercise was defined as intensive (>120 beats/minute) out-of-school exercise at least twice a week for one hour or more. Three measurements took place; one in September, a second by the end of the intervention in the following May and the last one ten months after the intervention. There were no significant differences between the intervention and control group in frequency of exercise at the end of the intervention or ten months after. Thus, despite its intensity and long duration this intervention was rather unsuccessful in behaviour modification. Christodoulidis and co-workers (2001) duplicated the above intervention in 105 first-grade senior high school students (55% girls). Only 25 PE lessons were administered throughout the academic year with emphasis on enhancing motivational climate and attitudes towards exercise. Apart from the above variables only frequency and time spent per session in vigorous out-of-school sports and exercise during the previous month was measured. Vigorous sports and exercise was defined as activity that increases heartbeats (>120 beats/min.) and lasts for one hour or more. Significant differences among intervention and control group appeared only regarding time spent in sports or exercise per session pre- and post-intervention [$F(1, 543)= 11,03$, $p<0.001$].

Thus, the available evidence from Greek PA interventions is limited and more studies are needed with greater emphasis on the methodological aspects of the studies and efficient use of resources.

5.8. Conclusions

There appears to be a variety of parameters that characterise successful interventions. A combination of available methods and strategies seems more appropriate to establish efficiency. Also, longer implementation periods appear to make a positive difference. Simple, tailored interventions targeting behavioural change of low intensity LTPA are recommended. Emphasis should be placed upon reaching a large proportion of the population since prevalence of inactivity is extensive but also high-risk groups should be treated with extra attention. Specifically for young people, the school environment seems to be very influential and efficient to intervene. Furthermore, school-based interventions have several practical advantages but have failed to meet the challenge of improving out-of-school involvement in PA. The selection of the age to intervene appears to have plenty of alternatives but primarily depends upon the aims of the study. The most appropriate period to intervene in order to have long lasting results for young people could be just before school graduation. Greek PA interventions are very scarce and need further efforts to enhance their methodological qualities. Finally, one of the most demanding tasks for future PA interventions is their long-term influence, especially in young people. While they seem to be capable of producing successful short-term results the impact tends to fade away in the long-term. Thus, successful interventions measuring long-term effects longitudinally are required. A prerequisite of these interventions is to have a sound theoretical basis in order to be designed and implemented effectively. Thus, consideration is given in chapter 6 as to the suitability of the TTM for the present study.

Chapter 6. The transtheoretical model

6.1 Theory-based interventions

Successful interventions ought to be based upon a sound theoretical framework (Sonstroem, 1988; Hillsdon et al., 2005; Schlicht, Kanning & Bos, 2007). This would not only obviously ensure their validity but also their reproducibility, improvement and efficiency. "In recent times, Health Psychologists have developed models to describe, predict, explain and ultimately change health behaviour" (Armitage & Conner, 2000, p.195). Several models have been tested and found successful in understanding and predicting a range of health behaviours including PA (Cropley, Ayers & Nokes, 2003). A brief description of the most influential contemporary health promotion models is presented in the following section.

6.2. Health promotion theories of behavioural modification

According to Biddle and Fuchs (2009), four of the most influential contemporary 'Health and Exercise Psychology' theories have been the Social Cognitive Theory (Bandura, 1986), the Theory of Reasoned Action (Fishbein & Ajzen, 1975; Ajzen & Fishbein, 1980), the Theory of Planned Behaviour (Schifter & Ajzen, 1985; Ajzen & Madden, 1986), and the Transtheoretical Model (TTM) (Prochaska & DiClemente, 1982).

Bandura's Social Cognitive Theory (1986) has been extensively used in the field of PA either independently or as part of other models such as the Theory of Planned Behaviour and the TTM (Marks, Murray, Evans, Willig, Woodall & Sykes, 2005). This

theory posits that behaviour is determined by personal, behavioural, and environmental factors, which interacts bi-directionally (Perry, Baranowki & Parcel, 1990; Strauss, Rodzilsky, Burack & Colin, 2001). According to Bunton and colleagues (1991, p.154) "Its core constructs included the role of modelling in the development of new 'healthy behaviours', the necessity of developing the appropriate skills to enable change and the encouragement of self-efficacy." The theory of planned behaviour (Schifter & Ajzen, 1985; Ajzen & Madden, 1986) was the successor to the Theory of Reasoned Action (Fishbein & Ajzen, 1975; Ajzen & Fishbein, 1980). The latter predicted and explained only volitional forms of behaviour (Sheppard, Hartwick & Warshaw, 1988), while the Theory of Planned Behaviour expanded its reach to behaviours beyond a person's complete control (Ajzen, 1988; 1991). Its basic assumptions as Atsalakis (1994, p.101) explained, in brief, were "…that a person's behaviour is determined by his or her intention to perform the behaviour. In turn, intention is determined by a combination of the person's attitudes toward performing the behaviour, his or her perception of social pressure for performing or not performing the behaviour and the perception of how easy or difficult performance of the behaviour is likely to be." All the above-mentioned models have contributed to the development of knowledge regarding health behaviour promotion. However, there appeared to be a need for a more practical and efficacious way of intervening in the field of health behaviours (Courneya, 1995) and also for a theory mostly developed around behaviour change rather than behaviour itself (Prochaska, Wright & Velicer, 2008). An attempt to fill this gap was made by the TTM, which has been praised for its clear strategies towards behaviour change in comparison to previous behavioural models (Adams & White, 2003).

6.3. The transtheoretical model

According to Armitage (2009, p.195) the TTM is "arguably the dominant model of health behaviour change, having received unprecedented research attention, yet it has simultaneously attracted exceptional criticism." Its origins can be traced back to the 1980s when Prochaska and DiClemente (1982; 1983) introduced it to serve as a general explanatory model of intentional behaviour. It emerged from a comparative analysis of the common elements of the leading theories of psychotherapy and behaviour change (Prochaska, 1979; 1984), which was also the reason for naming it trans-theoretical. According to Little and Girvin (2002, p. 226) Prochaska and DiClemente also "…drew on the work of Horn (1972, 1976, cited in DiClemente and Prochaska (1982)), who proposed four stages of progress in changing health-related behavior (contemplating change, deciding to change, short-term change, and long-term change)…"

After its initial successful application in smoking (Prochaska & DiClemente, 1983), it expanded in scope to include a plethora of health behaviours (Prochaska *et al.*, 2008) including exercise and PA (Marcus, Banspach, Lefebvre, Rossi, Carleton & Abrams, 1992a; Marcus & Owen, 1992; Marcus, Rakowski & Rossi, 1992b; Marcus, Rossi, Selby, Niaura & Abrams, 1992c; Marcus, Selby, Niaura & Rossi, 1992d; Marcus & Simkin, 1993). Biddle and Fuchs (2009) conceptualised the TTM as a 'hybrid theory' since it incorporates both explanatory and intervention-assisting elements. Through the stages of change (SOCs), decisional balance (DB) and Self-Efficacy (SE) constructs it seeks to explain both how and why behaviour change occurs and simultaneously through the appropriate processes of change (POCs) how this change be aided.

6.3.1. The stages of change

The stages of "readiness to change" are of fundamental importance in the operation of the model (Dannecker, Hausenblas, Connaughton & Lovins, 2003). They were conceptualised as a series of phases an individual passes through (back and forth) during a volitional behaviour change (Prochaska & DiClemente, 1983; Prochaska & Velicer, 1997). Each SOC incorporates intentional, behavioural and temporal aspects of behaviour change (Martin-Diener, Thuring, Melges & Martin, 2004), which allows the model to explain the process of behaviour change. The intention to be physically active, the actual state of being active or inactive and the "readiness" to change are examples of such components of behaviour change (Marshall & Biddle, 2001). Thus, a person can be willing to become physically active or not, can be physically active or not according to specific criteria, and lastly, can be ready to change in the near or far future. The temporal nature of SOCs has been described by Prochaska and Marcus (1994, p.162) as "…both stable and dynamic..." Thus, individuals temporarily stay in a certain stage or move across SOCs according to circumstances.

The two prevalent methods of stage allocation are either using a series of questions (algorithm) to categorise subjects into a distinct stage or a continuous measure that describes each SOC (Reed, Velicer, Prochaska, Rossi & Marcus, 1997; Dannecker et al., 2003) and the individual has to select the one that best matches his/her current condition (Littell & Girvin, 2002). The proposed number of these stages vary with five as the dominant and most widespread number (Littell & Girvin, 2002). The SOCs are defined in a variety of ways, but the following are the most common for PA (Nigg, 2002; Biddle & Fuchs, 2009):

Stage 1. Precontemplation (PC): people are not physically active and have no intention of making changes toward the new behaviour in the foreseeable future, usually in the following six months (Prochaska & Marcus, 1994).

Stage 2. Contemplation (C): people are still not physically active but they intend to change in the following six months.

Stage 3. Preparation (PR): people are still not physically active but they strongly intend to take action in the immediate future, usually in the following 30 days. Additionally, according to Reed and colleagues (1993) people may be active but not enough to reach the criterion level.

Stage 4. Action (A): people are physically active and have been so for less than six months. People have attained a certain criterion to be physically active that scientists and professionals agree is sufficient to reduce risk of disease.

Stage 5. Maintenance (M): people are physically active and have been so for more than six months. This six-month time frame was not arbitrarily selected but determined by empirical research as a threshold of more stable behaviour change (Prochaska *et al.*, 2008).

A certain criterion is used to distinguish between inactive (PC, C, PR) and active stages (A, M). A thorough meta-analysis of TTM studies (Marshall & Biddle, 2001) identified 16 different activity criteria, which formed four general categories for "regular exercise or PA": a) no specified criteria, b) three times per week for 15 to 30 minutes each time at an unspecified intensity level, c) three times per week at a moderate-to-vigorous level for 15 to 20 minutes each, and d) four to seven times per week at a moderate-to-vigorous level for 30 minutes each time. The plethora of criteria is indicative of a lack of standardisation in the methods of identifying SOCs, which complicates comparisons among studies (Marshall & Biddle, 2001; Littell & Girvin,

2002). Furthermore, different stage definitions, activity criteria or types of behaviour assessed can lead to different stage allocation of the same individuals (Martin, Mader & Calmonte, 1999; Martin-Diener et al., 2004).

Figure 6.1 graphically illustrates the two temporal and the two behavioural dimensions of the TTM. The behavioural dimension in the first three inactive stages (PC. C, PR) correspond to the intention of changing behaviour, while in the two active stages (A, M) to the actual new behaviour established by the fulfilment of the behavioural criterion. In PC, C and PR the temporal dimension is conceptualised as the chronological distance (in the following six months or 30 days) of behavioural intention towards being active, while in A and M where the activity criterion have been met, the temporal dimension refers to the duration of previous behaviour (being active for less or more than six months). According to Velicer and colleagues (2006) certain stages (PC, C, M) are occupied by individuals for longer periods than others (PR, A), which are less stable and more prone to change. A linear pattern (ladder) was originally suggested to describe stage-movement (Prochaska & DiClemente, 1983), which was later replaced by a spiral course (Prochaska, DiClemente & Norcross, 1992). The latter description catered for the relapse phenomenon when several attempts might be made by individuals to change behaviour before they could achieve and maintain their goal (Marcus *et al.*, 1992a).
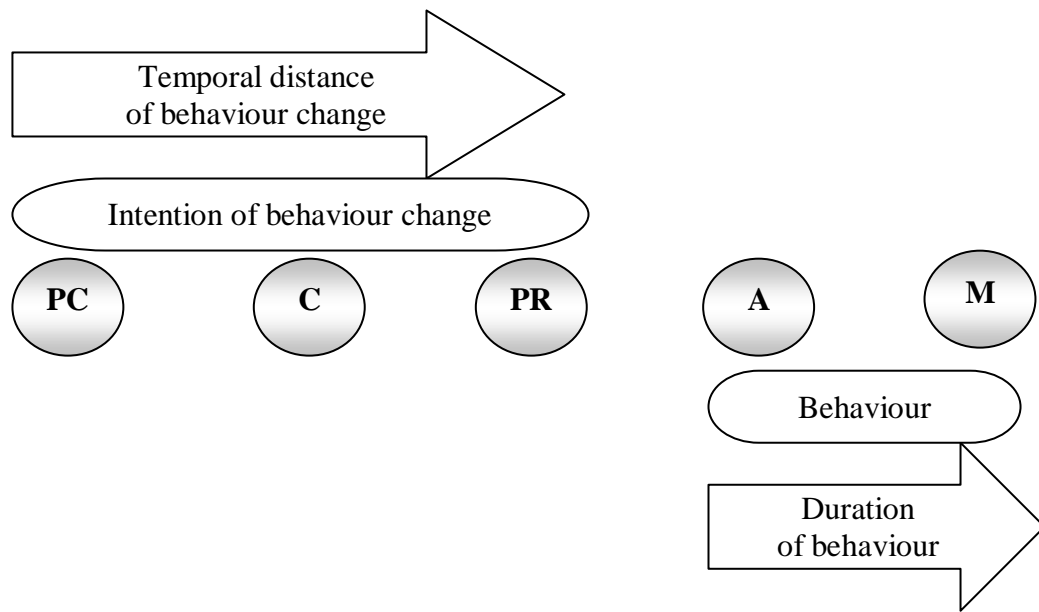
Figure 6.1. The temporal and behavioural dimensions of the stages of change

[Adapted from: Cancer Prevention Research Center (2000)]

Some perceptions of the TTM have integrated a sixth stage called *Termination* (Cardinal, 1999; Fallon & Hausenblas, 2001). Its characteristics are complete Self-Efficacy (SE) to maintain the healthy behaviour coupled with no temptation to relapse to the unhealthy behaviour (Prochaska & Velicer, 1997). While it was generally applied in cessation behaviours, such as quitting smoking, strong concerns have been raised regarding its applicability for adoption behaviours (Prochaska & Marcus, 1994; Cardinal *et al.*, 1998; Courneya & Bobick, 2000), for example, being physically active. As Wankel and Hills (1994, p.117) point out "With respect to changing from a sedentary to an active lifestyle, it is questionable whether a true termination point is ever reached." Additionally, Nigg (2002) argues that the termination stage is not typical for PA because individuals are always at risk of relapse and have to make conscious efforts to overcome the inertia of inactivity. Based on all the above arguments this sixth stage has been excluded from the current research project.

6.3.2. Other core constructs of the transtheoretical model

In the TTM the SOCs are linked to three other constructs: Processes of Change (POCs), Decisional Balance (DB) and Self-Efficacy (SE), which are hypothesized to mediate the change process (Marshall & Biddle, 2001). The TTM proposes various ways that a healthy behaviour change may be achieved, firstly, through the strategies of change (POCs) and secondly with moderators of change, such as the DB and SE (Biddle & Fuchs, 2009). The DB together with SE are considered intermediate or dependent measures/variables (Martin, Velicer & Fava, 1996) that determine when change occurs (Cancer Prevention Research Center, 2000), while the POCs are considered as independent measures/variables (Martin *et al.*, 1996) that explain how change occurs (Prochaska, Velicer, Diclemente & Fava, 1988).

6.3.2.1. Processes of change

The ten distinct POCs were identified by Prochaska (1979) via the comparative analysis of 18 leading theories of *Psychotherapy* and behaviour change. They represent personal strategies and techniques to influence cognitive, emotional and behavioural aspects and ultimately stay, progress or regress through the SOCs (Prochaska & DiClemente, 1983). They play a constructive role in the design, implementation and success of interventions (Biddle & Fuchs, 2009), by providing information on why and how movement through stages occurs (Cancer Prevention Research Center, 2000; Carron, Hausenblas & Estabrooks, 2002). According to the TTM, successful behaviour change interventions "…must be tailored to a person's current SOC and make use of the appropriate POCs." (Adams & White, 2003, p.106).

Those POCs accrued from personal experiences are labeled as experiential while those gathered from interaction with the environment and through action are labeled as behavioural processes (Nigg, Geller, Motl, Horwath, Wertin & Dishman, 2011). The ten POCs are presented below as cited in the relevant literature (Prochaska et al., 1992; Smedslund, 1997; Cancer Prevention Research Center, 2000) with the experiential POCs being the first five listed and the behavioural the last five:

1. **Consciousness Raising (CR):** gathering information and increasing awareness about the causes and benefits of a certain behaviour. Accomplished through observations, confrontations and searches in published materials.

2. **Dramatic Relief (DR):** experiencing and expressing feelings about one's problematic behaviour and solutions for it. Through emotional arousal it generates awareness of the problem. Common ways of initiating are through psychodrama or role-playing.

3. **Environmental Re-evaluation (ER):** cognitive (feelings) & affective (thoughts) assessments of how a personal habit affects one's social environment for example through role modelling. This social re-appraisal is implemented through empathy training or watching documentaries.

4. **Social Liberation (SL):** increasing social opportunities or alternatives especially for people who are relatively deprived or oppressed. These environmental opportunities signal the awareness of the problem and can be experienced through advocating for rights of repressed, empowering or policy-interventions.

5. **Self Re-evaluation (SRE):** cognitive (feelings) & affective (thoughts) assessments of one's self-image with and without a particular habit, for example being an active or inactive person. This self re-appraisal emphasises how wants, beliefs and feelings

are changing with respect to self-image and can be achieved through value clarification, imagery and corrective emotional experiences.

6. **Stimulus Control (SC):** avoiding or countering stimuli that elicit problem behaviours. Closely related to a more PA-friendly environment with less inactive temptations. It can be accomplished through avoidance techniques, environmental re-structuring and self-help groups.

7. **Helping Relationship (HR):** being open and trusting about the problem behaviour with someone who cares. This personal support can be found through rapport building, therapeutic alliance, counsellor calls and self-help groups.

8. **Counter Conditioning (CC):** requires the learning of healthier behaviours that can substitute for problem behaviours, for example to cycle in a stationary bike while watching TV. It includes relaxation, desensitisation and positive self-statements.

9. **Reinforcement Management (RM):** rewarding for accomplishing changes and reaching goals. Contingency contracts, overt and covert reinforcements, positive self-statements and group recognitions aiming at increasing the probability that healthier responses will be repeated.

10. **Self Liberation (SL):** is both the belief that one can change and the continuous commitment to act on that belief. It can be accomplished through decision-making therapy, New Year's resolutions or public testimonies.

The previous typical set of POCs was supported by research across various behaviours including exercise (Prochaska & Velicer, 1997). In general, the results of the extensive meta-analysis by Marshall and Biddle (2001) confirmed the use of all ten

POCs in PA behaviour change across all SOCs, with a peak in the active stages (A, M). A UK study (Goldberg, Christopher, Aznar, Barnes, Simmonds, McKenna, Page & Naylor, 1996) confirmed the above conclusion in an adolescent sample (n=970). The use of POCs increased significantly [MANOVA Pillais $F(40, 3048)=6.44$; $p<0.001$; Scheffe analyses ($p< 0.05$)] between inactive (PC, C, PR) and active stages (A, M). Thus, individuals seem to use these strategies more often when in the active stages.

Armitage (2009, p. 204) pointed out a paradox regarding the theoretical conceptualisation of POCs and their empirical use in research attempts: "[Despite being] conceptualised as independent variables (Prochaska, Redding, Harlow, Rossi & Velicer, 1994), yet they are most commonly used as dependent variables in cross-sectional surveys to identify differences between the SOCs (Rosen, 2000) than as true independent variables to be subjected to experimentation." Thus, POCs should be manipulated to examine their use in the intervention process.

Researchers generally supported the division of POCs into two categories (Prochaska & Velicer, 1997), "…five cognitive [or experiential] strategies aimed at changing ways of thinking and five behavioural [or environmental] strategies aimed at increasing specific behaviours." (Dunn, Marcus, Kampert, Garcia, Kohl & Blair, 1999, p. 329). However, as argued by Marshall and Biddle (2001) the adoption of the above classification for PA was based mostly on conceptual terms and not sound research findings. Thus, Marshall and Biddle (2001, p.242) concluded that "the distinction between the higher order constructs [experiential and behavioural] may not be worth preserving in the PA domain". The above led to the disregard of this dichotomous clustering of POCs in this Thesis data analysis and the use of each POC independently.

6.3.2.2. Decisional balance (pros and cons)

The concept of DB is based upon the theoretical model of decision making by Janis and Mann (1977). It reflected the cognitive weighing of the perceived relative benefits and costs of engaging in a specific behaviour (Prochaska *et al.*, 1988). A two-factor structure named Pros and Cons was developed (Velicer, DiClemente, Prochaska & Brandenburg, 1985; O'Connell & Velicer, 1988).

The DB of behaviour change varies systematically between the SOCs (Prochaska & Velicer, 1997). In relation to exercise, studies of Australian (Gorely, Gordon & Bull, 1993) and North American (Marcus & Owen, 1992; Marcus *et al.*, 1992b) adults and British students (Naylor & McKenna, 1995) have consistently revealed that the decision-making processes significantly differentiated between subjects in each SOC. Figure 6.2 provides an illustration of the Pros and Cons interaction among the various SOCs across a range of 50 health-related behaviours. With regard to PA and exercise it is in the early inactive stages (PC, C) that the costs outweigh the benefits. PR appears to be the stage at which Pros and Cons balance for PA (Marcus et al., 1992b; Buxton, Wyse & Mercer, 1996; Reed, 1999). In contrast, in the later active stages the benefits are more influential than the costs and often peak in A (Marcus *et al.*, 1992b; Reed, 1999). Thus, the static nature of the SOC can be explained through the concept of DB.
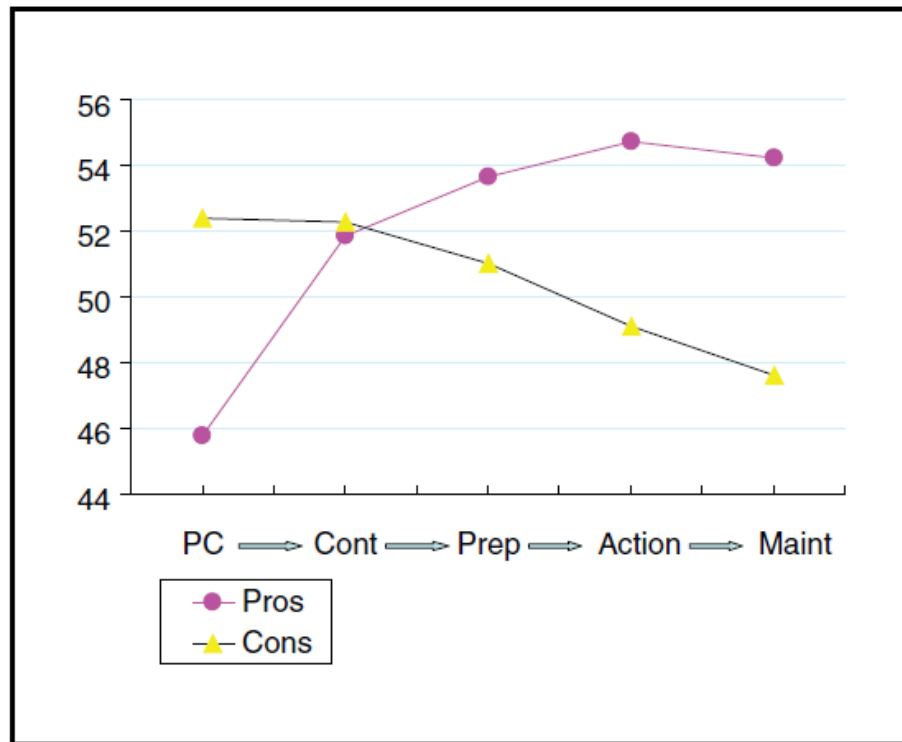
Figure 6.2. The pros and cons of changing behaviour across the stages of change for 50 health-related behaviours. Standardized *T* scores (mean=50, SD=10). *[Adapted from: Prochaska (2008, p.847)]*

Additionally, weighing of the DB scale may serve as a strategy leading to progression or regression through the SOCs (Biddle & Fuchs, 2009). For example, when the balance shifts towards the benefits then progress to more active stages is likely to follow. On the other hand, when the balance moves towards costs then regression is more probable. Pros and Cons seem to be able to predict the transitions between the inactive stages but lack predictive power for the active stages (Prochaska & Marcus, 1994; Buxton *et al.*, 1996; Reed, 1999; Carron *et al.*, 2002). Thus, the dynamic nature of the SOCs can also be explained through the concept of DB.

In a meta-analysis of TTM studies of PA and exercise Marshall and Biddle (2001) concluded that the Pros of being active generally increase from the least active

SOCs to the most active SOCs while the Cons decrease accordingly, as predicted by the TTM. The most pronounced effect sizes for both Pros and Cons for the comparisons between adjacent SOCs was found between PC and C (Pros d=0.97, failsafe k=50; Cons d=-0.46, failsafe k=17). Thus, it seems that this turning point where intention to become physically active develops is where beliefs and attitudes mostly change. Marshall and Biddle (2001) used the term stage transition to describe the meanings of the above comparisons. However, it should be noted that since most of the data were cross-sectional they did not describe an actual movement from one stage to the other but rather a comparison between those individuals in one SOC with the others that were in an adjacent SOC. Longitudinal data are more appropriate to evaluate stage transitions of the same individuals.

Lastly, Marshall and Biddle (2001) challenged the general research focus on the point at which the Pros typically level off with the Cons because it does not constitute a point of behaviour change but rather an attitude change. They acknowledged more importance in the magnitude of change in Pros and Cons associated with behaviour change. In this respect, Prochaska (1994) had stated the strong and weak "principles of progress" across 12 problem behaviours. They involved one SD increase in the Pros (strong principle) of a behaviour change from PC to A and a 0.5 SD decrease in the Cons (weak principle) of a behaviour change from C to A. Almost identical findings were reported across 48 health behaviors in a recent meta-analysis (Hall & Rossi, 2008), with the strong and weak principle to be one SD and 0.56 SD, respectively. Specifically for PA and exercise (Marshall & Biddle, 2001) the strong and weak principle from PC to A were found to be 1.3 SD and 1.2 SD, respectively. It is noteworthy that they have adjusted the Cons to include PC, as well, which resulted in an increase of the weak principle. Thus, they concluded that the same significance should be placed on the

increase of the Pros and the decrease of the Cons in any attempt for a positive PA behaviour change.

6.3.2.3. Self-efficacy and temptation

SE is considered as the self-perceived ability that one can engage in a particular behaviour under specific circumstances (Bandura, 1977) or else, the self-confidence that one can handle challenging or tempting situations without reverting to negative behaviours (Prochaska & Velicer, 1997; Marshall & Biddle, 2001). According to Bandura (1986) SE springs from past experiences, learning from others, verbal persuasion or other social influences and physiological feedback. SE levels are considered important in behaviour choice, for example being active (Bandura, 1986). Increased levels of SE are associated with more active SOCs (Marcus et al., 1992d; Marcus, Eaton, Rossi & Harlow, 1994; Gorely & Gordon, 1995; Cardinal, 1997; Nigg & Courneya, 1998) and are hypothesised to lead to stage progression while decreased levels of SE to stage regression (Sullum, Clark & King, 2000; Carron et al., 2002). Hence, SE seems to be a good predictor of progression and regression among the SOCs (Cancer Prevention Research Center, 2000). Marshall and Biddle's (2001) meta-analysis confirmed the hypothesis that SE increased from less active to more active SOC, but not linearly. Thus, effects estimates were moderate from PC to C, small-to-moderate from C to PR, moderate from PR to A, and moderate-to-large from A to M.

Temptation on the other hand is the opposite of SE. It represents the inner urge to engage in a behaviour under enticing circumstances (Cancer Prevention Research Center, 2000). Tempting situations are a frequent feature in our daily lives since it has been estimated that people spend almost a quarter of their waking hours dealing with

them (Hofmann, Baumeister, Forster & Vohs, 2011). As can be seen in figure 6.3, temptation and SE seem to function contrariwise across the SOCs (Hausenblas, Nigg, Dannecker, Downs, Gardner, Fallon, Focht & Loving, 2001; Carron et al., 2002). Additionally, after controlling for self-efficacy, Nigg and co-workers (2009) found temptation to be unrelated to PA indicating that temptation might be actually functioning parallel with SE. Researchers seem to have focused on SE since research examining the temptation construct for PA is scarce (Carron *et al.*, 2002). As a result of all the above, this study focused on SE rather than temptation.
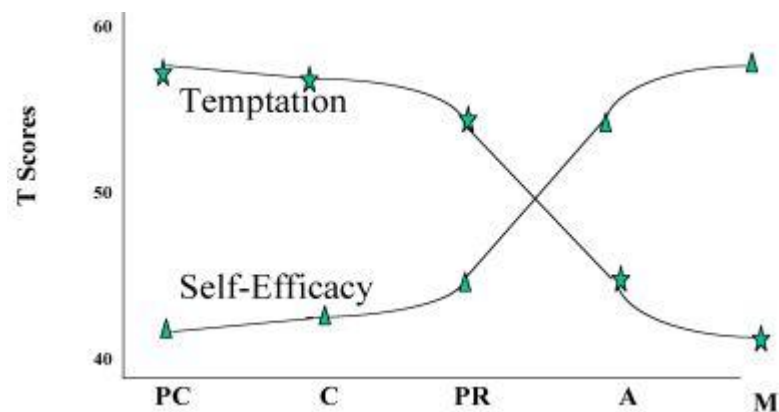
Figure 6.3. The relationship between stages of change and both self-efficacy and

temptation *[Adapted from: Cancer Prevention Research Center (2000)]*

6.3.2.4. Levels of change

Different levels of change seem to exist even within each SOC (McKenna & Francis, 2003). Two sub-types of precontemplators has been identified for PA (Reed, 1993). Precontemplation non-believers have some or all of the following characteristics:

a) do not believe in the value of being physically active

b) do not know the value of being physically active

c) do not consider themselves able to become physically active.

Precontemplation believers, on the other hand, acknowledge the value of regular PA but cannot or do not want to incorporate it into their lifestyles. Additionally, Gorely and Bruce (2000) found three different PA sub-stages within the contemplation stage namely, early contemplation, medium contemplation and pre-preparation, which were distinguished by SE, pros and cons. The authors concluded that "The existence of sub-stages indicated a true temporal order for the stages…" (Gorely & Bruce, 2000, p.89). Thus, there is evidence of different sub-types of individuals in certain stages but further research is needed to clarify whether they should be treated as separate stages in the analysis of the TTM or just as sub-levels of the same stage (Reed, 1999).

6.3.3. Validity of the transtheoretical model

As Smedslund (1997, p. 542) argued "The stages of change model was developed on the basis of experience and with the belief that it is empirical." However, as Smedslund (1997) continued the temporal sequence of the stages is not empirical, but indisputable logical truth. His views were based on a conceptual analysis of logical assumptions and definitions that theoretically shape the model. Littell and Girvin (2002) further acknowledged the heuristic value of the model, while other critiques have also claimed that the model possesses obvious face validity (Ashworth, 1997; Whitehead, 1997). Smedslund (1997, p. 542) concluded that "…the model represented a useful way of describing the process of personal change" and felt very confident of its validity. Additionally, he praised its usefulness "…to generate genuinely empirical research", for example, to plan appropriate interventions according to SOCs distributions.

The construct validity of the TTM has been consistently confirmed across 48 different health behaviors including PA and exercise (Hall & Rossi, 2008). Also, using data from nine studies, Hellsten and co-workers (2008) concluded that the SOC algorithm was significantly related to self-report and objective measures of PA. Furthermore, a meta-analysis of 71 TTM studies (Marshall & Biddle, 2001) and a review of several cross-sectional studies (Armitage, 2009) supported the model's construct validity for PA and exercise. In general, as predicted by the model, those in more active SOCs revealed higher levels of exercise and PA in a diversity of samples such as adolescent (Cardinal, 1995a; Wyse, Mercer, Ashford, Buxton & Gleeson, 1995; Lee, Nigg, DiClemente & Courneya, 2001), college (Calfas *et al.*, 1994; Pinto & Marcus, 1995), adult (Cardinal, 1997), police officers (Hausenblas, Dannecker, Connaughton & Lovins, 1999), blue-collar workers (Emmons, Marcus, Linnan, Rossi & Abrams, 1994), middle-aged females (Cardinal, 1995b) and older adult samples (Hellman, 1997). Small to moderate increases in PA from PC to C were identified by Marshall and Biddle (2001) claiming that this was against the model's predictions. Additionally, inconsistencies were identified in the differentiation of PA levels between certain SOCs (Dannecker *et al.*, 2003). However, the model does not preclude such differences, for example PC and C are both below the activity criterion but it could be the case that contemplators are closer to that criterion (more active) than pre-contemplators.

In a recent systematic review Spencer and co-workers (2006) found only one longitudinal validation study for exercise (Plotnikoff, Hotz, Birkett & Courneya, 2001b) where the component of SE was strongly confirmed in relation to theory requirements in contrast to DB and POCs that were only partially supported. Particularly for adolescents the core constructs of the model (POCs, DB, SE) seemed to differentiate

across SOCs in a manner consistent with the theory (Goldberg *et al.*, 1996; Nigg & Courneya, 1998; Nigg, 2001).

6.3.4. Theoretical interactions between the transtheoretical model constructs

Burkholder and Nigg (2002) assembled all the theoretical relations between the various TTM constructs in a pictorial representation (see: figure 6.4). In PC the processes of consciouness raising (CR), helping relations (HR) and social liberation (SL) are considered to be the most frequently used, the pros are expected to be lower than the cons and SE at its lowest. In C again CR and SL are considered common together with two other experiential POCs namely, self-reevaluation (SR) and dramatic relief (DR). The pros are hypothesized to be closing the gap with the cons and SE to be increasing. In the PR stage self-liberation (SL) accompanies the four POCs of the previous stage, the pros are expected to have outweighted the cons at least marginally and SE to still be increasing. In A all of the five behavioural POCs are most common, the decisional balance (DB) has definitely shifted towards the pros and SE is expected to show a rapid increase. Lastlly, in M stimulus control (SC), reinforcement management (RM), counterconditioning (CC) and helping relations (HR) are still present in the list of the most commonly employed SOCs, the DB has remained in favour of the pros and SE is expected to be at its peak. Most of the above trends have been empirically proven, as it was illustrated in this chapter, while a few need further clarification.

Precontemplation	Contemplation	Preparation	Action	Maintenance
Processes: Consciousness-Raising Helping Relationships Social Liberation	**Processes:** Consciousness Raising Social Liberation Self-reevaluation Dramatic Relief	**Processes:** Consciousness Raising Social Liberation Dramatic Relief Self-reevaluation Self-liberation	**Processes:** Self-Liberation Stimulus Control Reinforcement Mgmt Counterconditioning Helping Relationships	**Processes:** Stimulus Control Reinforcement Mgmt Counterconditioning Helping Relationships
Decisional Bal: Pros << Cons	**Decisional Bal:** Pros $\leq$ Cons	**Decisional Bal:** Pros $\geq$ Cons	**Decisional Bal:** Pros > Cons	**Decisional Bal:** Pros > Cons
Self-Efficacy: Lowest	**Self-Efficacy:** Increasing	**Self-Efficacy:** Increasing	**Self-Efficacy:** Rapid increase	**Self-Efficacy:** Peaks
Temptations: Highest	**Temptations:** Decreasing	**Temptations:** Decreasing	**Temptations:** Rapid decrease	**Temptations:** Lowest

Figure 6.4. Theoretical relationship between stages of change, processes of change, decisional balance, self-efficacy and temptation.

[adapted from: Burkholder and Nigg (2002)]

6.3.5. Advantages of the transtheoretical model

The competitive advantage of the TTM compared to other behaviour-change theories lies in its adaptability and practicality (Ashworth, 1997; Smedslund, 1997; Whitehead, 1997). The above are supported by its successful implementation in many health behaviours (Prochaska *et al.*, 2008). Laforge and co-workers (1999) also stressed the ease and cost-effectiveness of its implementation and measurement as another advantage that led to its popularity.

Additionally, Wankel and Hills (1994) pointed out the resemblance of the TTM to social marketing where a product is being developed and promoted to target a specific market segment. As Kreuter (2000) explained, the best term to describe the SOC approach is 'stage-matched' instead of 'tailored'. This term refers to the principle of 'audience segmentation' (Armitage, 2009) expressed by the categorisation into stages as opposed to a personalised adaptation. Accordingly, researchers can design interventions adapted to the needs of people that belong to a certain SOC (Reed, 1999). This leads to better intervention efficiency and higher retention rates (Carron *et al.*, 2002).

One of its major contributions to the field of PA behaviour is considered the synergy between intention and behaviour (Buxton *et al.*, 1996). According to Nigg (2002, p.321) the above "…conceptualisation leads to a broader range of outcomes of the behavioural change process that would normally not be detected with other approaches." For example, when an individual moves from C to PR the only necessary change is the focus of intention for behavioural change in the near future with possibly no other behavioural variation. This slight change in the focus of intention would

possibly have gone unnoticed by other approaches. Nonetheless, the model can distinguish between active and inactive individuals and thus, its results are comparable with those of former research (Courneya, 1995).

6.3.6. Limitations and critique of the transtheoretical model

Reviewers of the model admit its appealing characteristics but on the other hand acknowledge the severe criticism that it has provoked (Marshall & Biddle, 2001). The model's applicability in many forms of behaviour combined with a willingness to adopt it without adequate prior justification raised concerns regarding its validity (Culos-Reed, Gyurcsik & Brawley, 2001; Carron et al., 2002; Riemsma, Pattenden, Bridle, Sowden, Mather, Watt & Walker, 2002).

One of the most well-known theorists of behavioural psychology claimed that human behaviour is too complex to be bound by a set of stages (Bandura, 1997). Moreover, Riemsma and co-workers (2002) also expressed their concerns whether the stages are realistic or rather a simplification of behavioural change. No one can argue against the complexity of human behaviour but still the TTM is considered by Smedslund (1997) as conceptually and logically valid even beyond any empirical validation. Bandura (1997) has argued that a genuine set of stages should possess qualitative differentiation among its components accompanied by an invariant and non-reversible sequence of change. However, in order to describe the complexity of human behaviour a stage model is required to be more flexible and realistic than the one declared by Bandura (1997), for example, incorporating regression (Culos-Reed *et al.*, 2001).

Another criticism adopted by Brug and colleagues (2005, p.252) was that "…[the A and M] stages are based on the arbitrary categorizations rather than true differences and leave the model vulnerable to allegation that movement between some stages can be affected by the passage of time alone." However, this passage of time mentioned above is not "passive" but "dynamic" since individuals must make deliberate efforts to sustain their physically active lifestyle against the biological and public tendency of sedentariness (Nigg, 2002). Littell and Girvin (2002) presented evidence that individuals do not necessarily move only among adjacent stages. This stage skipping was attributed to either inconsistencies of the model or inability to capture intermediate stage transition between measurements. For example, between two measurements an individual might have moved from PC to C, then from C to PR and finally from PR to A but the method of assessment could only detect the starting stage (PC) and the final one (A), failing to capture the path in-between. Additionally, Litell and Girvin (2002) questioned the validity of the SOCs as they could not appear discrete (qualitatively different) in the reviewed cross-sectional studies where principal components, factor, or cluster analysis was applied. However, their conclusion did not pertain to mutually exclusive stage categorisation, for example via algorithms.

Five limitations of the TTM were suggested by Culos-Reed and colleagues (2001) and their arguments together with an attempt to address them will be presented: Firstly, the SOCs are not empirically confirmed as a robust construct by applied research. However, the SOCs originated from empirical research (Prochaska & DiClemente, 1983; Marcus *et al.*, 1992c) and have also been at least partly validated for exercise by several studies (Marcus *et al.*, 1992d; Wyse *et al.*, 1995; Cardinal, 1997; Hausenblas *et al.*, 1999; Cardinal, 2002). Secondly, the relationship between the POCs and the SOCs is not undoubtedly proven. However, as Nigg (2002) argues, the above

relationship clearly identifies the use of mediators (POCs) that are important in each SOC for stage progression. Thirdly, the TTM is mostly descriptive as opposed to explanatory. Sutton (1996) and De Bourdeaudhuij (1998) shared this view but they also suggested that the model should be considered as a prescriptive one, useful for designing interventions to help people change. Fourthly, the TTM does not address any moderator variables such as gender, age or ethnicity. However, analysis can be performed separately for each moderator category (for example, men and women) and then the two categories can be compared to see if there are differences between them. Lastly, the amalgam of theories used to develop the TTM endangers their individual validity as they interrelate with each other within the TTM. Nonetheless, these different constructs are solely related to and analysed with SOC and not with each other and thus, theoretically and practically they do not interrelate.

Narrative reviews of the TTM like the ones written by Marcus and Simkin (1994) and Reed (1999) have been accused of being selective of supportive studies to the TTM (Marshall & Biddle, 2001). Schmidt (1996) argued in favour of meta-analytic techniques compared to narrative reports, for example, meta-analyses are considered more objective in the selection of studies. However, a systematic review could also employ objective criteria. While Armitage (2009) acknowledges the value of the TTM he argues against the way that researchers have approached it. Others have also raised methodological or analytic concerns (Sutton, 1996; Ashworth, 1997). Examples to highlight the two previous opinions are presented next. As Buxton and colleagues (1996) explained, in some studies the five SOCs for exercise were reduced to three. While this approach might seem helpful in analysing data from small samples it diminishes most of the advantages of the model. Furthermore, the prevalent cross-sectional PA studies in the TTM literature lack the ability to confirm causal associations

between the SOCs and the other components of the model (Marshall & Biddle, 2001); moreover, they cannot confirm their predictive power nor validate the SOCs (Brug *et al.*, 2005). Taking the above arguments into consideration, Marshall and Biddle (2001, p.230) admitted that "…narrative reviews are consistent in providing support for the TTM in the PA domain..."

Finally, in their article with the rather provocative title "Why don't stage-based activity promotion interventions work?" Adams and White (2005, p.240) claimed a series of reasons for their long-term inefficiency:

 a) Exercise behaviour is a complex of different behaviours. However, PA is accumulated through interaction of active commuting, occupational, domestic and leisure-time activities (World Health Organisation, 2002). Someone can have a very physically demanding occupation and then in his/her leisure time might prefer to relax and rest. Thus, he/she would be considered active in terms of OPA but inactive in terms of LTPA. However, considering his/her TPA or HEPA, which is the sum of all types of PA, there would be no misconception. An individual would be considered active or inactive regarding his/her total amounts of accumulated PA, which is the decisive factor of whether his/her health would accrue any benefits.

 b) Determining current SOC is crucial to intervention delivery, yet few validated algorithms are used. However, the accuracy of measurement is a common problem in the field of PA, especially for young people (Twisk, 2001). Thus, it is not limited only to the SOCs. As Brug and co-workers (2005) argue, apart from the probable low reliability of staging algorithms there are also true stage transitions between measurements that might inhibit test-retest reliability. Thus, efforts should be made to validate the measurement instruments further. More objective methods of PA assessment might jeopardise the model's ease of administration.

c) Exercise behaviour is influenced by numerous external factors not considered by the TTM. Certainly, the TTM cannot incorporate all elements of a complex behaviour such as PA and as Brug and co-workers (2005) claimed, it should not be blamed for it. Many covariates of PA can still be investigated via the model through between-groups comparisons, for example, SOCs of males vs. SOCs of females.

d) The TTM suggests that stage progression is a significant outcome, but this is not always associated with behaviour change. Undoubtfully, the TTM proves more analytic than the dichotomous approach considering individuals to be either active or inactive. This is an important element of the SOCs incorporating behavioural, temporal and intentional aspects of PA. The model does not postulate that each SOC differs from the rest in terms of PA behaviour. The only differentiation, that is theoretically established, is that the three inactive stages (PC, C, PR) do not meet the activity criteria as opposed to the two active ones (A and M). However, small to moderate increases in PA have been evident from PC to C (Marshall & Biddle, 2001), the two most inactive stages. These behavioural changes were not sufficient to achieve the activity criterion but enough to differentiate between the two stages. The model does not preclude such changes since both SOCs are below the activity criterion but it could be the case that contemplators are closer to this criterion than pre-contemplators.

e) Stage-based interventions are highly complex and may require more than one level of development and evaluation. However, meaningful behavioural change can still be accessed through the SOCs by measuring those who moved from the three inactive stages (PC, C and PR) to the two active ones (A and M). This last argument could be considered a recommendation for future research efforts to clarify certain issues and surely is a very constructive suggestion for a better evaluation of TTM interventions.

The debate in favour and against the TTM seems to have divided commentators. According to Brug and colleagues (2005, p.255) "…we have reached an impasse; a gridlock where, working within restricted academic parameters, specific groups and individuals respectively recycle supportive and critical data associated with the model or argue about meaningless conceptual or methodological minutiae." As shown in the above paragraphs the TTM can stand against its critiques with logical favourable arguments. A constructive way forward would be to try to evaluate any deficiencies of the model and attempt to enhance them but also to take advantage of its strong elements with applied empirical research.

6.3.7. Prevalence of stages of change for physical activity

Marshall and Biddle (2001) conducted a thorough meta–analysis of studies employing the TTM from the emergence of the model in 1983 until January 2000. Their cumulative conclusions were very illustrative of the model's characteristics. One disadvantage regarding the generalisability of the findings was that the meta-analysis was limited to predominately the USA, UK, Canada and Australia. Neverthelses, they covered several developed countries, genders, the whole age-range and several settings (eg. community, educational, worksite). Across the collective sample (n=68,580), 14% of individuals were in the PC, 16% in C, 23% in PR, 11% in A and 36% in M. These proportions represented the total amount of individuals that were measured.

In the pan-EU study Kearney and colleagues (1999b) studied constructs of the TTM in weighted nationally representative samples of the 15 EU member states. The main advantage of this study was the national representativeness of their samples. However, the application of the model was not without mistakes. It incorporated a sixth

stage labeled 'relapse', when as Prochaska and Velicer (1997, p. 39) have clearly pointed out, there was a misinterpretation from one of their early articles "…that relapse is a separate stage… [it] is one form of regression, which is a return to an earlier stage." Additionally, their second and third stage differentiation was not based upon a time frame (six months vs. one month) but on the magnitude of the intention to change (thinking about changing vs. determined to change), which is not in accordance with most proposed SOC definitions. More importantly, no set criterion was utilized to differentiate between active and inactive individuals. The EU average score for the five SOCs was 3.44. As can be seen in table 6.1, on average, almost two thirds of the sample is equally divided in PC (29%) and M (30%). Kearney and colleagues (1999b) observed large differences among the SOCs in favour of males, young people (15-24 years old), tertiary-educated and single people. These groups also possessed the higher percentages in M (see: table 6.1). In contrast, females, older people (>24 years old), secondary- or less-educated and married or divorced people were the most prevalent in PC positioning them in a high-risk state for physical inactivity.

Table 6.1. EU citizens at various stages of change for physical acivity* classified by demographics *[Adapted from: Kearney and co-workers (1999b)].*

Country	n	Mean stage score*	PC	C	D	A	M	R
Ireland	1,001	3.69	15%	11%	8%	7%	47%	10%
Italy	673	3.53	15%	12%	8%	6%	39%	14%
UK	1,490	3.44	18%	11%	9%	7%	41%	13%
Denmark	1,147	3.21	25%	12%	10%	5%	38%	11%
Netherlands	1,010	3.16	26%	12%	7%	6%	37%	9%
Sweden	1,001	3.14	20%	20%	15%	4%	35%	15%
Austria	931	3.11	23%	13%	15%	4%	32%	7%
Finland	979	2.98	18%	22%	23%	5%	25%	6%
Luxemburg	518	2.87	30%	13%	7%	5%	28%	9%
Spain	1,000	2.76	33%	12%	9%	7%	25%	12%
Germany	1,159	2.72	32%	15%	9%	4%	26%	8%
France	1,003	2.65	38%	13%	6%	4%	27%	10%
Belgium	982	2.58	44%	8%	4%	3%	28%	8%
Portugal	1,007	2.29	46%	12%	4%	2%	21%	10%
Greece	1,011	2.09 (15th)	46% (1st)	11%	6%	3%	14% (15th)	13%
EU average**	**14,912**	**3.44**	**29%**	**13%**	**8%**	**5%**	**30%**	**10%**

Note: D=Decision, R=Relapse

* *The 'do not knows' are not included so percentages do not add up to 100%.*

***Mean stage score calculated as: precontemplation = 1, contemplation = 2,*

   Decision = 3, action = 4, maintenance = 5 (relapse excluded).

****Weighted according to population size.*

**** *Position among all EU countries.*

6.3.8. Physical activity interventions using the transtheoretical model

According to the Cancer Prevention Research Centre (2000) the TTM has several advantages compared to outcome-oriented models concerning intervention development and implementation in the areas of recruitment, retention, progress, process, and outcome. Firstly, traditional interventions often presuppose that participants are ready for a behaviour change, which is not always true since it depends upon their "readiness to change". On the contrary, the TTM recognises the segmentation

of individuals in stages of different "readiness to change". As a result (secondly), the TTM approach appeals to a higher proportion of the population and thus, very high recruitment rates are probable. Thirdly, the TTM has more sensitive measures of progress, both intentional and behavioural, and thus distinguishes and supports efforts, which traditional action-oriented approaches often fail to notice. Fourthly, the TTM is able to analyse, in detail, different aspects of the intervention process and eventually assist its development. Finally, based upon its high efficacy and recruitment rate the TTM can potentially enhance the intervention impact upon a health behaviour.

6.3.8.1. Pioneering transtheoretical model physical activity interventions

The foundational studies employing the TTM in PA interventions were undertaken by Dr Bess Marcus and her co-workers. Their initial TTM interventions targeting exercise and PA involved community and worksite samples in programmes such as *Imagine Action* (Marcus *et al.*, 1992a), *Jump Start to Health* (Marcus, Bock, Pinto, Forsyth, Roberts & Traficante, 1998a; Marcus, Emmons, Simkin-Silverman, Linnan, Taylor, Bock, Roberts, Rossi & Abrams, 1998b; Bock, Marcus, Pinto & Forsyth, 2001), and *Project Active* (Kohl, Dunn, Marcus & Blair, 1998; Dunn et al., 1999).

The *Imagine Action* campaign (Marcus *et al.*, 1992a) was the first PA intervention based upon the SOCs (n=610, mean age=42 years, 77% women). The six-week community-based intervention consisted of a combination of printed stage-matched manuals and the provision of PA opportunities. In the end, approximately 62% progressed to a more active SOC while only 4% regressed to a less active stage. Thus,

this type of low-cost intervention seemed to be able to produce positive results. On the other hand, the main limitations of this study were the lack of a control group and the examination of only three (C, PR and A) out of the five SOCs.

The *Jump Start to Health* study (Marcus *et al.*, 1998b; Bock *et al.*, 2001) initially focused on sedentary employees (n=150) in a specific workplace and tried to compare the influence of stage-based self-help printed manuals in one group with that of standard printed manuals of the American Heart Association in another. These materials were provided once in the beginning of the study and then after one month. The TTM approach proved more effective in helping participants become more active (37% vs. 27%), especially for those initially in the first three inactive SOCs. The *Jump Start to Health* study (Marcus *et al.*, 1998a) was also tested in a community sample with longitudinal re-applications of printed manuals and TTM assessment after one, three and six months from the initial application. Results showed a superiority of the TTM approach in helping participants to become and remain physically active in a 12-month period. The successful application of these printed manuals in PA interventions was of primary concern for the current study since they were the basis on which the current intervention's materials were developed (see: section 7.12.2). However, a primary limitation of these studies was the lack of a control group with which to compare the results of the two approaches.

Project Active (Kohl *et al.*, 1998; Dunn *et al.*, 1999) implemented two different types of PA interventions; the first with a lifestyle counselling approach based on the TTM and the second with a more traditional, structured exercise prescription approach. The interventions were delivered in two phases, intensive during the first six months and more regular during the next 18 months. Both groups received stage-based printed

manuals (the same as the current study). The lifestyle group received them from the beginning while the structured exercise group after the initial intensive six-month period. The study concluded that both approaches proved successful in producing significant improvements in PA levels. Specifically, the lifestyle intervention was three times more successful in increasing moderately intensive PA, while the exercise prescription was two times more successful in promoting vigorous PA. This differentiation in the magnitude of effects could be interpreted by the nature of each intervention that directly promoted each intensity level of PA.

Woods and colleagues (2002) implemented a six-month TTM intervention utilising a pre-post randomised control design with first-year undergraduate students in a Scottish university (n=459, mean age=19 years, 62% female). The personally addressed intervention consisted of two PA promotion packages (PAL1 and PAL2). The first was distributed in November while the other in the following January, both promoting a physically active lifestyle. This study addressed participants only if they were initially staged in PC or C, and thus, excluded those in the other three SOCs. Post-intervention a significantly greater proportion of the intervention students (80% vs. 68%) reported progressing through the SOCs continuum [$\chi^2(1, n=223) = 4243$, $p<0.05$]. Thus, it proved effective in the short-term in helping sedentary university students to progress through the SOCs continuum.

6.3.8.2. Reviews of transtheoretical model interventions

The effectiveness of each theory is evaluated when it is implemented in practice. Stage-matched interventions seem to be generally effective in the short-term but less so in the long-term. Adams and White (2003) conducted a comprehensive review of 16

TTM-based PA promotion interventions. In the short term (≤ 6 months), the majority (73%) of the intervention groups were more effective compared to their controls ($p<0.05$). A closer look at the short-term results also revealed that in all intervention groups there were significant absolute increases of PA levels or stage progression compared to their baseline measurements. On the other hand, about one third (29%) of the seven interventions reporting long-term effects (>6 months) were effective compared to their controls, but in absolute terms 70% of them showed significant increases compared to their baseline measurements. The chosen methods of intervention were interview counselling, written materials or a combination of both. In most studies the intervention group was compared to a group that did a non stage-matched intervention. The first approach highlighted not only the efficiency of stage-matched interventions but also their superiority to other methods. However, most studies lacked generalisability, mostly relying on worksite or patient samples. Another shortcoming was that studies were concentrated solely in the USA and the UK, which limits their generalisability. Similar results were reported by a more recent review (Hutchison *et al.*, 2009) of 24 PA interventions based on the TTM from 1996 to 2005, 21 of which were randomised controlled trials (RCTs). The interventions were almost equally distributed in three intensity categories (brief, medium, intensive). In the short term (≤ 6 months), 75% of the 24 studies were significantly more effective than the control conditions in SOC progression, PA levels, or both. In the long term (≥ 6 months), 25% of the 8 studies were significantly more effective than the control conditions, which highlight the difficulty in achieving long-term positive results.

Riemsma and co-workers (2002) reviewed seven RCTs, which have utilised the SOCs model to promote PA levels or SOC movement. However, in three of them (Graham-Clarke & Oldenburg, 1994; Braatz, Ames, Holmes-Rovner, King, McPhail &

Vogel, 1999; Harland, White, Drinkwater, Chinn, Farr & Howel, 1999) it was unclear to what degree they were truly stage-based. For example, in the *Fresh Start* study (Graham-Clarke & Oldenburg, 1994) the five stages were reduced to three (PC, C and PR as one stage) and while the intervention patients received stage-matched self-help materials they also viewed the same videos irrespective of their SOC. The whole approach of stage reduction and viewing of the same videos could not be considered best practice for the TTM (Adams & White, 2003). They concluded that little evidence existed to suggest that stage-based interventions were more effective than non-stage-based interventions or no intervention. However, their conclusions seem to hold true only for the long-term (> 6 months). In all four studies (Graham-Clarke & Oldenburg, 1994; Cardinal & Sachs, 1996; Goldstein, Pinto, Marcus, Lynn, Jette, Rakowski, McDermott, DePue, Milan, Dube & Tennstedt, 1999; Harland et al., 1999) reporting long-term effects (7-12 months) no positive effects were sustained by the stage-based interventions. However, this is a typical finding among PA interventions (Brug *et al.*, 2005). On the other hand, regarding PA levels in the short-term (<6 months), two out of five studies reported positive effects (Harland *et al.*, 1999; Peterson & Aldana, 1999), two reported negative effects (Cash, 1997; Goldstein *et al.*, 1999) and one reported mixed results (Cardinal & Sachs, 1996). Regarding the secondary outcome of stage movement, three out of four studies reported positive intervention effects (Braatz *et al.*, 1999; Goldstein *et al.*, 1999; Peterson & Aldana, 1999), while one reported negative results (Cardinal & Sachs, 1996). Finally, despite their expressed concerns regarding the TTM, Riemsma and co-workers (2002) still recommended well-designed tailored or stage-specific interventions with more accurate stage measurement and more frequent reassessment of SOC.

Bridle and co-workers (2005) reviewed seven PA interventions based on the TTM and were critical about their effectiveness. They stressed the importance of examining whether an intervention covers its theoretical background or fails in one of the following: a) lack of model specification, b) poor application of the model in practice. On this ground they challenged many of the reviewed studies as not representative of the TTM due to their concentration on the SOCs and disregard of other components of the TTM.

Noar and colleagues (2007) reviewed the short-term effects of tailored print health behaviour change interventions and found statistically significant ($p<0.01$) effect size differences (pairwise comparisons weighted by sample size) favouring interventions that utilised the theoretical concepts of SOCs or SE or POCs as opposed to those that did not. They also found significantly higher effect sizes for the interventions that used a no-treatment control group as opposed to a comparison condition.

6.3.9. Physical activity research in Greece employing the transtheoretical model

Research attempts to study samples using the TTM in PA are limited in Greece (Karasouli, 2006; Papaioannou, Bebetsos, Kafetzi & Sagovitch, 2006) and no TTM intervention was found. In the pan-EU study (Kearney *et al.*, 1999b), the Greek results revealed the lowest mean stage score (2.09) compared to an EU average of 3.44 (see: table 6.1). Another indication of high inactivity among the Greek sample was its highest percentage in the least active stage (46%) in contrast with the lowest percentage in the most active stage (14%). In all other stages (C, P, A) there was little variation from the EU average. Females seemed to be less active than males and there seemed to be a clear pattern of increased inactivity with age for both genders (see: table 6.2).

Table 6.2. Stages of change distribution by gender and age in the Greek sample

[*Adapted from: Kearney and co-workers (1999b)*].

Greece	Males				Females			
	All	15-34 years	35-54 years	55+ years	All	15-34 years	35-54 years	55+ years
PC	43%	29%	50%	57%	49%	29%	56%	68%
M	19%	28%	15%	11%	8%	12%	7%	4%

Christopoulou and colleagues (1996) investigated the SOCs for exercise in a Greek adult sample (n=178, 63% females, mean age±SD= 34.4+1.63 years). The exercise criterion was three times per week of at least 15 minutes. Subjects were distributed among the SOC for exercise as shown in table 6.3. One-way ANOVAs revealed that total scores of SE items significantly differentiated subjects in the respective SOC ($p < 0.001$) and *Tukey post-hoc* tests revealed that those in PC had significantly less SE levels than those in more active SOC (except those in A, probably because of the low number that might have weakened the estimations) and those in C and PR than those in M (see: table 6.4).

Table 6.3. Number, percentage and self-efficacy scores in each stages of change (±SD)

for exercise *[Adapted from: Christopoulou and colleagues (1996)]*

SOC	n	%	Self-efficacy score
PC	35	20%	3.05±2.22
C	45	25%	4.63±2.70
PR	52	29%	5.14±2.04
A	11	6%	6.39±2.34
M	35	20%	7.84±1.63

Table 6.4. Matrix of statistically significant Tukey post-hoc comparisons of self-

efficacy total scores and stages of change for exercise

[Adapted from: Christopoulou and colleagues (1996)]

	PC	C	PR	A	M
PC		$p<0.05$	$p<0.05$	*Non-significant*	$p<0.05$
C			*Non-significant*	*Non-significant*	$p<0.05$
PR				*Non-significant*	$p<0.05$
A					*Non-significant*
M					

Papaioannou and colleagues (2006) examined the psychometric characteristics of the POCs questionnaire for exercise (Nigg, Norman, Rossi & Benisovich, 1999), in a Greek sample of PE university students (n=482, mean age=19 years). Preliminary analysis supported the validity of the instruments according to the theoretical assumptions of the TTM. This sample could be regarded as a convenient one with little generalisability potential. Finally, Mpalaska and colleagues (2008) conducted a cross-sectional study among parents of exercising children in a Greek municipality (n=300, 59% men, mean age=39 years), which could also be regarded as a convenience sample. The SOC analogy was 37% in PC, 28% in C, 14% in PR, 10% in A and 11% in M. Moreover, they investigated the POC interactions with SOC and confirmed the TTM theory. Specifically, participants in M scored higher in every POC among the SOCs as opposed to participants in PC showing lower scores. Finally, PR scored higher in almost every POC compared to C. Regression analysis revealed that intention was significantly

predicted by certain POCs, namely counter conditioning, reinforcement management and stimulus control.

6.4. Conclusions

An intervention with solid theoretical foundations is considered better equipped to provide efficient results. Social Cognitive Theory, the Theory of Reasoned Action, the Theory of Planned Behaviour, and the TTM are considered four of the most influential contemporary 'Health and Exercise Psychology' theories. The TTM has been among the most popular yet more controversial psychological models. Its strengths stem from a logical framework of operation, ease of administration and successful adaptability in many health behaviours. Interventions for the promotion of PA based upon this model seem to be effective in the short-term but struggle for long-term efficiency, as with any other type of PA intervention. It was concluded by the author that the TTM was a model worth pursuing despite certain limitations. Suggestions for future research included the use of longitudinal and intervention designs in more representative and diverse samples combined with more standardised and validated methods of PA and SOC assessment (Marcus & Simkin, 1994; Marshall & Biddle, 2001). Lastly, more research attempts specifically for the Greek population are required since they seem to be lacking, especially regarding interventions.

6.5. Summary of the literature review

Analysis of the literature identified a certain gap, which would be exploited by this thesis. Previous research deficiencies seem to call for longitudinal projects and interventions targeting adolescence and the transitional periods to young adulthood and

adulthood. The TTM had the potential to serve as a framework for this study due to its advantages compared to other theories. A longitudinal design was considered appropriate to investigate trends of PA and functions of this model. Consequently, an intervention to enhance PA participation using the TTM could be designed and implemented in Greek school settings. The above conclusions formulated the basis of the following research method.

Method

Chapter 7. Research Design

7.1. Research gap

The literature review identified certain issues that required further clarification by future research. The low prevalence of PA globally and across all ages created a clear demand for interventions promoting physically active lifestyles. Specifically, the Greek population seemed to be at a high risk of physical inactivity even in the younger ages. School-based interventions were proposed for targeting these young ages. One fertile period to promote active living throughout the lifetime seemed to be just before graduation from school. Theoretically driven interventions tailored to the population were suggested with emphasis placed on their long-term effectiveness. The TTM is regarded as an appropriate model for such a project. It has been specifically suggested to PE professionals in attempts to promote and retain PA behaviour change (Cardinal *et al.*, 1998). Its competitive advantages distinguished it in terms of practicality and efficiency, which are very important components of interventions. Thus, interventions such as this study were considered essential to cope with the above-mentioned characteristics.

According to Armitage (2009) the majority of TTM studies have focused mainly on the SOCs component. West (2005) has criticised this over-emphasis on the SOCs that has left other important components under-researched. Thus, as Carron (2002) admitted, research examining the complete TTM is limited. In fact, in a recent TTM review (Hutchison *et al.*, 2009) only 29% of the interventions used all four constructs of

the model (SOCs, POCs, SE, Pros & Cons). As argued by the same reviewers, the above weakness fails to acknowledge the multidimensional nature of the model, which is a key competitive advantage of the model. Additionally, Littell and Girvin (2002) emphasized that longitudinal studies have been scarce until recent years. Hence, the current study attempts to address the above gaps by examining the TTM in its totality with a longitudinal design.

7.2. Significance of the study

According to Thomas and Nelson (1990) the significance of a study can be determined by whether it is regarded as basic or applied research since different criteria apply to these two categories. The current study should be considered as applied research since it is a theory-based intervention. Its evaluation should include the practical effects that it has accomplished but also the quality of work that led to these effects.

In terms of practicality a major breakthrough would be achieved if it could provide mid- and long-term success. However, considering its simple design even the more easily accomplished short-term results could prove useful. Due to its easy administration it could be easily generalized to a wider audience and also be re-implemented to intensify its effects.

The quality of measurement instruments is of paramount importance to the significance of a study. However, as has been highlighted by Gill (1997), there appear to have been major psychometric problems in *Sport Psychology* measures with a tendency to be used in diverse samples without basic item analysis or reliability and

validity testing. Thus, testing the validity, reliability and administrative feasibility specific to the targeted population, as has been done in the current study, is essential.

Difficulties in measurement of PA are evident in the literature (Welk, 2002), especially with children and adolescents (National Institute for Health and Clinical Excellence, 2007). Furthermore, the measurement of SOCs has proven challenging and lacks standardisation (Marshall & Biddle, 2001). This has led to frequent confusions in terms of definitions of PA, SOCs and activity criteria. Thus, standardisation is vital for the initial application of a TTM intervention in a particular country, language and age group, which would prepare the way for promising future studies.

7.3. Purpose of the study

The objective of promoting lifelong participation in PA, seems to be universally accepted (Green, Smith & Roberts, 2005). Inside school premises, motivating children to develop and maintain an active lifestyle is acknowledged as one of the main aims of contemporary PE (Biddle & Chatzisarantis, 1999). This is the case in Greek secondary schools, as well. Particularly during the last three years of schooling (in Lyceum) it is given the highest priority (Greek Pedagogical Institute, 2008). Actually, the whole PE curriculum in Lyceum is developed around this objective. Characteristically, it is expressed as: "a) The consciousness of the need for physical exercise and sports throughout the life course, and b) the adoption of sports habits or hobbies." (Greek Pedagogical Institute, 2008, p.94).

The above objective needs to be specifically targeted to be effective. Thus, the purpose of the current study was two-fold:

1. To design and implement for the first time in Greece a PA intervention targeting adolescents, which was based upon the TTM. The main concern in the design of the intervention procedures and materials was to keep it as simple as possible in order to be easily replicable on a wider scale.

2. To examine whether the intervention was useful in helping participants to adapt and maintain a physically active lifestyle during their final school years and even after their graduation from school.

7.4. Identification of variables

The main dependent variable in this study is involvement in physical activities. It is operationally defined as the stages of readiness to change of PA in second grade Lyceum students. The mean age of the participants was around 15 years at the beginning of the study and the location of the study was in the Prefecture of Heraklion in the Greek island of Crete. The independent variables that were manipulated through the intervention procedures were strategies/techniques, cognitive procedures and psychological states. They were operationally defined as the POC, Pros and Cons and SE (see: chapter 6), respectively, which are the other TTM components that drive movement through the SOCs continuum. Finally, gender was treated as a moderator variable to examine any significant differences in the intervention effects between girls and boys. Controlled variables were age of the participants and also location of their residence.

7.5. Limitations and delimitations of the study

The researcher-imposed delimitations of the present study are as follows:

1. The author of this thesis was teaching PE in public secondary schools in Greece and was awarded sabbatical leave from the Ministry of Education of Greece to undertake a PhD Degree. The requirements of the leave were that the research project had to be located in Greek secondary schools and be relevant to PE. The above requirements delimited the location, the age-range and the field of study. However, the significance and appropriateness of their investigation were further justified in the literature review.

2. The reviewed literature was mainly restricted to sources in the English language, which were assumed to contain adequate and representative information of the available body of scientific knowledge for the topic of the study.

3. The decision to select the Transtheoretical model as the theory of choice limited this study to the extent that this theory is valid and adequate to investigate adolescent PA behaviour (see: chapter 6).

4. The selected sample limited this study to the extent that it could be considered representative of the examined population (see: section 7.11).

5. The choice of the research instruments limited this study to the extent of their validity and reliability (see: sections 7.13, 7.14, 7.15).

The rest of the limitations are as follows:

1. The extent that the control group remained unaffected by any intervention effect (see: section 7.11). Despite planned efforts to minimise interaction between the

control and the intervention group, social encounters might have occurred since some of both groups lived in different parts of the same city (Heraklion).

2. Difficulties in locating participants in follow-up measurements, especially in the long-term and after leaving school (see: section 7.11).

3. The uncontrolled environment that might have exposed participants to a variety of influences regarding their PA behaviour. For example, the organisation of the Olympic Games in Athens in 2004, or the victories of the national football and basketball team in World and European Championships might have boosted students' intentions to participate in sports. However, if any of these influences did occur they should have influenced both the intervention and control group in similar ways. Thus, their comparative status should have been unaffected.

4. Seasonality of PA might have limited the results since the measurements were undertaken in autumn and spring and might not be representative of PA behaviour during other seasons (see: section 7.10).

7.6. Basic assumptions

Every study is nourished around a certain environment that is assumed to be fertile and open to examination. As Thomas and Nelson (2001) outlined, certain conditions are assumed as true and the examined variables are assumed to be measurable. This thesis is based upon the following assumptions:

1. The author of the thesis is adequately capable of understanding, summarizing and transferring in abstracted written form the findings of other researchers.

2. The Greek population does not significantly differ from the populations of other countries (mainly the UK and the USA), where the majority of principles, theories and methods governing the present thesis have been developed.

3. The supplied definition of PA typified the usual adolescent PA behaviour in this specific culture and environment.

4. The dependent variable, as operationally defined (see: section 7.2), constitutes a form of PA behaviour.

5. The independent variables, as operationally defined (see: section 7.2), were manipulated in the way that it was perceived by the intervention design.

6. Participants understood the instructions-directions and followed them accordingly.

7. Participants responded truthfully.

8. Although interactions on a social level between participants of the intervention and control group could not be controlled or measured, it could be assumed that they were not of such a high impact to alter the research results.

9. Finally, as Thomas and Nelson (2001, p.56) stated "The researcher must proceed on the assumption that the restrictions imposed on the study will not be so confining as to destroy the external validity [generalisability] of the results".

However, the preceding assumptions were given due consideration and appropriate care was taken with methodological aspects of the study presented in the following sections of this chapter in order to make the above assumptions as close to reality as possible.

7.7. Research hypotheses

This study examined adolescent PA behaviour change using the TTM. Short-term was defined as the duration between pre- and post-intervention for all hypotheses. Mid-term was defined as the duration between post-intervention and one year after the intervention for all hypotheses. Long-term was defined as the duration between one year and two years after the intervention for hypothesis 3 and as the duration between post-intervention and two years after the intervention for hypotheses 6, 9, 12 and 15. The following research hypotheses were proposed in relation to the expected intervention effects:

7.7.1. Latent within-group stages of change comparisons

Hypothesis 1. The students of the intervention group will show more progress through the SOCs continuum than those of the control group in the short-term.

Hypothesis 2. The students of the intervention group will show more progress through the SOCs continuum than those of the control group in the mid-term.

Hypothesis 3. The students of the intervention group will show more progress through the SOCs continuum than those of the control group in the long-term.

Latent transition analysis (LTA) was selected as the chosen method to test Hypotheses 1, 2 and 3 by using within-group comparisons across the various adjacent measurements and then comparing the results of the intervention with those of the control group.

7.7.2. Observable within-group stages of change comparisons

Hypothesis 1 would be further examined by investigating any observed (rather than latent) progress of the intervention group through the SOCs continuum in comparison with the control group. A non-parametric and a descriptive comparison of stage movement within groups were selected to address the above confirmation.

7.7.3. Observable within-group self-efficacy comparisons

Hypothesis 4. The students of the intervention group will show more favourable results according to the TTM in terms of their SE than those of the control group in the short-term.

Hypothesis 5. The students of the intervention group will show more favourable results according to the TTM in terms of their SE than those of the control group in the mid-term.

Hypothesis 6. The students of the intervention group will show more favourable results according to the TTM in terms of their SE than those of the control group in the long-term.

7.7.4. Observable within-group pros and cons comparisons

Hypothesis 7. The students of the intervention group will show more favourable results according to the TTM in terms of their Pros than those of the control group in the short-term.

Hypothesis 8. The students of the intervention group will show more favourable results according to the TTM in terms of their Pros than those of the control group in the mid-term.

Hypothesis 9. The students of the intervention group will show more favourable results according to the TTM in terms of their Pros than those of the control group in the long-term.

Hypothesis 10. The students of the intervention group will show more favourable results according to the TTM in terms of their Cons than those of the control group in the short-term.

Hypothesis 11. The students of the intervention group will show more favourable results according to the TTM in terms of their Cons than those of the control group in the mid-term.

Hypothesis 12. The students of the intervention group will show more favourable results according to the TTM in terms of their Cons than those of the control group in the long-term.

7.7.5. Observable within-group processes of change comparisons

Hypothesis 13. The students of the intervention group will show more favourable results according to the TTM in terms of their POCs than those of the control group in the short-term.

Hypothesis 14. The students of the intervention group will show more favourable results according to the TTM in terms of their POCs than those of the control group in the mid-term.

Hypothesis 15. The students of the intervention group will show more favourable results according to the TTM in terms of their POCs than those of the control group in the long-term.

Non-parametric within-group comparisons across the various measurements were chosen to test hypotheses 4 to 15.

7.8. Overview of the intervention

The intervention, which is the core construct of the study, was delivered while participants were attending the 2nd grade of Lyceum, just two years before their graduation from school. This finishing phase of secondary education provided a platform of comparison with the transitional period after graduation. The intervention materials consisted of a set of five stage-matched booklets, which were utilised by the students in the period in-between the first two measurements. The third and fourth measurement helped to assess any mid- and long-term intervention effects one and two

years after the completion of the intervention. The last measurement was the most challenging one since the main difference with the other three was that it was delivered outside the school premises since the participants had graduated and had began a new phase of their lives.

7.9. Pilot study of transtheoretical model questionnaires

A pilot study was conducted one year before the intervention (see: table 7.1). Its goal was to check administration issues of distributing the TTM questionnaires (see: section 7.13 for a description of the questionnaires) and to have a first indication of the SOCs distribution among the sample. Among the seven schools participating in the study (see: section 7.11) the Lyceum of Melesses was randomly chosen to engage in the pilot study. A class of twenty 2nd grade students was chosen to participate. The whole process of administering the TTM questionnaires in one class hour was piloted. The introduction of the process, the instructions and time needed to complete the questionnaires were carefully assessed. Furthermore, feedback was received from students of the pilot study about clarity and understanding of the questionnaires. The whole process did not reveal any serious administration problems. The questionnaires could easily be completed in less than a class hour without any problems. Additionally, the students were distributed across all the five SOCs, which was a positive sign for the implementation of the TTM with the research population. Since all issues were positively resolved the researcher decided to implement these procedures in the main study.

7.10. Longitudinal design

Four longitudinal measurements were conducted throughout the course of the study (see: table 7.1). One before the start of the intervention to acquire a baseline set of data. The second was completed at the finish of the intervention to assess its immediate effects. The third measurement was administered one year after the start of the intervention, to see whether any effects had lasted through the year. Finally, the fourth one was held two years after the start of the intervention, when the students had graduated from school. The time frame between each pair of successive measurements was at least six months in order to allow for all possible stage transitions to take place. For example, to confirm the transition of an individual initially placed at one of the inactive stages to M would require six months of being physically active. The last measurement examined whether the effects of the intervention, if any, had been sustained after graduation from school.

Table 7.1. Timetable of measurements

School Year	Grade	Nov.	Dec.	Jan.	Feb.	Mar.	April
2003 –2004	2nd *						Pilot
2004 –2005	2nd	1st Meas.	Intervention implementation				2nd Meas.
2005 – 2006	3rd	3rd Meas.					
2006 –2007	Graduates	4th Meas.					

*Note: *The students of the pilot study were not taken from the sample of the study but were those that studied in 2nd grade one year before the intervention.*

Seasonality of measurements was seriously considered since youth PA levels seem to have seasonal variations with a zenith in the summer and a nadir in the winter (Uitenbroek, 1993; Kohl & Hobbs, 1998). Hence, as illustrated in table 7.1, three out of

four measurements took place in the same month (November) and only one in a different month (April). This variation was inevitable since the intervention lasted four months from December to March. This was expected to cause minimum seasonality bias since, as mentioned above, both periods of measurements (autumn and spring) do not usually produce extremes in yearly youth PA participation and thus they are not expected to vary considerably. Furthermore, any bias would have been expected to affect both groups equally. Hence, it would probably not have brought about any variations in their between-groups comparisons. A possible solution would have been to implement a year-round intervention. Then all measurements would have been placed in the same period of the year. However, this approach would have been very time-consuming and would have imposed unacceptable practical difficulties.

7.11. Participants

The longitudinal design imposed considerable risks to the completion of the study. The ideal scenario was to have at least 100 students in each group for the last measurement. This would provide a sufficient pool to perform the required statistical tests. The projection of this outcome led to an estimated baseline sample of at least 300 students in each group, according to attrition rates of earlier studies (Adams & Brynteson, 1992; Andersen & Haraldsdottir, 1993; Kelder, Perry, Klepp & Lytle, 1994; Dale et al., 1998; Nigg & Courneya, 1998; Dale & Corbin, 2000; Nigg, 2001). The notion was that if such baseline numbers could be achieved then the desired 100 students in each group could be successfully retained after two years and four measurements. However, there was always the risk of high attrition along the way. This risk was continuously monitored after each measurement. The use of incentives, for example vouchers, prizes, money, is a common practice to enhance adherence in TTM

interventions (Marcus *et al.*, 1992d; Nigg & Courneya, 1998; Harland *et al.*, 1999; Nigg, 2001; Blissmer & McAuley, 2002). In the current project a "promised incentive" comprising of a single 300 Euros voucher was offered and only those who successfully finished all four measurements were eligible to go into a draw for the voucher.

The Heraklion District was chosen because of convenience reasons since it is the place of residence and work of the author. The population of 2nd grade students of General Lyceums in the Heraklion District was 2,000 in the 2004-2005 school year when the intervention took place (Regional Administration of Elementary & Secondary Education of Crete, 2005). The total number of schools was 36 comprising 15 urban and 21 rural. Prochaska and Velicer (1997) called for proactive recruitment strategies in order to reach all potential participants and achieve a high impact in the population. The active recruitment method used in this study "…begins with a defined sample pool that is directly contacted..." (Marshall & Biddle, 2001, p.231). The first step was to examine whether an experimental design with random assignment to intervention or control group could have been employed. However, this theoretically ideal method imposed a significant threat of diluting the real intervention effects. In the case of random selection of those in the intervention and control groups they would have been left to interact in the same classrooms or schools. Thus, contamination between the two groups would have been probable. A common solution in most youth intervention studies is the randomisation or assignment of schools, rather than students to intervention or control conditions (Stone *et al.*, 1998). Therefore, such a stratified quasi-experimental approach was favoured.

Seven schools were stratified in order to represent both urban and rural locations (see: figure 7.1). Four were involved in the intervention while three were allocated to

the control group. The schools were chosen to be analogous in terms of gender and urban or rural location (see: table 7.2). Generalisation to the Heraklion District population was considered likely due to the large proportion of the represented population (37%) and gender and location similarities (see: table 7.2). Some characteristics of the baseline sample were as follows: n=665, Mean age=15.8 years (SD=0.48, 73% 16-year-olds, 23% 15-year-olds), 57% were girls, 61% had an urban address and 60% were from the control schools (see: table 7.2). The control group was larger, which was desirable, since it was expected to have a lower retention rate according to earlier studies (Kelder *et al.*, 1994; Trudeau *et al.*, 1998). Subsequently, the intervention group was expected to show greater adherence due to higher involvement in the project.

Table 7.2. Population and baseline sample characteristics in academic year 2004-2005

[Adapted from: (Regional Administration of Elementary & Secondary Education of Crete, 2005) and (Greek Ministry of Education, 2005)]

Allocation	Name	2nd graders	Girls %	Urban/ Rural	2nd graders	Urban
	National	75,326	54%	Both		
	Heraklion District	2,000	53%	54%		
	Total of the 7 schools	738	56%	61%		
	Total of non-eligible	73	45%	61%		
Inter. & Con.	Total eligible	665	57%	61%		
Intervention	2nd Lyceum	154	56%	Urban	263	56%
	Meleses	38	50%	Rural		
	Arkaloxori	44	59%	Rural		
	Goubes	27	48%	Rural		
Control	4th Lyceum	170	56%	Urban	402	64%
	Gazi	102	52%	Rural		
	Moires	130	65%	Rural		

Crete

Heraklion
2nd & 4th

Gazi

Goubes

Melesses

Arkaloxori

Moires
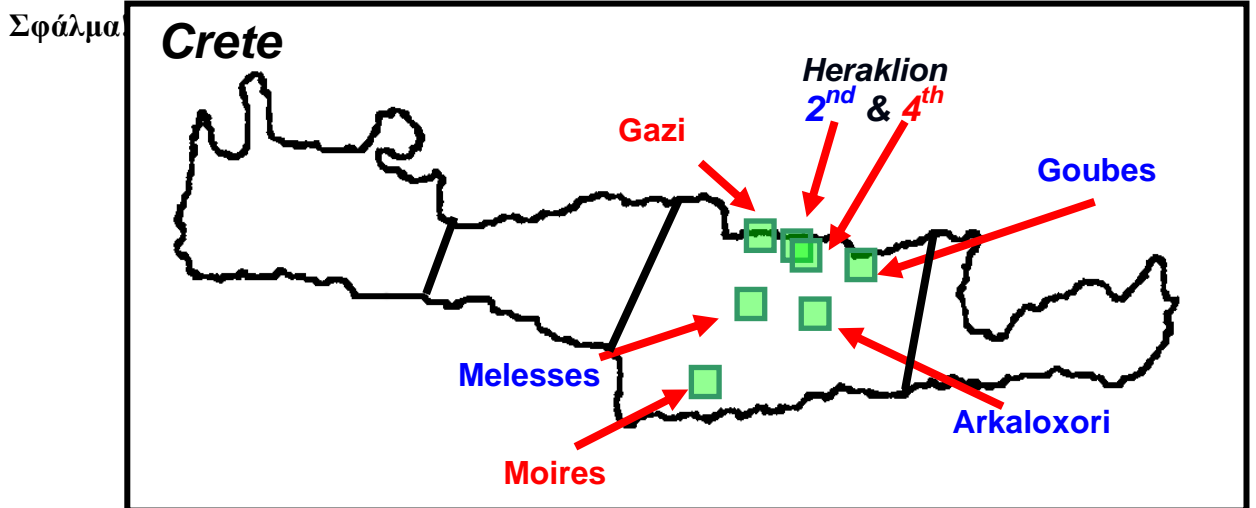
Figure 7.1. Map of participating schools in the Heraklion district of the island of Crete

in Greece *(In blue are the intervention schools, in red the control schools)*.

A total of 738 pupils were studying in the 2nd grade of the 7 research schools. Written consents signed by their guardians were returned from 707, and thus, only these were permitted to take part in the study. During the first administration of the questionnaires 11 students were absent and thus excluded. Fifteen were also excluded because of inadequate completion of their questionnaires. As a result, a total of 681 students were included in the initial data processing. From the analysis of the age distribution a total of 16 students were further excluded because they were between 18 and 24 years old, which was at least two years older than the most common age of the 2nd grade (16 years). Finally, a total of 665 were included in the subsequent analysis of the 1st measurement (see: table 7.3). This produced a response rate of 90%, which is considered high compared to a similar adolescent TTM study (Nigg & Courneya, 1998) which had a response rate of 61%. The total non-eligible students before the analysis of the results from the 1st measurement was 73 (45% girls) (see: table 7.3). The totals of non-completers from the 2nd, 3rd and 4th measurements were 92, 94 and 297, respectively (see: table 7.3). The first three measurements, which were held inside the school premises, had common reasons for non-inclusion. The main ones were being

absent during the measurements and inadequate completion of questionnaires. During the last measurement, which was primarily conducted with a mailed questionnaire, the main reasons were an inability to contact graduates or failure to return the questionnaires. Similar difficulties in locating graduates were experienced in a high school intervention study when their addresses had been changed or questionnaires were not forwarded to them by their siblings (Dale & Corbin, 2000).

Table 7.3. Sample frequencies for all four measurements**.**

	n	Total (retention rate)		intervention (retention rate)		control (retention rate)	
		Compl.	non-compl.	Compl.	non-compl.	Compl.	non-compl.
Prior to 1st meas.	738		31*	291	13*	447	18*
1st meas.	707	665 (90%)	42**	263 (90%)	15**	402 (90%)	27**
2nd meas.	665	573 (78%)	92	234 (80%)	29	339 (76%)	63
3rd meas.	573	481 (65%)	94	209 (72%)	25	270 (60%)	69
4th meas.	481	182 (25%)	297	95 (33%)	114	87 (19%)	183
		Total	**556**	**Total**	**196**	**Total**	**360**

*Note: Compl.= Completers, * No written consent (31), **absent during first*

measurement (11) or inadequate completion of questionnaires (15) or age

constraints (16)

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High response rates have been achieved in previous longitudinal research projects. Kelder and co-workers (1994) reported high response rates regarding in-school measurements from the 6th to the 12th grade (88%, 81%, 70%, 66%, 59% and 45%, respectively; n_{Int}=1.342; n_{Con}=1.034). Andersen and Haraldsdottir (1993) reported a 67% response rate in an eight-year follow-up of 16-19 year-old Danish students from late adolescence to young adulthood. Furthermore, a 49% response rate was achieved in an adolescent longitudinal TTM study (Nigg, 2001). High response rates (65% - 90%) were also accomplished in the present study for the in-school measurements (see: table 7.3). However, as shown by the relevant literature, lower response rates are expected for after-graduation measurements. The response rate of a similar intervention study of high school students ranged between 30% and 38% after graduation (Dale *et al.*, 1998; Dale & Corbin, 2000). College alumni produced post-graduation response rates between 32% and 67% (Adams & Brynteson, 1992). Also, Calfas and colleagues (2000) achieved a 93% retention rate in a two-year follow-up of an intervention performed upon senior university students. The *Trois Rivieres Study* (Trudeau *et al.*, 1998) was able to measure an impressive 55% for the intervention group and 37% for the control group twenty years after their initial measurements in the six years of primary school. Thus, the after-graduation measurement of this study had the most non-completers (see: table 7.3), which resulted in a final response rate of 25%. Slightly less than the intended total of 100 participants was attained in each of the two groups. However, as it is shown in section 8.3 the above mentioned attrition issue was efficiently tackled through the use of latent transition analysis (LTA). The difference among final completers (33% vs. 19%) in favour of the intervention group (see: table 7.3) was expected since similar differences were revealed in the last measurement of other longitudinal projects (Kelder *et al.*, 1994; Trudeau *et al.*, 1998).

7.11.1. Comparison of completers with non-completers

The non-parametric Kolmogorov-Smirnov test was selected to compare sub-groups of the sample because "…[it] tends to have better power than the Mann-Whitney test when sample sizes are less than about 25 per group" (Field, 2005, p.529). Non-eligible students were considered those who did not provide written consent, failed to attend or successfully complete the first measurement or were excluded due to age constraints. The comparison of eligible (n=665, 57% girls) with non-eligible students (n=73, 45% girls) in terms of gender revealed no significant difference between the two groups (z=0.93, p=0.35). Hence, the exclusion of non-eligible students did not seem to bias the baseline sample, at least in terms of gender distribution.

Likewise, a comparison of stage distribution between completers and non-completers was conducted to ensure that the exclusion of non-completers did not bias the final sample. This analysis was not carried out for the 1st measurement because of practical inability to collect complete and reliable data from those who were absent or had inadequately completed the questionnaires. These participants were included in the non-eligible group mentioned previously. Regarding the 2nd, 3rd and 4th measurements, the Kolmogorov-Smirnov test both for the intervention and control group indicated non-significant differences (*p>0.05*) between completers and non-completers (see: table 7.4). Therefore, it could be argued that the omission of non-completers did not seem to bias the remaining samples of the intervention or control group in terms of stage distribution.

Table 7.4. Stage comparisons of completers and non-completers using the

Kolmogorov-Smirnov test.

Measurements	intervention		control	
	z	*p*	z	*p*
1st	-	-	-	-
2nd	1.20	0.09	0.46	0.98
3rd	0.65	0.80	0.66	0.78
4th	0.19	1.00	0.45	0.99

The comparison of completers with non-completers was further extended to encompass gender, age and urban or rural residence. In most cases, non-significant differences (*p>0.05*) were found between completers and non-completers both in the intervention and control group (see: table 7.5). In two of the nineteen comparisons the differences were significant (highlighted with bold in table 7.5) although the effect sizes were only small (r=0.25 and r=0.18) and thus, it could be argued that their bias effect could not be considered as meaningful. Overall, it could be argued that the exclusion of non-completers did not seem to affect the intervention or control group substantially.

7.12. Intervention design

Adolescents have been identified as a high-risk group when they graduate from school and their systematic involvement in PE ceases (Aarnio *et al.*, 2002). This notion is further supported by mostly medium stability of PA from adolescence to young adulthood that decreases even more towards adulthood (see: chapter 4). Therefore, interventions with established long-term effectiveness are needed to reverse this trend. However, this is another shortcoming in the field of PA since interventions usually are effective only for a short time (see: chapter 5).

Table 7.5. Total comparisons of completers and non-completers using the Kolmogorov-Smirnov test.

Measurements	Intervention						Control					
	Gender		Residence		Age		Gender		Residence		Age	
	z	p	z	p	z	p	z	p	z	p	z	p
1st	-	-	-	-	-	-	-	-	-	-	-	-
2nd	1.18	0.12	0.11	1.00	0.20	1.00	0.46	0.98	0.71	0.70	0.35	1.00
3rd	1.03	0.24	0.06	1.00	0.18	1.00	0.76	0.61	0.50	0.97	0.33	1.00
4th	1.00	0.27	**1.89**	**0.00***	0.57	0.90	**1.75**	**0.00****	0.76	0.61	0.32	1.00

*small effect size, r=0.25, **small effect size, r=0.18*

Usually, follow-up data collected at least six months after the termination of the intervention period assess maintenance of PA (Marcus *et al.*, 2000). As admitted in relevant reviews (Stone *et al.*, 1998; Marcus *et al.*, 2000; Dobbins *et al.*, 2009) follow-up studies are rare. Caspersen and co-workers (2000, p.1608) identified several reasons for the lack of longitudinal studies including "the labour intensive work involved, significant cost, and long-term commitment from researchers and study participants." Hence, such studies are considered most valuable and are recommended for future interventions to assess PA adoption and adherence (Adams & White, 2003). Since the long-term aim of the current intervention is to increase PA participation of school graduates one logical approach would be to place the intervention as close as possible to this transitional period in order to increase its possibilities to be effective (because short-term effects are more probable than long-term ones) and reduce the negative effects usually imposed by the medium tracking of PA.

One approach would be to intervene after graduation when participants have entered the workplace or have become university students. However, prior studies have shown a difficulty to intervene effectively during tertiary education (Kahn *et al.*, 2002). Furthermore, school-based interventions are recommended to target young people (Dobbins *et al.*, 2009). Thus, the ideal time would be to target the students during their last school year (3rd grade of Lyceum). However, this strategy has an inherent difficulty since most students are intensively preparing themselves for their graduation exams, which are of paramount importance since they determine their future in the Greek tertiary education system. Thus, their study occupies most of their focus, time and energy. A confirmation of the above came from Papaioannou (2000) who found that the majority of 3rd grade Lyceum students exercise scarcely or not at all, in or out of school. Another Greek cross-sectional study (Papaioannou *et al.*, 2004) revealed declining

participation from High School (13-14 years of age) to Lyceum (16-17 years of age) regarding various types of exercise in both genders. The students in the 3rd grade of Lyceum are so concentrated on their studies that any possible distraction would not be accepted or supported by them or their families. Hence, the closest period to this ideal time was one grade earlier when they were not so occupied with their studies. This alternative was selected as the most appropriate strategy.

7.12.1. Intervention procedures

The intervention took place between the first and second measurement. It commenced after the first measurement with the distribution of the stage-matched manuals (see: section 7.12.2) in the classroom by the author and ended just after the second measurement with the students returning them to the author. The intervention procedures are outlined in detail in table 7.6.

Firstly, to conduct research within Greek schools it is necessary to obtain a special permit from the Pedagogical Institute (a department of the Ministry of Education) and to have the agreement and cooperation of the school directors and PE teachers. An application to the Pedagogical Institute was submitted in June 2004, accompanied by a reference letter from the PhD supervisor, the curriculum vitae of the researcher, a detailed description of the proposed research identifying its aims, the methodology to be employed, the schools that would be contacted and finally an estimation of the disturbance that would be caused to the normal functioning of the schools as a result of the research procedure. It should be noted that careful attention was paid to the last requirement in order not to take valuable time from school lessons. Specifically, only three hours of PE per class were utilized during all three in-school

measurements in the course of two years. The application procedure concerning the present research was certified with a positive answer along with the permit in October 2004. Special care was placed upon the matter of informing the school director, the teachers and the students' guardians before the start of the project in order to obtain their consent and cooperation. A copy of the permit (in Greek) is included in Appendix C. This study was also approved by the Ethics Committee of the Department of Sport, Health and Exercise Science of the University of Hull.

Subsequently, the directors of the school involved in the research were contacted by phone during October 2004 and separate presentations were scheduled in each school to inform them along with the teachers and the representatives of the guardians of the students. All meetings were successful in obtaining support from those involved. Afterwards a separate meeting was held with the PE teachers in order to schedule the administration of the questionnaires in an hour of PE. In general, the total duration of these meetings did not exceed 15 minutes.

The author made first contact with the 2nd grade students of the project by administrating an envelope to each one in the classroom. The envelope contained a description of the research project and a voluntary informed consent form (see: Appendix D) to be read and signed by one of their guardians. They were instructed to hand the envelopes to their guardians and return them back to their PE teachers during the following week. Accordingly, the collection of these consent forms by the researcher took place after seven days. Approximately 60 students claimed that their guardians had forgotten to sign the informed consents and they were allowed two more days to bring them back. After this second deadline no other notification was made and

they were excluded from the research. Administration and collection of the informed consents lasted 15 days.

Table 7.6. Timetable of intervention procedures.

Date	Procedure
May 2004	Study approved by the Ethics Committee of the Department of Sport, Health and Exercise Science of the University of Hull.
June 2004	Application to the Pedagogical Institute for a special permit to conduct research inside school premises.
October 2004	Permit obtained.
October 2004	Contact with the school directors.
October 2004	Presentations to school staff and guardian representatives to obtain support.
October 2004	Meetings with PE teachers to schedule administration of questionnaires.
November 2004	1st measurement: author distributed questionnaires in the class.
November 2004	Distribution of stage-matched manuals by the author and commencement of the actual intervention.
April 2004	2nd measurement: author distributed questionnaires in the class.
April 2004	End of actual intervention.
November 2005	3rd measurement: author distributed questionnaires in the class.
November 2006	4th measurement: questionnaires were sent by post.

The administration of the first three measurements was similar since the set of TTM questionnaires were completed in the classroom using about 20-30 minutes of a PE lesson. The author was present in every administration of the questionnaires in order

to supervise the whole procedure. Spencer and colleagues (2006) reviewed 12 TTM exercise studies of children, adolescents and college students and found that the majority were conducted in classrooms and this method gave higher response rates than other procedures.

In contrast, the final measurement that took place after graduation was not so straightforward. Printed sets of questionnaires were posted to the home addresses of the students and they were prompted to answer and return them as soon as possible. A total of 20 sets of questionnaires were also sent by e-mail. As expected, a considerable proportion of participants did not respond and further pre-planned actions were employed. Two weeks after the mailing of the questionnaires a first phone call was made to the students' homes first or mobile phones to ask whether they had received them and to encourage them to complete and return them. In a few cases where they had not received them or they had moved, another set of questionnaire was sent to the new address or by e-mail. If there was still no answer a second reminder phone call was made one week later. In this final contact they were also reminded that they would be eligible to enter a lottery incentive of 300 Euros if they completed all four measurements (see: section 7.11). In many cases the mobile numbers had changed (most common for a teenager in a two-year period) and therefore the researcher called their home number and asked to speak to them. If unavailable their new mobile number was requested. The whole procedure of the last measurement was very demanding in terms of time, effort and cost and very stressful since only a few questionnaires were returned at first and so the whole research project was in jeopardy. Follow-up calls were necessary for the majority of the students. In conclusion, the administration of the questionnaires was quite demanding due to its longitudinal character and large baseline sample. To illustrate the above point it should be mentioned that a large number of

questionnaires had to be printed, photocopied, administered and data-processed (a total of 2,426 questionnaires; each comprising of seven pages which adds up to a total of approximately 17,000 pages).

7.12.2. Intervention materials

Since the scale of physical inactivity is so extensive in the Greek population (see: section 3.4.) an effort to deal with this problem should prioritise reaching large proportions of the population. Hence, one of the main concerns regarding the intervention design was to keep it as practical and easily administered as it could be without sacrificing efficiency. In this sense if it was proven successful then it could be easily generalized to a wider population. This combination of simplicity and efficiency might have proved a very challenging task since it could lead to insufficient intervention effects. Thus, approaches such as education classes or seminars were rejected due to demands on class time and PE teacher's involvement. On the other hand, as argued by Little and Girvin (2002), self-help manuals are both efficient and cost-effective intervention methods. The distribution of printed materials was selected because they possessed all the necessary characteristics mentioned above and had been proven exceptionally successful. In a systematic review of PA interventions Dobbins and colleagues (2009) identified the distribution of printed educational materials as a common feature among successful interventions. Furthermore, printed intervention materials were utilised by 66% of the TTM interventions located by a recent review (Hutchison *et al.*, 2009). Thus, it is both a common method and a successful feature of PA interventions.

The intervention materials consisted of five printed manuals tailored to each SOC and developed to promote the adoption and maintenance of regular adolescent PA (see: Appendix E for a photo of the complete set of manuals). They were intended to be as short as possible in order not to deter readers due to their length (Noar *et al.*, 2007). Their shape (half A4 paper size), volume (10-15 pages) and content were based upon similar materials produced and successfully tested (see: section 6.3.8.1) by Marcus and colleagues (1992a; 1998a; 1998b; 2001) and others (Dunn *et al.*, 1999). According to Marcus and co-workers (1992a) the original materials drew upon the exercise adoption and adherence literature (Dishman, 1982; Martin & Dubbert, 1982; 1984; Dishman, 1988b; a), the appropriate POCs for each SOC, the Pros and Cons of regular exercise and the SE of staying active. The second edition changed the focus of the manuals to lifestyle PA (Marcus, Taylor, Simkin-Silverman, Emmons & Linnan, 1995). This was the edition on which the current study materials were based. Permission for the adaptation and translation of the above manuals was requested and received from Dr Marcus (see: Appendix H).

The aim of each manual was to assist individuals to progress to the next SOC. In particular, the objective of Manual 1 was to assist individuals to think about the role of PA in their life. This was achieved by proposing how to overcome common excuses for not participating in PA, illustrating the benefits of being active, the drawbacks of not being active and how to use DB to their benefit (see: Appendix F for the sample pages of Manual 1 and Appendix G for the English translation of the sample pages of Manual 1). Manual 2 focused on helping to consider and initiate activity. Individuals were advised about how to plan to be more active. The above together with emphasis placed on the benefits of PA helped them to overcome sedentary barriers. The purpose of Manual 3 was to make PA a regular lifestyle behaviour. It focused on the benefits of

PA, how to plan to become regularly active, attain high levels of SE and overcome barriers to regular PA. Manual 4 focused on how to help individuals stay motivated, recognize and overcome barriers to PA and build their SE to avoid relapse. Lastly, Manual 5 used similar strategies to Manual 4 in order to help individuals make PA a permanent part of their lives.

The translation of the English terms of the manuals to Greek was completed by the author of this thesis since he is considered a fluent speaker and writer of the English language (Cambridge Proficiency degree). The wording, titles, PA examples and images of the manuals were tailored to a Greek adolescent population. A graphic artist designed the covers and the layout of the inside pages of the manuals. Careful attention was given to the covers of the manuals in order to make them appealing to the target age group. As has been argued by Noar and colleagues (2007) the attractive layout of print materials enhances their efficiency by attracting and retaining the attention of the participants. A comic character was created by the artist to star in the covers and convey the general meaning of each manual. The students were expected to be able to identify themselves with this character (see: Appendix E for a photo of all manuals). A total of 350 manuals were printed by the author and bounded in order to be distributed after the first measurement. This task alone involved considerable time, effort and money resources. The appropriate number of manuals for each stage was prepared in advance based upon the results of the pilot study (see: section 7.12.3). A safety margin allowed for any variations in the main sample.

The manuals were distributed to the students by the author after they had self-reported their SOC in the pre-intervention measurement (see: table 7.1). This stage-matched approach was only adopted by some TTM interventions reviewed by Spencer

and colleagues (2006) while others used information of every SOC for each participant, which clearly contradicts the theory behind the TTM. The distribution and explanation of their proper use was done in the classroom during the first five minutes of a PE lesson by the researcher on a separate day after the first measurement. Students were encouraged to read them and try to follow their suggestions. After the post-intervention measurement they were prompted by the PE teachers to return them and, consequently, define an ending for the intervention period.

In the post-intervention measurement the students of the intervention group were asked three additional questions to provide feedback about the intervention manuals (n=228). In the open question "How many times did you read the manual?" only 4% of the respondents admitted that they had not read it at all, while the majority of the students (77%) claimed to have read it at least once and up to three times. The above percentages indicated that the manuals were used by the vast majority of the students. The second question was "How useful did you find the manuals?" with four suggested answers (Not at all, little, moderately, very). The majority of the students evaluated the manuals as very useful (46%) or moderately useful (37%) and only 14% as little and 4% as not at all useful. The above proportions highlight a general acknowledgement of the usefulness of the manuals by the students. The final open question was "How could the manual be improved?" Out of the 79 responses 16 kindly stated that no improvement was needed while most of the other students requested more information (19), more alternative activities (18), more home-based exercises (10) and nutritional information (8). All the above suggestions led to the conclusion that the students were eager to learn more about active living.

7.12.3. Control group

The typical procedure for stage-based interventions is to have a control group of usual practice or one that undertakes a non-staged intervention (Hutchison *et al.*, 2009). In a systematic review of RCTs by Riemsma and colleagues (2002) all trials compared a stage-based intervention with either a control group receiving information only (Graham-Clarke & Oldenburg, 1994; Cardinal & Sachs, 1996; Braatz *et al.*, 1999; Harland *et al.*, 1999), or a no-intervention control group (Cash, 1997; Goldstein *et al.*, 1999; Peterson & Aldana, 1999). In the present study the students in the control group continued to engage in their regular PE lessons. Thus, it could be argued that they continued to experience their usual practice but also no intervention was conducted with them. A similar approach can be found in the *Intervention Centered on Adolescents' PA and Sedentary Behaviour* (*ICAPS*), which is an ongoing school-based study with partnerships in the family and local community (Simon, Wagner, DiVita, Rauscher, Klein-Platat, Arveiler, Schweitzer & Triby, 2004). It is located in French middle schools (n=954, baseline mean age=11-12 years) and uses retrospective questionnaires to assess PA with an extensive recall period of one year. Its multilevel (personal, social and environmental) approach towards not only PE but to every possible opportunity in everyday life is a unique feature of this intervention. It shares numerous methodological similarities to the current study: a) It is being implemented with similar school years, b) the intervention and control group are randomised by school, c) the control group follows the usual PE curriculum but none of the intervention organised activities and d) it excludes PE from total PA due to its non-voluntary nature. Its design led to a longer duration of intervention implementation covering a 4-year period. After six months of implementation it was successful in significantly increasing organised LTPA for the intervention group in both genders (OR_{Girls}= 3.38; $p<0.01$; OR_{Boys}= 1.73; $p=0.01$)

7.13. Instruments of measurement

The current set of questionnaires among the TTM data gathered demographic information such as name, year of birth, address, home phone number, mobile phone number and e-mail of the students. Copies of the Greek TTM questionnaires that were used in this research appear in Appendix G.

PA questionnaires are practically "…ideal because they are less likely to alter PA behaviour, are cost-effective, can be adapted to a variety of settings and populations, and have reasonable reliability and validity when compared against other objective measures." (Nigg & Courneya, 1998, p.228). Large-scale and intervention studies often a priori select self-report measures of PA for their practical advantages (US Department for Health and Human Services, 1996; Dobbins *et al.*, 2009) and are likely to continue doing so until more objective measurement devices become affordable and practical to use in large samples (Mutrie & Woods, 2003). However, their inherent limitations should be considered, namely, self-report bias, errors in recall, and inaccuracy in describing habitual activity (Sallis & Saelens, 2000; Snel & Twisk, 2001). Furthermore, Marshall and Biddle (2001) encouraged presentation of specific validity and reliability estimations for every investigated sample, especially for moderate PA (MPA). In that sense, a pilot study and validity and reliability estimations were undertaken before proceeding with measurements to provide an estimate of the capabilities of the instruments.

7.13.1. Stages of change questionnaire

A variety of SOC scales for PA exist. They differentiate in several aspects such as the stage concepts, the behaviour description or/and the activity criterion (Martin-

Diener *et al.*, 2004). Buxton and co-workers (1996, p.251) identified numerous methods of SOC allocation including: "a five-point Likert scale to rate each stage (Marcus *et al.*, 1992d), a true-false response format (Marcus & Simkin, 1993), an 11-point ladder (Marcus & Owen, 1992; Marcus *et al.*, 1992b), and a five-point ordered categorical measure (Cardinal, 1993)." Reed and co-workers (1997) and Norman and co-workers (1998) investigated different stage algorithms and recommended that: a) Stages should be clearly and concisely defined including frequency, duration, and intensity of PA. b) To illustrate the definitions further several examples of the behaviour should be given that are suitable for the sample population, c) Finally, the structure of the response categories can either take a five-choice format or a four-item yes or no format. These suggestions were closely considered and addressed in the SOCs instrument of this study.

It was decided that an individual's habitual PA behaviour would be assessed using a five-choice format SOC questionnaire (Nigg, 2002) and specifically an adapted version of this scale for adolescents (Nigg & Courneya, 1998). The original instrument was further modified by the author of this study to measure PA instead of exercise (see: Appendix I). Firstly, a long definition of being physically active was provided with adequate examples: "Physical Activity includes activities such as brisk walking, dancing, running, bicycling, swimming, tennis or any other activity or sport which makes you move, breathe faster, sweat even a little and increases your heartbeat without being especially tiring. The activities which interest us are those which are either moderate in intensity (not especially tiring) or vigorous (more tiring)." As argued by Spencer and colleagues (2006) a clear and precise definition of PA is required to place participants into stages correctly. The importance of the accuracy of a PA definition is highlighted by the fact that differentiated definitions of a behaviour tend to result in

diverse SOC proportions in the same population (Valero, Ocana, Parrado, Pintanel & Capdevilla, 2007).

The criterion for being considered physically active is of paramount importance in the development of the SOCs questionnaire. The importance of sustaining a PA 'threshold' to accumulate health gains have been previously emphasised (National Center for Chronic Disease Prevention and Health Promotion - Centers for Disease Control and Prevention, 1997). Recent recommendations for young people suggest at least an hour of MVPA five or more days of the week (Biddle, Sallis & Cavill, 1998; Cavill et al., 2001; Institute of Medicine, 2002/2005; Strong et al., 2005; US Department for Health and Human Services & US Department of Agriculture, 2005). Thus, the following criterion was included in the SOC questionnaire: "In order for a person of your age to be considered regularly physically active he/she would have to complete 1 hour of moderate to vigorous physical activities at least 5 times per week" This criterion was further clarified in the SOC questionnaire with specific examples: "This so called hours could either be continuous, for example, 60 minutes of running, or separated into smaller intervals during the day, for example, a twenty minute period of fast walking during the morning, a ten minute period of bicycling in the afternoon and a thirty minute period of dancing at night, completing 60 minutes of bodily activities." Combinations of moderate and vigorous PA are legitimate in order to meet current recommendations (Haskell, Lee, Pate, Powell, Blair, Franklin, Macera, Heath, Thompson & Bauman, 2007). Also, short bouts of PA (for example, five to ten minutes) are more common than sustained bouts in the natural behaviour of young people (Sleap & Warburton, 1992; Sleap & Tolfrey, 2001; Trost, 2005).

Lastly, a statement for the exclusion of PE was provided: "Do not take into account the physical activities during the lesson of Physical Education because it has the manner of a compulsory lesson." Since the TTM deals only with volitional forms of behaviour (Nigg, 2002) compulsory PE in schools was not included in the amount of PA that was required by an individual to be considered physically active. This approach was supported by similar TTM studies such as a UK study examining a youth sample of year 7 and year 12 students (Goldberg *et al.*, 1996) and a Canadian study of 9-12 grade students (mean age=15 years, age range=13-19 years) (Nigg & Courneya, 1998; Nigg, 2001).

After the above narrative introduction; five statements representing the five SOC definitions were provided to the participants. They were instructed to select only the one that would be representative of their current PA status. In a comparison of available staging methods the long definition and five-choice format approach, as has been selected for the current study, was recommended by Reed and co-workers (1997) for its clarity, brevity and accuracy in estimating exercise.

7.13.2. Processes of change, self-efficacy and decisional balance questionnaires

The ten POCs were assessed using a 39-item questionnaire (Marcus *et al.*, 1992c). Individuals were asked to read the statements that represented the POCs (four for each POC except one) to recall the past month and rate the frequency of occurrence of each item on a five-point Likert scale (1= *never* to 5= *repeatedly*) (see: Appendix I). SE levels were assessed using a five-item scale (Marcus *et al.*, 1992c). Respondents were asked to rate their confidence that they could persist in being physically active during their leisure-time in five challenging situations (see: Appendix I). A five-point

Likert scale (1= *not at all confident*, 2= *a little confident*, 3= *moderately confident*, 4= *very confident*, 5= *completely confident*) was preferred to the longer Likert scales due to brevity and clarity issues and also to resemble the other five-point Likert scales of the POCs and DB measures. Finally, DB (see: Appendix G) was assessed using a 10-item scale for the Pros and 6-item scale for the Cons (Marcus *et al.*, 1992b). Participants were asked to rate the level of importance of each Pro or Con in a five-point Likert scale (1= *not at all important* to 5= *very much important*). The above scales had been successfully tested and applied in adolescent samples (Nigg & Courneya, 1998; Nigg, 2001; Woods *et al.*, 2002).

7.14. Cross-cultural adaptation of questionnaires

The cross-cultural adaptation of instruments is a delicate matter since words or expressions can have remarkable context variations across cultures (Gill, 1997). An inaccurate translation may affect the validity of the instrument (Jones, 1987). As Chen and colleagues (2003) indicated any psychometric properties of the original questionnaire must be re-established for the translated version, as if it was a new instrument. The correspondence of meaning between the original and the translated version of the questionnaires of the thesis was evaluated by the back-translation method (Jones & Kay, 1992) as described in a cross-cultural study by Zhu and Kang (1998). The English versions of the TTM scales were translated into Greek by the author of this Thesis since he is certified to be a fluent speaker and writer of both languages (Cambridge Proficiency Degree in English; and Greek as his native language). Afterwards, the Greek version was translated back to English by a bilingual expert (Greek Teacher of the English Language). The translated-back-to-English version was then compared with the original English version to investigate for any differentiations.

The only problem that was identified was the presence of synonyms in the back-translated version of the questionnaires, which did not constitute a serious threat to its validity. A similar method was employed in a recent Greek study attempting a preliminary analysis of a different POCs questionnaire (Papaioannou *et al.*, 2006).

Furthermore, the content of the instruments in terms of understanding and wording was evaluated by a panel of experts (Sport Psychology Teachers and PE Teachers) and a pilot group of twenty 2nd grade Lyceum students (described in section 7.9). Their feedback was carefully acknowledged for the adaptation of the questionnaires. Special attention was given to the cultural context of words and phrases in order to describe the same ideas precisely in both cultures.

7.15. Validation of questionnaires

The validation of the SOC questionnaire included a concurrent comparison with a combination of heart rate monitoring (HRM) and activity diaries. Furthermore, two facets of reliability, internal and external, were examined for all the TTM questionnaires.

7.15.1. Concurrent validity

HRM is considered an objective indirect measure of PA (Welk, Corbin & Dale, 2000; Sirard & Pate, 2001; Sleap & Tolfrey, 2001) since it records a body function that reflects the frequency, duration and intensity of PA (US Department for Health and Human Services, 1996; Armstrong, 1998). According to Rowe and colleagues (2004), HRM can be used for concurrent validation of a MVPA measure. Specifically, the

validation procedure of the SOCs questionnaire investigated whether participants legitimately reported being in an active (A or M) or inactive (PC, C or PR) stage. Similar methods have previously demonstrated the concurrent validity of SOC for exercise scales, by using less objective methods such as self-report questionnaires (Marcus *et al.*, 1992d; Marcus & Simkin, 1993; Wyse *et al.*, 1995).

A stratified sample of twenty 2nd grade Lyceum students was randomly selected from the seven schools in the study. The stratification was two-part. Firstly, the sample was stratified by gender (11 girls, 55%) in order to be representative of the baseline sample (n=665, 57% girls). Secondly, the sample was stratified by school in order to have a minimum of one boy and one girl from every school. Written voluntary and informed consent, specifically for this part of the research, was acquired from their guardians (see: Appendix K).

The procedure was as follows: during four days, each student wore a telemetry micro-computer receiver (Polar S610i, Finland) resembling a wrist-watch and an elastic transmitter (Polar coded transmitter, Finland) on the chest. At least four days of monitoring is required to create a representative picture of PA, especially for young people, and this series of days should combine any two weekdays and the whole weekend (Janz, 2003). The typical sequence for this validation started on Thursday morning and lasted until Monday morning. They were advised to take off the telemetry apparatus during sleeping hours. Heartbeats were recorded every 15 seconds, which is a smaller unit of time compared to the more common one-minute intervals (Armstrong & Bray, 1991; Durant, Baranowsky, Davis, Rhodes, Thompson, Greaves & Puhl, 1993). This could be considered advantageous since the HR variability could be described in greater detail. Data were downloaded from the receiver to a laptop computer once after

the first two days and again at the end of the fourth day. Then they were processed using the accompanied software (Polar Precision Performance 3.2). According to the US Department for Health and Human Dervices (1996, p.31) "…[heart rate] monitors have to be worn for extended periods by the participant, and they pose some discomfort and inconvenience." However, only one student did not manage to complete the procedure because of skin irritation and was replaced by another one randomly selected from the same school. Incentives to participate in this validation procedure were provided to students in the form of a CD record of their choice, which was presented shortly after the end of their project.

HRM accuracy is optimum during MVPA while it decreases substantially during light or extremely vigorous PA (Freedson & Miller, 2000). Hence, HRM can provide a sufficient estimate of HEPA but not total energy expenditure (Ainslie *et al.*, 2003; Janz, 2003). Nevertheless, these inconsistencies did not influence the current validation process since it was only involved with MVPA. Adjusting for individual resting HR can improve the accuracy of PA measurement (Moon & Butte, 1996) by taking into account individual fitness levels and age (Janz, 2003; Trost, 2005). Further calibration for fitness level and age could have been achieved by certain methods (for example, FLEX HR) but they are costly, time consuming and require maximum exertion from participants (Durant et al., 1993; Pate, Baranowski, Dowda & Trost, 1996). The above refinements were not considered necessary for this small-scale validation study.

Resting HR can either be measured or estimated from HR data. Although measurement techniques are preferable to estimation procedures they require a strict protocol (Ainslie *et al.*, 2003) that was difficult to secure in the school environment. The estimation of resting HR (RHR) was performed during data analysis by averaging

the counts of the three lowest HRs (Nieman, 1999). Heart rate reserve (HRR) was estimated by subtracting the RHR from maximum HR. Several reviews of relevant studies (Freedson, 1989; Janz, Golden, Hansen & Mahoney, 1992) have shown that 200 beats per minute is a stable and close estimate of maximun HR during childhood and adolescence. Thus, this number could be used instead of measuring maximum HR using intensive fitness tests. An estimate of the intensity of PA was determined by using a specific percentage of HRR as a threshold for MVPA (Rowland, 1993; Epstein, Paluch, Kalakanis, Goldfield, Cerny & Roemmich, 2001). The criterion for MVPA was set at 50% of HRR as was previously done in studies involving children and adolescents (Janz, 2003). The above method was recommended by the ACSM (Slooten, Kemper, Post, Lujan & Coudert, 1994; Gavarry, Bernard, Giacomoni, Seymat, Euzet & Falgairette, 1998) to estimate exercise intensity and classify subjects according to established guidelines.

To estimate the total weekly time spent in MVPA the following procedure was applied. The total time spent during the two weekdays was multiplied by five and divided by two to estimate the total time during the five weekdays. The weekly time was estimated by adding the weekend time to the time for the five weekdays. In order for a student to be regarded as physically active he/she should have accumulated at least 300 minutes of MVPA per week. [Total time in MVPA=WE time+ (5/2*WD time)]

Analysts propose combining HRM with other methods to refine variation bias (American College of Sports Medicine, 2000) and to acquire the best possible picture of habitual PA (Ainslie *et al.*, 2003; Janz, 2003). The compatibility of HRM with activity diaries in estimating time spent in MVPA has been proven for 15 year-old adolescents (Twisk, 2001). Hence, during the four days of measurement students were prompted to

fill in an activity diary (Ekelund, Yngve & Sjostrom, 1999). In this diary they reported every activity they engaged in, and specifically its type, duration and intensity. The data from the diaries confirmed whether the individual was engaged in appropriate PA when the HR readings were high. Furthermore, they were also used to amplify lost or erratic data, for example by transmitter interferences (Page, Cooper, McKenna, Foster, Riddoch & Fox, 2000). This procedure was expected to enhance the validity of the HRM. Previous combinations of HRM with other methods such as accelerometry (Montoye, Kemper, Saris & Washburn, 1996), have been successful (Rennie, Rowsell, Jebb, Holburn & Wareham, 2000).

After the completion of the measurement with the HR monitors each student answered a questionnaire that consisted of two questions. The first one was that of the SOCs questionnaire with which they self-reported their current SOC. The students were regarded inactive if they were in PC, C or PR and active if they were in A or M. In the second question students stated whether they were active during the previous week when they wore the monitors. Data processing revealed extended lack of data for three students, who were excluded from any further analysis. The HRM results in terms of whether a participant was active or inactive matched with the SOC in 14 of the 17 cases while with weekly PA they matched in 15 of the 17 cases (see: Appendix L, table AL.1). This small disparity of results from the two methods might be partly explained by the fact that the SOCs referred to a more extended period of time (previous month) than the one referring to weekly PA. Thus, in some cases students might have reported that they were in an active stage, although in the week of measurement they happened to be inactive. Hence, their SOC did not match their weekly PA and their HRM results. Finally, the HRM results were correlated to those of the two questions. The Spearman's correlation coefficient (rho) between HRM and SOC was moderate (0.54, *p=0,03*), but

high between HRM and weekly PA (0.76, *p*=0,00), showing a moderate concurrent validity between HRM and self-reporting of SOC. However, when the two cases in which the weekly PA did not match with the SOC were excluded and thus the standard error of different measurement periods (one week versus one month) was eliminated then the rho between HRM and SOC was high (0.76, *p*=0.00), showing a high concurrent validity between HRM and self-reporting of SOC.

7.15.2. Internal reliability

Internal consistency for the SOCs questionnaire is inapplicable since it consists of only one item. All other TTM questionnaires were evaluated for internal reliability using Cronbach's alpha coefficient, which is considered appropriate for Likert scales (Thomas & Nelson, 2001). The acceptable minimum criterion for a measure to be considered reliable ranges between 0.70 (Thomas & Nelson, 2001) and 0.80 (Vincent, 1999; Howitt & Cramer, 2003). However, when alphas are above 0.90 it is indicative of a measure comprising of almost identical items, which narrows the generic meaning of the scale (Bryman & Cramer, 1997). Regarding the rest of the TTM measures adequate levels of internal consistency are commonly cited (see: table 7.7).

The POCs questionnaire comprises ten different processes and should not be treated as one scale as has been reported in earlier adolescent and adult studies (see: table 7.7). The orthodox approach is to report separate coefficients for each set of questions that measure a certain process (Bryman & Cramer, 1997). Overall, alphas for SE and Pros and Cons scales seem to be high in adolescent and adult samples (see: table 7.7). Five-item SE questionnaires showed adequate reliability (Plotnikoff *et al.*, 2001b). Higher coefficients were reported for the more extended SE scales (Wakui, Shimomitsu,

Odagiri, Inoue, Takamiya & Ohya, 2002; Rhodes, Berry, Naylor & Higgins, 2004). This was expected, since more items were included in the analysis, which alone inflates the coefficient (Field, 2005). The DB questionnaires with ten pros and six cons items showed adequate reliability (Nigg, 2001; Plotnikoff, Blanchard, Hotz & Rhodes, 2001a; Sarkin, Johnson, Prochaska & Prochaska, 2001). The pros scales produced higher coefficients than the cons scale in all studies. In some instances like the ten pros-six-cons-item DB questionnaires this could be attributed to the higher number of items included in the pros scale compared to the cons scale. Nevertheless, even when the number of items of both scales was equal or even lower for the pros their coefficients were still higher.

Table 7.7. Cronbach's alpha coefficients reported for transtheoretcial model scales

	n	Country	mean age (age range)	type	POC	SE	Pros	Cons
Nigg and Courneya (1998; 2001)	819	Canada	14.9	Ex	0.77	0.85^{10}	0.92^{10}	0.81^{6}
Nigg (1998)	400	Canada	17.6	Ex	0.79	0.89^{10}	0.90^{10}	0.78^{6}
Rhodes *et al.* (2004)	284	Canada	15-17	Ex		0.76^{5}	0.85^{8}	0.78^{5}
Wakui *et al.* (2002)	450	Japan	18.4 (18-21)	Ex		0.82^{5}	0.77^{6}	0.76^{6}
Jordan *et al.* (2002)	223	USA	19.8	Ex			0.95^{10}	0.94^{10}
Plotnikoff *et al.* (2001b)	500	Canada	40.7 (18-65)	VEx	>0.70		0.77-0.82^{5}	0.69-0.72^{6}
Plotnikoff *et al.* (2001a)	703	Canada	40.7 (18-65)	VEx		0.88-0.90^{8}	0.79^{5}	0.71^{6}
Sarkin *et al.* (2001)	670	USA	50.9 (adults)	MEx		0.88^{6}	0.87^{4}	0.71^{4}
Martin-Diener *et al.* (2004)	1,471	Swiss	adults (≥ 20)	VPA			0.87	0.76

Notes: superscipted text indicates number of items in scale,

MEx=Moderate exercise, VEx=Vigorous exercise, VPA=Vigorous Physical Activity.

A stratified random sample (n=61) was taken from the research sample to test internal reliability. This sample revealed reliable alpha coefficients for each of the nine POCs, ranging between 0.74 and 0.85 (see: table 7.8). The only exception was Social Liberation, which revealed a medium value of 0.62. However, after the deletion of one item (SOL19) the alpha coefficient for Social Liberation rose to acceptable levels (0.76). Thus, item SOL19 was excluded from the data analyses. Moreover, the coefficient for the 5-item SE Questionnaire was also sufficient (α=0.74, n=61). As for the 10-item Pros Questionnaire and the 6-item Cons Questionnaire the alphas were as high as 0.90 (n=60) and 0.83 (n=61), respectively. The above data highlighted a satisfactory level of internal consistency among all TTM scales of this study.

Table 7.8. Internal reliability coefficients of the processes of change scale

POC	Questions	Items	Cronbach's α (n=54-61)
Consciousness Raising	1-4	4	0.82
Dramatic Relief	5-7	3	0.82
Environmental Re-evaluation	8-11	4	0.80
Self Re-evaluation	12-15	4	0.81
Social Liberation	16-19	4	**0.62**
Social Liberation with Q19 deleted	16-18	3	**0.76**
Counter conditioning	20-23	4	0.85
Helping Relationships	24-27	4	0.80
Reward Management	28-31	4	0.77
Self-Liberation	32-35	4	0.78
Stimulus Control	36-39	4	0.74

7.15.3. Test-retest or external reliability

Adequate test-retest reliability levels in an intervention ensure that differences in the results reflect an intervention effect and not a biased variation (Patterson, 2000).

Estimations of test-retest reliability should be based upon the ICC from an ANOVA (Sallis & Saelens, 2000). As Ntoumanis (2001) suggests, for non-parametric data the Friedman chi-square (χ^2) test should replace the *F* test in the ANOVA for any significant differences between trials. A one-way ANOVA was used, in which "…all sources of variation other than differences among people are considered error…" (Patterson, 2000, p.16). Intraclass correlation encompass both measurement error and true inter-individual variability in PA and it is considered acceptable above 0.70 (Vincent, 1999) or preferably 0.80 (Bland & Altman, 1986; Thomas & Nelson, 2001). As Baranowsky and De Moor (2000) argued the ideal value would be around 0.80 since higher than this is not providing extra accuracy while lower than this impose strong accuracy problems.

Another characteristic of test-retest reliability is the time intervals between tests. As Patterson (2000, p.16) argued, the trials should cover the same time period or overlapping days, or else it might be the case that test-retest reliability "…includes true variability in PA and treats it as measurement error." This notion was followed in this study since participants were recalling the previous month while the interval between the test and re-test was two weeks, as in the majority of TTM validation studies (Marcus *et al.*, 1992b; Marcus *et al.*, 1992c; Courneya, 1995; Plotnikoff *et al.*, 2001b; Wakui *et al.*, 2002).

The same stratified random sample of 61 students of the research sample that had been selected to test internal reliability was used to examine test-retest reliability, as well. After employing a one-way ANOVA and by evaluating the Friedman χ^2 test Between Measures no statistical difference of the SOCs means were found between repeated measures (see: table 7.9). The calculated 2-week test-retest ICC indicated a

high consistency. For each of the other TTM scales that comprised of more than one item (SE, Pros, Cons, POCs) the following procedures were followed. Two new variables (test and retest) were computed by the mean of the items that constituted each scale. In those participants where there was a missing value in one of the items the Mean was not calculated and regarded as a missing value. The ICC was calculated between these two new variables to test the consistency of each scale. The 2-week test-retest ICCs (one-way, single trial) of those scales were also presented in table 7.9. In the cases of SE, Pros, Consciousness Raising, Environmental Re-Evaluation, Counter Contitioning, and Helping Relationships high ICCs were evident, which were supported by either non-significant differences among their Friedman tests or significant differences with small effect sizes (around 0.20), which indicated that the meaningfulness of the above differences was low. In the remaining seven cases (see: table 7.9 [in bold]) the ICCs were around 0.60, which is below the accepted threshold of 0.70. However, their Friedman tests were either non-significant or with significant differences with small effect sizes (around 0.20), which indicated that the meaningfulness of these significant differences was low. Furthermore, their mean differences were not so large. Thus, based upon all the above evidence they can be claimed to have at least marginal test-retest reliability. To conclude, the scale measuring the most important element of the TTM, which is SOCs, along with six other scales proved to have adequate test-retest reliability. For the remaining seven scales there is evidence of marginal test-retest reliability and therefore these should be treated with caution.

Table 7.9. Test-retest results for each measured scale

Scale (Items)	Test Mean (*SD*)	Re-test Mean (*SD*)	Friedman χ^2 test between measures (*df*)	ICC one-way, single-trial (95% CI)
Stages (1)	3.21 (1.46)	3.20 (1.44)	0.05 (1, 60), *p*=0.83	0.92 (0.87-0.95)
Self-efficacy (5)	2.97 (0.66)	2.82 (0.80)	4.99 (1, 60), *p*=0.03, *ES*=0.23	0.73 (0.59-0.83)
Pros (10)	3.85 (0.71)	3.70 (0.81)	5.37 (1, 59), *p*=0.01, *ES*=0.22	0.72 (0.57-0.82)
Cons (6)	2.84 (0.91)	2.87 (0.84)	1.30 (1, 60), *p*=0.26	**0.57** (0.38-0.72)
Consciousness raising (4)	2.98 (0.79)	2.91 (0.86)	1.10 (1, 60), *p*=0.30,	0.80 (0.69-0.88)
Dramatic relief (3)	3.37 (0.91)	3.17 (0.89)	3.79 (1, 60), *p*=0.06	**0.60** (0.42-0.74)
Environmental re-evaluation (4)	2.84 (0.91)	2.87 (0.84)	0.15 (1, 60), *p*=0.70	0.71 (0.56-0.82)
Self re-evaluation (4)	3.69 (0.95)	3.43 (0.86)	6.63 (1, 59), *p*=0.01, *ES*=0.20	**0.61** (0.42-0.74)
Social liberation (3)	2.67 (0.73)	2.66 (0.82)	0.01 (1, 60), *p*=0.93	**0.62** (0.44-0.76)
Counter conditioning (4)	3.25 (0.95)	3.15 (0.95)	1.52 (1, 59), *p*=0.22	0.78 (0.66-0.86)
Helping Relationships (4)	2.65 (1.03)	2.75 (0.89)	1.37 (1, 60), *p*=0.25	0.77 (0.64-0.85)
Reward Management (4)	3.39 (0.95)	3.33 (0.90)	0.41 (1, 60), *p*=0.53	**0.67** (0.51-0.79)
Self Liberation (4)	3.69 (0.81)	3.39 (0.90)	12.38(1, 59), *p*=0.001, *ES*=0.21	**0.65** (0.48-0.78)
Stimulus Control (4)	2.80 (0.79)	2.57 (0.81)	6.92 (1, 60), *p*=0.001, *ES*=0.24	**0.59** (0.40-0.73)

7.16. Conclusions

A research gap was recognized concerning PA promotion in young ages, especially in Greece. Theoretical-oriented and school-based interventions were highly recommended for these ages and the TTM seemed to be a practical and efficient suggestion. Thus, the first objective of this study was to examine the implementation of the TTM in the examined population and the second to design a practical and efficient intervention. Spencer and co-workers (2006) proposed a set of recommendations specifically for the design and implementation of TTM-based exercise interventions which included: a) a precise definition of the term exercise to place individuals across the SOCs accurately, b) the selection of valid and reliable instruments, c) the employment of all TTM constructs, and d) accounting for difficulties in the establishment of the validity of the TTM in children and adolescents. The above-mentioned recommendations were carefully and successfully addressed in this study. Overall, the research design was formulated to ensure that the whole project would run according to academic standards. Measurement instruments demonstrated satisfactory concurrent validity compared to a combination of heart rate monitoring and activity diaries. Additionally, they seemed to possess internal and, in most cases, external reliability. Thus, they were confidently utilized in this research project. The TTM was examined in its totality and the applicability of the TTM to an adolescent sample was supported. The next chapter discusses the statistical analysis of the observed results of SOCs.

Chapter 8. Statistical analysis of the observed results

8.1. Introduction

The intervention employed a pre-post control design to examine whether it could successfully accelerate the progress of the intervention students to more active stages, de-accelerate their regression to less active stages and preserve those in active stages (Nigg, 2002). The purpose of the observed SOCs results analysis was to test any short-term intervention effects (hypothesis 1). A comparison was performed between the intervention and control group during the first two measurements (pre-intervention vs. post-intervention). Additionally, the short-, mid- and long-term intervention effects of the rest of the TTM components (POCs, SE, Pros and Cons) will also be examined to test hypotheses 4 to 15.

8.2. Assumption of normality

In order to analyze the data with parametric tests the assumption of a normal distribution must be met. In this case the Kolmogorov-Smirnov test was used to assess whether the distribution in each group was normal (Field, 2005, p.93-96). In both groups the deviation from normality was significant in all measurements (see: table 8.1). Thus, the use of non-parametric tests seemed to be the more proficient approach to analyze these data.

Table 8.1. Kolmogorov – Smirnov test for the assumption of normality

	Intervention group			Control group		
	Z	*df*	*p*	*Z*	*df*	*p*
pre-intervention	0.24	263	0.000	0.25	402	0.000
post-intervention	0.24	234	0.000	0.23	339	0.000
1 year after intervention	0.31	209	0.000	0.31	270	0.000
2 years after intervention	0.22	95	0.000	0.24	87	0.000

8.3. Origin of intervention and control group

The Mann-Whitney U test and the Two-Sample Kolmogorov-Smirnov test were used to test whether the intervention and control group originated from the same population (Field, 2005). The first test compared the number of times a student's stage from the intervention group was ranked higher than a student's stage of the control group (Field, 2005). No significant mean stage differences between the two groups were evident before the intervention (U=50427, n_{Int}=263, n_{Con}=402, *p(2-tailed)*=0.29). The second test was employed to compare the stage distribution between the intervention and control group before the intervention (Field, 2005). The stage distribution between the two groups was not significantly different [Z=0.9, *p(2-tailed)*=0.4]. Thus, it was concluded that the intervention and control group originated from the same population and could be compared with a pre-post intervention design.

8.4. Statistical analysis of the observed intervention effects of the stages of change

Firstly, the Wilcoxon Signed Ranks Test was used to test within group for any short-term differences between stage-progressed and stage-regressed students separately for the intervention and control group.

Secondly, the difference between the post-intervention stage number (1, 2, 3, 4 or 5) with the pre-intervention stage number (1, 2, 3, 4 or 5) showed the magnitude and direction of stage movement. It could either be zero for maintainers, a positive figure for the students who progressed or a negative figure for the students who regressed.

Another descriptive method of stage analysis proposed by Nigg (2002) was utilised to assess total stage movement by group. The intervention and control group were compared pre- and post-intervention by calculating the sums of stages progressed or regressed for each group (see: table 10.2). These two figures were subtracted to see whether the total was positive or negative for each group. A higher positive sum meant more stage progression, while a higher negative sum indicated more stage regression.

8.5. Statistical analysis of the observed intervention effects of the rest of the model's components (self-efficacy, pros and cons, processes of change)

One of the advantages of this thesis is the examination of the TTM in its totality (see: section 7.1). Thus, apart from the SOCs the rest of the TTM components (SE, Pros and Cons, POCs) were also examined for any intervention effects. The one to five Likert scale formats of the questions that were used to measure these components (see: section 7.13) placed them in the ordinal variable category. Furthermore, it enabled

the calculation of mean variables based on clustering of the relevant components. Specifically, the mean of the five SE questions composed the mean SE variable. The mean of the ten Pros questions formulated the mean Pros variable, and the mean of the six Cons questions the mean Cons variable. Finally, the mean of the four questions that addressed each POC [except from Dramatic Relief (DR) that had only three questions and Social Liberation (SOL) that was reduced to three due to internal validity considerations] composed the mean variable of each POC.

The Friedman test, which is the non-parametric equivalent of the one-way repeated measures ANOVA (Field, 2005), was employed to test within-group differences for the various TTM components across all four measurements. Separate comparisons were arranged for the intervention group, the control group and the boys' intervention group, the boys' control group, the girls' control group and the girls' intervention group. Subsequently, a post hoc analysis using the Wilcoxon Signed-Rank test (Field, 2005) was used to explore differences in the various TTM components in pairs of measurements (pre- vs. post-intervention, post-intervention vs. one year after, post-intervention vs. two years after and two years after vs. one year after).

The Friedman Test examined only those participants eligible in all four measurements ($n_{intervention}$=95, $n_{control}$=86). However, in the post hoc analyses all participants who had provided data from each pair of examined measurements were included (see: tables AN.1–AN.10) to enhance statistical power to detect differences that rely heavily on sample size (Field, 2005).

The post hoc analysis would have to account for an inflated family-wise error rate because it combined four comparisons. This means that the probability of falsely

rejecting the null hypothesis where the means of the compared variables do not differ (Type 1 error) was inflated to 19% $[1 - (0.95)^4 = 0.19]$ in comparison to the generally accepted 5% in the social domain (Field, 2005). Thus, a Bonferroni correction was applied to these post hoc tests (Field, 2005). The standard $p=0.05$ level was divided by the number of comparisons (four), which resulted in an adjusted level of significance of $p=0.0125$.

In the presence of statistical significant differences between measurements an effect size (ES), was calculated to assess the practical significance of the results (Kirk, 2001). According to Rosenthal (1991) the equation to convert a z-score from the Wilcoxon   Signed-Rank   test   into   an   effect   size   estimate   is:

$$ES = \frac{z\,score}{\sqrt{number\ of\ observations}}$$. In addition, Cohen (1992) has proposed the following criteria for the magnitude of an ES to be small if $ES > 0.1$, medium if $ES > 0.3$ and large if $ES > 0.5$.

The above analysis investigated any within-group trends among the four measurements. It examined longitudinal differences after the completion of the intervention in the short-, mid- and long-term. However, in order to establish any treatment effect the intervention condition needed to be compared to the control condition. The superiority of the intervention group compared to the control would justify that any differences in the intervention group was not due to natural occurring changes. In the following situations a positive comparative intervention effect would be justified:

a) The intervention group revealed a statistically significant positive difference between two measurements ($p<0.0125$), while the control group showed non-significant changes.

b) The intervention group revealed a statistically significant positive difference between two measurements ($p<0.0125$), while the control group showed a significant ($p<0.0125$) negative difference.

c) The intervention group revealed a statistically significant positive difference between two measurements ($p<0.0125$), while the control group showed a significant ($p<0.0125$) positive difference with a smaller effect size.

In the following case a stabilizing effect would be justified:

a) The intervention group revealed a non-significant difference between two measurements ($p>0.0125$), while the control group showed a significant ($p<0.0125$) negative difference.

8.6. Conclusions

The observed data of the SOCs were analysed for the short-term using various descriptive methods. Regarding the rest of the TTM components (POCs, SE, Pros and Cons) appropriate non-parametric tests were selected to examine any intervention effects in the short-, mid- and long-term. Thus, the analysis of the field data was carried out based on the above methods as it is shown in chapters 10 and 12. The next chapter discusses why Latent Transition Analysis was selected to analyse the categorical longitudinal data of SOCs.

Chapter 9. Latent statistical analysis

9.1. Introduction

The analysis of longitudinal data is considered to be a very challenging task. Collins (2006) proposes a conceptual framework for longitudinal research that integrates three elements: a comprehensive theoretical model of change, which is based on a correspondent temporal design that can thoroughly describe the change process, complemented with a functional statistical model capable of analysing the resulting data in detail. The first two elements were represented by the TTM in this thesis and were analysed in chapter 6. The third one is represented by LTA and is the focus of this chapter.

9.2. Latent categorical analysis

A common feature in psychology is the attempt to "measure quantities that cannot be observed directly, quantities that are usually called *hypothetical constructs* or *latent variables*" (Graham, Collins, Wugalter, Chung & Hansen, 1991, p.49). A latent variable can be measured with a set of observed variables combined with an error component related to them (Collins & Lanza, 2010). Examples from the TTM includes the various POCs, Pros and Cons and SE, which can be analysed according to their set of questions in the TTM instruments. When a latent variable is measured by only one item it is considered a manifest variable (Velicer, Martin & Collins, 1996), which is the case for the SOCs.

A latent variable assigns each individual into one discrete latent class (LC) (Collins, Lanza, Schafer & Flaherty, 2002). LCs are static variables that do not change between measurements (Martin *et al.*, 1996). They can be a characteristic like male and female gender, or a treatment condition such as intervention and control group (Martin *et al.*, 1996). Latent statuses (LSs) on the other hand, are dynamic variables exhibiting differentiations between measurements (Collins & Cliff, 1990), for example SOCs (Pallonen, Prochaska, Velicer, Prokhorov & Smith, 1998). They should be measured at least twice to identify their variance over time (Martin *et al.*, 1996).

The use of numerous observed variables impose the need to relate them with the latent variable using a certain measurement model (Nylund, 2007). When the latent and observed variables are considered to be categorical (such as the SOCs) the statistical method of latent class analysis (LCA) (Lazarsfeld & Henry, 1968) is suitable in this role (Nylund, 2007). This statistical model is directly analogous to factor analysis, with the only difference that the latter is used for continuous, normally distributed variables (Collins & Lanza, 2010). LCA is able to handle static latent variables and also incorporate measurement error in a model (Velicer *et al.*, 1996). According to Martin and colleagues (1996) it is applicable to categorical stage sequential variables (such as the SOCs). However, a limitation of LCA is its inability to analyse dynamic variables (Graham *et al.*, 1991). Thus, a type of autoregressive model called latent transition analysis (LTA) was conceptualised (Graham *et al.*, 1991; Collins & Wugalter, 1992) as an extension of LCA that can also incorporate dynamic LSs (Gebhardt, Dusseldorp & Maes, 1999).

9.3. Utility of Latent Class Analysis and Latent Transition Analysis

Measurement models such as LCA or LTA are suggested to examine "the chaotic nature of health behaviour…" (Smith & Biddle, 2008, p.105) and are considered "highly valuable…in the study of behavioural change in physical exercise." (Gebhardt *et al.*, 1999, p.1105). Complex models of behavior can be assessed with LTA (Velicer *et al.*, 1996) and it is acknowledged as particularly useful for examining ordered sequences of discrete stages such as the SOC (Gebhardt *et al.*, 1999; Collins *et al.*, 2002; Nigg, 2002). Finally, Collins (2006) considered LTA suited to examine models with numerous stages where individuals are free to shift between them; such as the TTM.

According to Velicer (1996, p.S208) "LTA models represent an alternative to traditional outcome analysis that is more powerful, more meaningful, and more sensitive." Furthermore, according to the same author it is flexible and can examine numerous research questions such as: a) the applicability of several temporal theoretical models of change, b) compare treatment and control group for intervention effects, c) evaluate different measures of SOCs, and d) identify the prevalence of each SOC. LTA can answer research questions about prevalence of SOCs and transitions between them expressed as probabilities (Collins, 2006). The WinLTA version 3.1 software (Collins *et al.*, 2002) was used to conduct all LTA analyses.

Missing data is a very serious and unavoidable problem in longitudinal research and the way they are handled is an important decision to be made by the researchers. According to Collins (2006), missing data can originate by partly or completely missing a measurement or providing inadequate information. Ad hoc procedures such as

deletion of cases or mean substitution have been very common but resulted in power loss and results bias (Collins, 2006). LTA can handle missing data without the burden of the above disadvantages because participants should be eliminated from the analysis only if they missed every measurement or a covariate (Nylund, 2007).

Another important consideration for panel longitudinal data is the timing, frequency and spacing of measurements since they seriously affect the results and need to be considered in accordance with the theoretical model in use (Collins, 2006). For example, the transition between SOCs might be underestimated if the measurements allow for more than one transition to take place between measurements.

Finally, LTA seems to perform better with large sample sizes (Velicer *et al.*, 1996), and should be used very cautiously or even avoided for samples fewer than around 300 participants (Collins *et al.*, 2002). In the present study the LTA of the whole sample involved 665 participants, the analysis of girls 377 and of boys 288, which can be considered adequate for the whole sample and the girls and marginally adequate for boys.

9.4. Components of latent class analysis and latent transition analysis

The by-product of LCA and LTA are a set of four estimated parameters that are symbolised by four Greek letters:

a) The *gamma* parameters (γ) indicate the distribution of the population among the various LCs (Martin *et al.*, 1996), for example, the division of the sample in the intervention and control group. This analogy is usually inputted in the model prior to

running the analysis. They do not change between measurements and are not mandatory to run the analysis (Velicer *et al.*, 1996).

b) The *delta* parameters (δ) represent the probability of membership in each of the LSs across each measurement and LC (Collins *et al.*, 2002), for example, the estimated proportions of each of the five SOCs in the intervention or control group at each measurement. The model allows for separate computations of each LC, for example, for the intervention and control group. The δ values across measurements are indicative of the SOC membership.

c) The *tau* parameters (τ) represent probabilities of preservation, progression or regression among the SOC continuum between two measurements in each LC (Velicer *et al.*, 1996). A transition probability matrix illustrates all the transition probabilities between the five SOCs across two measurements (for an example see: Appendix AM, table AM.1). As explained by Velicer and colleagues (1996) stability, or the probability of maintaining SOC, is highlighted by the values on the diagonal of this matrix from top left to bottom right. Subsequently, progression to a more active SOC is represented by the values above that diagonal and regression by the values below that diagonal. Thus, the effectiveness of an intervention can be summarized by comparing the transition probability values of the treatment and control group (Martin *et al.*, 1996).

d) The *rho* (ρ) parameters are estimates of a particular item response probability conditional on LS and LC membership (Martin *et al.*, 1996). According to Collins (2006), the ρs are the conceptual equivalent of factor loadings because they express the relation between the observed and latent variables. Their role is twofold; they define the LS and represent measurement error (Martin *et al.*, 1996). In general, ρs close to zero or one reflect more measurement precision (Collins & Wugalter, 1992).

Two other criteria to evaluate a set of item-response probabilities (ρs) are LC or LS homogeneity and separation. A LC or LS is considered highly homogeneous when its majority provides the same observed response pattern, when this is also a distinctive feature of that specific LC or LS then there is also high separation between LCs or LSs (Collins & Lanza, 2010). To illustrate these two concepts in a ρs matrix: a good homogeneity is represented by a specific ρ standing out in each row and good separation by a specific ρ standing out in each column (see: table 11.1).

Model identification is a prerequisite for model estimation and it is achieved when the observed data can lead to a unique estimate of model parameters (Kaplan, 2008). Positive degrees of freedom is indicative but not a sufficient requirement for identification (Velicer *et al.*, 1996). Identification is higher with large sample sizes (large n), less sparseness in the contingency table (large n/W), good homogeneity and LS separation (Collins & Lanza, 2010). If identification is problematic than the number of parameters to be estimated should be reduced by imposing constraints such as fixing a parameter to a specified value or setting it to be equal to another one (Collins & Wugalter, 1992).

Models can be determined by fixing, constraining, or freely estimating parameter values (Collins & Lanza, 2010). The Expectation Maximization Algorithm (Dempster, Laird & Rubin, 1977) is used to calculate the goodness of fit (G^2) of a model by comparing how well the model's predictions fit to the observed proportions of response patterns (Gebhardt *et al.*, 1999). The degrees of freedom of G^2 are calculated as the number of possible response patterns (W) minus the number of estimated parameters (p) minus one (df = W-p-1) (Collins & Lanza, 2010). A model could be

considered as one that fits well with the data (is a reasonable representation of the actual data) when it possesses a comparatively small G^2 (Graham *et al.*, 1991). However, as McCutcheon explains (2002), with many sparsely populated cells, and more variables in a model the statistic tends to become unreliable. Additionally, as Collins and Wugalter (1992) admit it is difficult to compare a more complex model with a simpler one. Thus, in the above two situations the Akaike Information Criterion (AIC) is proposed to assess model fit (Akaike, 1987) by applying a penalty function for specifying and testing a less parsimonious model. AIC can be estimated from the equation: $AIC = G^2 + 2p$, where p is the number of estimated parameters (Graham *et al.*, 1991). Smaller values of this criterion indicate best fit.

A differentiation among LTA models lies in the order of the comparisons between measurements. In a first-order LTA model transitions between LS are examined only between subsequent measurements, while in a second-order model they are also examined between non-adjacent measurements (Collins & Lanza, 2010). The first-order models are the most common because second-order and higher-order models tend to be very complicated.

Finally, the intervention and control group comparisons across the four measurements could be justified only if the criterion of measurement invariance could be verified between them (Collins & Lanza, 2010). If the two groups possessed similar error components across measurements then their comparisons would be meaningful (Collins & Wugalter, 1992), and so would any identified intervention effects. The justification is that since the ρ parameters define the LSs, between-group differences in ρs would make comparisons of transition probabilities (τs) meaningless (Graham *et al.*, 1991) since they would be comparing different LSs.

9.5. Model fit

In order to find the best model to fit with the data three LTA models were compared (see: table 9.1). "All models were nested, [meaning that each narrower model]…was a special case of a larger model with certain parameters fixed at zero." (Schumann, Ulrich, Rumpf & Meyer, 2006, p.103). Model 1 permitted only one stage transition (back or forth) between measurements. Model 2 permitted up to two stage transitions (back or forth) between measurements. Finally, Model 3 permitted all the possible stage transitions (up to four back or forth) between measurements, reflecting reality and the full possibilities of the SOC theory. Although the G^2 was less than the critical value $(\alpha = 0.05)$ of the χ^2 distribution in the three examined models there appeared to be identification problems caused by sparseness (Collins & Lanza, 2010). The n/W ratio was small (665/1248=0.53) suggesting that the distribution of G^2 was not well enough approximated by the χ^2 distribution for the p values to be accurate (Collins & Lanza, 2010). Thus, it could not be concluded that all three models fitted well with the data based upon the G^2 distribution. Therefore, it was necessary to rely on the AIC criterion for model selection (Collins & Lanza, 2010).

Table 9.1. Model fit of the three tested models

	Allowed SOC transitions	Parameters estimated (p)	df=W-p-1	G^2	a=0.05	AIC=G^2+2p
Model 1	1 forward– 1 backward	73	1102	308	1180	308 +2* 73=454
Model 2	2 forward– 2 backward	121	1026	328	1102	328 +2*121=570
Model 3	free	289	958	284	1031	284 +2*289=862
Difference M3 and M1			1102-958=144	308-284=24 (p=1.00)	173	
Difference M3 and M2			1026-958=68	328-284=44 (p=0.99)	88	

The next logical step was to determine which one of the three would be the preferred model. Model 1 had the lowest AIC, which placed it on the top of the list, followed by Model 2 and Model 3 (see: table 9.1). Subsequently, in order to compare whether two of the above models fitted equally well with the data the G^2 differences between these models were examined (see: table 9.1). The G^2 difference between Model 3 and Model 1 was G^2_{M1}- G^2_{M3}=24 (*df*=144), which was non-significant in the *a*=0.05 level (*p*=1.00), so it could be concluded that the two Models fitted equally well with the data. The same conclusion was drawn for the G^2 difference between Model 3 and Model 2 which was G^2_{M2}- G^2_{M3}= 44, (*df*=68), *p*=0.99. Clearly Model 1 seemed to be the model of best fit in terms of AIC and the most parsimonious of all, which might have led to its selection. However, its superiority to the other two models proved to be non-significant. This superiority might have been caused by the fact that the most likely transition between measurements is one stage forward or backwards (Martin *et al.*, 1996) rather than two, three or four. On the other hand, this constraint minimised the scope of Model 1 in terms of simulating reality. The same as the above applies to the comparison of Model 2 with Model 3. Therefore, because no statistical difference could be found in the comparisons of Model 3 with Model 1 and Model 2, Model 3 (free stage transitions) was chosen because it could illustrate reality more accurately with non-significant statistical losses.

9.6. Measurement invariance

A verification of measurement invariance between the intervention and control group across the four measurements would justify their comparison (see: section 9.2). To test the above hypothesis an LTA was performed specifying the LSs (SOCs) and constraining the item-response probabilities (ρs) to be equal across groups and

measurements. If the measurement error parameters (ρs) could be constrained with no significant change between the fit of the two models then the constrained model could be used for further analysis. In order to test whether Model 3 and Model 4 fitted equally well with the data their G^2 difference was examined (see: table 9.2). It was found to be non-significant at the a=0.05 level [G^2_{M4}- G^2_{M3}=92 (df=141), p=1]. Therefore it could be concluded that the two models fitted equally well with the data and thus the ρs could be constrained to be equal across groups and measurements. Since there were no significant differences in the item-response probabilities any group difference in stage prevalence could be considered as quantitative and could be expressed in terms of differences in stages prevalence (δs). Thus, Model 4 could be used in the analysis without any significant problems. Furthermore, this decreased the number of estimated parameters of the model, which subsequently increased its parsimony.

According to Bray (2007) and also Collins and colleagues (2010) a model can be identified by using several random starting values (10 to 100). For models in which all sets of starting values did not converge to the same solution, the one with the smallest replicated G^2 would be preferred (Bray, 2007; Collins & Lanza, 2010). In the current study Model 4 was identified with the above method. In particular, seven of the ten sets of self-inputted starting values converged to the G^2=376 to 377, while the remaining three converged with higher G^2=401 to 466. Thus the smallest G^2 that was repeated in the majority of the cases established identification of Model 4.

Table 9.2. Test of measurement invariance between Model 1 with free ρs and Model 2 with ρs constrained to be equal across

groups and measurements

Whole sample	ρs Constrained	Parameters estimated (P)	$Df = W - p - 1$	G^2	a = 0.05	AIC = G^2 + 2P
Model 3	No	289	959	284	1031	284 + 2 * 289 = 862
Model 4	Yes	149	1099	377	1177	377 + 2 * 149 = 675
Difference between M3and M4			1099 – 958 = 140	377 – 284 = 92 (p=1)	170	

9.6.1. Measurement invariance of boys and girls

The same procedure as above was conducted separately for each sub-sample of boys and girls. The G^2 difference of Model 5 and Model 6 was found to be non-significant at the a=0.05 level [G^2_{M6}- G^2_{M5}=71 (df=140), p=1.00] (see: table 9.3). As for Model 7 and Model 8 for girls, their G^2 difference was found to be non-significant at the a=0.05 level [G^2_{M8} - G^2_{M7}=72 (df=140), p=1.00] (see: table 9.4). Therefore it could be concluded that the pairs of compared models fitted equally well with the data. Thus, the two constrained models, Model 6 for boys and Model 8 for girls, could be used in further analysis without any significant problems.

Table 9.3. Test of measurement invariance of boys between Model 5 with free ρs and Model 6 with ρs constrained to be equal across groups and measurements

Boys	ρs Constrained	Parameters estimated (P)	$Df = W - p - 1$	G^2	a = 0.05	AIC = G^2 + 2P
Model 5	No	169	959	125	1032	125 + 2 * 169 = 463
Model 6	Yes	149	1099	196	1177	196 + 2 * 149 = 494
Difference between M5 and M6			140	71 ($p = 1.00$)	169	

Table 9.4. Test of measurement invariance of girls between Model 7 with free ρs and Model 8 with ρs constrained to be equal across groups and measurements

Girls	ρs Constrained	Parameters estimated (P)	$Df = W - p - 1$	G^2	a = 0.05	AIC = G^2 + 2P
Model 7	No	169	959	208	1032	208 + 2 * 169 = 546
Model 8	Yes	149	1099	280	1177	280 + 2 * 149 = 578
Difference between M7 and M8			140	72 ($p=1.00$)	169	

9.7. Conclusions

LTA was selected as an appropriate and advantageous method to test for any intervention effects regarding the SOCs. A LTA model with free stage transitions was successfully tested for this study and measurement invariance of the model was achieved to make any comparisons between measurements meaningful. Thus, the analysis of the field data based on the above methods is presented in chapter 11.

Results

Chapter 10. Analysis of the observed intervention effects upon the stages of change

10.1. Introduction

The purpose of this chapter is to analyse the observed SOCs data pre- and post-intervention in order to examine any intervention effects. Descriptive methods will be used for the whole sample to analyse any short-term intervention effects, which pertains to Hypothesis 1. The comparison between the intervention and control group regarding stage movement pre- and post- intervention will be the main concern of this chapter.

10.2. Comparison of stage movement within groups after the intervention

Within the intervention group, there were significantly more stage-progressed compared to stage-regressed students (75 vs. 38) after the intervention [Wilcoxon Signed Ranks Test, n=234, Z=-3.3, *p(2-tailed)* =0.001]. In contrast, within the control group there were more stage-regressed compared to stage-progressed students (96 vs. 85) after the intervention, but the difference was not significant [Wilcoxon Signed Ranks Test, n=339, Z=-1.7, *p(2-tailed)* =0.087]. There were also 121 maintainers in the intervention group and 158 in the control group. Thus, the intervention group showed significantly more stage-progressed students after the intervention, while in the control group those who progressed were not statistically different from those who regressed (see: figure 10.1).
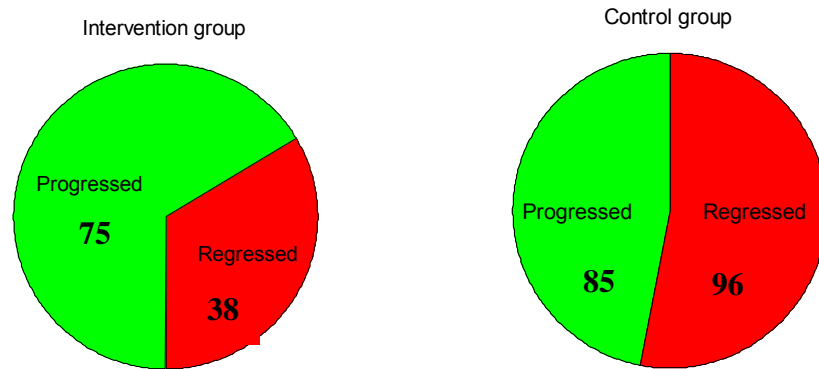
Figure 10.1. Total progressed or regressed students after the intervention within each
group

10.3. Descriptive analysis of stage distribution just before and just after the intervention.

The stage distribution in the intervention and control group before and after the intervention is shown in table 10.1.

Table 10.1. Cross-tabulation of stage pre-intervention with stage post-intervention

Count (% within stage pre-interv.)			Post-intervention SOC					
			PC	C	PR	A	M	Total
Intervention group	pre-intervention	PC	**6 (24%)**	8 (32%)	2 (8%)	8 (32%)	1 (4%)	25
		C	1 (2%)	**15 (36%)**	5 (12%)	16 (38%)	5 (12%)	42
		PR	1 (3%)	7 (20%)	**10 (29%)**	12 (34%)	5 (14%)	35
		A	0 (0%)	5 (11%)	2 (4%)	**24 (55%)**	13 (30%)	44
		M	0 (0%)	6 (7%)	5 (6%)	11 (12%)	**66 (75%)**	88
	Total		8 (3%)	41 (18%)	24 (10%)	71 (30%)	90 (39%)	234
Contro group	pre-intervention	PC	**11 (41%)**	9 (33%)	2 (7%)	4 (15%)	1 (4%)	27
		C	6 (10%)	**28 (47%)**	8 (14%)	11 (19%)	6 (10%)	59
		PR	2 (7%)	4 (14%)	**3 (11%)**	17 (61%)	2 (7%)	28
		A	4 (5%)	13 (16%)	10 (13%)	**28 (35%)**	25 (31%)	80
		M	5 (3%)	9 (6%)	12 (8%)	31 (21%)	**88 (61%)**	145
	Total		28 (8%)	63 (19%)	35 (10%)	91 (27%)	122 (36%)	339

A new variable was calculated by subtracting the SOC of each student before the intervention from that after it. If the sum was positive it meant that the student progressed to a higher stage, while if it was negative it represented stage-regression. In the cases of those who maintained their stage in both measurements this variable was zero. The higher the number the more stages the student regressed or progressed. As can be seen in figure 10.2, a higher percentage of control students regressed four, three, two or one stage just after the intervention and also progressed one stage. On the other hand,

a higher percentage of intervention students maintained their stages and progressed two or three stages. This lower percentage of regression and higher percent of progression, in most cases, highlights a positive intervention effect.
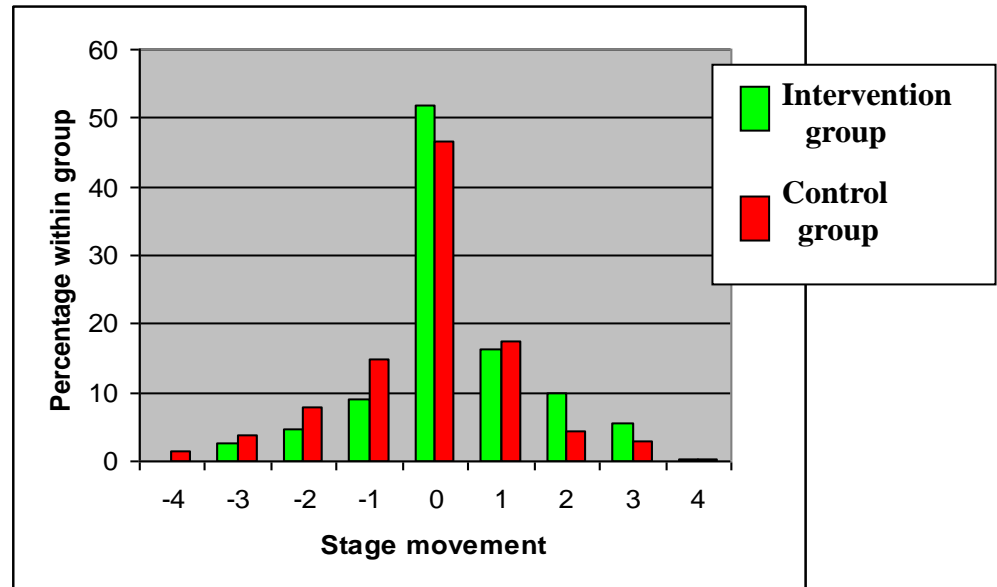
Figure 10.2. Comparison of stage movement within the two groups after the intervention

Another method of stage analysis recommended by Nigg (2002) was utilised to assess total stage movement by group. A comparison was made between the intervention and control group pre- vs. post-intervention by summing the total amount of SOCs progressed or regressed for each group (see: table 10.2). Thus, the count of students who progressed a certain number of stages (one, two, three or four) was multiplied with that number (one, two, three or four) to calculate the total amount of progressed stages. Additionally, the above procedure was repeated to calculate the total amount of regressed stages. These two figures were subtracted to see whether the total number of stages progressed or regressed was positive or negative. A higher positive sum would reveal more stage progression. On the other hand, a higher negative sum

would reveal the opposite trend. For the intervention group a positive sum of 66 stages was found, while in the control group a negative sum of -41 stages was found. When divided by the number of students in each group it was concluded that, on average, 28% of the intervention group advanced to the next stage, while, for the control group 12% regressed to the preceding stage.

Table 10.2. Average stage movement pre- vs. post-intervention

Pre- vs. post-intervention stage movement	Intervention group	Control group
	Count (stage movement x count)	Count (stage movement x count)
-4 stages	0 (0)	5 (-20)
-3 stages	6 (-18)	13 (-39)
-2 stages	11 (-22)	27 (-54)
-1 stage	21 (-21)	51 (-51)
0 stages	121 (0)	158 (0)
1 stage	38 (38)	59 (59)
2 stages	23 (46)	15 (30)
3 stages	13 (39)	10 (30)
4 stages	1 (4)	1 (4)
Total count (Sum of stage movement)	234 (66)	339 (-41)
Sum of stage movement / Total	66/234 = +0.28 in average, 28% advanced to the next stage	-41/339 = -0.12 in average, 12% regressed to the preceding stage

The total amount of stages progressed or regressed pre- vs. post- intervention was also examined. Thus, the count of students who progressed a certain number of stages (one, two, three or four) was multiplied with that number of stages (one, two, three or four) to calculate the total amount of progressed stages (see: table 10.3). A

positive number of total progressed stages was found for each group. Additionally, the above procedure was repeated to calculate the total amount of stages regressed (see: table 10.4). A negative number of total stages regressed was found for each group. A higher positive sum indicated more stage-progression. On the other hand, a higher negative sum revealed the opposite trend. For the intervention group a total of 61 stage-regressions was found, while in the control group 164. When divided by the number of regressed students, on average, the intervention group regressed 1.6 stages vs. 1.7 stages for the control group. Additionally, 127 stage progressions were found for the intervention group and 123 for the control group. When divided by the number of progressed students, on average, the intervention group progressed 1.7 stages vs. 1.4 stages for the control group. These calculations also led to the conclusion that the intervention, on average, helped students to progress more and regress less across the SOC continuum.

Table 10.3. Average stage progression pre- vs. post-intervention

Pre- vs. post-intervention stage progression	Intervention	Control
	Count (stage progression x count)	**Count** (stage progression x count)
-4	0 (0)	5 (-20)
-3	6 (-18)	13 (-39)
-2	11 (-22)	27 (-54)
-1	21 (-21)	51 (-51)
Total **(Total of stage regression)**	38 (-61)	96 (-164)
Total of stage regression / Total	of students that regressed, on average, they regressed -61/38 = 1.6 stages	of students that regressed, on average, they regressed -164/96 = 1.7 stages

Table 10.4. Average stage progression pre- vs. post-intervention

Pre- vs. post-intervention stage progression	Intervention	control
	Count (stage progression x count)	Count (stage progression x count)
1	38 (38)	59 (59)
2	23 (46)	15 (30)
3	13 (39)	10 (30)
4	1 (4)	1 (4)
Total **(Total of stage progression)**	75 (127)	85 (123)
Total of stage progression / Total	of students that progressed, on average, they progressed 127/75 = 1.7 stages	of students that progressed, on average, they progressed 123/85 = 1.4 stages

10.4. Conclusions

The intervention and control group were proved to originate from the same population since no significant differences in stage distribution were found between them prior to the intervention. This conclusion allowed the comparisons pre- vs. post-intervention to be considered legitimate. Additionally, the test for normality was negative and thus non-parametric tests were employed.

A descriptive analysis of stage distribution pre- vs. post-intervention led to some interesting conclusions regarding short-term intervention effects. A dynamic shift towards more active stages was found in the intervention group, while in the control group this momentum was more pronounced towards the less active stages. Furthermore, on average, 28% of the intervention students advanced to the next SOC,

while 12% of the control students regressed to the preceding SOC. The above descriptive facts illustrated the dynamics towards progression by the intervention group and towards regression by the control group. Furthermore, intervention students regressed slightly fewer stages on average (1.6 vs. 1.7). Additionally, intervention students progressed more stages on average than the control group (1.7 vs. 1.4). Significantly more stage-progressed compared to stage-regressed students were found in the intervention group (75 vs. 38). In contrast, more stage-regressed students were found in the control group (96 vs. 85), but the difference was not significant. Therefore, progression generally seemed to be more likely for the intervention group and regression for the control group. To conclude, the observable short-term intervention effects were considered positive in many aspects.

An attempt to confirm the above mentioned observed positive short-term effects is made in chapter 11 using LTA. Furthermore, the observed intervention effects of the other TTM components, namely POCs, SE and pros and cons are examined in chapter 12, with the purpose of obtaining a complete picture of the efficiency of the intervention based upon the available observed data.

Chapter 11. Intervention evaluation using latent transition analysis

11.1. Introduction

LTA provides a framework with which to analyse longitudinal categorical data and examine their relative intervention effects. Latent within-group comparisons of the SOCs were performed across the various adjacent measurements for the whole sample and for each gender separately to test Hypotheses 1, 2 and 3, respectively.

11.2. Latent transition analysis for the whole sample

A first-order LTA was carried out for the whole sample (n=665) using two LCs (Intervention and Control group) and one manifest item (SOC) with five LSs (PC, C, PR, A, M) [Complementary characteristics of the LTA: Unique Response Patterns = 278, Maximum Iterations = 5000, Convergence Criterion = 0.000001, Missing Data in Response Patterns = Yes, Starting G^2= 1511.691, G^2 Test of Model Fit = 376.515, df = 1099, G^2 Test for MCAR = 251.767, df = 356]. Table 8.1 is identical for the intervention and control group in all measurements because the ρs were constrained to be equal across groups and measurements. This method established comparison eligibility between the intervention and control group across measurements. After the initial analysis, the 3rd and 4th LSs were reversed, a procedure called *Label Switching* (Chung, Loken & Schafer, 2004). This procedure is acceptable since the ordering of LSs is arbitrary (Collins & Lanza, 2010) and because the model's ρs could fit better with their interpretation in that sequence (Collins *et al.*, 2002). The error components (ρs) incorporated a high LS homogeneity in most cases (except PR) and an excellent LS separation in every case (see: table 11.1).

The estimates of proportions of membership in each LC (γ parameters) were 0.40 for the intervention group and 0.60 for the control group. The estimates of proportions of each SOC for each group (δ parameters) are shown in table 11.2. It must be mentioned here that only the δ parameters for the first measurement were estimated, the others being computed using the transition probabilities (τ parameters). Comparison of the proportions of students who were in the two active stages in each measurement could indicate a positive or negative trend of SOC membership for each group across measurements (see: table 11.2). The intervention group seemed to have a high increase just after the intervention compared to a small drop by the control group. They both had similar drops one year after the intervention and both had a significant increase two years after the intervention, with the control group having the largest. Thus, comparison of the sums pre-post-intervention showed a significant short-term effect in favour of the intervention group (+0.14 vs. -0.05). Regarding the mid-term comparisons both groups revealed a considerable drop (-0.27 and -0.21). It seemed that they were both negatively affected probably by the studying demands of the last year in school and the exam preparation for Higher Education Institutions. Finally, in the long-term when the students had graduated from their schools, both groups increased their proportions in the active stages with the control group showing a greater gain (+0.11 vs. +0.21). The above comparisons of δ parameters revealed a positive short-term effect of the intervention in the whole sample, a neutral mid-term and a negative long-term effect.

Table 11.1. Item-response probabilities (ρs) of the stages of change conditional on stages of change in each measurement and across groups

IG	PC^{M1}	C^{M1}	PR^{M1}	A^{M1}	M^{M1}	CG	PC^{M1}	C^{M1}	PR^{M1}	A^{M1}	M^{M1}
PC	0.76	0.24				PC	0.76	0.24			
C	0.02	0.98				C	0.02	0.98			
PR		0.24	0.52		0.24	PR		0.24	0.52		0.24
A				0.91	0.09	A				0.91	0.09
M				0.10	0.90	M				0.10	0.90

Note: The above tables of M$_1$ (1st measurement) are identical for the two groups (Intervention and control) and

for the other three measurements (M$_2$, M$_3$, M$_4$)

Table 11.2. δ parameters in each stage of change across groups, the cumulative percentages of the two active

stages (A and M) and in parenthesis the differences of the cumulative percentages between measurements

IG	Pre-interv.	Post-interv.	One year after	Two years after		**CG**	Pre-interv.	Post-interv.	One year after	Two years after
PC	0.13	0.04	0.04	0.09		PC	0.11	0.12	0.16	0.16
C	0.08	0.12	0.42	0.22		C	0.11	0.11	0.37	0.18
PR	0.27	0.19	0.15	0.19		PR	0.16	0.20	0.11	0.10
A	0.16	0.30	0.14	0.28		A	0.20	0.25	0.10	0.24
M	0.36	0.36	0.25	0.22		M	0.42	0.32	0.26	0.33
A+M $(\Delta T_t - T_{t-1})$	0.52	0.66 (+0.14)	0.39 (-0.27)	0.50 (+0.11)		A+M $(\Delta T_t - T_{t-1})$	0.62	0.57 (-0.05)	0.36 (-0.21)	0.57 (+0.21)

The transition probabilities (τs) across subsequent measurements could help to evaluate any intervention effect. The best possible scenario for the intervention would have been to assist more students to progress to more active SOCs, stabilised them there and avoided subsequent regression to less active SOCs. Figures 11.1 to 11.6 illustrate the most important transition probabilities ($\geq$0.10) between subsequent measurements. The pre-post-intervention comparison of the transition probabilities between the intervention and control group led to the following conclusions (see: figures 11.1 and 11.2): In the less active stage (PC) the intervention group showed a strong tendency to progress one, two or three stages (70% in total) as opposed to a strong resistance to change (66%) by the control group. In the second "inactive" stage (C) the intervention group showed a stronger tendency to progress than the control group (47% vs. 28%). In PR the intervention group seemed to have a greater tendency to progress (76% vs. 57%). In A the intervention group seemed less stable (34% vs. 65%) and more prone to regress (55% vs. 24%). Finally, in M the intervention group showed almost complete stability (96%), while the control group was less stable (70%) with a tendency to regress to less "active" stages (26%). To conclude the comparison between the two groups pre-post intervention revealed encouraging results in favour of the intervention group. One general conclusion might be that the intervention seemed able to "mobilise" more of the participants from the less active stages (PC, C, PR) while "stabilising" more of those in the active stages with the exception of the A stage.
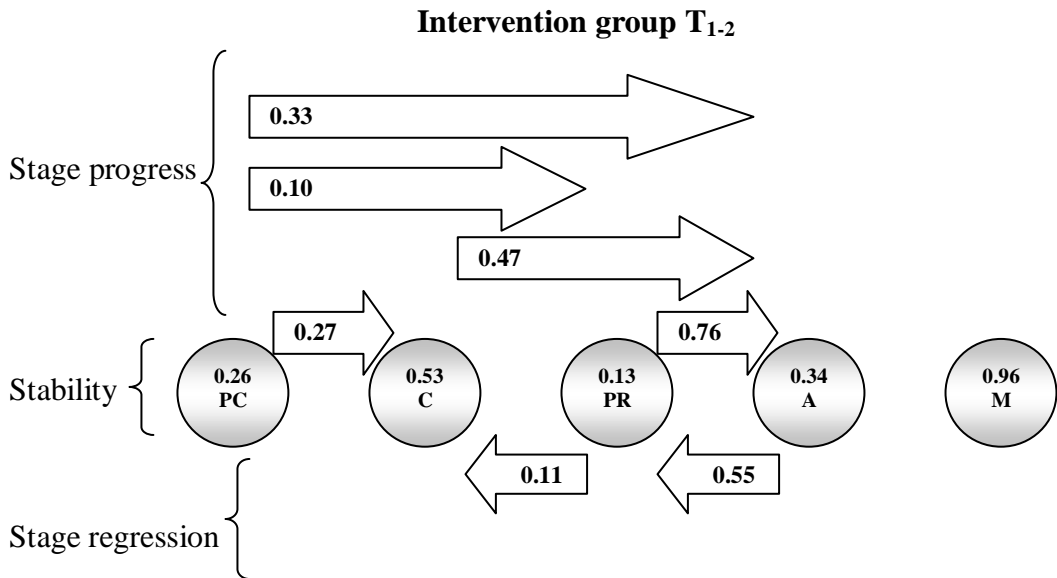
Figure 11.1. Transition probabilities (≥0.10) among the intervention group pre- and
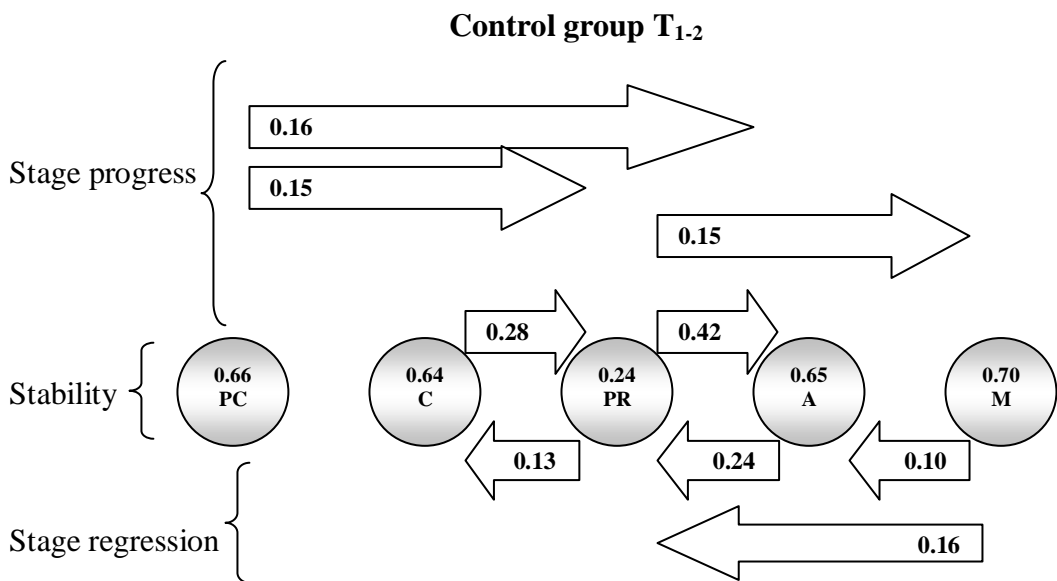
post-intervention

Figure 11.2. Transition probabilities (≥0.10) among the control group pre- and post-

intervention

The comparison of the transition probabilities between the intervention and

control group just after the intervention and one year after led to the following

conclusions (see: figures 11.3 and 11.4): In the less active stage (PC) the intervention

group showed a higher tendency to progress (57% vs. 19%). In the second "inactive" stage (C) both groups were quite stable (90% and 100%). In PR both groups showed about the same tendency to progress and regress. In the active stages (A, M) both groups showed a tendency to regress with the control group a little more prone to it. To conclude, the comparison between the two groups just after the intervention and one year after the intervention revealed similar discouraging results since in most cases participants were prone to regression to earlier stages. This could have been expected since the students were in their last year of school and were preparing for their final exams towards higher education. In these circumstances their leisure time had been minimised together with their opportunities to be active.

Intervention group T₂₋₃

Stage progress · 0.57

Stability
- 0.43 PC
- 0.90 C
- 0.26 PR
- 0.29
- 0.25 A
- 0.69 M

0.10 · 0.45 · 0.24

Stage regression
- 0.51
- 0.23
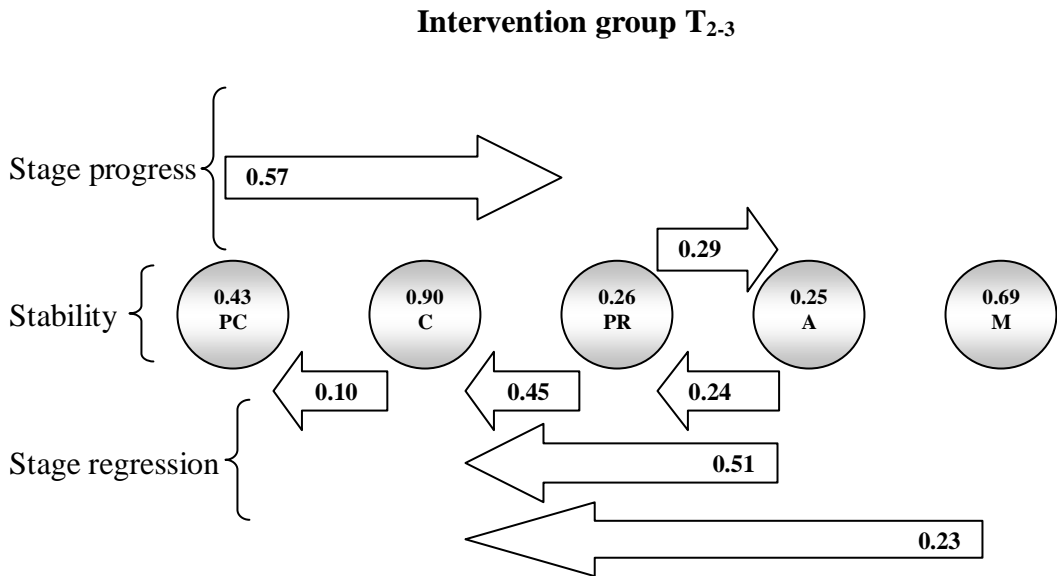
Figure 11.3. Transition probabilities (≥0.10) among the intervention group post-

intervention and one year after

Control group T₂₋₃

Stage progress · 0.19 · 0.16

Stability
- 0.69 PC
- 1.00 C
- 0.11 PR
- 0.19
- 0.16 A
- 0.60 M

0.44 · 0.13

0.10 · 0.12

Stage regression
- 0.37
- 0.25
- 0.20
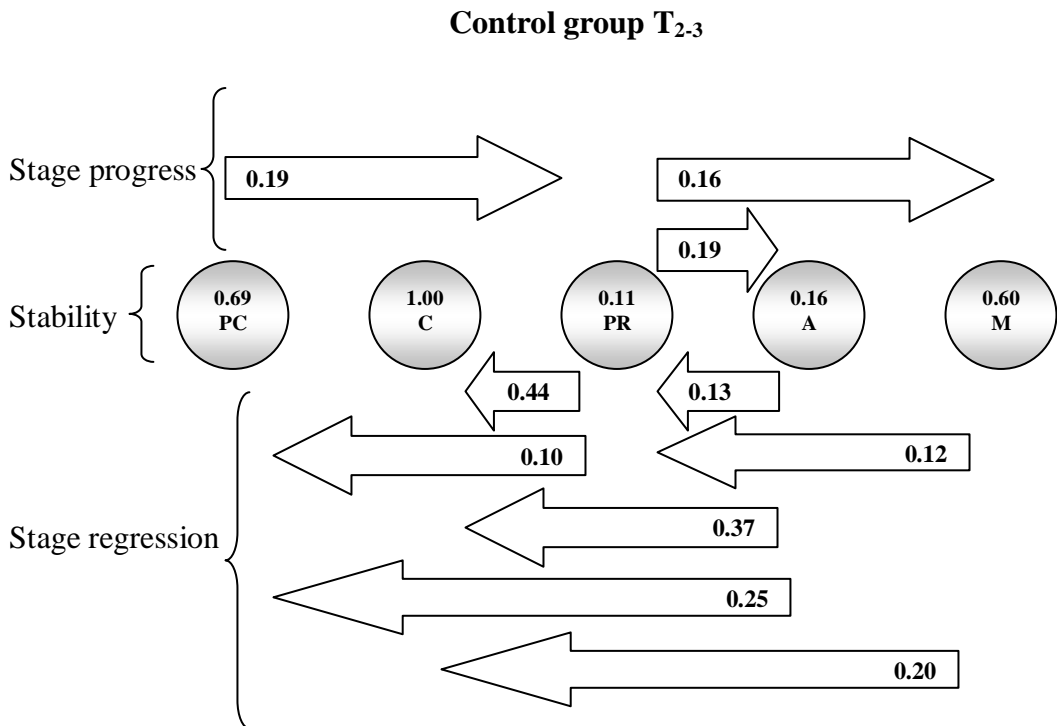
Figure 11.4. Transition probabilities (≥0.10) among the control group post-intervention

and one year after

The comparison of the transition probabilities between the intervention and control group one and two years after the intervention led to the following conclusions (see: figures 11.5 and 11.6): In the less active stage (PC) both groups showed similar stability (71% and 84%). In the second "inactive" stage (C) both groups again showed a similar high tendency to progress (71% and 72%). In PR the intervention group showed a greater tendency to progress (65% vs. 41%) and no tendency to regress compared to a tendency of 31% to regress by the control group. In A there was total regression (100%) in both groups towards PR and C. Finally, in M both groups were quite stable (87% and 90%). To conclude, comparison of the two groups between one and two years after the intervention revealed similar mixed results.

Intervention group T$_{3\text{-}4}$
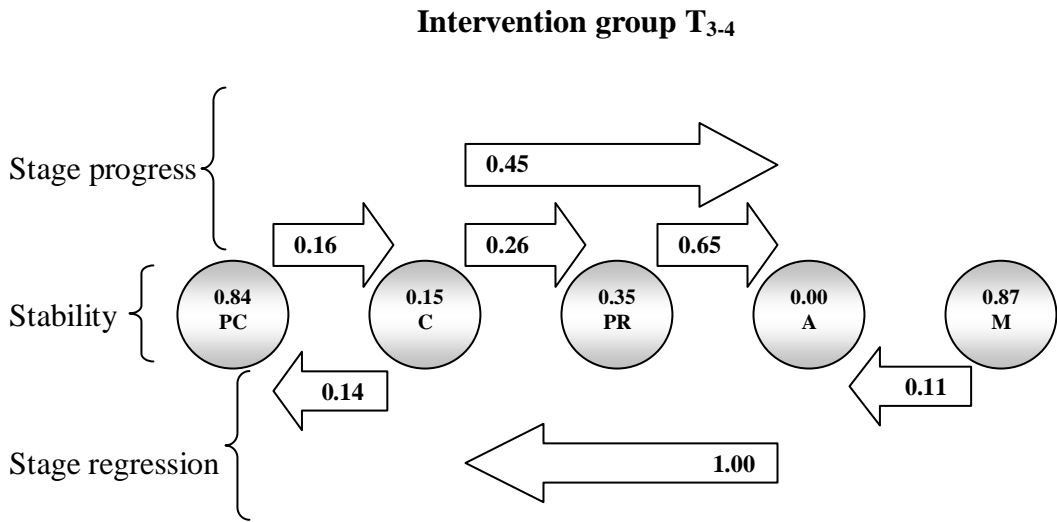
Figure 11.5. Transition probabilities (≥0.10) among the intervention group one year after and two years after the intervention
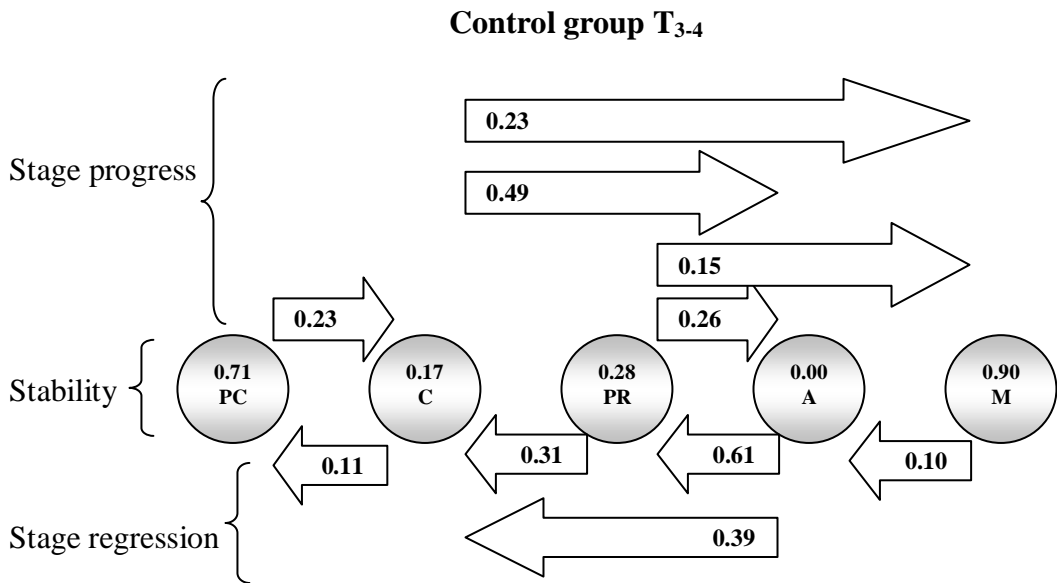
Control group T$_{3\text{-}4}$

Figure 11.6. Transition probabilities (≥0.10) among the control group one year after and two years after the intervention

11.3. Latent transition analysis of boys

A first-order LTA was carried out for the sub-sample of boys (n=288) using two LCs (Intervention and Control group) and one manifest item (SOC) with five LSs (PC, C, PR, A, M) [Complementary characteristics of the LTA: Unique Response Patterns = 133, Maximum Iterations = 5000, Convergence Criterion = 0.000001, Missing Data in Response Patterns = Yes, Starting G^2= 832.833, G^2 Test of Model Fit = 195.766, df = 1099, G^2 Test for MCAR = 160.668, df = 356]. Table 11.3 is identical for each group and across measurements because the ρs were constrained to be equal across groups and measurements. This method established comparison eligibility between the intervention and control group across measurements. The error components (ρs) showed a high LC homogeneity in most cases (except PR) and a high LC separation in every case (see: table 11.3).

Table 11.3. Boys' item-response probabilities of the SOC conditional on SOC in each measurement and across groups.

IG Boys	PC^{T1}	C^{T1}	PR^{T1}	A^{T1}	M^{T1}	CG Boys	PC^{T1}	C^{T1}	PR^{T1}	A^{T1}	M^{T1}
PC	1.00					PC	1.00				
C		1.00				C		1.00			
PR		0.04	0.43	0.39	0.13	PR		0.04	0.43	0.39	0.13
A				0.83	0.17	A				0.83	0.17
M			0.04		0.96	M			0.04		0.96

Note: The above table of T_1 (1st measurement) is identical for the other three measurements (T_2, T_3, T_4), IG = Intervention group, CG=Control group

The estimates of proportions of membership in each LC (γ parameters) were 0.41 for the intervention group and 0.59 for the control group. The estimates of proportions of each SOC for each group (δ parameters) are shown in table 11.4. Comparison of the proportions of boys in the two active stages (A and M) indicated a

high increase of the intervention group just after the intervention compared to a medium drop by the control group (+0.21 vs. -0.12). One year after the intervention, the intervention group had a high drop accompanied with a medium one by the control group (-0.34 vs. -0.15). This downward trend continued for the intervention group two years after the intervention while the control group managed to raise its proportions considerably (-0.05 vs. +0.33). Thus, a significant short-term intervention effect for boys was revealed. In the mid-term both groups seemed to be negatively affected, but the intervention group to a higher degree, by the studying demands of the last year in school and the exams' preparation for the Higher Education Institutions. Finally, in the long-term, after the students had graduated from their school the control group managed to increase its proportions considerably. On the contrary, the intervention group slightly decreased its proportions in the case of boys.

Table 11.4. Boys' δ parameters in each stage of change across groups, the cumulative percentages of the two active stages

(A and M) and in parenthesis the differences of the cumulative percentages between measurements.

Intervention Boys	Pre- interv.	Post- interv.	One year after	Two years after		Control Boys	Pre- interv.	Post- interv.	One year after	Two Years after
PC	0.07	0.04	0.02	0.06		PC	0.07	0.08	0.09	0.05
C	0.13	0.09	0.38	0.28		C	0.11	0.10	0.32	0.17
PR	0.23	0.09	0.16	0.27		PR	0.11	0.23	0.15	0.00
A	0.10	0.31	0.13	0.10		A	0.20	0.19	0.09	0.24
M	0.47	0.47	0.31	0.29		M	0.51	0.40	0.35	0.53
A+M $[\Delta(T_t - T_{t-1})]$	0.57	0.78 (+0.21)	0.44 (-0.34)	0.39 (-0.05)		A+M $[\Delta(T_t - T_{t-1})]$	0.71	0.59 (-0.12)	0.44 (-0.15)	0.77 (+0.33)

The transition probabilities (*τs*) across subsequent measurements could help to evaluate the intervention effect, as has been done for the whole sample in section 11.2. Figures 11.7. to 11.12 illustrate the most important transition probabilities of boys (≥0.10) between subsequent measurements.

Boys intervention group T$_{1-2}$
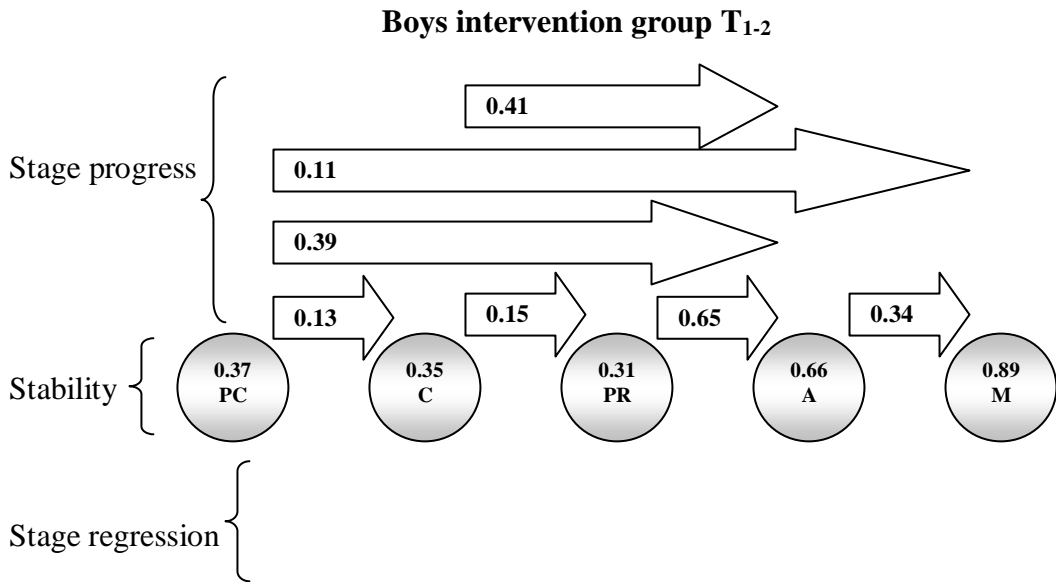
Figure 11.7. Transition probabilities of boys (≥0.10) among the intervention group pre- and post-intervention

Boys control group T$_{1-2}$
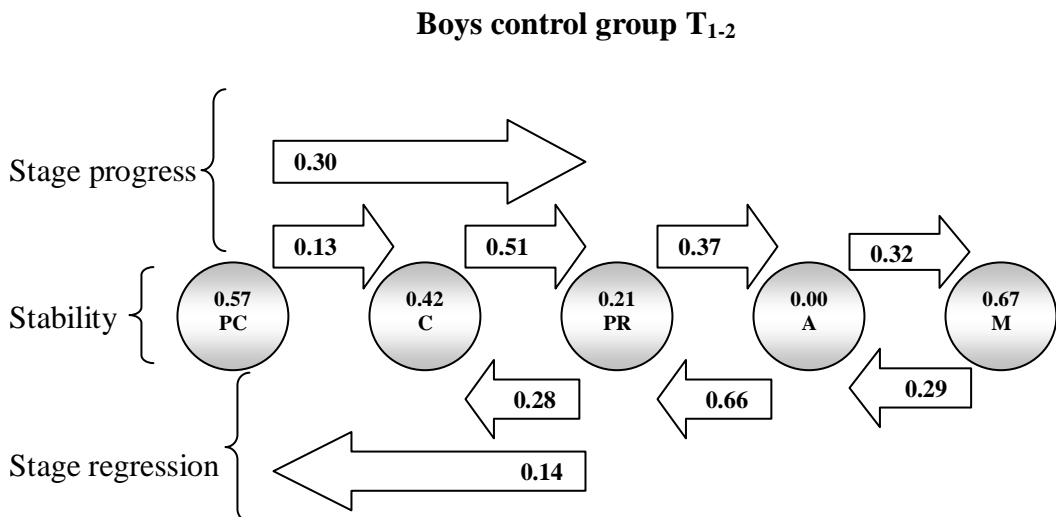
Figure 11.8. Transition probabilities of boys (≥0.10) among the control group pre- and post-intervention

The pre-post-intervention comparison of the transition probabilities of boys led to the following conclusions (see: figures 11.7 and 11.8): In the less active stage (PC) the intervention group showed a strong tendency to progress one, two or three stages (63% in total) compared to a lesser tendency by the control group (43%) to progress one or two stages. In the second "inactive" stage (C) both groups showed a similar tendency to progress (56% vs. 51%). In PR the intervention group seemed to have a stronger tendency to progress (65% vs. 37%), while the control group also tended to regress (42%) one or two stages. In the next two "active" stages (A and M) the intervention group showed much better stability rates in contrast to a tendency by the control group to regress. To conclude, comparison of boys between the two groups pre-post intervention revealed very encouraging results in favour of the intervention group. One general conclusion might be that the intervention could "mobilise" more of the male participants from the less active stages to progress while stabilising more of those in the active stages. Finally, it did not seem to have led boys to regress, as opposed to the control group in which there were considerable regression tendencies.

Boys intervention group T$_{2\text{-}3}$

Figure 11.9. Transition probabilities of boys (≥0.10) among the intervention group post-intervention and one year after

Boys control group T$_{2\text{-}3}$

Figure 11.10. Transition probabilities of boys (≥0.10) among the control group post-intervention and one year after

The comparison of the transition probabilities for boys between the intervention and control group just after the intervention and one year after led to the following conclusions (see: figures 11.9 and 11.10): In the less active stage (PC) the control group

showed a slightly higher tendency to progress (84% vs. 75%). In the second "inactive" stage (C) the control group was slightly less stable (73% vs. 85%) but also showed a tendency to progress compared to the opposite trend by the intervention group. In PR both groups were totally (100%) unstable mostly towards regression. In A both groups were also very unstable with the intervention group tending to regress while the control group showed mixed tendencies. Finally, in M both groups were quite stable (65% and 70%) but also revealed medium tendencies (18% and 27%) to regress three stages to C. To conclude, comparison of boys between the two groups just after the intervention and one year after the intervention revealed quite discouraging results, especially for the intervention group. These general results were expected since the students were at their last year of school and were preparing for their final exams towards higher education. Furthermore, it seems that the mobilisation just after the intervention did not manage to be maintained one year after against the studying demands of the students' last year of schooling.

Boys intervention group T₃₋₄
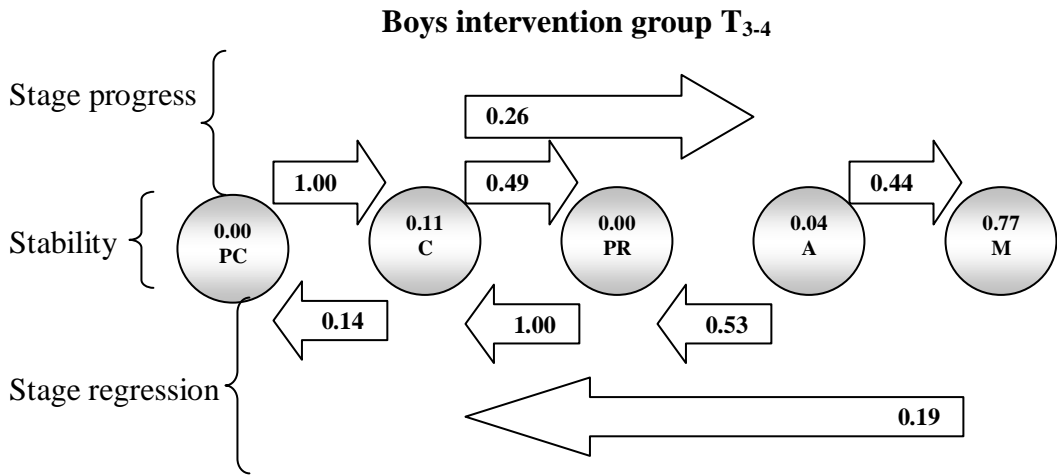
Figure 11.11. Transition probabilities of boys (≥0.10) among the intervention group

one year after and two years after the intervention

Boys control group T₃₋₄
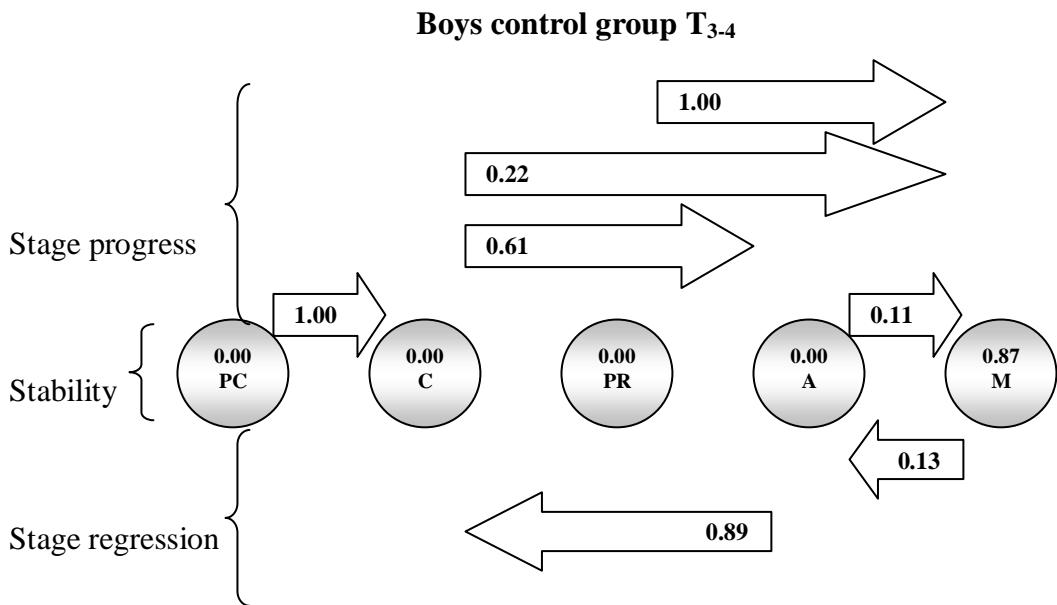
Figure 11.12. Transition probabilities of boys (≥0.10) among the control group one year

after and two years after the intervention

The comparison of the transition probabilities for boys between the intervention and control group one and two years after the intervention led to the following conclusions (see: figures 11.11 and 11.12): In the less active stage (PC) both groups showed complete tendency (100%) to progress to the next stage. In the second

"inactive" stage (C) both groups showed a similar strong tendency to progress one or two stages (73% and 75%). In PR the intervention group showed a complete tendency (100%) to regress one stage while the control group showed complete tendency (100%) to progress two stages. In A both groups showed very low stability while the control group showed a higher tendency to regress two stages (89%) compared to a lower tendency from the intervention group to regress just one stage (53%) and a considerable tendency to progress one stage (44%). Finally, in M both groups were quite stable (77% and 87%). To conclude, comparison between the two groups one and two years after the intervention revealed some similar and some mixed results. In general, transition from secondary education to higher education, employment or a different situation produced mixed results between the intervention and control group for boys.

11.4. Latent transition analysis of girls

A first-order LTA was carried out for the sub-sample of girls (n=377) using two LCs (Intervention and Control group), one manifest item (SOC) with five LSs (PC, C, PR, A, M) [Complementary characteristics of the LTA: unique response patterns = 211, maximum iterations = 5000, convergence criterion = 0.000001, missing data in response patterns = Yes, starting G^2 = 1057.149, G^2 test of model Fit = 279.953, df = 1099, G^2 test for MCAR = 225.632, df = 356]. Table 11.5 is identical for each group and across measurements because the ρs were constrained to be equal across groups and measurements. This established comparison eligibility between the intervention and control group across measurements. After the initial analysis, the 3rd and 4th LSs were reversed, a procedure called *Label Switching* (Chung *et al.*, 2004) that resulted in a better fit of the model's ρs with their interpretation in that sequence. The error

components (ρs) showed a high LC homogeneity (except for PR and A) and a good LC separation in most cases (except for A) (see: table 11.5).

Table 11.5. Girls' item-response probabilities of the SOC conditional on SOC in each measurement and across groups

IG Girls	PC^{T1}	C^{T1}	PR^{T1}	A^{T1}	M^{T1}	CG Girls	PC^{T1}	C^{T1}	PR^{T1}	A^{T1}	M^{T1}
PC	0.71	0.25	0.01		0.03	PC	0.71	0.25	0.01		0.03
C	0.05	0.95				C	0.05	0.95			
PR			0.36	0.49	0.15	PR			0.36	0.49	0.15
A		0.49		0.51		A		0.49		0.51	
M				0.11	0.89	M				0.11	0.89

Note: The above table of T_1 (1st measurement) is identical *for the other three measurements (T_2, T_3, T_4)*

The estimates of proportions of membership in each LC (γ parameters) were 0.39 for the intervention group and 0.61 for the control group. The estimates of proportions of each SOC for each group (δ parameters) are shown in table 11.6. As shown in table 11.6 comparison of the proportions of students in the two active stages indicated a small increase by the intervention group just after the intervention compared to a considerable drop by the control group. One year after the intervention the intervention group managed to retain its proportions while the control group had a small drop. Two years after the intervention both groups produced a significant increase. Thus, a significant short-term intervention effect was revealed. In the mid-term the studying demands of the last year in school and the exam preparations did not seem to affect the intervention group as much as the control group. Finally, in the long-term when the students had graduated from their school both groups managed to increase their proportions quite considerably. To conclude, the intervention effect for girls was quite positive in the short- and mid-term and neutral in the long-term.

Table 11.6. Girls' δ parameters in each stage of change across groups, the cumulative percentages of the two active stages (A and M) and in parenthesis the differences of the cumulative percentages between measurements.

Intervention Girls	Pre-interv.	Post-interv.	One year after	Two years after		Control Girls	Pre-interv.	Post-interv.	One year after	Two years after
PC	0.17	0.04	0.05	0.11		PC	0.12	0.14	0.18	0.19
C	0.15	0.17	0.43	0.04		C	0.13	0.18	0.43	0.07
PR	0.39	0.42	0.16	0.14		PR	0.23	0.33	0.12	0.16
A	0.00	0.10	0.15	0.51		A	0.15	0.06	0.08	0.31
M	0.29	0.27	0.22	0.20		M	0.36	0.29	0.19	0.27
A+M $[\Delta(T_t - T_{t-1})]$	0.29	0.37 (+0.08)	0.37 (0.00)	0.71 (+0.34)		A+M $[\Delta(T_t - T_{t-1})]$	0.51	0.35 (-0.16)	0.27 (-0.08)	0.58 (+0.31)

The transition probabilities (τs) across subsequent measurements could help to evaluate the intervention effect, as has been done for the whole sample in section 11.2. Figures 11.13 to 11.18 illustrate the most important transition probabilities (≥ 0.10) between subsequent measurements for girls.
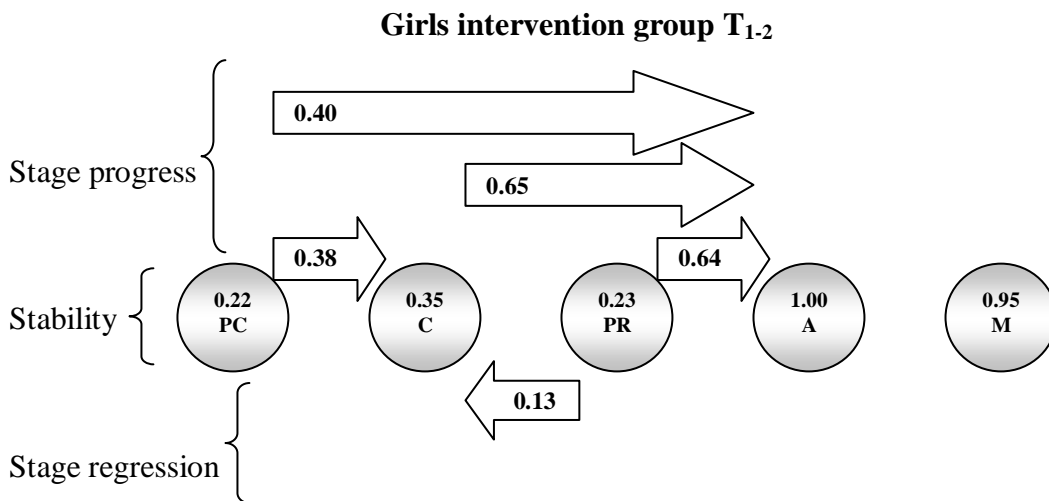
Figure 11.13. Transition probabilities of girls (≥ 0.10) among the intervention group pre- and post-intervention
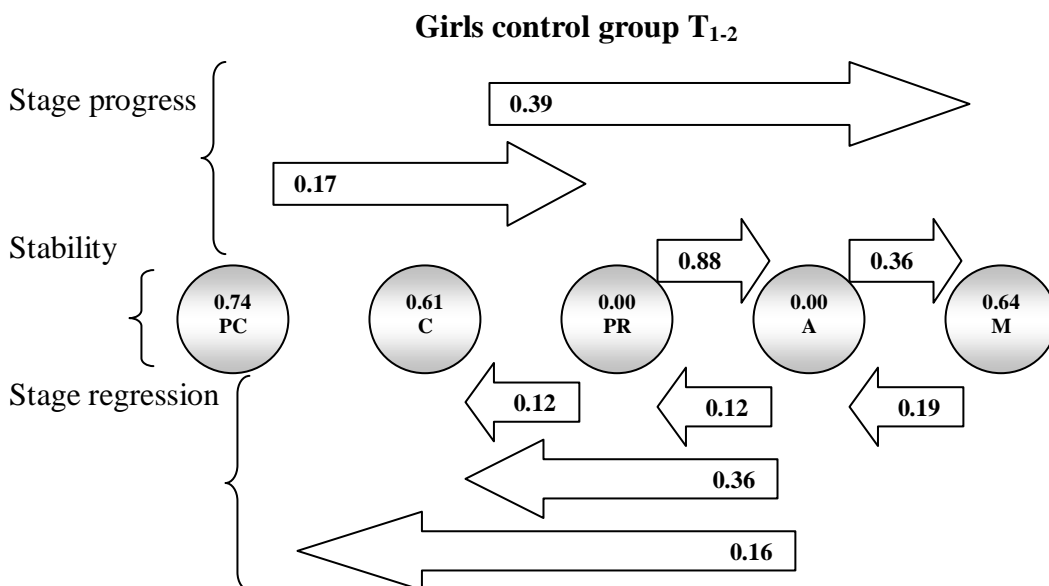
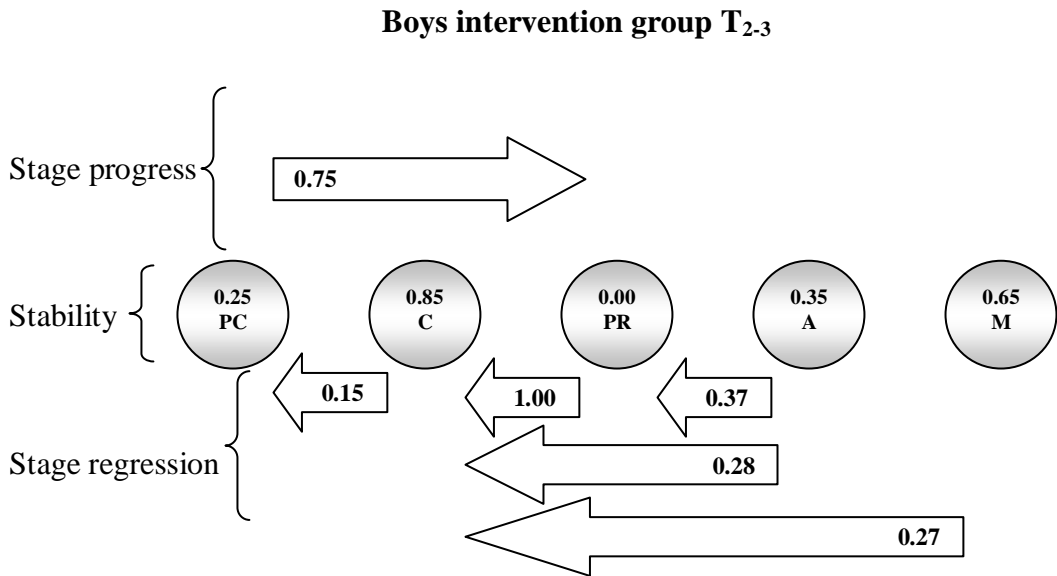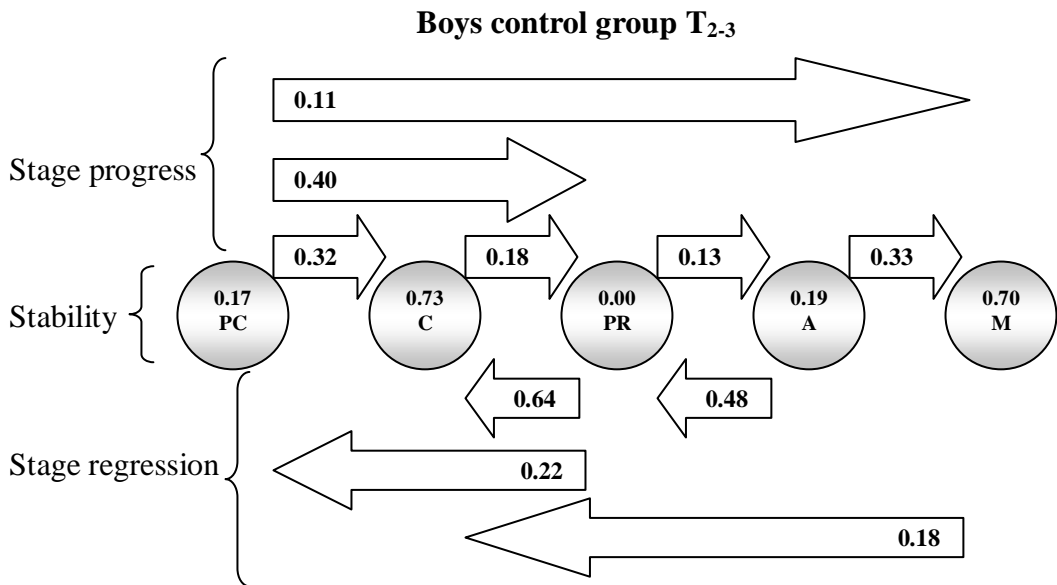**Figure 11.14.** Transition probabilities of girls (≥ 0.10) among the control group pre- and post-intervention

The pre- vs. post-intervention comparison of the transition probabilities of girls between the intervention and control group led to the following conclusions (see: figures 11.13 and 11.14): In the less active stage (PC) the intervention group showed a strong tendency to progress one or two stages (78% in total) compared to a strong (74%) resistance to change by the control group. In the second "inactive" stage (C) the intervention group showed a stronger tendency to progress two stages to PR than the control group (65% vs. 39%). In PR the intervention group showed a strong tendency to progress one stage (64%) compared to an even stronger tendency to progress one stage (88%) by the control group. In A the intervention group showed complete stability (100%) compared to mixed tendencies to progress one stage (36%) and regress one (12%), two (36%) or three stages (16%) by the control group. In M both groups showed high stability rates with the intervention group leading (95% vs. 64%). To conclude, comparison of girls between the two groups pre-post intervention revealed very encouraging results in favour of the intervention group. One general conclusion might be that in most cases the intervention could "mobilise" more of the female participants from the less active stages to progress while stabilising more of those in the active stages.

Girls intervention group T$_{2-3}$

Stage progress

0.23

Stability

| 0.73 PC | 0.99 C | 0.00 PR | 0.00 A | 0.66 M |

0.38   0.27

0.62   0.73

Stage regression

0.28
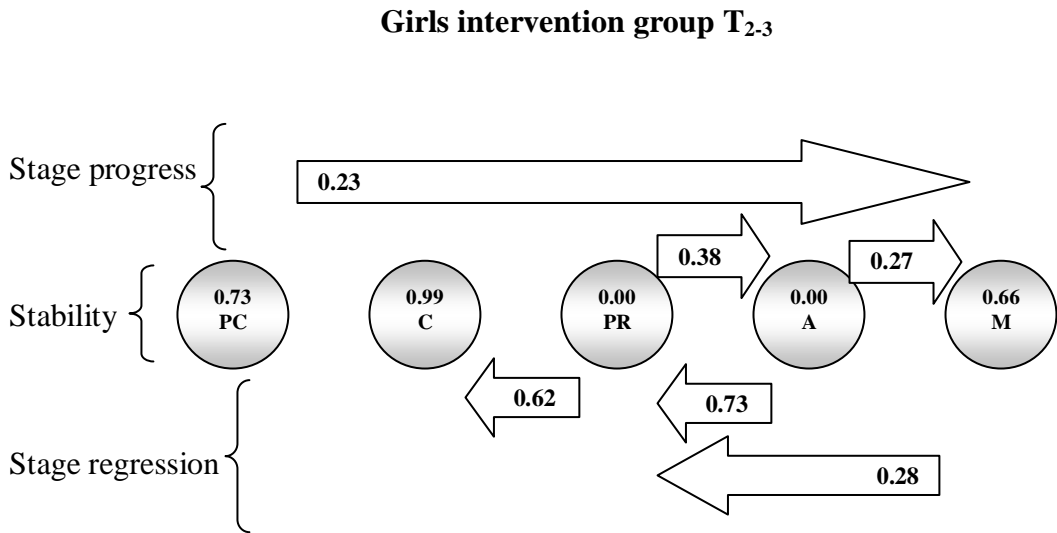
Figure 11.15. Transition probabilities of girls (≥0.10) among the intervention group post-intervention and one year after

Girls control group T$_{2-3}$

Stage progress

Stability

| 1.00 PC | 1.00 C | 0.00 PR | 0.00 A | 0.44 M |

0.24   0.96

0.62   0.12

Stage regression

0.27

0.17
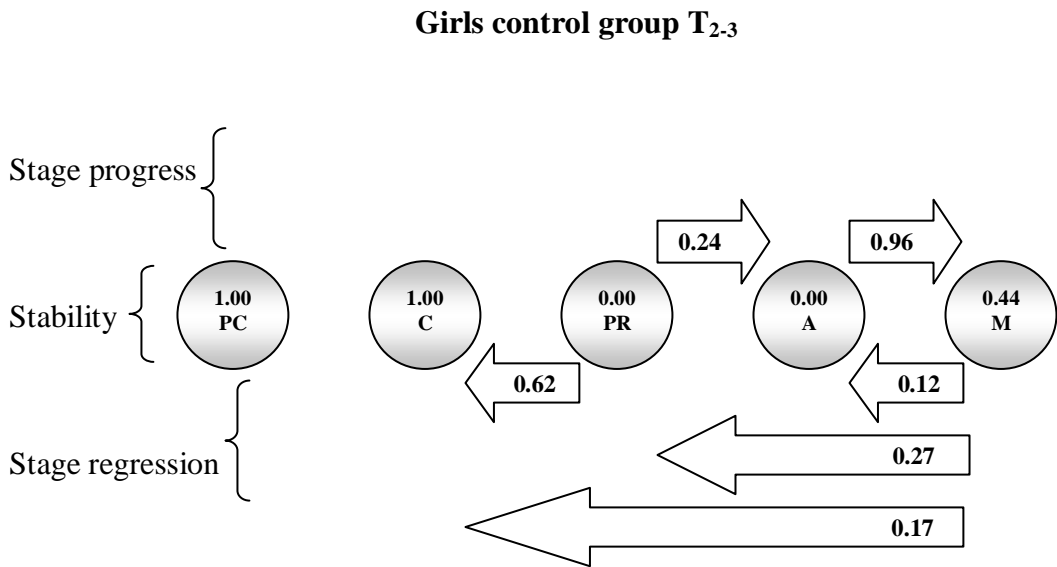
Figure 11.16. Transition probabilities of girls (≥0.10) among the control group post-intervention and one year after

The comparison of the transition probabilities between the intervention and control group just after the intervention and one year after led to the following

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conclusions (see: figures 11.15 and 11.16): In the less active stage (PC) the intervention group showed a higher tendency to progress (23% vs. 0%). In the second "inactive" stage (C) both groups were completely stable (99% and 100%). In PR both groups equally showed a higher tendency to regress than to progress. In A the control group showed almost complete tendency to progress (96%) while the intervention group showed a higher regression tendency (73% vs 27%). Finally, in M the intervention group showed higher stability and a smaller tendency to regress two stages (28%) compared to a stronger tendency by the control group (56%) to regress up to three stages. To conclude, the comparison between the two groups just after the intervention and one year after the intervention for girls revealed similar discouraging results. In the less active stages there were no strong tendencies to progress while in the more active stages stability was low. However, the intervention group seemed to show slightly better results. Negative results from both groups were expected since the students were at their last year of school and were preparing for their final exams towards higher education. Finally, it seems that the mobilisation just after the intervention did not manage to be maintained against the studying demands one year after, during the students' last year of schooling.

Girls intervention group T_{3-4}

Stage progress

0.78

Stability

| 1.00 PC | 0.07 C | 1.00 PR | 0.95 A | 0.89 M |

0.15

Stage regression
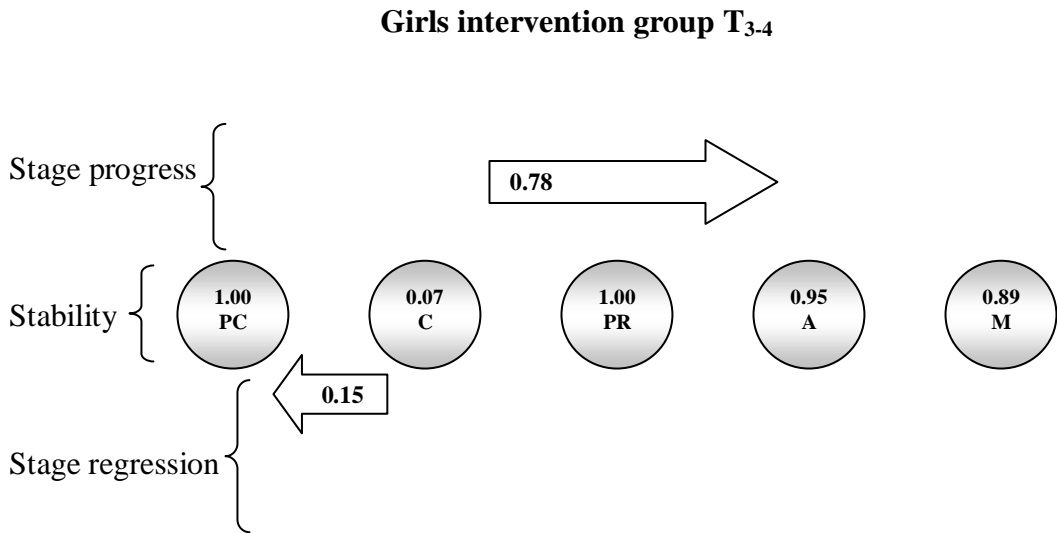
Figure 11.17. Transition probabilities of girls ($\geq$0.10) between the 3rd and 4th

measurement among the intervention group

Girls control group T_{3-4}

Stage progress

0.12

0.22   0.72   0.73   0.91

Stability

| 0.78 PC | 0.00 C | 0.00 PR | 0.00 A | 0.90 M |

0.10   0.27

0.10

Stage regression
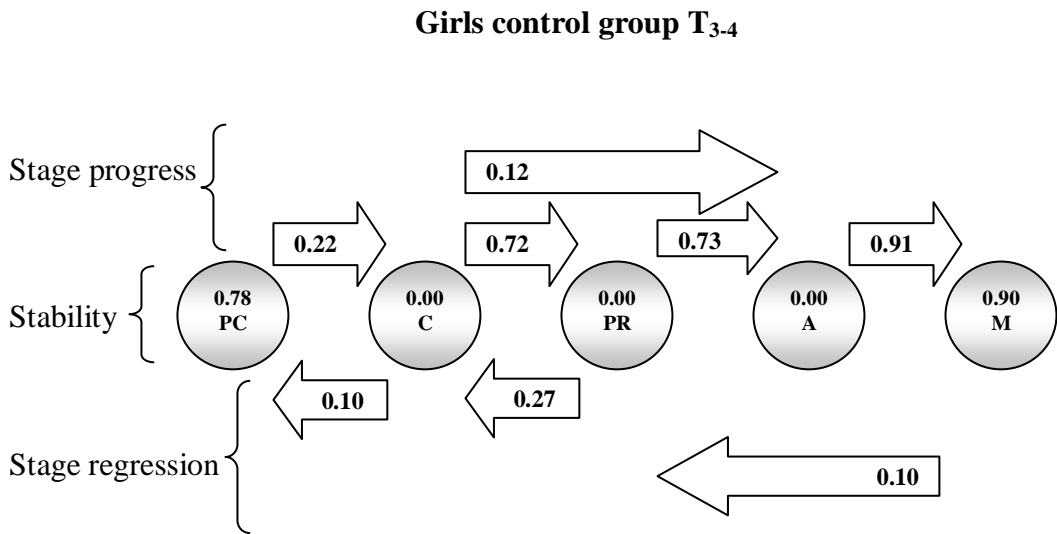
Figure 11.18. Transition probabilities of girls ($\geq$0.10) among the control group one year

after and two years after the intervention

The comparison of the τs of girls between the intervention and control group one

and two years after the intervention led to the following conclusions (see: figures 11.17

and 11.18): In the less active stage (PC) both groups showed very strong resistance to

change (100% and 78 %). In the second "inactive" stage (C) both groups showed a

similar high tendency to progress (78% and 84%). In PR the intervention group was completely stable (100%) while the control group showed a strong tendency to progress one stage (73%). In A the intervention group showed very strong stability (95%) compared to a very strong tendency to progress by the control group (91%). Finally, in M both groups were quite stable (89% and 90%). To conclude, comparison of the two groups between one and two years after the intervention revealed stability in most cases for the inervention group while the control group was more prone to progression. This transitional period incorporated the passage from secondary education to higher education, employment or a different situation.

11.5. Conclusions

The transition probabilities (τs) of the intervention and the control group were compared between the various adjacent measurements for the whole sample and for each gender separately (see: table 11.7). A positive effect was designated when the intervention group helped more students to progress to more active stages, less students to regress to less active stages or more students to maintain their active stage (in total $\geq$ 0.10). A neutral effect was designated when there were no considerable differences between the two groups and, lastly, a negative effect was acknowledged when the comparison favoured the control group.

Concerning hypothesis 1 a very positive effect was clearly evident in the short-term comparisons. Thirteen of the fifteen comparisons were positive. This was a confirmation of the intervention's success immediately after its application. Concerning hypothesis 2 a neutral effect was revealed in the mid-term with seven of the fifteen comparisons being neutral and the rest split between positive and negative. Lastly,

concerning hypothesis 3 in the long-term a neutral effect was still evident in most cases, with the majority of the remaining ones being negative. In general, the intervention seemed to be successful in the short-term with neutral effects in the mid-term and mixed neutral with negative effects in the long-term.

Table 11.7. Comparison between the intervention and control group regarding the transition probabilities (τ) in each stage between adjacent measurements.

	Pre- Post-intervention effect (Short-term)					Post- 1 year after-intervention effect (Mid-term)					1 year after- 2 years after-intervention effect (Long-term)				
	PC	C	PR	A	M	PC	C	PR	A	M	PC	C	PR	A	M
Whole sample	+	+	+	-	+	+	-	o	+	o	o	o	+	o	o
Boys	+	+	+	+	+	o	-	o	-	o	o	-	-	+	-
Girls	+	+	-	+	+	+	o	o	-	+	-	o	-	-	o

Note: (+) = a comparison that favoured the intervention group, (-) = a comparison that favoured the control group, (o) = a comparison that favoured neither group.

The short-term comparison of the proportions in the two active stages (A and M) favoured the intervention group in total and for each gender separately (see: table 11.8). In the mid-term both groups seemed to be negatively affected by the minimisation of leisure time due to studying demands. Their mid-term comparison became neutral for the total and for girls but negative for boys. Finally, in the long-term the comparison remained neutral only for girls but favoured the control group regarding the total and boys. The short-term conclusions of the LTA were confirmed by the observed results of the SOCs presented in chapter 10.

In order for the complete picture of the TTM to be outlined the next chapter will examine any intervention effects, based on observed data, regarding the rest of the model's components, namely SE, POCs, Pros and Cons.

Table 11.8. Comparison between the intervention and control group regarding the difference $[\Delta(T_t - T_{t-1})]$ of the sums

of the stages of change proportions (δs) in the two active stages (A+M) between adjacent measurements

	Post- vs. Pre-Int.	1 yr after vs. Post-Int.	2 yrs after vs. 1 yr after Int.		Post- vs. Pre-Int.	1 yr after vs. Post-Int.	2 yrs after vs. 1 yr after Int.
IG	0.66 – 0.52 = **+0.14**	0.39 -0.66 = **-0.27**	0.50 – 0.39 = **+0.11**	**CG**	0.57 – 0.62 = **-0.05**	0.36 – 0.62 = **-0.21**	0.57 – 0.36 = **+0.21**
IG Boys	0.78 – 0.57 = **+0.21**	0.44 – 0.78 = **-0.34**	0.39 – 0.44 = **-0.05**	**CG Boys**	0.59 – 0.71 = **-0.12**	0.44 – 0.59 =**-0.15**	0.77 – 0.44 = **+0.33**
IG Girls	0.29 - 0.37 = **+0.08**	0.37 – 0.37 = **0.00**	0.71 – 0.37 = **+0.34**	**CG Girls**	0.35 – 0.51 = **-0.16**	0.27 – 0.35 = **-0.08**	0.58 – 0.27 = **+0.31**

Note: Int=Intervention, IG=Intervention group, CG=Control group, yr(s)=year(s)

Chapter 12. Analysis of the observed intervention effects upon self-efficacy, processes of change and pros and cons

12.1. Introduction

One of the advantages of this thesis is the examination of the TTM in its totality (see: section 7.1). Apart from the SOCs the rest of the TTM components (SE, Pros and Cons, POC) were also examined for any intervention effects, as described in the Methods (section 8.5). Thus, hypotheses 4 to 15 will be examined here. A longitudinal approach was employed (see: section 8.5), namely, within-group differences of the means of the various TTM components (SE, Pros and Cons, POCs) across all four measurements were examined with the Friedman test. The within-group comparisons investigated separately the intervention group, the control group, the girls' intervention group, the girls' control group, the boys' intervention group and the boys' control group. Subsequently, a post hoc analysis using the Wilcoxon Signed-Rank test was used to explore differences in the means of the various TTM components in pairs of measurements (pre- vs. post-intervention, post-intervention vs. one year after, post-intervention vs. two years after and two years after vs. one year after). A Bonferroni correction was applied to the above post hoc tests to control for the family-wise error, which resulted in a corrected level of significance of $p=0.0125$. Where statistical significant differences were reported between measurements an effect size (ES) was calculated.

12.2. Within-group differences in self-efficacy

The results established any effects within the intervention or control group regarding SE.

12.2.1. Within-intervention group self-efficacy differences

The Friedman test for the intervention group across the four measurements suggested that there were significant differences in the mean SE scores [$\chi^2(3)$=8.62, p=0.04]. Figure 12.1 illustrates the within-group SE variation across measurements. Post hoc analysis revealed that SE just after the intervention was significantly higher compared to that before the intervention (3.17 vs. 2.94, z = -4.85, p = 0.00), with a small effect size (ES=0.22). One year after the intervention SE was significantly lower compared to that just after the intervention (2.95 vs. 3.17, z = -4.53, p = 0.00), with a small effect size (ES=0.22). Two years after the intervention SE was not significantly different to that just after the intervention (3.03 vs. 3.17, z = -1.13, p = 0.26). Finally, two years after the intervention SE was not significantly different to that one year after the intervention (3.03 vs. 2.95, z = -1.18, p = 0.24).
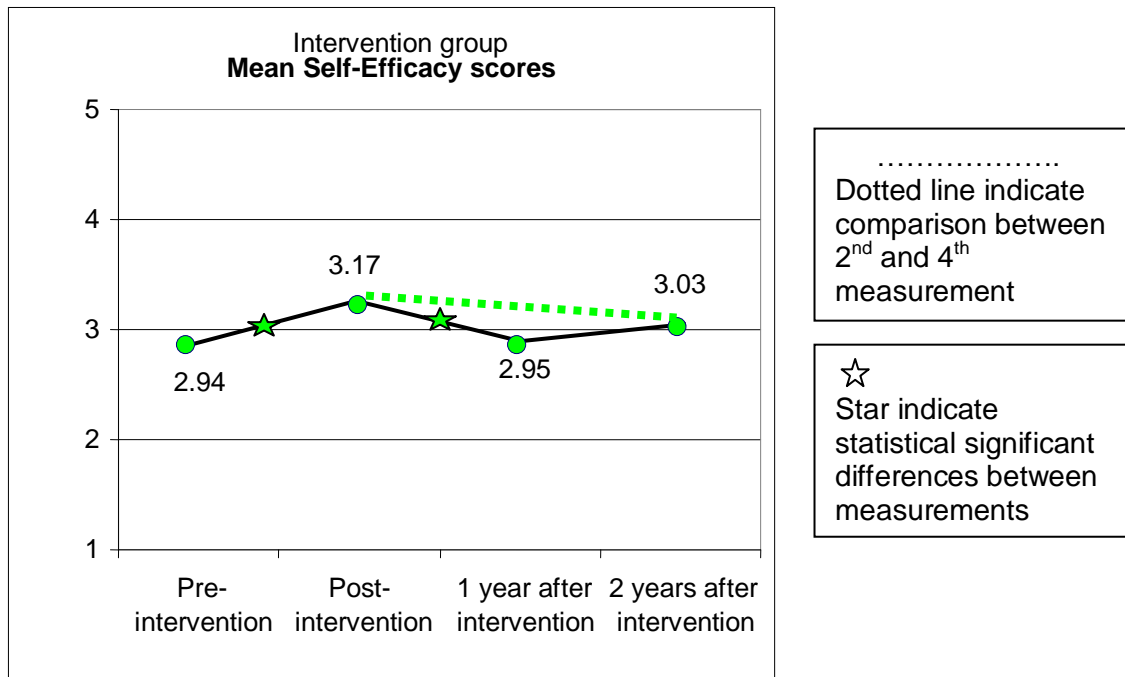
Figure 12.1. Mean self-efficacy scores of the intervention group across measurements.

12.2.2. Within-control group self-efficacy differences

Figure 12.2 illustrates the within group SE variations across measurements. The Friedman test for the control group across the four measurements suggested that there were no significant differences in the mean SE scores [$\chi^2(3)=5.38$, $p=0.15$]. However, post hoc analysis revealed that one year after the intervention SE was significantly lower compared to that just after the intervention (2.77 vs. 2.89, $z = -3.08$, $p = 0.00$), with a small effect size (ES=0.15). The remaining comparisons confirmed the non-significant differences [(2.89 vs. 2.92, $z = -0.75$, $p = 0.46$); (2.95 vs. 2.89, $z = -0.15$, $p = 0.88$); (2.95 vs. 2.77, $z = -1.91$, $p = 0.06$)].
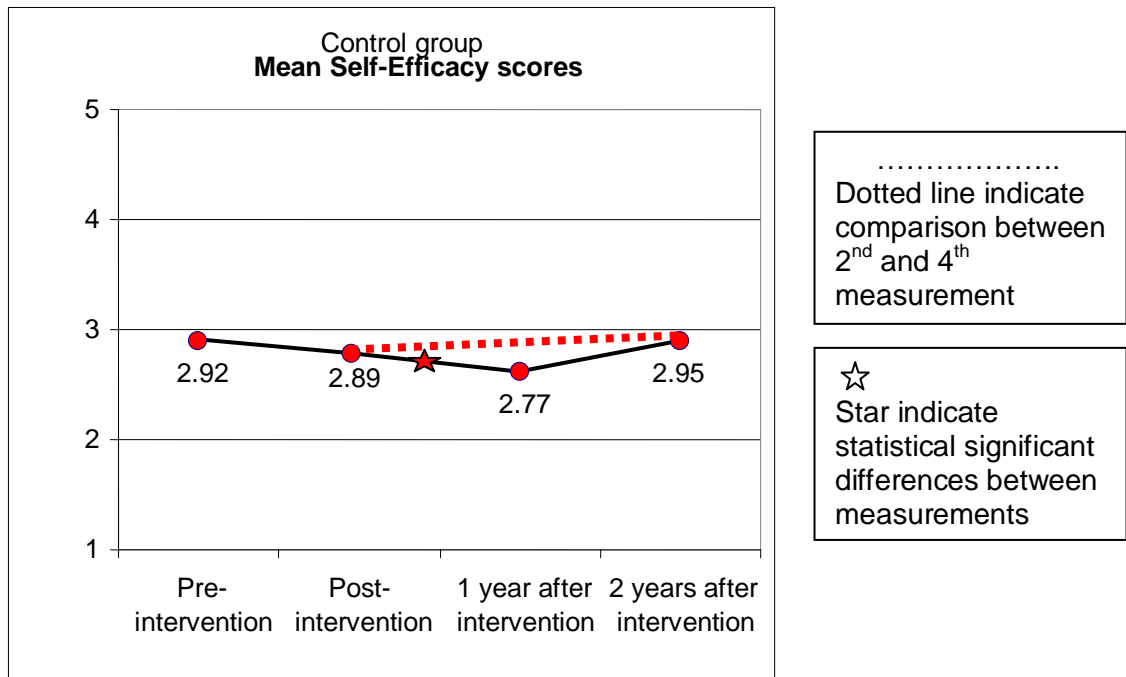
Figure 12.2. Mean self-efficacy scores of the control group across measurements.

12.2.3. Conclusions of the intervention and control group regarding self-efficacy

In the short-term the intervention group showed a significant rise in SE just after the intervention compared to a non-significant drop by the control group. In the mid-term both groups suffered a significant drop. In the long-term both groups showed non-significant changes. Thus, the intervention seemed to have a positive short-term effect upon SE (hypothesis 4), which was not maintained in the following two years (hypothesis 5 and 6).

12.3. Within-group and within-gender self-efficacy differences

The results established any effects in the intervention and control gender subgroups regarding SE.

12.3.1. Within-girls' intervention group self-efficacy differences

Figure 12.3 illustrates the within-group SE variation across measurements. The Friedman test for the girls' intervention group across the four measurements suggested that there were significant differences in mean SE scores [$\chi^2(3)=8.05$, $p=0.045$]. The Wilcoxon Signed-Rank test for the girls' intervention group showed that SE just after the intervention was significantly higher compared to that before the intervention (3.10 vs. 2.90, $z = -3.15$, $p = 0.00$), with a small effect size (ES=0.19). One year after the intervention SE was significantly lower compared to just after the intervention (2.86 vs. 3.10, $z = -4.42$, $p = 0.00$), with a small effect size (ES=0.28). The remaining comparisons produced non-significant differences [(2.91 vs. 3.10, $z = -2.04$, $p = 0.04$); (2.91 vs. 2.86, $z = -0.21$, $p = 0.83$)].
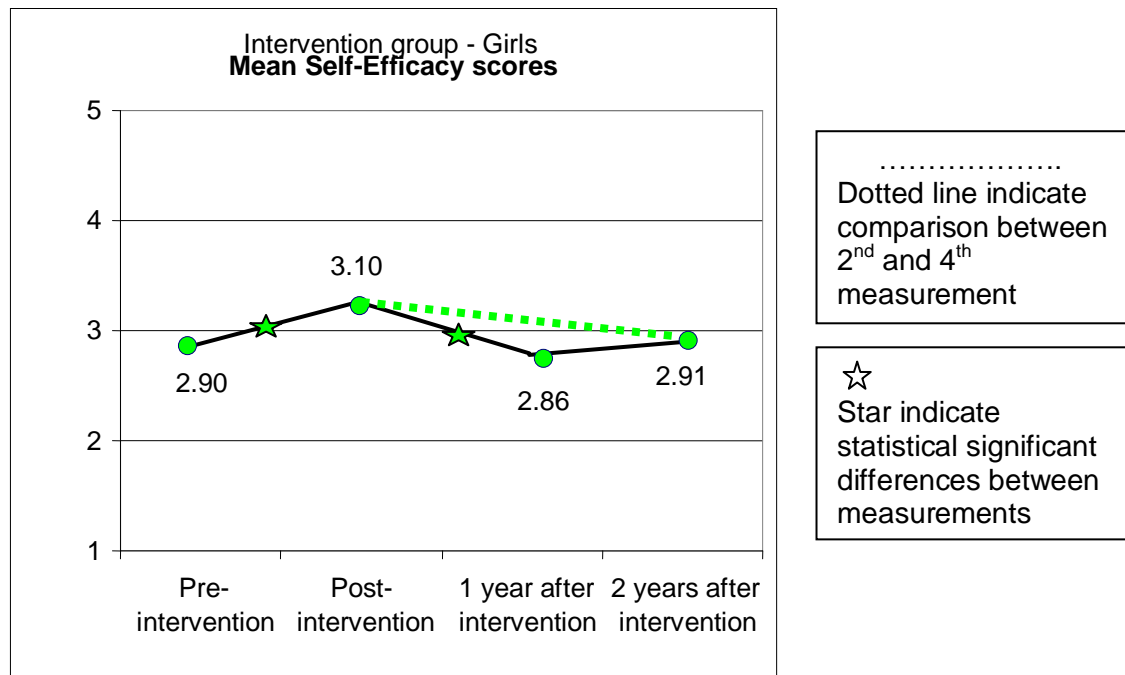
Figure 12.3. Girls' self-efficacy scores of the intervention group across measurements

12.3.2. Within-boys' intervention group Self-Efficacy differences

Figure 12.4 illustrates within-group and gender SE variations across measurements. The Friedman test for the boy's intervention group suggested that there were non-significant differences in mean SE scores [$\chi^2(3)= 3.78$, $p=0.29$]. However, post hoc analysis revealed that SE just after the intervention was significantly higher compared to that before the intervention (3.25 vs. 2.98, $z = -3.78$, $p = 0.00$), with a small effect size (ES=0.27). The remaining comparisons confirmed the non-significant differences [(3.08 vs. 3.25, $z = -2.05$, $p = 0.04$); (3.21 vs. 3.25, $z = -0.63$, $p = 0.53$); (3.21 vs. 3.08, $z = -1.67$, $p = 0.10$)].
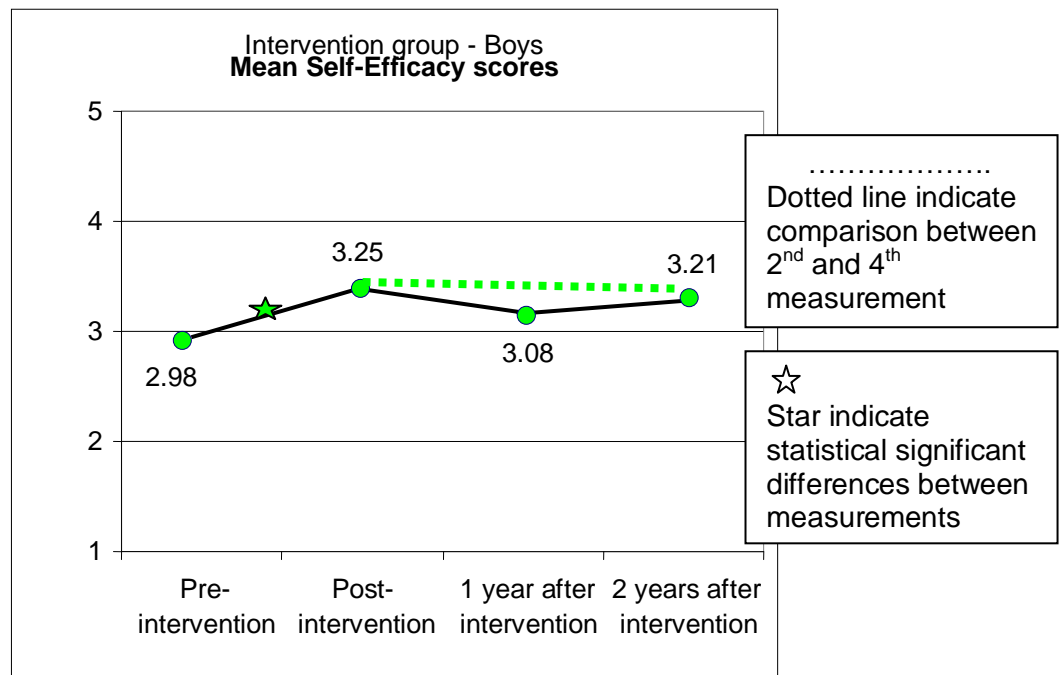
Figure 12.4. Boys' self-efficacy scores of the intervention group across measurements

12.3.3. Within-girls' control group Self-Efficacy differences

Figure 12.5 illustrates within-group and gender SE variations across measurements. The Friedman test for the girls' control group suggested that there were non-significant differences in mean SE scores [$\chi^2(3)= 5.84$, $p=0.12$]. However, post hoc analysis revealed that SE one year after the intervention was significantly lower compared to just after the intervention (2.67 vs. 2.87, $z = -2.90$, $p = 0.00$), with a small effect size (ES=0.16). The remaining comparisons confirmed the non-significant differences [(2.87 vs. 2.92, $z = -0.92$, $p = 0.36$); (2.91 vs. 2.87, $z = -0.44$, $p = 0.66$); (2.91 vs. 2.67, $z = -2.21$, $p = 0.03$)].
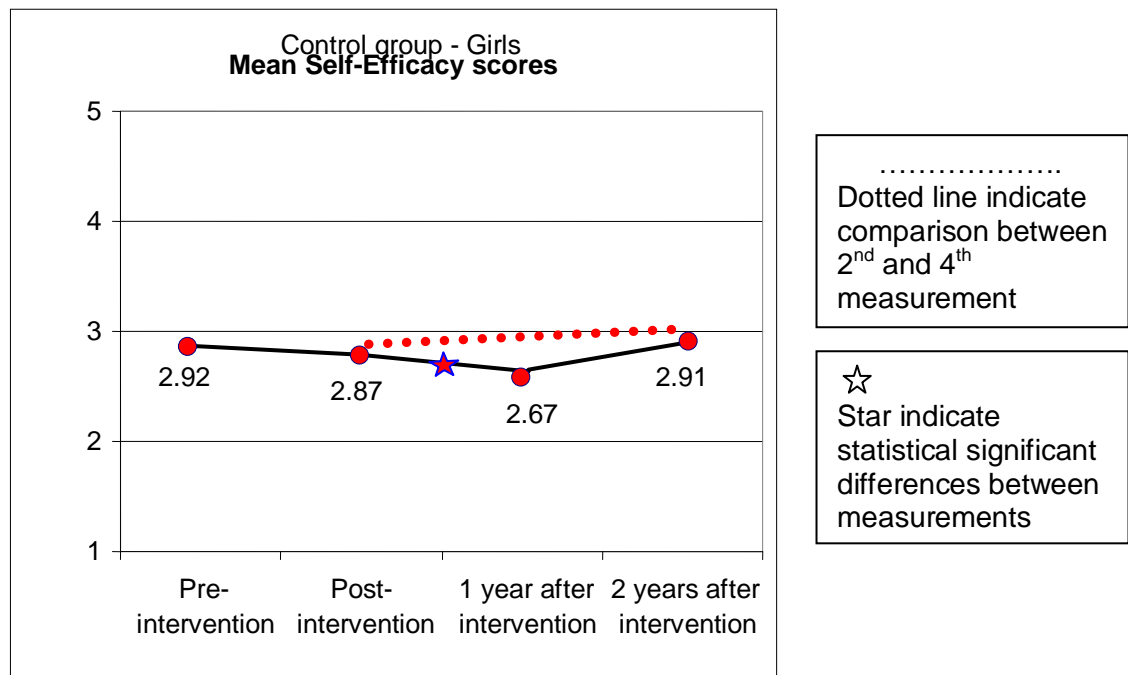
Figure 12.5. Mean self-efficacy in the control group of girls during the four

measurements

12.3.4. Within-boys' control group self-efficacy differences

Figure 12.6 illustrates within-group and gender SE variations across measurements. The Friedman test for the boys' control group suggested that there were non-significant differences in mean SE scores [$\chi^2(3)= 0.29$, $p=0.96$]. All post hoc comparisons confirmed the above suggestion [(2.93 vs. 2.92, $z = -0.07$, $p = 0.94$); (2.92 vs. 2.93, $z = -1.42$, $p = 0.16$); (3.05 vs. 2.93, $z = -0.37$, $p = 0.71$); (3.05 vs. 2.92, $z = -0.02$, $p = 0.98$)].
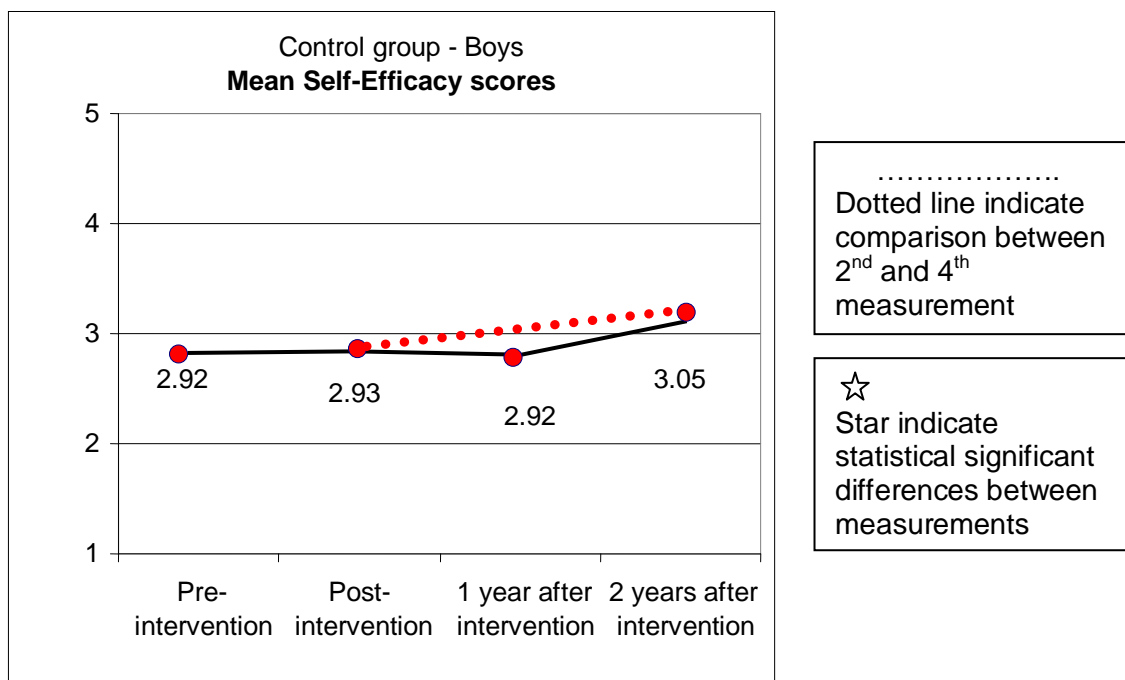
Figure 12.6. Mean self-efficacy in the control group of boys during the four

           measurements

12.3.5. Conclusions of the intervention and control gender sub-groups regarding self-efficacy

In the short-term the intervention group showed a significant rise in SE in both genders. In contrast, the control group showed no significant change in both genders. In

the mid-term only the girls suffered a significant change (decrease) in both the intervention and control group. In the long-term the intervention effects in both genders were neutralized and so were the differences in the control group.

Thus, the intervention seemed to have a positive short-term effect upon SE for both genders (hypothesis 4), which was not maintained in the following two years (hypothesis 5 and 6). These neutralizing effects in the mid- and long-term were evident in the control group, as well.

12.4. Within-group differences in the pros and cons

The results established any effects in the intervention and control group regarding the Pros and Cons.

12.4.1. Within-intervention group pros and cons differences

Figure 12.7 illustrates withingroup Pros and Cons variations across measurements. The Friedman test for the intervention group suggested that there were non-significant differences in the mean Pros scores [$\chi^2(3)= 5.22$, $p=0.16$]. However, post hoc analysis revealed that the Pros just after the intervention were significantly higher compared to before the intervention (3.96 vs. 3.81, $z = -3.06$, $p = 0.00$), with a small effect size (ES=0.14). The remaining comparisons confirmed the non-significant differences [(3.88 vs. 3.96, $z = -1.01$, $p = 0.31$); (4.01 vs. 3.96, $z = -0.50$, $p = 0.62$); (4.01 vs. 3.88, $z = -1.31$, $p = 0.19$)].

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Σφάλμα!
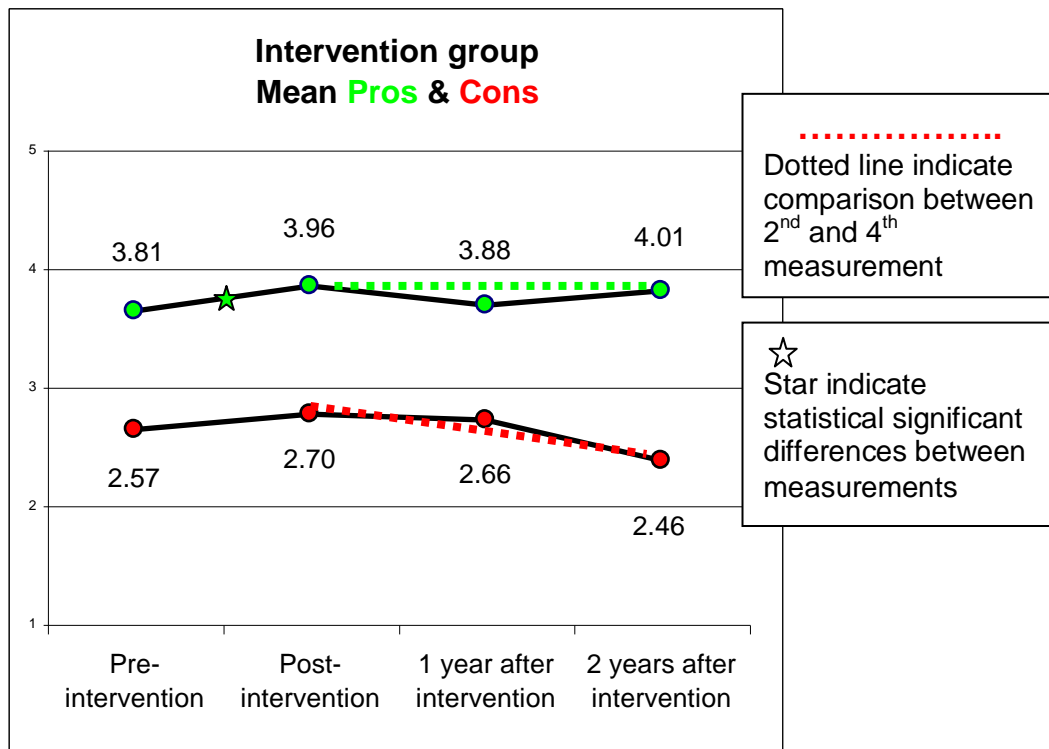
Figure 12.7. Mean pros and cons scores of the intervention group across measurements

Regarding the mean Cons scores the Friedman test for the intervention group suggested that there were non-significant differences across measurements [$\chi^2(3)= 0.88$, p=0.83]. All post hoc comparisons confirmed the non-significant differences [(2.70 vs. 2.57, z = -2.35, p = 0.02); (2.66 vs. 2.70, z = -0.53, p = 0.60); (2.46 vs. 2.70, z = -0.82, p = 0.41); (2.46 vs. 2.66, z = -0.47, p = 0.64)].

12.4.2. Within-control group pros and cons differences

Figure 12.8 illustrates within-group Pros and Cons variations across measurements. The Friedman test for the control group suggested that there were non-significant differences in the mean Pros scores [$\chi^2(3)= 6.15$, p=0.10]. However, post hoc analysis revealed that the Pros just after the intervention were significantly lower

compared to before the intervention (3.72 vs. 3.87, z = -4.84, p = 0.00), with a small effect size (ES=0.19). In the remaining comparisons the non-significant differences were confirmed [(3.68 vs. 3.72, z = -1.21, p = 0.23); (4.00 vs. 3.72, z = -1.10, p = 0.27); (4.00 vs. 3.68, z = -2.42, p = 0.015)].
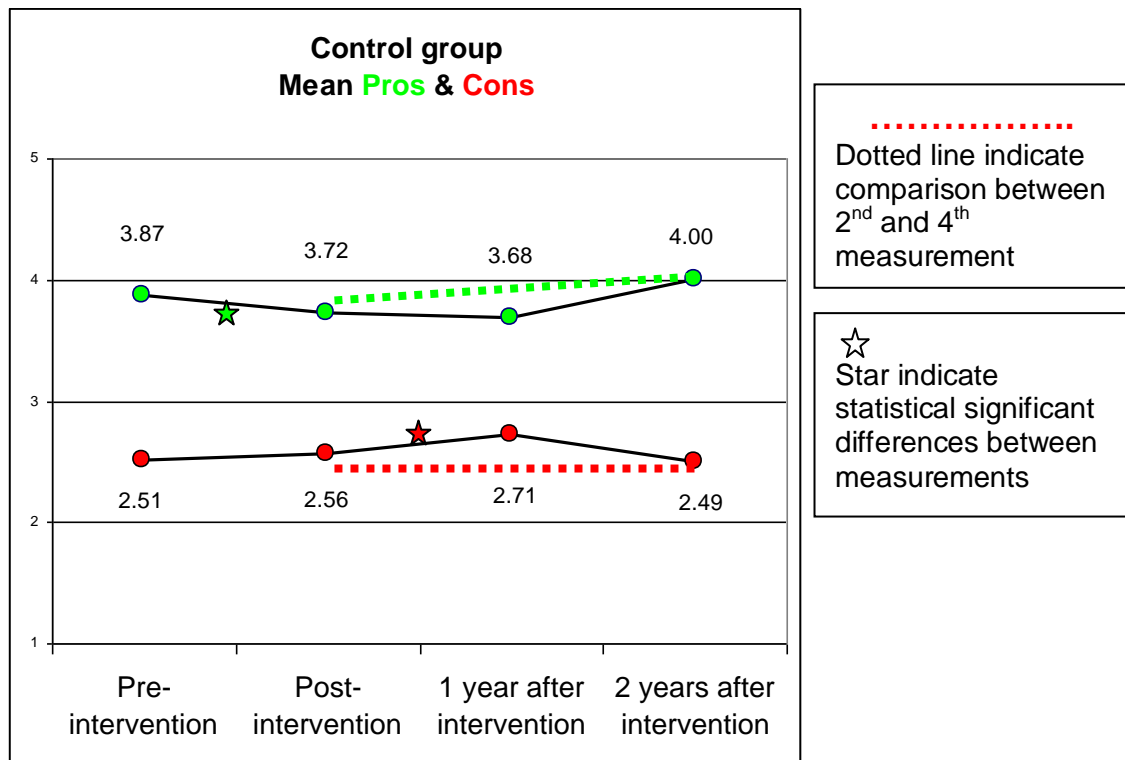
Figure 12.8. Mean pros and cons scores of the control group.

Regarding the mean Cons scores the Friedman test for the control group suggested that there were significant differences across measurements [$\chi^2(3)$= 9.51, p=0.02]. The Cons of the control group just after the intervention were not significantly different to those before the intervention (2.56 vs. 2.51, z = -2.21, p = 0.03). One year after the intervention the Cons were significantly lower compared to just after the intervention (2.71 vs. 2.56, z = -3.88, p = 0.00), with a small effect size (ES=0.17). Two years after the intervention the Cons were not significantly different compared to just after the intervention (2.49 vs. 2.56, z = -0.72, p = 0.47). Finally, the Cons two years

after the intervention were not significantly different than those one year after the intervention (2.49 vs. 2.71, $z = -1.52$, $p = 0.13$).

12.4.3. Conclusions of the intervention and control group regarding pros and cons

Regarding the Pros, the intervention group showed a significant short-term rise, which was neutralized in the mid- and long-term. The control group showed a significant drop in the short-term, which was also neutralized in the mid- and long-term. Thus, the intervention seemed to have a positive short-term effect upon the Pros (hypothesis 7), which could not be maintained in the following two years (hypotheses 8 and 9).

Regarding the Cons, the intervention group revealed non-significant differences in every comparison. The control group also showed non-significant changes in the short- and long-term and a significant rise in the mid-term. The latter is considered a negative effect. Thus, the intervention seemed to have a neutral effect in the short- and long-term (hypotheses 10 and 12) and a stabilizing effect in the mid-term (hypothesis 11).

12.5. Within-group and within-gender pros and cons differences

The results established any effects in the intervention and control gender-subgroups regarding the pros and cons.

12.5.1. Within-girls' intervention group pros and cons differences

Figure 12.9 illustrates the within-group and gender Pros variations across measurements. The Friedman test for the girls' intervention group suggested that there were no significant differences in the mean Pros across measurements [$\chi^2(3)=5.54$, $p=0.14$]. All post hoc comparisons confirmed the non-significant differences between measurements [(4.03 vs. 3.94, $z = -1.64$, $p = 0.10$); (4.02 vs. 4.03, $z = -0.18$, $p = 0.85$); (4.13 vs. 4.03, $z = -0.83$, $p = 0.41$); (4.13 vs. 4.02, $z = -1.86$, $p = 0.06$)].
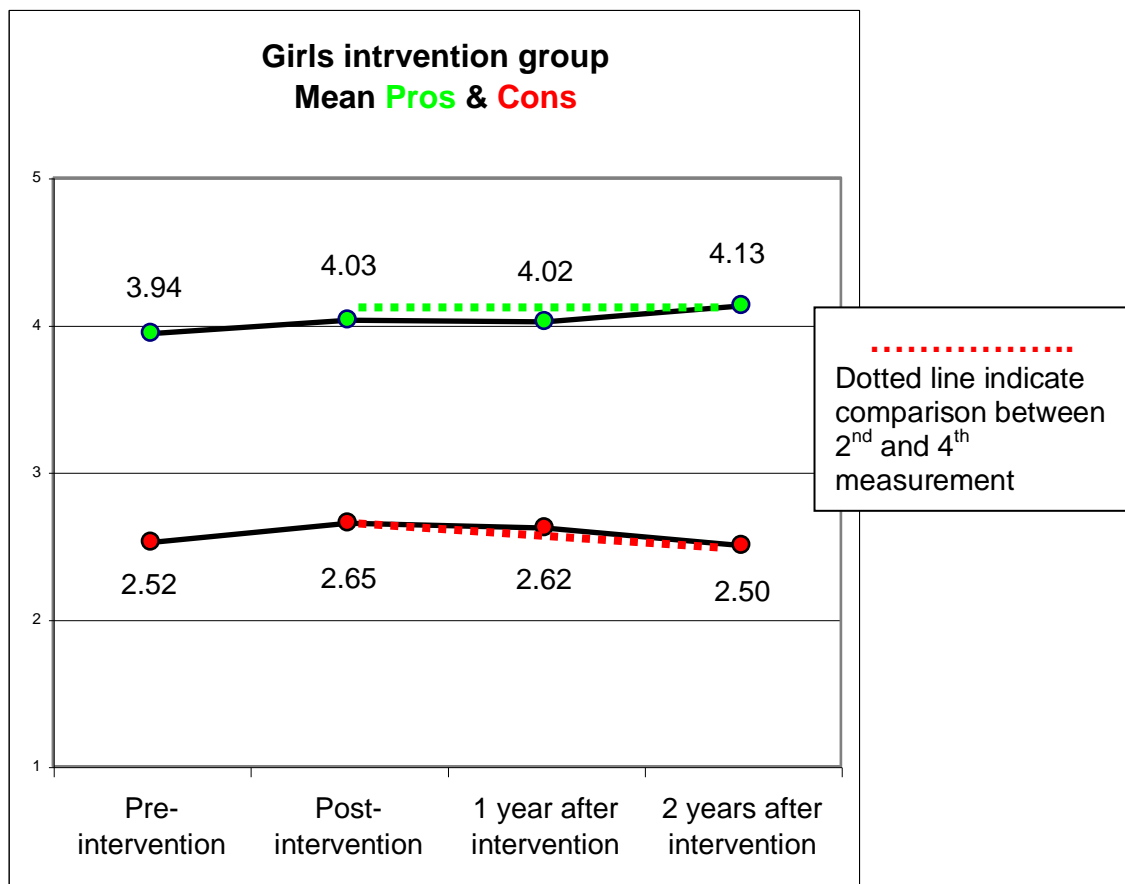
Figure 12.9. Mean pros and cons in the intervention group of girls across the four

measurement

Regarding the mean Cons scores the Friedman test for the girls' control group suggested that there were no significant differences across measurements [$\chi^2(3)$=1.85, p=0.60]. All post hoc comparisons confirmed the non-significant differences between measurements [(2.65 vs. 2.52, z = -1.45, p = 0.15); (2.62 vs. 2.65, z = -0.19, p = 0.85); (2.50 vs. 2.65, z = -1.04, p = 0.30); (2.50 vs. 2.62, z = -1.87, p = 0.06)].

12.5.2. Within-boys' intervention group pros and cons differences

Figure 12.10 illustrates the within-group and gender Pros and Cons variations across measurements. The Friedman test for the boys' intervention group suggested that there were no significant differences in the mean Pros scores across measurements [$\chi^2(3)$=0.61, p=0.89]. However, post hoc analysis revealed that the Pros just after the intervention were significantly higher compared to those before the intervention (3.85 vs. 3.64, z = -2.62, p = 0.00), with a small effect size (ES=0.19). In the remaining comparisons no significant differences were found [(3.69 vs. 3.85, z = -1.57, p = 0.12); (3.81 vs. 3.85, z = -0.19, p = 0.85); (3.81 vs. 3.69, z = -0.06, p = 0.95)].
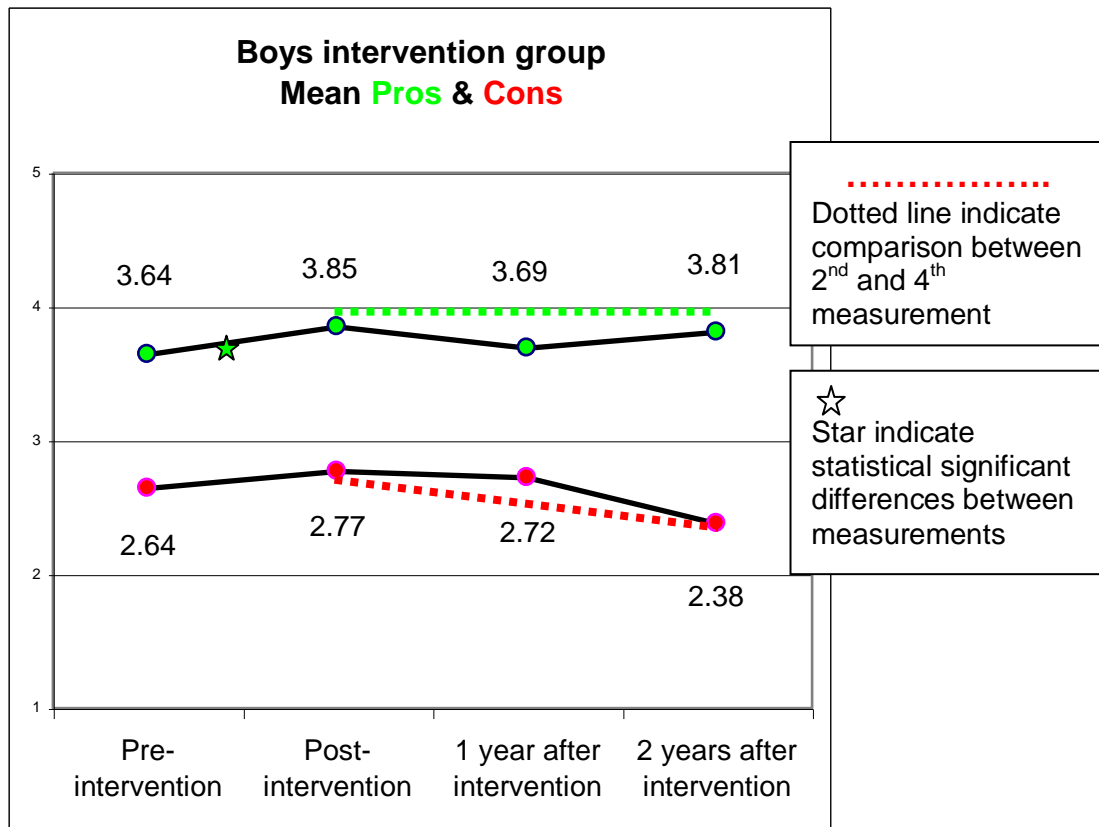
Figure 12.10. Mean pros and cons in the intervention group of boys across the four

measurements

Regarding the mean Cons scores the Friedman test for the boys' intervention group suggested that there were no significant differences in the mean Cons scores across measurements [$\chi^2(3)=3.11$, $p=0.38$]. All comparisons confirmed the above suggestion of non-significant differences between measurements [(2.77 vs. 2.64, $z = -2.27$, $p = 0.02$); (2.72 vs. 2.77, $z = -1.87$, $p = 0.06$); (2.38 vs. 2.77, $z = -0.93$, $p = 0.35$); (2.38 vs. 2.72, $z = -1.39$, $p = 0.17$)].

12.5.3. Within-girls' control group pros and cons differences

Figure 12.11 illustrates the within-group and gender Pros variations across measurements. The Friedman test for the girls' control group suggested that there were

significant differences between the mean Pros scores across measurements [$\chi^2(3)$= 11.77, p=0.01]. Post hoc analysis revealed that the Pros just after the intervention were significantly lower compared to those before the intervention (3.81 vs. 4.00, z = -3.84, p = 0.00), with a small effect size (ES=0.19). One year after the intervention the Pros were not significantly different to those just after the intervention (3.72 vs. 3.81, z = -1.94, p = 0.05). Two years after the intervention they were not significantly different to those just after the intervention (4.03 vs. 3.81, z = -0.93, p = 0.35). Finally, the Pros of girls two years after the intervention were significantly higher compared to those one year after the intervention (4.03 vs. 3.72, z = -2.92, p = 0.00), with a small effect size (ES=0.26).
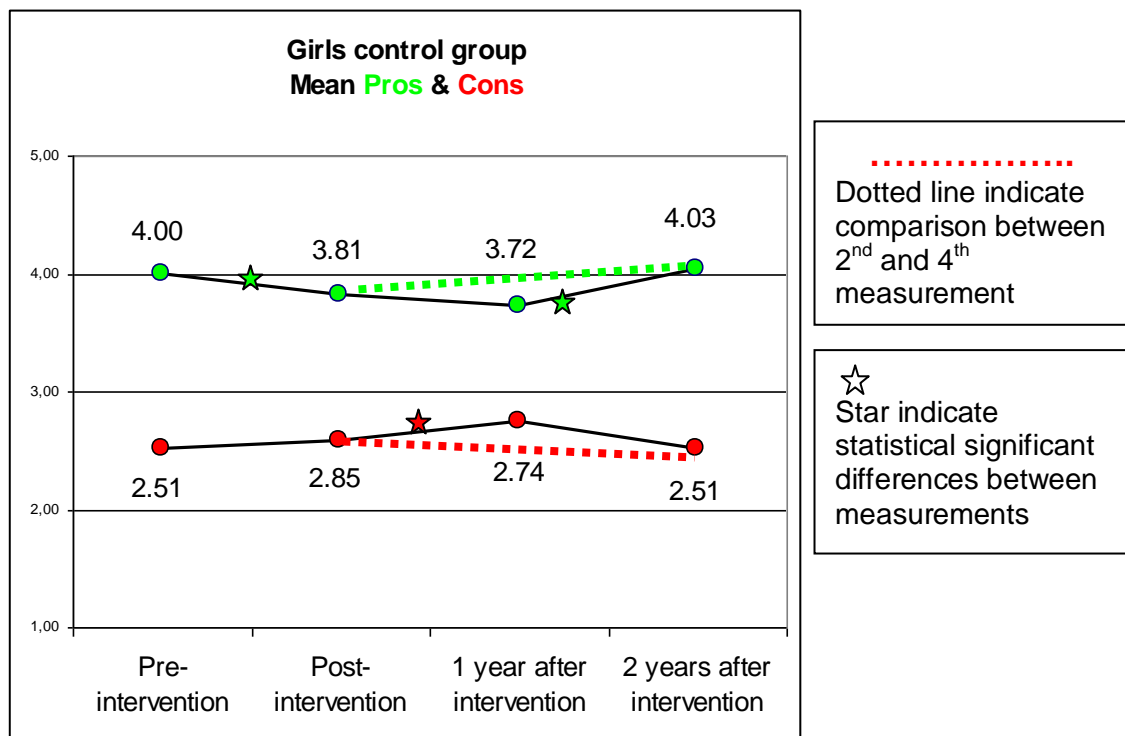
Figure 12.11. Mean pros and cons in the control group of girls across the four measurements

Regarding the mean Cons scores the Friedman test for the girls' control group suggested that there were no significant differences in the mean Cons scores across measurements [χ^2(3)= 6.03, p=0.11]. However, post hoc analysis revealed that the Cons one year after the intervention were significantly lower compared to just after the intervention (2.74 vs. 2.58, z = -2.81, p = 0.00), with a small effect (ES=0.15). The remaining comparisons confirmed the non-significant differences between these measurements [(2.58 vs. 2.51, z = -1.82, p = 0.07); (2.51 vs. 2.58, z = -0.67, p = 0.50); (2.51 vs. 2.74, z = -2.04, p = 0.04)].

12.5.4. Within-boys' control group pros and cons differences

Figure 12.12 illustrates the within-group and within-gender Pros and Cons variations across measurements. The Friedman test for the boys' control group suggested that there were non-significant differences in the mean Pros scores across measurements [χ^2(3)= 4.36, p=0.23]. All post hoc comparisons between measurements confirmed the non-significant differences [(3.58 vs. 3.68, z = -2.43, p = 0.02); (3.63 vs. 3.58, z = -0.42, p = 0.68); (3.93 vs. 3.58, z = -0.58, p = 0.56); (3.93 vs. 3.63, z = -0.35, p = 0.72)].
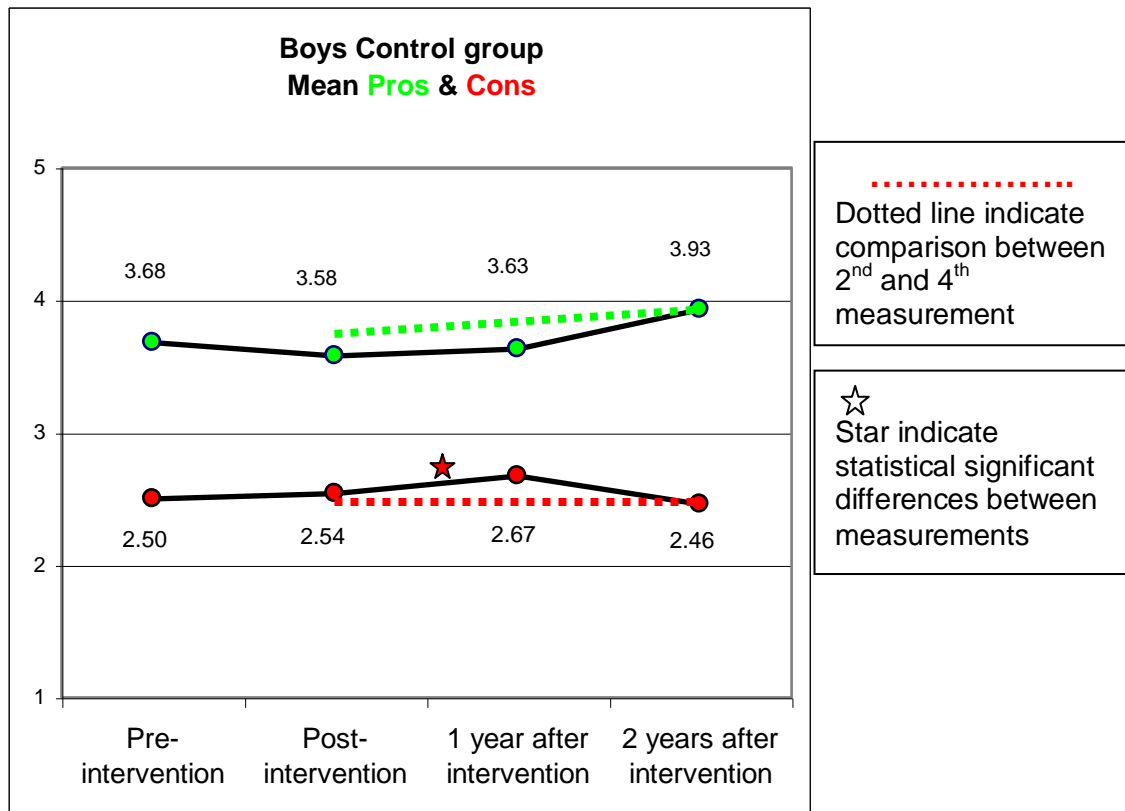
Figure 12.12. Mean pros and cons in the control group of boys across the four

measurements

Regarding the mean Cons scores the Friedman test for the boys' control group suggested that there were non-significant differences across measurements [$\chi^2(3)= 5.23$, $p=0.26$]. However, post hoc analysis revealed that the Cons one year after the intervention were significantly lower compared to just after the intervention (2.67 vs. 2.54, $z = -2.73$, $p = 0.00$), with a small effect size (ES=0.18). In the remaining comparisons the non-significant differences were confirmed [(2.54 vs. 2,50, $z = -1.24$, $p = 0.22$); (2.46 vs. 2.54, $z = -2.49$, $p = 0.013$); (2.46 vs. 2.67, $z = -0.34$, $p = 0.74$)].

12.5.5. Conclusions of the intervention and control gender sub-groups regarding pros and cons

Regarding both the Pros and Cons the girls' intervention group did not show any significant differences across all comparisons. Thus, they did not reveal negative differentiations such as those found in the control group. In particular, the Pros of the girls' control group showed a significant drop after the intervention, which was followed by a significant rise two years after the intervention, while the Cons showed a significant rise (negative effect) one year after the intervention.

Regarding the Pros of the boys' intervention group they were higher after the intervention with all other comparisons showing no significant differences. In contrast, the Pros of the boys' control group revealed non-significant differences across all comparisons.

Regarding the Cons of the boys' intervention group they did not show any significant differences across all comparisons. In contrast, the Cons of the boys' control group were higher (negative effect) one year after the intervention with all other comparisons showing no significant differences.

It can be concluded therefore that the intervention seemed to have a stabilizing comparative short-term effect on the mean Pros for the girls (hypothesis 7), and a stabilizing comparative mid-term effect on the mean Cons for the girls (hypotheses 11). Additionally, there appeared to be a positive comparative short-term effect on the boys' Pros (hypothesis 7), and a stabilizing comparative mid-term effect on the Cons (hypotheses 11).

12.6. Within-group and within-gender differences in the processes of change

The mean score of each POC was derived from the four Likert-scale questions that comprised it (see: Appendix N) except for SOL and DR that comprised of only three questions (see: section 7.13.2). Each POC was treated independently because no other clustering of POCs has been clearly established for PA (see: section 6.3.2.1). The several groups that were involved in the comparisons of the POCs scores are described in Appendix N. The comparisons established any effects in the intervention or control group. It must be mentioned that the Likert scale estimated how often the participants had used each POC.

The comparative analysis of the intervention vs. control group regarding the POCs (see: table 12.1) revealed that in the short-term the intervention group showed seven statistically significant positive differences and only three neutral among the ten POCs (hypothesis 13). In contrast, the control group showed four negative comparisons, three positive and three neutral (hypothesis 13). In the mid-term the intervention group seemed to have returned to its pre-intervention state by showing seven negative and three neutral comparisons in contrast to eight neutral and only two negative from the control group (hypothesis 14). In the long-term the two groups were equal with nine neutral and only one negative comparison (hypothesis 15).

The comparative analysis of the girls' intervention vs. control group regarding the POCs (see: table 12.2) revealed that in the short-term the intervention group showed four statistically significant positive differences and six neutral among the ten POCs (hypothesis 13). In contrast, the control group showed four negative comparisons accompanied by six neutral ones. In the mid-term the intervention group showed seven

neutral and three negative comparisons in contrast to nine neutral and only one negative from the boys control group (hypothesis 14). In the long-term the two groups were equal with ten neutral comparisons each (hypothesis 15).

The comparative analysis of the boys' intervention vs. control group regarding the ten POCs (see: table 12.3) revealed that in the short-term the intervention group showed six significant positive differences and only four neutral (hypothesis 13). In contrast, the control group showed nine neutral comparisons and only one positive. In the mid-term the intervention group seemed to have returned to its pre-intervention state by showing four negative and six neutral comparisons (hypothesis 14). In contrast, the boys' control group revealed only neutral comparisons. In the long-term the two groups were equal with nine neutral and only one negative comparison each (hypothesis 15).

To conclude, in relation to the utilisation of POCs a comparative treatment effect was evident in the short term in the intervention group and its gender-oriented subgroups (hypothesis 13). However, this trend was reversed in the mid-term (hypothesis 14) and was neutralised in the long-term (hypothesis 15).

Table 12.1. Within-group comparisons of the intervention and control group in each process of change across measurements

POCs	Intervention group comparisons				Control group comparisons			
	Pre-Post-Interv.	Post-1 yr after Interv.	1yr after-2 yrs after Interv.	Post-2 yrs after Interv.	Pre-Post-Interv.	Post-1 yr after Interv.	1yr after-2 yrs after Interv.	Post-2 yrs after Interv.
CR	+	--	o	o	o	o	o	o
DR	o	o	o	o	--	o	+	o
ER	+	o	o	o	o	o	o	o
SR	o	--	o	o	--	o	o	o
SOL	+	--	o	o	+	o	o	--
CC	+	--	o	o	--	--	o	o
HR	+	--	--	--	+	o	o	o
RM	+	o	o	o	--	o	o	o
SEL	+	--	o	o	+	--	o	o
SC	o	--	o	o	o	o	o	o
Total (+,o,--)	7,3,0	0,3,7	0,9,1	0,9,1	3,3,4	0,8,2	1,9,0	0,9,1

Note: (+) = a comparison that favours the latter measurement, (-) = a comparison that favours the former measurement,

(o) = a comparison that favours neither measurement.

Table 12.2. Within-group comparisons of the girls' intervention and control group in each process of change across measurements

POC	Girls' intervention group comparisons				Girls' control group comparisons			
	Pre-Post-Interv.	Post-1 yr after Interv.	1yr after-2 yrs after Interv.	Post-2 yrs after Interv.	Pre-Post-Interv.	Post-1 yr. after Interv.	1yr after-2 yrs after Interv.	Post-2 yrs after Interv.
CR	+	--	o	o	o	o	o	o
DR	o	o	o	o	o	o	o	o
ER	o	o	o	o	o	o	o	o
SR	+	o	o	o	--	o	o	o
SOL	+	--	o	o	o	o	o	o
CC	o	--	o	o	--	--	o	o
HR	+	o	o	o	o	o	o	o
RM	o	o	o	o	--	o	o	o
SEL	o	o	o	o	o	o	o	o
SC	o	o	o	o	--	o	o	o
Total (+, o, --)	4, 6 ,0	0, 7, 3	0, 10, 0	0, 10, 0	0, 6, 4	0, 9, 1	0, 10, 0	0, 10, 0

Note: (+) = a comparison that favours the latter measurement, (-) = a comparison that favours the former measurement,

(o) = a comparison that favours neither measurement.

Table 12.3. Within-group comparisons of the boys' intervention and control group in each process of change across measurements

POCs	Boys' intervention group comparisons				Boys' control group comparisons			
	Pre-Post-Interv.	Post-1 year after Interv.	1yr after-2 years after Interv.	Post-2 years after Interv.	Pre-Post-Interv.	Post-1 year after Interv.	1yr after-2 years after Interv.	Post-2 years after Interv.
CR	+	o	o	o	o	o	o	o
DR	o	o	o	o	o	o	o	o
ER	o	o	o	o	o	o	o	o
SR	o	o	o	o	o	o	o	o
SOL	+	o	o	o	o	o	o	o
CC	+	--	o	o	o	o	o	o
HR	+	--	o	--	+	o	--	--
RM	+	o	o	o	o	o	o	o
SEL	+	--	o	o	o	o	o	o
SC	o	--	o	o	o	o	o	o
Total (+, o, --)	4, 6, 0	0, 6, 4	0, 10, 0	0, 9, 1	1, 9, 0	0, 10, 0	0, 9, 1	0, 9, 1

Note: (+) = a comparison that favours the latter measurement, (-) = a comparison that favours

the former measurement, (o) = a comparison that favours neither measurement.

12.7. Conclusions

Regarding SE, POCs and Pros for the whole sample and for each gender a positive comparative treatment effect was evident in the short-term (hypotheses 4, 7, 13), but was not maintained in the mid- (hypotheses 5, 8, 14) and long-term (hypotheses 6, 9, 15) (see: table 12.4). However, these mid- and long-term effects should not be considered as negative but rather neutral in comparison to the control group, which also showed similar results in most cases. The exception was the Cons where there were neutral effects in the short- (hypothesis 10) and long-term (hypothesis 12) and stabilizing effects in the mid-term (hypothesis 11) in all the groups under comparison.

12.8. Internal summary of main findings

LTA findings (see: chapter 11) clearly evidenced the intervention's success immediately after its application. However, in the mid- and long-term the intervention effects were neutralised. Additionally, a pre- vs. post-intervention analysis of the observed data confirmed the short-term positive treatment effects for the SOCs (see: chapter 10). Regarding all the other TTM components (SE, Pros and Cons, POCs) a longitudinal analysis consisting of within-groups comparisons confirmed the positive comparative short-term effects of the intervention (see: chapter 12). However, these effects were reversed or neutralised in the mid-term and remained neutral in the long-term. A discussion of all the above results in order to investigate their meaning is the main concern of the next chapter.

Table 12.4. Within-group comparisons of the intervention and control group and sub-groups in each Transtheoretical model component in the short-term (S), mid-term (M) and long-term (L)

	Intervention group			Control group			Boys' intervention group			Boys' control group			Girls' intervention group			Girls' control group		
	S	M	L	S	M	L	S	M	L	S	M	L	S	M	L	S	M	L
SE	+	--	o	o	--	o	+	o	o	o	o	o	+	--	o	o	--	o
Pros	+	o	o	--	o	o	+	o	o	o	o	o	o	o	o	--	o	+
Cons	o	o	o	o	(--)	o	o	o	o	o	(--)	o	o	o	o	o	(--)	o
POCs	+	--	o	--, +, o	o	o	o, +	o, --	o	o	o	o	o, +	O, --	o	o, --	o	o

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Discussion – Conclusions - Recommendations

Chapter 13. Discussion of findings

13.1. Overview of the study

The positive influence of PA to health is well documented for a number of health aspects and in various age groups such as childhood, adolescence and adulthood (see: chapter 2). Especially for young people PA involvement is very important because it can benefit their current and long-term health and also their natural development (see: chapter 2). Any negative side- effects of PA cannot counterbalance the positive ones (see: chapter 2). Despite the well-established knowledge of PA's health benefits a worldwide epidemic of physical inactivity is growing (see: chapter 3). The adoption of an inactive lifestyle seems to originate as early as adolescence and tends to have a higher impact on girls (see: chapter 3). Particularly in Greece, the prevalence of PA is exceptionally low; in fact, it is considered one of the lowest in the European Union (see: chapter 3). As a result of low worldwide PA levels the health and longevity of people seem to be seriously affected (see: chapter 3). The starting age of this problem seems to lie in the early period of adolescence and especially during the transitional phases leading to young adulthood or adulthood, which are identified as the most problematic in terms of stability of PA (see: chapter 4).

PA interventions are means to help people adopt and maintain an active lifestyle. Successful examples should combine extended population reach with sensitivity in high-risk groups (see: chapter 5). Specifically for young people school-based interventions are highly recommended (see: chapter 5). However, there appears to be a

lack of long-term evaluation of interventions and a lack of interventions with long-term success (see: chapter 5). Finally, Greek interventions are scarce and of limited success (see: chapter 5). Well-designed interventions should be based and evaluated upon a sound theoretical framework. The TTM is a health-promotion theory suggested for intervention purposes. The main competitive advantages are its practicality and adaptability (see: chapter 6). Thus, the TTM was the theory of choice on which to base the current project. Its emergence has dichotomised scholars into those who extensively research it and those who intensively criticise it (see: chapter 6). Despite extensive research interest the TTM literature indicated a need for longitudinal research projects and interventions with long-term efficiency (see: chapter 6).

Based on the above literature review the aim of this thesis was to design and implement a practical and efficient intervention to promote PA involvement (see: chapter 7). Greek secondary students were intervened during their second-from-last school year. The choice for this age period was made on the grounds that it is an important transitional period that leads from adolescence to young adulthood. A quasi-experimental design with non-random assignment of the intervention and control group was chosen (see: chapter 7). Treatment effects were measured longitudinally during a period of three years (in the last two school years and in the year after graduation). Specifically for the examined population, the selected research instruments were shown to possess satisfactory concurrent validity compared with a combination of heart rate monitoring and activity diaries and, additionally, internal and external reliability (see: chapter 7).

The analysis of the longitudinal categorical data was a very challenging task. The method that was chosen as appropriate and advantageous to treat such data was

LTA. The derived models fitted well with the data (see: chapter 9) and the conclusions were encouraging (see: chapter 11). In the short-term there were positive intervention effects for the whole sample and for each gender separately (see: chapter 11). However, as in other studies, the mid- and long-term effects were neutral (see: chapter 11).

Additionally, a pre- post-intervention analysis of the observed data was conducted which confirmed the short-term positive treatment effects for the SOCs (see: chapter 10). Regarding all the other TTM components (SE, Pros and Cons, POCs) a longitudinal analysis consisting of within-groups comparisons confirmed the positive comparative short-term effects of the intervention (see: chapter 12). However, these effects were reversed or neutralised in the mid-term and remained neutral in the long-term (see: chapter 12).

13.2. Discussion of results

The analysis of the longitudinal categorical data was a very challenging task. The method chosen as appropriate and advantageous to treat such data was LTA. The derived models fitted well with the data and the conclusions were encouraging (see: chapter 9). In the short-term there were positive intervention effects for the whole sample and for each gender separately (see: chapter 9). However, as expected, in the mid- and long-term the effects became mixed neutral and negative (see: chapter 9).

Additionally, a pre- and post-intervention analysis of the observed data was conducted only to confirm the short-term positive treatment effects for the SOCs (see: chapter 10). Regarding all the other TTM components (SE, Pros and Cons, POCs) a longitudinal analysis consisting of within-groups comparisons confirmed the positive

comparative short-term effects of the intervention (see: chapter 12). However, these effects were reversed or neutralised in the mid- and remained neutral in the long-term.

13.2.1. Short-term intervention effects

In the short-term there were positive intervention effects for the whole sample and for each gender separately. Although it appears to be a common finding among TTM interventions it was a very encouraging fact considering the minimal resources employed in the intervention. Two interventions that successfully incorporated materials on which this study's manuals were based will now be presented:

a) Woods and colleagues (2002) implemented a six-month TTM intervention utilising a pre-post randomised control design with first-year undergraduate students in a Scottish university (n=459, mean age=19 years, 62% female). The personally addressed intervention consisted of two PA promotion packages (PAL1 and PAL2) one distributed in November and the other in the following January. The type of TTM instruments to assess SOCs (Marcus *et al.*, 1992d; Loughlan & Mutrie, 1995) and POCs (Marcus *et al.*, 1992c; Nigg & Courneya, 1998) was similar to the current study, which makes comparisons of results more appropriate. Additionally, both studies targeted young people in their transitional phase from late adolescence to young adulthood. However, a key difference was the implementation of Woods's intervention after school graduation in a university setting, which limited its reach only to those who attended higher education. Another shortcoming of this study was that participants were only included if initially staged in PC or C, and thus, it did not assess those in the other three SOCs. Post-intervention a significantly greater proportion of the intervention students (80% vs. 68%) reported progressing through the SOCs continuum

[χ^2(1, n=223) = 4243, $p<0.05$]. Thus, a similar intervention to the current one proved effective in the short-term in helping sedentary university students to progress through the SOCs continuum.

b) *Project Active* (Kohl *et al.*, 1998; Dunn *et al.*, 1999) compared a lifestyle with an exercise prescription PA intervention in sedentary healthy adults. Both interventions were delivered in two phases, the first six months in an intensive fashion and the other 18 months in a more regular fashion. Both phases were evaluated immediately after their end, so both measurements should be considered short-term. The lifestyle intervention incorporated the same TTM manuals as the current study from the beginning while the structured exercise approach only after the initial intensive phase. Both groups significantly increased PA levels during the first six and 24 months of intervention.

Spencer and co-workers (2006) concluded that the majority of well-designed stage-matched interventions offered at least short-term positive effects. Moreover, in a comprehensive review of 16 TTM-based PA promotion interventions Adams and White (2003) concluded that the majority of them (73%) revealed significant intervention effects in the short term ($\leq$6 months). Actually, their results were compared to the control conditions, usually another type of intervention. In absolute terms, 100% of the interventions showed significant positive changes in the short-term. Furthermore, a recent TTM review (Hutchison *et al.*, 2009) reported significant short-term effects in 75% of the interventions (stage progression and/or PA levels).

The above studies indicate that TTM-based PA interventions can be considered effective in the short-term and this was confirmed by the current study.

13.2.2. Long-term intervention effects

According to Adams and White (2003) the time frame of long-term effects should be six months or more, which reflects the time frame utilised in the definitions of PC, C, A and M. The same criterion was applied by Hutchison and colleagues (2009) in a recent review of TTM interventions. In the present study, to distinguish between the third and fourth measurement's results, the former were addressed as mid-term and the latter as long-term. In the mid- and long-term in the present study the intervention effects became neutral, for the whole sample and for each gender separately, which is a common finding in the field (see: section 5.5). The review of Adams and White (2003) revealed that only 29% of the reviewed TTM-based PA interventions were significantly effective in the long-term (>6 months) compared to the control conditions. However, in absolute terms 71% of the interventions showed significant positive changes in the long-term. Furthermore, Hutchison and colleagues (2009) reported significant long-term effects in 25% of the TTM interventions (stage progression and/or PA levels). Riemsma and co-workers (2002), in their review of seven RCTs utilising the SOCs model with PA, concluded that there was an inability to sustain any positive effects beyond a three-month time frame. One proposed explanation for the long-term ineffectiveness of PA interventions has been stated by Kremers and colleagues (2007). They argued that the majority of interventions target the individual so the remaining unaltered social and environmental factors tend to draw individuals back to their original dispositions. Apart from the environmental influence the inherent weakness of low PA tracking over long periods of time (Malina, 1996) cannot be underestimated.

Is long-term PA intervention efficacy realistic or is it a chimera? There is a biological tendency to be inactive which is experimentally established by animal studies

(see: chapter 3). Thus, entropy seems to apply in the animal kingdom, as well, with a tendency to preserve energy reserves rather than spending them. The above is illustrative of the difficulty in achieving long-term PA effects. The two following examples highlight the challenging nature of this issue. *Project Active Teens* (Dale *et al.*, 1998; Dale & Corbin, 2000) altered part of the PE curriculum, as opposed to the current study that worked independently from the PE curriculum. In 22 of the 24 separate gender comparisons of moderate PA (≥5 days per week) or vigorous PA (≥3 times per week) no significant between-group differences were found two, three and four years after the intervention. Additionally, the *Physically Active for Life* (PAL) study (Pinto, Goldstein, DePue & Milan, 1998; Goldstein et al., 1999; Pinto, Lynn, Marcus, DePue & Goldstein, 2001) used a slightly enhanced research and intervention design to the PACE studies mentioned previously and targeted patients over 50 years. After one and a half months significantly more intervention patients were in the PR or A stage (89% vs. 74%, $p<0.001$) but this trend was then reversed and ultimately neutralised after 8 months (79% vs. 88%, $p<0.07$). Additionally, no significant between-group differences were found in the proportions of active participants in either measurement (at least 30 minutes of moderate exercise on five days or more days per week or at least 20 minutes of vigorous exercise on three or more days per week).

Are there examples of effective PA interventions in the long-term? The *Trois Rivieres Study* was an intensive in frequency and extensive in duration quasi-experimental intervention in primary school children (Trudeau *et al.*, 1998). The long-term results showed no between-group differences in the percentages of those who did not exercise. On the other hand, females in the intervention group exercised more frequently with higher intensity in the long-term. Thus, this intervention study provided only partial long-term success highlighting the difficulty in attaining it despite the high

impact of the intervention. The *Child and Adolescent Trial for Cardiovascular Health (CATCH)* study was a multi-component educational, behavioural and environmental school-based intervention emphasising non-competitive types of PE. It was delivered in 3,714 US middle-school elementary students that were randomised by school to the intervention or control group. In the short-term it managed to increase the average time devoted to MVPA, both within PE classes and out-of-school (Luepker, Perry, McKinlay, Nader, Parcel, Stone, Webber, Elder, Feldman, Johnson, Kelder & Wu, 1996; McKenzie, Nader, Strikmiller, Yang, Stone, Perry, Taylor, Epping, Feldman, Luepker & Kelder, 1996). The 3-year follow-up revealed a long-term sustainability of the short-term effects although they were reduced (Nader, Stone, Lytle, Perry, Osganian, Kelder, Webber, Elder, Montgomery, Feldman, Wu, Johnson, Parcel & Luepker, 1999). Furthermore, the *Change of Heart* study (Hilton, Doherty, Kendrick, Kerry, Rink & Steptoe, 1999; Steptoe, Doherty, Rink, Kerry, Kendrick & Hilton, 1999 ; Steptoe, Kerry, Rink & Hilton, 2001) was a multi-component UK intervention that addressed three modifiable CVD risk factors namely, sedentary lifestyle, high-fat diet and smoking. Trained nurses delivered TTM-based counselling as opposed to ordinary counselling. The intervention proved successful both in the short-term (four months) and long-term (12 months). The probability of having moved to the two active stages was 1.89 in favour of the intervention group (95% CI=1.07-3.36) after four months and 1.68 (95% CI=1.08-2.61) after 12 months. These results highlighted the superiority of TTM counselling. Finally, The *Oslo Youth* study (Klepp, Oygard, Tell & Vellar, 1994) involved elementary and junior high school students in Norway (n=570) participating in a health education programme for nine months. A surprising finding was that although no statistical significant differences between the intervention and control group were found pre- or post-intervention, strangely they became evident in a 12-year follow-up. During adulthood (mean age=25 years) more of the intervention group

exercised at least twice per week (49% vs. 40%, *p*=0.01) when adjusted for baseline values. However, the authors stated that this conclusion should be treated with caution and did not provide any explanation. Thus, there appear to be examples of successful interventions in the long-term, but they are not in the majority.

13.2.3. Intervention effects across genders

Calfas and colleagues (2000) stressed the importance of analysing intervention results by gender to produce meaningful conclusions but also because of the lack of this kind of analysis in most studies. Furthermore, the meta-analysis of Marshall and Biddle (2001) identified a very limited number of TTM studies examining gender differences. Each gender was separately analysed in the current study, and as seen in chapter 11, it was successful in the short-term for both genders although its impact was nullified in the mid- and long-term with no gender exception. These results lead to the conclusion that the intervention worked in similar ways with both genders. A similar intervention that analysed each gender separately was *Graduate Ready for Activity Daily (GRAD)* (Calfas *et al.*, 2000), a multi-component randomised controlled intervention incorporating elements of the TTM. It was conducted with 338 senior US university students and was implemented in two phases. In the first one, students participated in "either a cognitive-behavioural intervention course [intervention group] or a knowledge-oriented general health course [control group] during the semester before graduation." (Calfas *et al.*, 2000, p.28). In the second phase (after graduation), the intervention group received peer-led phone and mail behavioural support for 18 further months. Measurements were taken at baseline and one and two years after graduation with an impressive 93% final retention rate. This exceptional rate might be attributed to the tertiary education status of the participants but also to the type of pre-graduation

intervention consisting of two courses (one for the intervention and one for the control group), which offered valuable credits to the students. This intervention produced different results for each gender. Young males intervened in their senior year in the university and one and two years after graduation showed no significant effects on PA (total energy expenditure, VPA, MPA, strength and flexibility) or mediators of PA, while women showed favourable long-term changes in the POCs but not in the other mediators of PA (enjoyment, social support, SE, benefits and barriers), and some short-term positive effects on strength. Thus, the TTM component seemed to be successful in inducing long-term changes in POCs in women, who seemed to be more receptive than men to the intervention messages.

13.3. Evaluation of the research process

A paradox highlighted by Box and colleagues (Box, Hunter, Hunter & Hunter, 1978, p.303) is that "the best time to design an experiment is after it is finished, [while] the worst time is [at] the beginning." However, a researcher has to work on a real time sequence and design the experiment when the least is known about it; based on previous knowledge and upon his/her own expertise and critical judgement. After the completion of a research project a researcher can reflect on the whole process and evaluate mistakes that were made and things that were learned. This appraisal ultimately leads to personal progress and valuable feedback for similar future attempts.

One component of the research process that is frequently underestimated, not undertaken or not presented in published articles is the pilot study. However, it should be considered a useful milestone of every research project and has to be thoroughly conducted and evaluated. In this study it was a valuable tool in the design of the

instruments and the whole process. It helped to foresee possible mistakes and difficult situations and not let them interfere with the research process. For example, it provided a first indication of the prevalence of each SOC in the selected population. This finding was utilised in the printing of appropriate numbers of manuals for each SOC. Otherwise the printing of the manuals would have to be made after the analysis of the first measurement, which might have delayed their administration. Furthermore, the pilot study tested the administration procedures and ensured that one PE hour was more than adequate to complete the TTM questionnaires, so no further interruptions to the school timetable would be needed and the research timetable could be followed accordingly. A proposed addition could have included a supplementary pilot study concerning the acceptance and use of the intervention manuals. This would have provided feedback about the appeal of manuals to the study population, although this is not common practice. One other approach to piloting might have been to test several measurement instruments, for example staging algorithms, or intervention materials and select the best ones. However, this extensive multi-testing approach could be considered as a main study on its own and is not common practice for pilot studies. Thus, to save time and effort the most appropriate measurement instruments and intervention materials were selected on the basis of their previous successful applications.

Additional elements of paramount importance are early planning and adherence to the research timetables. This is especially true for complicated research designs, such as longitudinal interventions, where a series of steps have to be followed to arrive at satisfactory conclusions. In the current study the research timetable had to take account of specific conditions that are present in every school year. These included school vacations, days that the students were unavailable and the PE schedule (two hours per week in the 2nd grade of Lyceum and one hour per week in the 3rd grade). These

conditions had to be addressed to arrange for the measurements. The involvement of seven different schools also imposed complications in programming. Since the schools were located large distances apart only one school could be measured each working day. There were also absentee students who had to be surveyed at some point, so an additional visit to each school was needed after the completion of each measurement in order to cater for these students who were initially absent. Furthermore, all measurements had to be finished in a specific time frame of one month to avoid seasonality effects. A deficiency in these elements or even an unpredicted element (for example a long strike of teachers) could have imposed considerable risks. Because of this, some extra days were assigned in advance to cater for any unexpected interferences. Despite the complications execution of the study went according to plan.

Contamination of the intervention and control group was avoided in the current study by allocating different schools to different groups. In the *Trois Rivieres Study* (Trudeau *et al.*, 1998) the students of the treatment and control group were studying in different classes but in the same school. Retrospective self-reports of the students showed that they were not adversely affected by this social mixture, but since the accuracy of this method was questionable the researchers had to create a matched cohort control group that had participated in another PA survey to check for potential cross-contamination (LaBarre, Jequier, Shephard, Lavallee & Rajic, 1994). Thus, this initial weakness of group isolation led to questionable procedures to ensure non-contamination between groups. An innovative but risky approach came from *Project Active Teens* (Dale *et al.*, 1998; Dale & Corbin, 2000). In this quasi-experimental study the control group, which received the standard PE programme, consisted of students transferred to the study school one year after the intervention. This strategy ensured non-contamination of the control group but was heavily dependent on the prospective

number of students being transferred to this school in the following year of the intervention, which was not guaranteed in any way.

There appears to be confusion in the literature about the meaning of long-term effects (>6 months). For example, in a review of international school-based interventions to prevent obesity Sharma (2006) concluded that the majority of the interventions lasted for one academic year and subsequently researchers focused on measuring long-term changes one year after baseline. However, since the common duration of interventions was one year the measurement one year after the baseline should be considered post-intervention and thus measuring short-term effects. The same confusion was apparent in *Project GRAD* (Calfas *et al.*, 2000) where a follow-up two years after baseline was claimed to measure long-term intervention effects. However, they were measuring short-term effects since the intervention had lasted a full semester in the senior year and 18 more months after graduation, summing to 24 months after baseline. Thus, the duration of mid- and long-term effects should not be counted from the beginning of the intervention but just after its completion. Otherwise, the duration of the intervention itself would be a major confounding factor in this analysis.

A strategy of consecutive measurements was employed by *Project Active Teens* (Dale *et al.*, 1998; Dale & Corbin, 2000). This study provided ninth-grade students with a programme of conceptual PE for two days per week during the whole school year incorporated in the five-day traditional sports-based PE. The students consisted of two cohorts, the 1995 cohort (n_{int}=99, n_{con}=39) was measured in grades 11 and 12 and finally 18 months after graduation from high school, while the 1996 cohort (n_{int}=151, n_{con}=44) was measured in grades 10 and 11 and finally 12 months after graduation. In the last measurement graduates were mailed their follow-up

questionnaires. In comparison to the current study, the intervention was placed two years earlier but both devoted two measurements during the last years of schooling and one shortly after graduation. Thus, both studies used similar measurement placement before and after graduation from school to investigate whether school-based interventions created long-term effects that persisted into young adulthood. However, the results of *Project Active Teens* were not encouraging one to three years after the intervention and also after graduation, which highlights the apparent difficulties in establishing long-term success in this transitional period.

In the present study the final measurement was the most difficult to implement but also the most interesting since participants had entered a very important transitional phase of their lives. Having finished the long chapter of "compulsory" or "uniform" education they started making important choices for their future. Many aspects of their lives might have altered in the mean time, namely, their residence, their family environment and also their working or studying conditions. These changes may have transformed their everyday living and consequently their PA behaviour. Additionally, change of residence and sometimes other contact details introduced a difficulty in locating them. This triggered a series of procedures to find their new contact details and send them the questionnaires. The vast majority of these participants were ultimately contacted but with considerable extra time, cost and effort.

13.4. Discussion of research hypotheses

The research hypotheses pertained to the various intervention effects. A positive SOCs effect would be justified if the intervention successfully helped more students to progress or fewer students to regress along the SOCs continuum. These behavioural and

cognitive changes represent all the efforts (successful or not) made by the individuals towards a more active lifestyle. However, each change possesses quite distinct characteristics. Each stage transition has a different epidemiological meaning and importance. The transition from an inactive stage (PC, C or PR) to an active one (A or M) highlights the achievement of the activity criterion, which distinguishes the population into active and inactive (Nigg, 2002). This type of transition is the most important since it establishes success on the health-related component of PA behaviour. Consequently, relapse from an active stage (A or M) to an inactive one (PC, C or PR) would be considered a serious negative behavioural effect since it represents a descent below the activity criterion and with it the loss of the benefits of being physically active. Progression between inactive stages (PC, C or PR) is also noteworthy because it represents a reinforcement of the intention of changing behaviour, a temporal shortfall of the intended initiation of this change and also the first attempts to reach the prescribed activity goal (Carron *et al.*, 2002). Although these delicate changes do not categorise an individual as physically active they do show the way towards this end. This sensitivity is considered a competitive advantage of the TTM since it is able to detect such subtle but important changes that would have passed unnoticed by other approaches (Nigg, 2002). Furthermore, Marshall and Biddle (2001) revealed evidence that people in the inactive stages of PC and C differed in PA levels. So progression among inactive stages might be accompanied by increased involvement in PA, which is a behavioural aspect, as well. Finally, progress through the two active stages indicates the development of a sustained active lifestyle (US Department for Health and Human Services, 1999).

13.5. Contribution to knowledge - Originality

13.5.1. Intervention efficiency

The success of an intervention depends on many factors. Logically, the more resources allocated the more chances of success. According to the intensity and frequency criteria set by the review of Hutchison and colleagues (2009) to categorise TTM interventions as brief, medium or intensive the current intervention falls in the category of "brief." They commented that interventions implemented for longer time periods and more frequentlly were more effective in the short-term than brief ones [(86%-89%) vs. 57%]. Additionally, only one medium-intensity and one intensive study reported significant long-tem effects compared to none that were brief. Thus, at least medium intensity seems to be required to enhance the probabilities of being efficient in the short- and long-term. Brief intensity seems to decrease the probabilities of success while high intensity does not seem to add any additional benefits over medium intensity.

A review of school-based PA interventions (Dobbins *et al.*, 2009) confirmed that those with longer duration had more chances to be successful. However, even interventions with a long duration are not guaranteed success. For example, the *Class of 1989* study (Kelder, Perry & Klepp, 1989; Kelder et al., 1994) was an extended US behavioural health programme lasting from the 6th to the 10th grade (baseline n=2,376). Students were annually surveyed until their graduation from high school in the 12th grade. Self-reported questionnaires measured hours of exercise per week and a PA score, which included frequency and intensity. Despite its long duration it achieved no more than partial success since it only increased activity levels in the 12th grade and

then just for girls. In contrast to the current study they did not follow-up their participants after graduation. A Greek example of an unsuccessful intensive and extended quasi-experimental intervention (Digelidis *et al.*, 2003) reported no significant differences between the intervention and control group in frequency of exercise in the short- or long-term (see: section 5.6). Thus, despite its intensity and extended duration this intervention was unsuccessful in behaviour modification. On the other hand, overuse of resources diminishes generalization potential by imposing practical and economical constraints. There is a risk and a dilemma involved. The fewer resources used, the more the risk of a possible failure. Furthermore, a dilemma arises as to how much can be gained from certain limited resources. The optimum solution is to have the least resources allocated that would ensure an effective intervention. This represents a difficult balance involving ease of application and practicality on one scale combined with efficiency on the other scale. A generally safer strategy is to apply an intervention with a very strong influence on the participants. This could be accomplished by enhancing the combined effect of frequency, duration and intensity of the intervention. This approach is likely to improve the possibilities of being effective but may create difficulties in future efforts of generalization to a wider population.

Based upon the above argumentative dialogue the philosophy behind the current intervention is crystallised in the motto "Less is more." (Browning, 1855). "Less" refers to the minimum interference in the usual lifestyles of students caused by the intervention and also the practical aspects of the implementation of the intervention. Specifically, the resources allocated by the schools (PE classes, contribution from PE teachers, involvement of school administration and students) were kept to a minimum (see: chapter 7). In fact, only two PE hours were allocated in the 2nd grade of Lyceum for the pre- and post-intervention measurements and only one in the 3rd grade. No other

school resources were used at all, apart from a short briefing before the start of the project and some five-minute administrative breaks to provide and return the participants' informed consents and to hand in the intervention manuals. The intervention was implemented during the free time of the students when they read the manuals and followed their guidance. This "self-service" approach minimized school interference as required by the Greek Ministry of Education. Thus, the current intervention could be considered successful in its attempt to interfere as little as possible with the school resources. Furthermore, the printed manuals contributed to the practicality of the intervention since they were inexpensive and easily administered.

"More", on the other hand, refers to the optimum results that can be expected from the available resources. The ultimate reward from the "The less is more" approach is that with fewer resources allocated without sacrificing efficiency it is easier to generalise to wider populations in order to impose a higher impact. The *Newcastle Exercise Project* (Harland *et al.*, 1999) compared four different TTM interventions with gradual impact levels. The first comprised of only one counselling interview, the second added 30 PA vouchers, the third intensified the counselling to six interviews and the fourth also added the vouchers to the six interviews. The least intensive interventions lasted two weeks, while the most intensive 3 months and were reviewed pre- and post-intervention, 3 months after baseline and finally one year after baseline. The short-term increases in the PA score and frequency of participation in moderate or vigorous activities (3 months after baseline) were not sustained in the 12-month follow-up regardless of the impact of the intervention. Therefore, the intensity of the intervention (number of interviews and provision of vouchers) did not seem to differentiate the results of the intervention in the short- or long-term. In such cases successful less intensive protocols are an added value to the practicality of the intervention. However,

not every time does "less" lead to "more." This is highly dependent on the quality of available resources. They should be able to impose a strong appeal to the participants in order to motivate them. The current intervention was successful in doing so in the short-term but these positive effects were neutralised in the mid- and long-term. Arguably, being aware of the complexity of human behaviour, there should be little expectation from a brief intervention in duration and frequency to accomplish "miracles." However, its practical character provides future potential for re-implementation and generalisation to wider populations.

13.5.2. Intervention innovation

In the current project there were newly developed intervention manuals. Their concept was adapted from existing manuals but they were specifically written and designed to target Greek adolescents (see: section 7.12.2). Additionally, all the content was customised according to the specific social and cultural environment of these ages in Greece. A mini survey (see: section 7.12.2) provided valuable information that confirmed the use and acceptance of the manuals by the participants and also provided some suggestions for improvements. Thus, these manuals are readily available for future attempts to influence Greek adolescent populations and also there is available feedback to cater for their future development and enhancement.

13.5.3. Specific requirements of implementing research in Greece

The Greek population is not well-known for its liking of PA. It is characterised by small proportions engaging in health-enhancing PA, especially in children, adolescents and young people (see: section 3.4). An examination of studies that have

tackled these crucial issues would provide a clearer picture for Greece. According to the first published systematic review of Greek PA and exercise-related studies that were implemented between 1993 and 2006 (Tzormpatzakis & Sleap, 2007) there was a lack of available longitudinal data, which are considered of the highest methodological quality. Moreover, an updated search of the available resources revealed only three published systematic interventions (see: section 5.7). Another serious shortcoming of the available research conducted in Greece was the lack of properly validated instruments for Greek samples. Commonly, previous instruments have been translated into Greek and used in research without prior validation in a Greek sample. These limitations were addressed in the current study by implementing a longitudinal design, by conducting a long-term investigation of the intervention effects and by specifically adapting and validating the research instruments for the studied population. The longitudinal approach was time-demanding, required extensive field work based on detailed planning but also ensured meaningful and quality data of short-, mid- and long-term treatment effects. Nevertheless, all the previously mentioned efforts would have been in vain if the psychometric characteristics of the measurement instruments were not adequate in the investigated population. Thus, the instruments were extensively tested for concurrent validity and internal and external reliability. In addition, the back-translation method was implemented to establish the desired precision and adaptability in the transformation of these instruments to be operational for a different language and country.

13.5.3.1. Cross-cultural research adaptation.

A major challenge in cross-cultural research is the adaptation of the research instruments to the specific population in terms of language, culture, lifestyle, age and

education. A simple translation of the research instruments without any further cross-cultural validation could impose considerable bias (Jones, 1987; Chen *et al.*, 2003) and could not ensure satisfactory validity and reliability for a different population. Gill (1997) noted a propensity from *'Sport Psychology'* measures to be used in different samples to those for which they were validated. In the current project the assessment measures (questionnaires) were translated, adapted and validated thoroughly and specifically for Greek adolescents. The back-translation method proved valuable for the development of the research instruments. In addition, it was not so time-consuming nor did it demand extensive resources. Furthermore, it protected the study from misconceptions of terms by the participants that might have affected its validity. Thus, these instruments were thoroughly adapted to the specific population of investigation in order to ensure their orthodox use and the back-translation method could be suggested for any future attempts to adapt questionnaires written in English in Greek samples.

13.5.3.2. Validation of instruments

The validation of the SOC questionnaire was given considerable attention since the allocation of stage membership is the most important element of the TTM assessment. Thus, its concurrent validity was justified against a combination of HRM and activity diaries. This small-scale study compared weekly PA measured by the above combination of methods with the self-report assessment of being physically active by the SOCs questionnaire. In that sense, the behavioural part of the SOCs questionnaires, namely the classification of the participants into active or inactive, was validated. In all the TTM questionnaires consistency of responses was ensured via internal reliability for a single administration and test-retest reliability for consecutive administrations (Patterson, 2000). In every examination the TTM instruments demonstrated satisfactory

levels of validity and reliability to justify their administration to the specific population with relative confidence.

13.6. Risks involved in longitudinal research

The value of longitudinal research projects is confirmed by a variety of PA reviews and reports (Adams & White, 2003; Dobbins *et al.*, 2009), however, they still remain a minority of chosen research designs (see: section 7.12). For example, a recent review of school-based PA interventions identified only two out of fourteen studies reporting outcomes other than immediately following the intervention (Dobbins *et al.*, 2009). In the same vein, less than half of the TTM interventions reviewed by Adams and White (2003) included a long-term follow-up (>6 months). There is a reluctance to engage in long-term intervention projects because there are great risks that dissuade researchers from attempting them. The most important challenge is to keep participant attrition low throughout the measurements in order to derive more power from the results. This is very important for the statistical power of the observed results. Dale and Corbin (2000, p.66) have admitted the "…difficulties in locating students following graduation [from school]…" This challenge was met in the current study by utilising practicality of measurements, persistence when participants were hard to reach or reluctant to continue and also incentives to keep participants motivated. Despite the above precautions the last measurement, after graduation, produced high attrition rates that resulted in marginal numbers of remaining participants. However, this weakness affected only the analysis of observed data. In the main analysis this issue was tackled by LTA, since one of its advantages is that it is able to deal with missing data in a satisfactory way (see: section 9.3). In particular, it does not exclude participants if they failed to conduct all measurements (as with the analysis of the observed data), but

incorporates their data in the analysis. This technique diminished the problems associated with participant attrition.

13.7. Constraints on the research project resources

There were some constraints imposed on the resources of this research project due to certain circumstances. Firstly, the Greek Ministry of Education requested the researcher to interfere as little as possible with the everyday life and curriculum of the students. This was addressed by using the minimum school resources, occupying as little as possible of the students' time and PE lessons. This requirement played a crucial role in the selection of the intervention type, which had to be easily administered and not time-consuming. Time constraints were also imposed on the implementation of the research study since a PhD requires certain deadlines to be met. However, the current project was quite extended in terms of its longitudinal measurements that occupied three years of field research.

Financial costs were also of concern. They can be divided in two general categories. The first regards the implementation of the intervention, which will also be the probable cost of a re-application of this intervention in the future. The second category of expenses concerns the assessment of the project. The first category included only one A4 page of the SOCs questionnaire for each participant in order to determine his/her initial SOC and also the production of one intervention manual for each student. Thus, in a future attempt of a similar intervention the costs would be quite low adding to its practicality. The expenses of the six remaining A4 pages of the other TTM questionnaires, the second, third and fourth measurement and the postal and telephone calls of the last measurement burdened only the evaluation of the project.

All the above types of constraints are considered common and expected in PhD research (Phillips & Pugh, 2000). Although they play a role in the research framework they should not be considered as impassable obstacles. The crucial decisions of the research study have to be undertaken with a clear vision of the study aims taking in mind all the possible obstacles and considering ways to overcome them.

13.8. Limitations of the research project

The fundamental limitations of a theory-based research project spring from the selected theory or model. In the current project the TTM has several advantages that justified its selection (see: section 6.3.5) but also imposed certain limitations (see: section 6.3.6). The most criticised aspect of the model is its inability to describe and explain behaviour fully. Certainly, there are a number of issues left unexplained by the model but considering the complexity of human behaviour this is understandable. Additionally, the fact that it is a model mainly occupied with behaviour change rather than behaviour itself makes it more suited for intervention studies like the present one that aim at changing behaviour towards a desirable path.

As discussed in section 7.5 there were certain limitations imposed by the Greek authorities and from the methodological choices made by the researcher. The most pronounced limitation was the use of self-report measures to collect PA data. Their weaknesses are well documented but on the other hand they are widely acknowledged as the most feasible method in population surveys (see: section 7.13). Specifically for this study, research-time spent in schools had to be kept to a minimum, and self-report questionnaires are less time-consuming to administer than other methods.

Unobtrusiveness was also a major challenge in terms of research bias but also as a requirement from the Greek Ministry of Education. Thus, intrusive methods such as HRM or accelerometry were excluded from the main study. However, HRM was selected as an objective method in the small-scale validation study that involved only 20 students and was conducted in only four days for each student. Additionally, the measurement after graduation excluded methods that could not be administered from a long distance since many of the participants might have moved away from their baseline residence. Due to the lack of an objective TTM measure considerable efforts were undertaken to select the most appropriate self-report instruments and validate them in as many ways as possible to minimise any potential bias. The utilised TTM questionnaires were extensive and covered every aspect of the TTM relevant to PA. This was an important element of the study in order to acquire a complete insight into the TTM, which was lacking in previous research (Carron *et al.*, 2002). Their contribution to the study should be considered valuable.

The fact that this study was the first of its kind for Greece could have brought up the question of why make a start with such a large scale study and not with a smaller one? Surely, a small project would have provided the advantage of ease of enhancement and re-implementation of several versions of it. However, longitudinal studies are difficult to be tested and re-implemented because they require several years spent in field research. Thus, this project was carefully piloted and designed in order to be able to stand the test of time (several measurements) without any adjustments. For example, the baseline samples were selected to be large enough to be able to provide sufficient numbers until the final measurement and the research instruments were carefully designed and tested in order not to require any adjustments during the consecutive measurements.

The control group type is another possible limitation for an intervention. Most interventions in the clinical field provide a standard type of treatment for the control group and compare this basic treatment with the intervention treatment. The logic behind this approach is that it is unethical to use participants who gain no personal health benefit from the study (Dunn *et al.*, 1999). On the other hand, the current intervention had no intervention for the control group. The purpose of such an approach was to reveal absolute intervention effects rather than any comparison with another kind of intervention. Examination of the absolute intervention effects should be the starting point in order to show if the intervention is successful in attaining its aims and then its comparative effects could be investigated. Otherwise, the comparative effectiveness of the intervention would be greatly affected by the quality of intervention against which it is compared. In the case of a comparison with a badly designed intervention it would be easier to show that it is effective rather than when it is compared with a well-designed one. Peterson and Aldana (1999) illustrated the above notion perfectly since they utilised both kinds of control groups. They compared a PA promoting intervention that used stage-matched printed information with a control group that was given generic PA promoting printed information and a no intervention control group. However, the study was work-based, which limited its generalisability and increased the risk of group contamination. Additionally it utilised a relatively short follow-up period of only six weeks and the final sample favoured white, female, well-educated participants, which also limited its generalisability. However, its results showed that the stage-based approach increased exercise levels significantly more than the non-staged intervention and the no-intervention control group (13% vs. 1% vs. –8%, respectively, $p<0.05$). Furthermore, it managed to show significantly more stage progression than the other two groups (33% vs. 19% vs. 14%, respectively, $p<0.05$). In this case the superiority of the intervention was evident against both types of control groups.

Chapter 14. Conclusions and recommendations

14.1. Conclusions of the current study

The literature review revealed significant evidence to establish the link between PA and health in all ages. However, the associations were weaker in young people compared to adults and this could be attributed to inherent difficulties in the measurement of PA, especially in these young ages. There were also indisputable facts about the low prevalence of PA in all ages around the world and especially in Greece. The transitional periods from adolescence to young adulthood and adulthood were identified as critical due to their low stability of PA. Thus, these age groups were in greatest need for interventions to adapt and maintain an active lifestyle. The period just before graduation from school seemed the best age group in terms of being as close as possible to the turning point of this transitional period leading to young adulthood.

The intervention was based upon the TTM, which was considered as valid for a longitudinal investigation of a PA intervention. Combined with the statistical method of LTA they proved capable of evaluating the intervention effects in detail. The current intervention was simple, proved to be effective in the short-term and had the potential to be easily generalised to a wider population.

LTA supported the superiority of the intervention group in the short-term compared to the control group regarding the SOCs (hypothesis 1). The analysis of observable descriptive data also examined this hypothesis and confirmed the above findings. These results established the successful implementation of the intervention in the short-term. However, in the mid- and long-term (hypotheses 2 and 3) these effects

became neutral or mixed (mostly neutral and negative), which showed a weakening of the original intervention effects with the passage of time. Although this was expected it is an issue that needs further attention from future research efforts.

The components of SE and the Pros seemed to have benefited in the short-term from the intervention, but as was the case with the SOCs, their mid- and long-term results were neutral (hypotheses 4 to 9). The Cons (hypotheses 10 to 12) showed a different acolouthia being neutral in the short-term, positive in the mid-term and neutral in the long term for the whole sample and for each gender separately. Lastly, the strategies and techniques of POCs (hypotheses 12 to 15) proved to benefit from the intervention in the short-term but were reversed to negative in the mid-term and then became neutral in the long-term. In general, most of the TTM components seemed to benefit, at least for the short-term, from the intervention.

14.2. Recommendations for future research and for Greek society

How can positive intervention results be maintained over time? A quantitative meta-analysis of PA interventions (Dishman & Buckworth, 1996) implied the need for sustained or repeated implementation of interventions. Additionally, Biddle and Fuchs (2009) recently concluded that, while interventions can ignite physically active behaviour, this behaviour change needs supplementary support, with booster sessions, to maintain its effects through time. A possible solution to long-term effectiveness of PA interventions might lie in this strategy of finding an appropriate time frame and re-applying the intervention (in the original version or a more compact one) in order to accumulate successive short-term effects. Short-term benefits of being physically active are able to create health-enhancing biological changes and thus should not be treated as

unworthy. Furthermore, several short-term benefits placed close together could introduce similar benefits to sustained participation. According to the principle of reversibility or detraining when an active person becomes inactive she/he does not lose all the health benefits derived from his/her fitness immediately but gradually at approximately one third of the rate of acquisition (Jensen & Fisher, 1972). Generally, an individual loses a significant part of his/her physical conditioning after 2-6 weeks of insufficient training (Godfrey, Ingham, Pedlar & Whyte, 2005). Thus, a successful re-implementation of an intervention placed inside this time period could re-activate the inactive person and improve his/her fitness from an elevated point compared to their baseline levels. This approach is in accordance with the TTM because as people move through the SOCs continuum they need different stimuli according to their current SOC. This tailored longitudinal approach adapts to the individual's needs as they change stages through time and thus, the re-application of the intervention seems logical to ignite more effective results sustained through cumulatively longer periods of time. Thus, since the short-term effects of the current intervention were very positive in spite of its simplicity, a logical recommendation might be to repeat the intervention, for example, every 4-6 months, in order for the short-term effects to last longer and accompany the adolescents through their difficult transitional phase. Hence, future studies might test the efficiency of this proposed strategy of multiple implementations and also investigate the optimum time frame for re-implementation of the intervention.

The current study emphasized the successful implementation of a TTM-based PA intervention in the critical period of late adolescence and the transition to young adulthood. This kind of easily administered, low cost intervention could be implemented on a larger scale (even nationally) and provide the students with

ammunition against sedentary lifestyles, at least for the short-term and if successively repeated possibly for a longer period.

Moreover, the recent emergence of mobile phone applications provides opportunities to develop interventions using this medium. Since young people are so accustomed to modern technology the content of the printed manuals could be inputted in an interactive application that could be easily stored in mobile phones and used by the participants in their leisure time. This format could be even more appealing to young people but research is needed to evaluate its value.

Additionally, the longitudinal data of the current study can provide a platform to examine the interaction between the various constructs of the TTM in order to discover the most efficient ones. Then, a re-design of the intervention materials according to the above conclusions would probably enhance their efficiency by adapting them to the specific population. Based on the notion that the current study could have applicability in a variety of settings another recommendation for future research efforts might be to consider implementing this type of intervention in different settings to examine its generalisability.

Finally, since the conclusions and recommendations of the current study were encouraging it could successfully serve the aim of helping young people adopt and maintain an active lifestyle and also lead the way for similar future studies by providing them with specific validated tools and added confidence to continue exploring the same field of research.

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Appendix A:

Studies of physical activity participation in Greece

A.1. Eurobarometers

The Eurobarometers are international surveys across all EU member states examining public opinion on a variety of issues since 1972. In every member state, a multi-stage, random sample is interviewed. The use of the international PA questionnaire (IPAQ) enabled estimation of the frequency, duration, and level of intensity of TPA or HEPA in the previous seven days (Craig *et al.*, 2003) and in multiple-domains such as leisure-time, at work, at home, or for transportation (Pate *et al.*, 1995; Sjöström *et al.*, 2006). The IPAQ has been tested for reliability and validity with convenience samples in a cross-national study and it was concluded that it possessed acceptable measurement properties (Craig *et al.*, 2003). Nevertheless, rather low test–retest reliability and comparability with extant national EU PA items were found when it was used for the *EUPASS* project (Rutten *et al.*, 2003), indicating possible weaknesses of the IPAQ.

A.2. Pan-EU Survey

The Pan-EU survey was conducted in 1997 among the 15 member states in the EU at that time (Kearney *et al.*, 1999a). Nationally representative samples from each member state were interviewed in a two-week period between February and April 1997 (Martinez-Gonzalez *et al.*, 2001). Seasonality was not taken into account since only spring participation was examined. The self-report instruments used to evaluate participation in leisure-time PA were the Compendium of PA and a

questionnaire designed by Paffenbarger (Martinez-Gonzalez *et al.*, 2001), with no further validation for each member state sample.

A.3. The European Prospective Investigation into Cancer and Nutrition study (EPIC)

EPIC is a prospective cohort study investigating the role of nutrition and other lifestyle and environmental factors on the aetiology of cancer and other chronic diseases (Trichopoulou *et al.*, 2001). Participants will be followed up for the rest of their lives (Riboli & Kaaks, 1997), although no longitudinal data regarding PA have been published yet. Occupational and leisure time activities were assessed for an overall evaluation of PA level. Type, intensity, and duration of PA were examined in a typical week during the previous year. The PA questionnaire was validated only for a Dutch sample (Pols *et al.*, 1997). The validation study showed that these questions were not appropriate for estimating energy expenditure on an absolute level, but the reproducibility and relative validity of ranking the participants were within acceptable ranges (Pols *et al.*, 1997). Haftenberger and co-workers (2002) conducted a cross-sectional analysis of baseline data from the *EPIC* study within the 50-64 years age group.

A.4. The European Health and Behaviour Survey (EHBS)

Conducted between 1989 and 1992 (Steptoe *et al.*, 1997), the *EHBS* was a questionnaire survey of university students from 21 European countries studying non-health-related courses. However, it should be mentioned that the samples were not

representative of the student population in each country. For example, the Greek sample was taken only from two of the 19 universities, one in Heraklion and one in Ioannina. Among other variables, the researchers asked about type and frequency but not mode of exercise over the previous two weeks. Participants were considered active if they had taken part in any exercise in the previous two weeks. In subsequent analyses, participants were divided into rare (1-4 times) and frequent ($\geq$5 times) exercisers in the previous two weeks. Data were collected over several months in each country to account for seasonal effects. Information about non-respondents (20% of the original sample) was not collected. As admitted by Steptoe and co-workers (1997, p.851), "it is possible that non-respondents had less interest in health issues...[so] the data might be biased toward more favourable attitudes to exercise". In a pilot study of 46 UK students, test-retest stability over 17 days for exercise proved mediocre, since 22% of the respondents changed categories (Wardle & Steptoe, 1991).

A.5. The International Health and Behaviour Survey (IHBS)

The *IHBS* followed-up the *EHBS* 10 years after in 13 of the original 21 participating countries (Steptoe *et al.*, 2002). However, it did not follow-up the same students and thus the data were not longitudinal. In most countries the same Universities were utilised in both surveys. However, in Greece, only one of the two universities participated in both studies. A more convenient one substituted the other in the follow-up study. This methodological anacoluthia probably has weakened the validity of the cross-sectional comparisons. As expected, health behaviours were assessed with identical questions in both studies. As with the *EHBS*, a limitation of

the survey was that students were not systematically sampled from universities across each country, so they were not representative of the student population.

A.6. The ATTICA Study

The *ATTICA* study was a health and nutrition survey carried out during 2001 and 2002 in Athens and its environs (Pitsavos *et al.*, 2003b). In most reports relating to this study, analysis was carried out for a multi-stage (city, sex, age) random sample of 3,042 participants, 50% men, aged 18-89 years, without any evidence of cardiovascular or other chronic diseases (see: table 3.2). However, in some reports the sample was filtered and several sub-samples were used (see: table 3.2). Participants were interviewed with a Greek version of a questionnaire assessing energy expenditure through frequency (times per week), duration (in minutes) and intensity (light, moderate, vigorous) of sports-related PA during a usual week (Pitsavos *et al.*, 2003b). The original English questionnaire was validated for a North American population (Pate *et al.*, 1995) but the translated version was not validated for the Greek population. Participants were considered physically active if they reported non-OPA at least once per week during the previous year. Sedentary proportions ranged greatly from 50% to 62% in various reports of the study (see: table 3.3). One proposed explanation for this fluctuation could be the different samples used by each report. However, in six reports of the same sample (n=3,042) the sedentary proportion still ranged from 50% to 59%. Additionally, in some reports the difference in gender participation is significant while in others it is not (see: table 3.3). Thus, a possible methodological inaccuracy might have caused these variations.

A.7. Other important research projects

While conducting a cross-sectional medical study (*MetS-Greece study*) Athyros and colleagues (2005) interviewed a nationally representative sample. Representation was established in relation to age, gender and type of residence. The study was carried out in 2003 and its aim was to estimate the prevalence of the metabolic syndrome in Greece. Data about work-type and LTPA were obtained with a structured interview.

Milias and co-workers (2006) carried out a telephone survey of a nationwide, random, multistage sample of the Greek population in the autumn of 2004. The main aim of this study was to evaluate the prevalence of self-reported hypercholesterolaemia (higher than normal cholesterol levels in the blood) in relation to nutritional habits. Physically active participants were defined as those who reported that they participated in a leisure exercise programme at least once a week, or that their occupation presupposed a certain level of physical fatigue.

Low levels of PA, expressed as walking in kilometres per week during leisure time and at work, were shown by Adamopoulos and co-workers (1993) in a random sample of the Athens adult population. On the contrary, a high proportion of active participants was reported in a study of male Greek army recruits (Pitsavos *et al.*, 1998). Active was defined as exercising at least three times per week for more than 45 min each time. This sector of the population showed different activity patterns compared to the general population probably because of their occupational

requirements and the lower mean age. Thus, this cohort ought not to be considered as representative of the wider population.

Finally, a Greek cross-sectional study gathered PA and exercise data through self-reported questionnaires from the full spectrum of Secondary Education (Papaioannou *et al.*, 2004). The random stratified sample consisted of 11 year-olds studying in the elementary school (n=1,734), 13 year-olds attending junior high school (n=2,151) and 16 year-olds (n=2,106) from senior high school (Lyceum). About one third of the sample was from Athens, the capital of Greece, another third from Thessaloniki the second largest city of Greece and the remainder from four Greek towns of populations around 50,000–70,000. Thus, mostly the urban student population was surveyed. Vigorous exercise was defined by intensity (HR≥120 beats/min.) and duration (≥1 hour). Given examples included basketball, football and aerobics. Regular exercise was defined as exercise occurring at least two times per week. The study focused on vigorous sports or exercise and regular vigorous exercise out of school, alone or with friends.

Appendix B:

Tracking of physical activity in several life periods

B.1. Description of tracking studies during childhood and adolescence

The *Cardiovascular Risk in Young Finns* study (*CVRYF*) is an ongoing longitudinal research project in Finland (Raitakari *et al.*, 1994; Telama *et al.*, 1994; Telama *et al.*, 1996; Telama *et al.*, 2005). The stratified random sample represented five geographical areas of the country. Participants were 9, 12, 15, and 18 years of age at baseline and were followed-up 3, 6, 9, 12, and 21 years later. In the first four longitudinal measurements PA was measured by means of a short questionnaire, which produced an index of LTPA taking into account intensity, frequency and duration of activities. However, one limitation of this study was that the questions did not clearly relate to international guidelines. Particularly, frequency did not have a categorisation of participation on most days of the week (3-5 times) and also it asked the respondents to recall only lengthy bouts of activities (at least 30 minutes). The 30-minute criterion might have underestimated participation since recent recommendations urge children and adolescents to be typically active even in shorter bouts (European Heart Health Initiative, 2001; US Department for Health and Human Services & US Department of Agriculture, 2005). Additionally, intensity of PA and LTPA were only rough estimations of usual behaviour. Telama and colleagues (1996) reported on a 12-year follow-up of the *CVRYF* study. Some methodological changes were evident compared to the four earlier measurements. In particular, PA was estimated with more up-to-date questions and so earlier data had to be recoded.

Furthermore, the simplex model was also used instead of correlation analysis in order to account for measurement error based on the reliability of the instrument (Telama *et al.*, 1996). Thus, the confidence in the findings of this report is higher compared to the two earlier ones.

In another Finnish study, Aarnio and colleagues (2002) conducted a longitudinal postal survey among 2,934 Finnish twins aged 16, 17 and 18 years. Only frequency of PA was assessed in all three measurements. The lack of measurement of more facets of PA other than frequency is a clear methodological shortcoming and also since only twins were surveyed the generalisability of this study is questionable.

McMurray and colleagues (2003) studied a representative sample of 153 North Carolina students for seven years longitudinally. Initially they were aged between 7 and 11 years. PA was assessed by a questionnaire recording type and frequency of activities, which were then multiplied by the MET of each activity to create an activity score. Another North Carolina sample of 181 students (Mean age = 10.7 years) was followed-up by Pate and colleagues (1999) in grades 5, 6 and 7. Spring after-school PA was assessed using the Previous day PA recall log.

Evidence of longitudinal tracking of adolescent PA was presented by Kelder and colleagues (1994) in a school-based CVD prevention programme involving 2,376 US students at baseline. Seven annual measurements between the 6th and the 12th grade were administered. Self-reported hours of exercise per week and an activity score estimating frequency and intensity of PA were collected. Percentile tracking

was employed both in hours of exercise per week (<1, 2-3, 4-5, >6) and activity score (low, medium, high).

A nationally representative sample of Canadians, 11-12 year-olds at baseline, was followed-up seven years later (Fortier *et al.*, 2001). PA was estimated with a questionnaire based on the Minnesota LTPA Questionnaire (Taylor *et al.*, 1978) with one-year recall period. However, this extended recall period is possible to have caused recall bias.

In the *Amsterdam Longitudinal Growth and Health Study* 181 Dutch adolescents were studied annually from 13 to 16 years of age (Van Mechelen & Kemper, 1995; Van Mechelen *et al.*, 2000) using semi-structured interviews. Weekly PA and also weekly energy expenditure in organised sports were estimated by 3-month recall.

The *Leuven Longitudinal Study on Lifestyle, Fitness and Health* (Vanreusel *et al.*, 1993; Vanreusel *et al.*, 1997) employed retrospective annual standardised interview-administered questionnaires to produce a sport participation score of hours per week. The extended recall period should be considered a possible reason for loss of accuracy of the self-reported data. Inter-age correlations were reported between the two extreme categories of those that accumulated less than an hour of sports participation per week against those with six or more hours per week.

Guerra and colleagues (2003) reported on a longitudinal research project looking at cardiovascular risk factors in 692 Portuguese children (53% girls) aged 8–

15 years. A PA questionnaire previously validated by Mota *et al.* (2002) was used. Participants reported out of school PA during the previous week performed for at least 15 minutes.

Janz *et al.* (2000) conducted a longitudinal study of 110 pre-pubertal students from Muscatine Iowa (USA) ranging in age from 7 to 12 years. They were measured every three months for five years. Seasonal variations were not examined but all four measurements during the year were averaged so yearly seasonality effect was controlled. Vigorous PA episodes of at least 20 minutes were estimated using the 3-Day Sweat Recall questionnaire. The instrument was shown to be reliable and valid compared to accelerometry (Janz *et al.*, 1995). A different procedure for estimating tracking was employed since all measurements were compared to the last one and not with the baseline measurement, as usual. In spite of the fact that this methodology cannot be considered false the usual procedure could have been employed, as well.

B.2. Description of tracking studies from childhood and adolescence into young adulthood

The *CVRYF* study revealed a wealth of information regarding tracking of PA in several time intervals. Moreover, Yang and colleagues (1999) reported a 12-year follow-up of the *CVRYF* study (n=1,395). Two Canadian studies also explored the tracking issue in this age span. Fortier and co-workers (2001) examined 7-year tracking of both energy and time expended in PA for both genders. In the second Canadian study Campbell and co-workers (2001) reassessed a sample of 153 children

and adolescents (initially aged 8 to 20 years) after 12 years. Daily energy expenditure and time spent in MVPA were estimated by a 3-day activity record.

In the *Amsterdam Longitudinal Growth and Health Study* (Twisk *et al.*, 2000; Van Mechelen *et al.*, 2000) two additional measurements were conducted at the age of 21 and 27 years (baseline age 13 years). Daily PA in the previous three months was estimated by an interviewer-administered questionnaire covering all habitual PA (school, work, sports etc.). In a Belgian study, De Bourdaeudhuij and co-workers (2002) longitudinally examined a random sample of 172 young people 16-25 years of age at baseline. Daily PA was assessed by means of a questionnaire administered with a structured interview. Another European study (Andersen & Haraldsdottir, 1993) examined changes in CHD risk factors from adolescence to young adulthood in a representative sample of Danish students (n=203, age range=16-19 years). They were initially tested in 1983 and followed-up eight years later. Self-reported PA was estimated by hours spent per week in sports and daily life activities in the last year. The extended recall period has the disadvantage of a possible recall bias. Late teenage PA could predict young adult PA only in men and with moderate significance.

Dovey and colleagues (1998) conducted a longitudinal cohort study in New Zealand using face to face interviews. They reported on data collected at the ages of 15 and 18 years, when 73% participants had graduated from school. The Minnesota LTPA questionnaire was used recalling past year's PA (type, frequency and duration). However, it carried the same recall bias disadvantage due to the extended recall period.

Using data from the *Northern Ireland Young Hearts Project* Boreham and colleagues (2004) reported on PA tracking of 245 males and 231 females adolescents (15 years of age) who were followed-up at 22 years of age. Participants were initially placed into three categories of low, medium and high PA levels. Tracking was assessed by a weighted kappa coefficient that indicated whether the above categorization was sustained at follow-up.

B.3. Description of tracking studies from childhood and adolescence into adulthood

Telama and co-workers (2005) reported on a 21-year follow-up of the *CVRYF* study. Secondly, in the *Leuven Study* Vanreusel and colleagues (1997) reported tracking coefficients for sports participation in Belgian males measured initially between 13 and 18 years of age, through to 30 and 35 years of age. The same patterns were exploited for a female cohort (n=257) originating from the *Leuven Study* (Scheerder et al., 2006). They covered early adolescence (12-14 years) to adulthood (32-34 years) and late adolescence (15-18 years) to later adulthood (35-41 years).

A longitudinal UK study examining LTPA and occupational PA (OPA) investigated factors in childhood and adolescence which predicted participation in later life (Kuh & Cooper, 1992). A stratified sample of 3,500 participants was studied during infancy, childhood, adolescence and adulthood. Their teachers at 15 years of age were asked to assess their energy level in three categories. When the participants became 36 years of age they were interviewed with questions based upon the Minnesota LTPA questionnaire (Taylor *et al.*, 1978). Level of PA was expressed by

frequency and duration of active leisure pursuits in the previous month. Although this research effort is exceptional for its duration (started in 1946) there should be serious methodological concerns about it. Firstly, the teacher's rating of energy level is not an objective estimate of PA and it was not validated as such for this population. Secondly, the two different measures of PA level complicate comparisons and is a definite source of error. Even though its results should be treated with scepticism it is one of the rare studies that attempted to investigate this issue in this age range.

B.4. Description of tracking studies during adulthood

Telama and colleagues (2005) reported on a 21-year follow-up of the *CVRYF* study. Fortier and colleagues (2001) reported correlations for both energy and time expended in PA regarding the adult age groups 19-29, 30-39, 40-49, 50-59 and 60-69 years and their 7-year follow-ups. In the *Leuven Study* (Beunen *et al.*, 1997) a sub-sample of 236 Flemish males were examined at 30 and 35 years of age by written questionnaires verified with oral interviews.

CARDIA was a longitudinal study from five US geographical areas (Andersen *et al.*, 1996). The assessment of a PA score was obtained by means of an interview-administered questionnaire covering moderate and vigorous types of PA in the previous year. A series of four measurements with a time interval of two, five and seven years took place. The baseline age of participants was 18-30 years (n=5,115).

Lastly, Kirjonen and colleagues (2006) conducted a longitudinal study in Finnish employees initially aged between 18 and 64 years. The extended age range of

the sample could be seen as an advantage since it covered all adulthood and created a holistic view of the phenomenon in this population. The sample was representative of the adult population and was followed-up after 5, 10, and 28 years. LTPA and housework PA was estimated by a questionnaire and an interview. Type, frequency, duration and intensity of the previous year's physical activities were self-reported. This extended recall period could have possibly led to some inaccuracy.

Table AB.1. Interage correlation (r) and common variance (r^2) of PA between

measurements during childhood and adolescence

Baseline & follow-up age or age range (years)	Sample (r / r^2)	
	Males (r / r^2)	Females (r / r^2)
Raitakari *et al.* (1994), longitudinal, $n_{1st-2nd\ meas} = 1,159$, $n_{1st-3rd\ meas} = 961$		
12-15	0.35 / 12%	0.33 / 11%
15-18	0.45 / 20%	0.37 / 14%
12-18	0.18 / 3%	0.17 / 3%
Telama *et al.* (1994), longitudinal, n = 2,736		
9-12	0.48 / 23%	0.44 / 19%
12-15	0.52 / 27%	0.42 / 18%
15-18	0.55 / 30%	0.49 / 24%
9-15	0.34 / 12%	0.21 / 4%
12-18	0.39 / 15%	0.29 / 8%
9-18	0.29 / 8%	0.20 / 4%
Telama *et al.* (1996), longitudinal, n = 2,337		
9-12	0.72-0.82 / 52%-67%	0.53-0.86 / 28%-74%
12-15	0.65-0.77 / 42%-50%	0.62-0.83 / 38%-69%
15-18	0.65-0.90 / 42%-81%	0.54-0.81 / 29%-66%
18-21	0.69-0.99 / 48%-98%	0.73-0.97 / 53%-94%
12yr tracking	0.22-0.50 / 5%-25%	0.17-0.58 / 3%-34%
McMurray *et al.* (2003), longitudinal, n = 791		
(8-12) – (10-14)	0.25/0.37[a] / 6%/14%[a]	0.32/0.30[a] / 10%/ 9%[a]
(10-14) – (11-15)	0.40/0.52[a] / 16%/27%[a]	0.58/0.54[a] / 34%/29%[a]
(11-15) – (12-16)	0.50/0.56[a] / 25%/31%[a]	0.54/0.50[a] / 29%/25%[a]
(12-16) – (13-17)	0.52/0.48[a] / 27%/23%[a]	0.45/0.53[a] / 20%/28%[a]
(8-12) – (13-17)	0.37/0.18[a] / 14%/ 3%[a]	0.23/0.26[a] / 5%/ 7%[a]
Pate *et al.* (1999), longitudinal, n = 181		
(10-11) - (12-13)	0.24/0.36/0.45[b] / 6%/13%/20%[b]	
(10-11) - (12-13)	0.23/0.08*/0.38[b] / 5%/NS*/14%[b]	0.23/0.20*/0.25[b] / 5%/NS*/6%[b]
Fortier *et al.* (2001), longitudinal, n = 1,909		
(11-12) – (18-19)	0.08*/0.12*[c] / NS*/NS*[c]	-0.09*/-0.10*[c]/ NS*/NS*[c]
Raudsepp & Pall (1997), longitudinal, n = 34		
(11-12) – (12-13)	0.51/0.42[d] / 26%/18%[d]	
Guerra *et al.* (2003), longitudinal, n = 692		
(8-15) - (9-16)	0.29 / 8%	
Aarnio *et al.* (2002), longitudinal, n = 2,934		
16-17	0.63 / 40%	0.58 / 34%
17-18	0.61 / 37%	0.54 / 29%
16-18	0.56 / 31%	0.44 / 19%

Table AB.1. continued...		
Vanreusel *et al.* (1993; 1997), longitudinal , n_{13-14}=236, n_{15-18}=176		
13-18 (annually)	0.53-0.62[e] / 28%-38%[e]	
13-18 (2-year)	0.42-0.48[e] / 18%-23% [e]	
13-18 (3-year)	0.35-0.43[e] / 11%-18% [e]	
13-18 (4-year)	0.33-0.35[e] / 10%-11% [e]	
13-18	0.37[e] / 14% [e]	
Van Mechelen & Kemper (1995); Twisk *et al.* (2000), longitudinal, n= 181		
13-16 (annually)	0.44 /19%	0.58 / 34%
13-16 (3-year)	0.32 /10%	0.25 / 6%
Janz *et al.* (2000), longitudinal, n = 110		
(7-12) – (11-16)	0.32[f] / 10% [f]	0.43[f]/ 18% [f]
(8-13) – (11-16)	0.36[f]/ 13% [f]	0.56[f]/ 31% [f]
(9-14) – (11-16)	0.52[f]/ 27% [f]	0.62[f]/ 38% [f]
(10-15) – (11-16)	0.52[f]/ 27% [f]	0.65[f]/ 42% [f]

*Notes: P < 0.05 except * which are non significant (NS), meas = measurement,*

[a] African American/Caucasian, [b] *Vigorous PA /moderate to vigorous PA/energy expended,* [c] *Energy/Time expended in PA,* [d] Spring/Autumn participation in PA, [e] Time in sports participation, [f] Vigorous PA events.

Table AB.2. Interage correlation (r) and common variance (r^2) of PA between measurements from childhood and adolescence to young adulthood.

Baseline & follow-up age or age range (years)	Sample (r / r^2)	
	Males (r / r^2)	Females (r / r^2)
Raitakari *et al.* (1994), longitudinal, $n_{1st-2nd\ meas}$ = 1,159, $n_{1st-3rd\ meas}$ = 961		
15-21	0.27 / 7%	0.27 / 7%
18-21	0.54 / 29%	0.39 / 15%
Telama *et al.* (1994), longitudinal, n = 2,736		
12-21	0.25 / 6%	0.18 / 3%
15-21	0.36 / 13%	0.30 / 9%
15-24	0.26 / 7%	0.31 / 10%
18-21	0.58 / 34%	0.48 / 23%
18-24	0.50 / 25%	0.42 / 18%
18-27	0.47 / 22%	0.41 / 17%
21-24	0.62 / 38%	0.48 / 23%
21-27	0.41 / 17%	0.40 / 16%
24-27	0.78 / 60%	0.46 / 21%
Telama *et al.* (1996), longitudinal, n = 2,337		
12-21	0.06* / NS*	0.20 / 4%
15-21	0.24 / 6%	0.16 / 3%
15-24	0.06* / NS*	0.11* / NS*
18-21	0.40 / 16%	0.23 / 5%
18-24	0.32 / 10%	0.39 / 15%
18-27	0.27 / 7%	0.29 / 8%

Table AB.2. continued...		
Telama *et al.* (1996), longitudinal, n = 2,337		
12-21	0.06* / NS*	0.20 / 4%
15-21	0.24 / 6%	0.16 / 3%
15-24	0.06* / NS*	0.11* / NS*
18-21	0.40 / 16%	0.23 / 5%
18-24	0.32 / 10%	0.39 / 15%
18-27	0.27 / 7%	0.29 / 8%
Telama *et al.* (2005), longitudinal, n = 1,563		
9 - 24	0.31 / 10%	0.21 / 4%
9 - 27	0.28 / 8%	-0.01* / NS*
12 - 24	0.33 / 11%	0.19 / 4%
12 - 27	0.42 / 18%	0.19 / 4%
15 - 24	0.37 / 14%	0.34 / 12%
15 - 27	0.44 / 19%	0.18 / 3%
18 - 27	0.61 / 37%	0.31 / 10%
Fortier *et al.* (2001), longitudinal, n = 1,909		
(13-14)- (20-21)	0.10*/0.02* [a] / NS*/NS* [a]	0.12*/0.10* [a] / NS*/NS* [a]
(15-16)-(22-23)	0.20*/0.33 [a] / NS*/11% [a]	0.28*/0.23* [a] / NS*/NS* [a]
(17-18)-(24-25)	0.16*/0.12* [a] / NS*/NS* [a]	0.21*/0.12* [a] / NS*/NS* [a]
Campbell *et al.* (2001), longitudinal, n=153		
(8-20) – (20-32)	0.14/0.04* [b] / NS*/NS* [b]	0.22*/0.22* [b] / NS*/NS* [b]
Twisk *et al.* (2000); Van Mechelen *et al.* (2000), longitudinal, n =181		
13-21	<0.20 / < 4%	<0.20 / < 4%
13-27	0.34 / 12%	
Anderssen & Haraldsdottir (1993), longitudinal, n = 203		
16-19	0.31 / 10%	NS* / NS*
De Bourdaeudhuij *et al.* (2002), longitudinal, n = 172		
(16-25) – (22-32)	-0.03*/-0.09* [c] / NS*/NS* [c]	0.41/0.34* [c] / 17% */12% [c]

*Note: p < 0.05 except * which are non significant (NS),*

[a] *Energy/Time expended in PA,*

[b] Time spent in MVPA / Daily energy expenditure adjusted for body mass,

[c] Energy expended in Moderate/Total PA

Table AB.3. Interage correlation (r) and common variance (r^2) of PA between

measurements from childhood and adolescence to adulthood.

Baseline & follow-up age or age range (years)	Sample (r / r^2)	
	Males (r / r^2)	Females (r / r^2)
Telama *et al.* (2005), longitudinal, n = 1,563		
9 - 30	0.35 / 12%	0.17 / 3%
12 - 30	0.23 / 5%	0.15* / NS*
12 - 33	0.33 / 11%	0.23 / 5%
15 - 30	0.40 / 16%	0.31 / 10%
15 - 33	0.19 / 4%	0.29 / 8%
15 - 36	0.44 / 19%	0.14* / NS*
18 - 30	0.44 / 19%	0.39 / 15%
18 - 33	0.35 / 12%	0.42 / 18%
18 - 36	0.43 / 18%	0.29 / 8%
18 - 39	0.33 / 11%	0.26 / 7%
Vanreusel *et al.* (1993; 1997), longitudinal , n_{13-14}=236, n_{15-18}=176		
13-30	0.09*[a] / NS*[a]	
14-30	0.07*[a] / NS*[a]	
15-30	0.09*[a] / NS*[a]	
16-30	0.08*[a] / NS*[a]	
17-30	0.21[a] / 4% [a]	
18-30	0.31[a] / 10% [a]	
13-35	0.20[a] / 4% [a]	
14-35	0.14 [a] / 2% [a]	
15-35	0.15 [a] / 2% [a]	
16-35	0.14*[a] / NS*[a]	
17-35	0.16 [a] / 3% [a]	
18-35	0.18 [a] / 3% [a]	
Scheerder *et al.* (2006), longitudinal , n_{12-14}=125, n_{15-18}=132		
(12-14) – (32-34)		0.10*[a] / NS*[a]
(15-18) – (35-41)		0.41[a] / 17% [a]

*Note: p < 0.05 except * which are non significant (NS), [a] Time in sports*

participation

Table AB.4. Interage correlation (r) and common variance (r^2) of PA between

measurements during adulthood

Baseline & follow-up age or age range (years)	Sample (r / r^2)	
	Males (r / r^2)	Females (r / r^2)
Telama *et al.* (2005), longitudinal, n = 1,563		
21 - 30	0.58 / 34%	0.51/ 26%
21 - 33	0.29/ 8%	0.41/ 17%
21 - 36	0.47/ 22%	0.41/ 17%
21 - 39	0.36/ 13%	0.29/ 8%
24 - 33	0.51/ 26%	0.47/ 22%
24 - 36	0.52/ 27%	0.31/ 10%
24 - 39	0.41/ 17%	0.26/ 7%
27 - 36	0.48/ 23%	0.33/ 11%
27 - 39	0.50/ 25%	0.37/ 14%
30 - 39	0.50/ 25%	0.31/ 10%
Kirjonen *et al.* (2006), longitudinal, n_1=742, n_2=652, n_3=441		
(18-64)- (23-69)	0.44/0.44/0.36 [a] / 19%/19%/13% [a]	
(18-64)- (23-69)	0.46/0.47/0.37 [a] / 21%/22%/14 [a]	0.34/0.34/0.29 [a] / 12%/12%/ 8% [a]
(18-64)-(28-74)	0.26/0.32/0.27 [a] / 7%/10%/7% [a]	
(18-64)-(28-74)	0.25/0.30/0.23 [a] / 6%/9%/5% [a]	0.29/0.34/0.32 [a] / 8%/12%/10% [a]
(18-64)-(46-92)	0.18/0.20/0.20 [a] / 3%/4%/4% [a]	
(18-64)-(46-92)	0.19/0.22/0.24 [a] / 4%/5%/6% [a]	0.18/0.19/0.07* [a] / 3%/4%/NS* [a]
Anderssen *et al.* (1996), longitudinal, n = 3,632		
(18-30)-(20-32)	0.61 / 37%	
(18-30)-(23-35)	0.52 / 27%	
(18-30)-(25-37)	0.49 / 24%	
(20-32)-(23-35)	0.63 / 40%	
(20-32)-(25-37)	0.57 / 32%	
(23-35)-(25-37)	0.66 / 44%	
Fortier *et al.* (2001), longitudinal, n = 1,909		
(19-29)- (26-36)	0.31/0.33 [b] / 10%/11% [b]	0.33/0.33 [b] / 11%/11% [b]
(30-39)-(37-46)	0.21/0.23 [b] / 4%/ 5% [b]	0.23/0.28 [b] / 5%/ 8% [b]
(40-49)-(47-56)	0.20/0.18* [b] / 4%/ NS* [b]	0.11*/0.23 [b] / NS*/ 5% [b]
(50-59)-(57-66)	0.28/0.04* [b] / 8%/ NS* [b]	0.11*/0.22 [b] / NS*/ 5% [b]
(60-69)-(67-76)	0.39/0.30 [b] / 15%/ 9% [b]	0.11*/0.24 [b] / NS*/ 6% [b]
Beunen *et al.* (1997), longitudinal, n = 236		
30 - 35	0.41 / 17%	

*Note: p < 0.05 except * which are non significant (NS), [a] Time used for PA/ intensity*

of PA/ strenuous PA, [b] Energy/Time expended in PA

Appendix C:

Permission to conduct research inside public schools

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ΕΛΛΗΝΙΚΗ ΔΗΜΟΚΡΑΤΙΑ
ΥΠΟΥΡΓΕΙΟ ΕΘΝ.ΠΑΙΔΕΙΑΣ & ΘΡΗΣΚΕΥΜΑΤΩΝ
ΕΝΙΑΙΟΣ ΔΙΟΙΚΗΤΙΚΟΣ ΤΟΜΕΑΣ ΘΕΜΑΤΩΝ
ΣΠΟΥΔΩΝ, ΕΠΙΜΟΡΦΩΣΗΣ ΚΑΙ ΚΑΙΝΟΤΟΜΙΩΝ
ΔΙΕΥΘΥΝΣΗ ΣΠΟΥΔΩΝ Δ/ΘΜΙΑΣ ΕΚΠΑΙΔΕΥΣΗΣ
ΤΜΗΜΑ Α'

Ερμού 15   101 85   Αθήνα
Τηλέφωνο : 210-3235722
FAX   : 210-3224249
Πληροφορίες : Αν. Πασχαλίδου

Να διατηρηθεί μέχρι ....

Βαθμός Ασφαλείας ....

Αθήνα   11-11-04
Αριθ. Πρωτ 1 ε 7 7 8 1 /Γ2
Βαθ. Προτερ.

ΠΡΟΣ :

1. κ. Νικόλαο Τζωρμπατζάκη
   Θερίσσου 34
   71304 Ηράκλειο
2. Διεύθυνση Δευτεροβάθμιας Εκπαίδευσης
   Ηρακλείου.

ΘΕΜΑ : Έγκριση διεξαγωγής έρευνας.

Απαντώντας σε σχετική αίτησή σας και μετά τη γνωμοδότηση του Τμήματος Ερευνών Τεκμηρίωσης και Εκπαιδευτικής Τεχνολογίας του Παιδαγωγικού Ινστιτούτου (**πράξη 6/2004**), σας γνωρίζουμε ότι **ε π ι τ ρ έ π ο υ μ ε** τη διεξαγωγή έρευνας τον κ. Νικόλαο Τζωρμπατζάκη κατά τη διάρκεια του σχολικού έτους 2004-2005 και 2005-2006 με τις εξής προϋποθέσεις: α) Να γίνει ενημέρωση του Διευθυντή, του συλλόγου διδασκόντων καθώς και των γονέων και κηδεμόνων των μαθητών για την έρευνα, πριν την έναρξή της β) Η έρευνα να γίνει με τη σύμφωνη γνώμη του Διευθυντή και του συλλόγου διδασκόντων καθώς και με την έγγραφη συγκατάθεση των γονέων και κηδεμόνων των μαθητών (κάθε γονέα χωριστά)

Επισημαίνεται ότι η συμμετοχή στην έρευνα δεν είναι υποχρεωτική.

Η έρευνα έχει θέμα: *«Η προώθηση της δια βίου άσκησης σε μαθητές Β΄ τάξης Λυκείου. Η περίπτωση του Ηρακλείου Κρήτης»*

και απευθύνεται στους μαθητές του 2ου και 4ου Ενιαίου Λυκείου Ηρακλείου, Ενιαίου Λυκείου Γαζίου, Ενιαίου Λυκείου Μοιρών, Ενιαίου Λυκείου Αρκαλοχωρίου, Ενιαίου Λυκείου Μελεσών, Ενιαίου Λυκείου Γουβών και Ενιαίου Λυκείου Επισκοπής.

Για την πραγματοποίηση της έρευνας θα πρέπει :

1. Οι επισκέψεις στα σχολεία να γίνουν μετά από συνεννόηση με τον Διευθυντή τους και σε συνεργασία με το σύλλογο καθηγητών, ώστε να μη παρεμποδίζεται η ομαλή διεξαγωγή των μαθημάτων.

2. Τα αποτελέσματα της έρευνας, μετά την ολοκλήρωση της, να κοινοποιηθούν στην Υπηρεσία μας και στο Παιδαγωγικό Ινστιτούτο.

3. Ο Διευθυντής της Διεύθυνσης Δευτεροβάθμιας Εκπαίδευσης Ηρακλείου να ενημερώσει σχετικά τους Διευθυντές των σχολείων ευθύνης του, ώστε να διευκολύνουν τον ενδιαφερόμενο στην πραγματοποίηση της έρευνας αυτής.

Ο ΔΙΕΥΘΥΝΤΗΣ

Εσωτ. Διανομή

Δ/νση Σπουδών Δ. Ε.

Τμήμα Α'

ΠΑΥΛΟΣ ΓΡ. ΝΤΑΒΑΡΙΝΟΣ

Πιστό Αντίγραφο
ο προϊστάμενος Τμήματος
Διεκπ/σης & Πρωτοκόλλου

Appendix D:

Letter and informed consent of the main study

Τζωρμπατζάκης Νικόλαος (MSc)

Καθηγητής Φυσικής Αγωγής

Υποψήφιος Διδάκτορας του Πανεπιστημίου Hull

Θερίσσου 34, 713 04 Ηράκλειο, Τηλ. 2810 371051

Αγαπητοί γονείς,

Στα πλαίσια της έρευνας με θέμα «**Διαχρονική έρευνα παρέμβασης για την προώθηση του σωματικά δραστήριου τρόπου ζωής σε μαθητές της 2ας Τάξης Ενιαίων Λυκείων του Νομού Ηρακλείου**» που διεξάγω μετά από έγκριση του Τμήματος Ερευνών του Παιδαγωγικού Ινστιτούτου του Υπουργείου Εθνικής Παιδείας και Θρησκευμάτων με την υπ'αριθμό 6/2004 πράξη σας στέλνω αυτό το γράμμα για να δώσετε την έγγραφη συναίνεσή σας για την συμμετοχή του παιδιού σας στην διαδικασία της έρευνας.

Σκοπός της έρευνας είναι η προώθηση του δραστήριου τρόπου ζωής στους νέους. Για αυτόν το λόγο σε ένα μέρος των μαθητών θα δοθεί ενημερωτικό υλικό με τη μορφή παρέμβασης ενώ οι υπόλοιποι μαθητές θα αποτελέσουν την ομάδα ελέγχου. Συγκεκριμένα, θα ζητηθεί από το παιδί σας να συμπληρώσει ερωτηματολόγια του **Διαθεωρητικού Μοντέλου Αλλαγής Συμπεριφοράς σχετικά με τη Σωματική Δραστηριότητα**. Δύο μετρήσεις θα γίνουν στην $2^α$ Λυκείου, μία στην $3^η$ Λυκείου και μία την επόμενη χρονιά από την αποφοίτησή τους από το σχολείο. Παρακαλώ, αν συμφωνείτε να συμπληρώσετε την δήλωση συναίνεσης.

Με τιμή

Νικόλαος Τζωρμπατζάκης

Έγγραφη δήλωση συναίνεσης

Τόπος...

Ημερομηνία...................../........../..............

Ονοματεπώνυμο...

Συναινώ για τη συμμετοχή του παιδιού μου ....
στην έρευνα με θέμα «**Διαχρονική έρευνα παρέμβασης για την προώθηση του σωματικά δραστήριου τρόπου ζωής σε μαθητές της 2ας Τάξης Ενιαίων Λυκείων του Νομού Ηρακλείου**» που διεξάγει ο Νικόλαος Τζωρμπατζάκης.

Ο/Η Δηλών

Υπογραφή

Appendix E:

Photo of the five stages of change manuals

Appendix F:

Sample pages of manual for stage 1
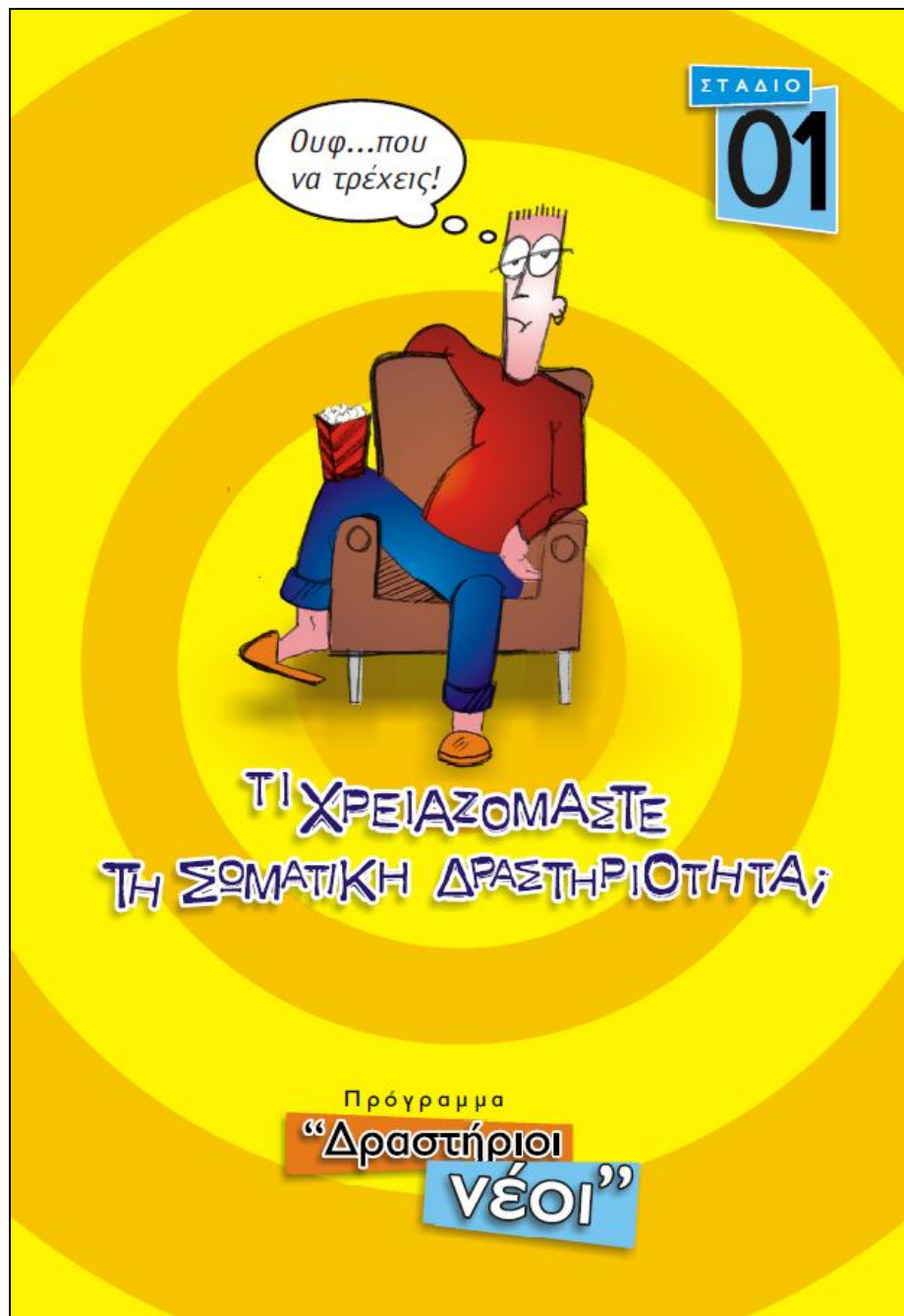
Αυτός ο οδηγός απευθύνεται σε νέες και νέους οι οποίοι δεν είναι δραστήριοι σωματικά προς το παρόν και δεν έχουν πρόθεση να γίνουν περισσότερο δραστήριοι μέσα στους επόμενους 6 μήνες. Αν και δεν είσαι τώρα σωματικά δραστήριος/α, μπορεί να θελήσεις να γίνεις κάποια μέρα.

Οι αλλαγές στη συμπεριφορά μας χρειάζονται χρόνο.

Τα άτομα μετακινούνται σε 5 στάδια στην πορεία τους για να γίνουν περισσότερο δραστήρια:

1° Στάδιο Δεν σκέφτονται να γίνουν περισσότερο δραστήρια

2° Στάδιο Αρχίζουν να σκέφτονται να γίνουν περισσότερο δραστήρια

3° Στάδιο Γίνονται περισσότερο δραστήρια περιστασιακά, αλλά όχι συστηματικά

4° Στάδιο Είναι συστηματικά δραστήρια για λιγότερο από 6 μήνες

5° Στάδιο Παραμένουν συστηματικά δραστήρια για περισσότερο από 6 μήνες

Ο σκοπός αυτού του οδηγού **δεν** είναι να σε κάνει να ξεκινήσεις ένα εντατικό πρόγραμμα άσκησης, αλλά να σε βοηθήσει να δεις τόσο τα υπέρ όσο και τα κατά της σωματικής δραστηριότητας. Θέλουμε να σε βοηθήσουμε να σκεφτείς σχετικά με το ρόλο της σωματικής δραστηριότητας στη ζωή σου.

Πρόγραμμα "Δραστήριοι ΝΕΟΙ" ΣΤΑΔΙΟ 01

01

Να μερικοί λόγοι για να μείνεις σωματικά αδρανής:

«Δεν έχω χρόνο για να γίνω
περισσότερο δραστήριος»

Το να κάνεις τη σωματική δραστηριότητα μία προτεραιότητα στη ζωή σου δε σημαίνει ότι πρέπει να βρεις έξτρα χρόνο. Με τόσες υποχρεώσεις σχολικές και εξωσχολικές κάτι τέτοιο φαίνεται αδύνατο.

Όμως με μία ώρα μέτριας σωματικής δραστηριότητας την ημέρα, τις περισσότερες ημέρες της εβδομάδας (5-7 φορές), μπορείς να δεις μεγάλη βελτίωση τόσο στη φυσική σου κατάσταση όσο και στην εμφάνισή σου.

Σκέψου μόνο πόσο χρόνο ξοδεύεις καθημερινά βλέποντας τηλεόραση. Ίσως το να βρεις συνολικά μία ώρα τη ημέρα για να είσαι περισσότερο δραστήριος/α α μην είναι τόσο δύσκολο. Αν το θέλεις μπορείς να είσαι δραστήριος/α ακόμη και βλέποντας τηλεόραση π.χ. μπορείς να χορεύεις το αγαπημένο σου βιντεοκλίπ.

Άλλοι τρόποι για να γίνεις δραστήριος/α χωρίς να χάσεις πολύτιμο χρόνο είναι: να χρησιμοποιείς τις σκάλες, και όχι το ασανσέρ, να περπατάς ή να παίρνεις το ποδήλατο όποτε μπορείς. Ακόμη και 5-λεπτα ή 10-λεπτα δραστηριότητας στη διάρκεια της ημέρας όταν προστεθούν και συμπληρώσουν ένα ικανοποιητικό χρόνο σε βοηθάνε να βελτιώσεις την φυσική σου κατάσταση και την εμφάνιση σου. Άλλωστε καλύτερα είναι να κάνεις έστω και λίγη δραστηριότητα παρά καθόλου.

«Συχνά έπανα τον εαυτό μου να είμαι ¨πεσμένος¨ χωρίς συγκεκριμένο λόγο. Οι φίλοι μου έκαναν τρέξιμο και μου πρότειναν να ασκούμαι μαζί τους. Εμένα όμως δεν μου αρέσει το τρέξιμο, αλλά πάντα μου άρεσε το ποδήλατο, έτσι ξεκίνησα ξανά βόλτες με το ποδήλατό μου. Δεν χρειάστηκε πολύ καιρός για να νιώσω ότι ήμουν πολύ καλύτερα μετά τις βόλτες μου. Αισθανόμουν πιο χαλαρωμένος και ¨ανεβασμένος¨.»

Γιάννης Τ., Ηράκλειο.

Πρόγραμμα
"Δραστήριοι ΝΕΟΙ"   ΣΤΑΔΙΟ 01

02

312

«Ποτέ δεν μου άρεσε να γυμνάζομαι»

Κάποια άτομα έχουν άσχημες εμπειρίες από τη γυμναστική και δεν τους αρέσει η έντονη άσκηση. Ο ιδρώτας, το λαχάνιασμα και η κούραση κάνει κάποια άτομα να νιώθουν άβολα.

Τα παλαιότερα χρόνια υπήρχε η αίσθηση ότι χρειαζόταν πολύς κόπος για κρατηθεί κάποιος σε φόρμα. Τα τελευταία χρόνια όμως η φράση: «δε θέλει κόπο, θέλει τρόπο» δείχνει την μοντέρνα άποψη για τη σωματική δραστηριότητα.

Τώρα γνωρίζουμε ότι μπορείς να αποκτήσεις τα οφέλη της σωματικής δραστηριότητας χωρίς έντονη κούραση και πόνο. Δεν χρειάζεται να γίνεις αθλητής για να τα κερδίσεις. Με απλές δραστηριότητες, τις οποίες ήδη κάνεις, όπως περπάτημα, ποδήλατο, χορό, κολύμπι μπορείς να βελτιώσεις τη φυσική σου κατάσταση και την εμφάνισή σου. **Άρα, βρες τρόπους να αυξήσεις το χρόνο που ξοδεύεις για αυτές τις δραστηριότητες που ήδη κάνεις και διασκέδασέ τες.**

«Οι μύς μου θα πονάνε αν γίνω σωματικά δραστήριος»

Είναι αλήθεια ότι όταν ξεκινάς να γυμνάζεσαι έντονα είναι συνηθισμένο να ¨πιαστείς¨ και να πονάνε οι μύς σου. Όμως μπορείς να το αποφύγεις αυτό αν δε ασκηθείς πολύ έντονα από τις πρώτες φορές αλλά αυξήσεις σταδιακά τη δυσκολία. Η μέτρια σωματική δραστηριότητα μπορεί να έχει τα ίδια αποτελέσματα με την έντονη χωρίς ενοχλήσεις.
Επίσης με προθέρμανση και διατάσεις πριν και μετά τη δραστηριότητά σου μπορείς να αποφύγεις μεγάλο μέρος των ενοχλήσεων. Το σώμα σου θα σου δώσει ξεκάθαρα μηνύματα για το αν αυτό που κάνεις υπερβαίνει τα όριά σου. Αν ¨ακούς¨ το σώμα σου προσεκτικά δεν πρόκειται να τραυματιστείς.

Να μερικοί ακόμη λόγοι για να μείνεις σωματικά αδρανής:

«Δεν έχω αρκετά χρήματα για να ξοδέψω για γυμναστική»

Το κόστος της άσκησης μπορεί να σου φαίνεται υψηλό, για παράδειγμα η συνδρομή σε ένα γυμναστήριο ή σε ένα αθλητικό σύλλογο. Όμως το να αυξήσεις το χρόνο που περπατάς, κολυμπάς στη θάλασσα, κάνεις ποδήλατο ή παίζεις κάποιο άθλημα με τους φίλους σου δεν θα σου κοστίσει σχεδόν τίποτα.

«Πολλούς μήνες πριν, είχα μερικά παραπανίσια κιλά και όλες μου οι φίλες μου έλεγαν ότι καλό θα ήταν να αδυνατίσω. Ξεκίνησα να περπατάω γρήγορα για 10 λεπτά κάθε απόγευμα με τις φίλες μου για βόλτα. Δεν κουραζόμαστα και περνούσαμε και καλά. Τώρα, μετά από δύο μήνες περπατάμε σχεδόν 30 λεπτά τις περισσότερες μέρες της εβδομάδες. Έχω δει διαφορά στη σιλουέτα μου και νιώθω πολύ καλύτερα.»

Ελένη Γ., Αθήνα.

Πρόγραμμα "Δραστήριοι Νέοι" ΣΤΑΔΙΟ 01

**«Ανησυχώ ότι μπορεί να τραυματιστώ
ή να αρρωστήσω αν γίνω σωματικά δραστήριος/α»**

Οι περισσότεροι τραυματισμοί που συμβαίνουν κατά τη διάρκεια της άσκησης μπορούν να αποφευχθούν με τον κατάλληλο εξοπλισμό όπως αθλητικά παπούτσια, ελαφριά ρούχα όταν κάνει ζέστη και ζεστά όταν κάνει κρύο. Είναι πολύ σημαντικό στο ξεκίνημα η ένταση να είναι μέτρια και όσο περνάνε οι μέρες να αυξάνεις την διάρκεια και την ένταση ¨ακούγοντας¨ το σώμα σου.

«Δεν έχω την ενεργητικότητα για να γίνω πιο δραστήριος»

Πολλά άτομα θεωρούν ότι δεν έχουν αρκετή ενέργεια για να γίνουν πιο δραστήρια. Τα καλά νέα για αυτούς όμως είναι ότι όσο γίνεσαι έστω και λίγο πιο δραστήριος/α, θα νιώσεις γεμάτος/η με περισσότερη ενέργεια.

Να μερικοί λόγοι για να γίνεις σωματικά δραστήριος/α:

Είναι διασκεδαστικό!

Υπάρχει μεγάλη ποικιλία δραστηριοτήτων για να ασχοληθείς και να γίνεις δραστήριος/α περνώντας ευχάριστα την ώρα σου. Μπορείς να διαλέξεις μια δραστηριότητα που σε διασκεδάζει ή να συνδυάσεις μερικές για ποικιλία. Ασχολήσου με ένα άθλημα, κάνε ποδήλατο, χόρεψε, κάνε βόλτες με γρήγορο περπάτημα παρέα με τους φίλους σου.

Κάνει καλό στο σώμα σου

Μπορείς να βελτιώσεις την εμφάνισή σου και τις αναλογίες του σώματός σου. Για παράδειγμα, τα άτομα που θέλουν να αδυνατίσουν τα καταφέρνουν καλύτερα όταν συνδυάζουν υγιεινή διατροφή με σωματική δραστηριότητα στην καθημερινή τους ζωή.

Θέλεις να «κάψεις» 100 παραπάνω θερμίδες σήμερα;

Περπάτησε γρήγορα για 15 λεπτά	30 θερμίδες
Ανέβα 2 ορόφους από τις σκάλες	15 θερμίδες
Χόρεψε το αγαπημένο σου τραγούδι	25 θερμίδες
Κάνε 15 λεπτά ποδήλατο	30 θερμίδες
Σύνολο	100 θερμίδες

Πρόγραμμα "Δραστήριοι Νέοι" ΣΤΑΔΙΟ 01

Η σωματική δραστηριότητα μπορεί να βελτιώσει την φυσική κατάστασή σου.

Η αντοχή σου, η δύναμή και η ταχύτητά σου μπορούν να βελτιωθούν καθώς όργανα του σώματος σου όπως η καρδιά οι πνεύμονες, οι μύες κ.α. εξασκούνται στο να δουλεύουν καλύτερα. Το αποτέλεσμα όλων αυτών είναι η βελτίωση της φυσικής σου κατάστασης που σε βοηθάει να ολοκληρώνεις τις εργασίες σου στη διάρκεια της ημέρας με λιγότερη κούραση.

Μπορείς να κάνεις νέες γνωριμίες

Συνήθως οι χώροι όπου ασκείται πολύς κόσμος, όπως γυμναστήρια, στάδια είναι και χώροι όπου μπορείς να γνωρίσεις άτομα της ηλικίας σου με κοινά ενδιαφέροντα. Μπορείς ακόμη να κάνεις τις αγαπημένες δραστηριότητές σου με την παρέα των φίλων σου.

Πρόγραμμα "Δραστήριοι ΝΕΟΙ" ΣΤΑΔΙΟ 01

Να μερικοί ακόμη λόγοι για να γίνεις σωματικά δραστήριος:

Η συστηματική σωματική δραστηριότητα αυξάνει την αυτοπεποίθησή σου

Όσο το σώμα σου γίνεται δυνατότερο, υγιέστερο και ομορφότερο σου δίνει μια αίσθηση υπερηφάνειας και αυξάνει την αυτοπεποίθησή σου.

Η συστηματική σωματική δραστηριότητα μπορεί να βοηθήσει στη μείωση του άγχους και του στρες

Με την σωματική δραστηριότητα παράγονται ορισμένες ουσίες στο σώμα μας που μας κάνουν να νιώθουμε χαλαρωμένοι και μας ανακουφίζουν από το στρες και το άγχος (π.χ. των εξετάσεων). Οπότε η μέτρια (όχι πολύ κουραστική) σωματική δραστηριότητα μπορεί να βοηθήσει να χαλαρώσουμε το άγχος που μπορεί να κουβαλάμε π.χ. από διάβασμα.

Η συστηματική σωματική δραστηριότητα μπορεί να μειώσει την μελαγχολία

Είναι φυσιολογικό κάποιες μέρες να αισθανόμαστε μελαγχολία ή κάπως ¨πεσμένοι¨ και σε αυτήν την περίπτωση μπορούμε να βελτιώσουμε τη διάθεσή μας κάνοντας μια σωματική δραστηριότητα που μας αρέσει. Κατά τη διάρκεια και μετά το τέλος της νιώθουμε πιο χαρούμενοι και ¨ανεβασμένοι¨.

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Πρόγραμμα
"Δραστήριοι ΝΕΟΙ"
ΣΤΑΔΙΟ 01

Τα υπέρ και τα κατά της σωματικής δραστηριότητας

Ακουλουθούν κάποια αρνητικά σχόλια σχετικά με το να γίνεις πιο δραστήριος/α.

Ποια είναι η δική σου άποψη;

1. Η συστηματική σωματική δραστηριότητα θα πάρει πολύ από το χρόνο μου.

        (Κύκλωσε ένα αριθμό από τους παρακάτω)

Διαφωνώ απόλυτα	1	2	3	4	5	Συμφωνώ απόλυτα

2. Στο τέλος της ημέρας είμαι πολύ εξαντλημένος για να κάνω σωματικές δραστηριότητες.

        (Κύκλωσε ένα αριθμό από τους παρακάτω)

Διαφωνώ απόλυτα	1	2	3	4	5	Συμφωνώ απόλυτα

3. Θα μου μένει λιγότερος χρόνος για την οικογένειά μου και τους φίλους μου αν γίνω συστηματικά δραστήριος.

        (Κύκλωσε ένα αριθμό από τους παρακάτω)

Διαφωνώ απόλυτα	1	2	3	4	5	Συμφωνώ απόλυτα

Πρόσθεσε τους αριθμούς που κύκλωσες στις 3 παραπάνω ερωτήσεις και υπολόγισε το σύνολο.

Σύνολο...............
Αυτό είναι το σκορ σου σχετικά με τα κατά της σωματικής δραστηριότητας.

Πρόγραμμα "Δραστήριοι νέοι" ΣΤΑΔΙΟ 01

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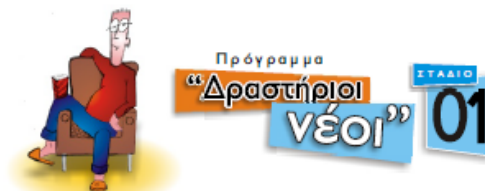
Τα υπέρ και τα κατά της σωματικής δραστηριότητας

Ακολουθούν κάποια θετικά σχόλια σχετικά με το να γίνεις πιο δραστήριος/α.

Ποια είναι η δική σου άποψη;

1. Θα αισθάνομαι περισσότερη αυτοπεποίθηση αν κάνω συστηματικά σωματικές δραστηριότητες.

(Κύκλωσε ένα αριθμό από τους παρακάτω)

Διαφωνώ	1	2	3	4	5	Συμφωνώ
απόλυτα						απόλυτα

2. Θα αισθάνομαι λιγότερο στρες και άγχος αν κάνω συστηματικά σωματικές δραστηριότητες.

(Κύκλωσε ένα αριθμό από τους παρακάτω)

Διαφωνώ	1	2	3	4	5	Συμφωνώ
απόλυτα						απόλυτα

3. Θα αισθάνομαι περισσότερη άνετα με το σώμα μου αν κάνω συστηματικά σωματικές δραστηριότητες.

(Κύκλωσε ένα αριθμό από τους παρακάτω)

Διαφωνώ	1	2	3	4	5	Συμφωνώ
απόλυτα						απόλυτα

Πρόσθεσε τους αριθμούς που κύκλωσες στις 3 παραπάνω ερωτήσεις και υπολόγισε το σύνολο.

Σύνολο...............

Αυτό είναι το σκορ σου σχετικά με τα υπέρ της σωματικής δραστηριότητας.

Για να μάθεις τι σημαίνουν τα σκορ σου διάβασε την επόμενη σελίδα.

Πρόγραμμα "Δραστήριοι νέοι" ΣΤΑΔΙΟ 01

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Σε ποιες ερωτήσεις πήρες υψηλότερο σκορ σε αυτές που αναφέρονταν στα κατά ή στα υπέρ της σωματικής δραστηριότητας;

Αν το σκορ των «κατά» ήταν υψηλότερο, θα ήταν καλύτερο να σκεφτείς λίγο περισσότερο σχετικά με την σωματική δραστηριότητα. Μέσα στις επόμενες εβδομάδες θα ήταν καλό να κάνεις μια λίστα όλων των «υπέρ» που μπορείς να σκεφτείς για τη σωματική δραστηριότητα. Επίσης καλό θα ήταν να ξαναδιάβαζες αυτόν τον οδηγό, δίνοντας ιδιαίτερη προσοχή στο κομμάτι με τους λόγους για να γίνεις σωματικά δραστήριος/α.

Αν το σκορ των «υπέρ» ήταν υψηλότερο, καλό θα ήταν να αρχίσεις να διαβάζεις άρθρα σχετικά με τη σωματική δραστηριότητα την άσκηση και την γυμναστική. Επίσης θα μπορούσες να μιλήσεις με φίλους σου ή την οικογένειά σου που ασχολούνται με σωματικές δραστηριότητες για το πως ξεκίνησαν και τους λόγους που το κάνουν.

Αυτός ο οδηγός σχεδιάστηκε για να σε βοηθήσει να σκεφτείς για τις σχετικές με τις σωματικές δραστηριότητες συνήθειές σου. Θα θέλαμε να έχεις μία ισορροπημένη άποψη για τις σωματικές δραστηριότητες, γνωρίζοντας τα οφέλη και τα ρίσκα τους. Σε αυτό το σημείο είναι δική σου επιλογή το αν διαλέξεις να γίνεις περισσότερο δραστήριος/α.

Καλή επιτυχία!

Πρόγραμμα "Δραστήριοι νέοι" ΣΤΑΔΙΟ 01

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Appendix G:

English translation of sample pages for manual 1

Title: What do I need physical activity for?
Programme «Active Youth»
Manual No1

(end of front cover of the manual)

This manual is intended to young people who are not physically active for the time being and do not have the intention to become more active in the next 6 months. Even if you are not physically active now, you might want to become one day.

Changes in your behaviour take time.

People move across 5 stages in their course to become more active:

1st Stage – Not thinking about being more active

1st Stage – Not thinking about being more active

2nd Stage – Starting to think about being more active

3rd Stage – Being active occasionally, but not systematically

4th Stage – Being active systematically, but for less than 6 months

5th Stage – Being active systematically for more than 6 months

The purpose of this manual is **not** to get you to start and intensive exercise programme, but to help you see the positive and negative points of physical activity. We want to help you think about the role of physical activity in your life.

(end of page 1 of the manual)

<u>Here are some reasons to stay inactive:</u>

"I don't have time to be more active"

Making physical activity a priority in your life doesn't mean that you have to find extra time to do it. With so many curricular and extra-curricular commitments this seems impossible.

However, it only takes an hour of moderate physical activity per day, most of the days of the week (5-7 times), to see great improvement in your physical condition and appearance.

Consider only the amount of time you spend watching television daily. Maybe finding one hour per day to become more active would not be that difficult. In fact, you can be active even during watching television, for example, by dancing while watching your favourite video-clip.

Other ways to become active without loosing much of your valuable time is: taking the stairs instead of the elevator, walking or taking your bike whenever you can. **Even several 5- or 10-minute bouts of activity during the day can help you enhance your physical condition and appearance.** Even little activity is better than none.

> *«I often found my self being "down" with no particular reason. Some of my friends jogged and suggested to train with them. I don't like running, but I always liked bicycling so I started riding my bike again. It didn't take me long to feel much better after my rides. I felt more relaxed and "up-beat."»*
>
> *John T., Heraklion.*

(end of page 2 of the manual)

"I never liked exercising"

Some people have bad experiences with from exercise in school or do not like intense exercise. Sweating, puffing, and panting make some people feel uncomfortable. In the past there was the belief that it required a lot of effort from someone to keep in shape. Lately, the popular phrase "no pain, just do it" shows the modern approach to physical activity.

Now we know that you can have the benefits of physical activity without intense effort and pain. You don't have to be an athlete to deserve these. With simple activities, that you already do, like walking, bicycling, dancing, swimming you can improve your physical condition and appearance. **So, find ways to increase the time you spend on activities you already do and enjoy.**

"My muscles will get sore if I become physically active"

It is true that when you start intense exercise it is usual to get sore muscles. But you can avoid it by not exercising very intensive during your first attempts but gradually increase your efforts. Moderate physical activity can have the same results with vigorous physical activity without the pain.

Additionally, with the proper warm-up and stretching before and after your activities you can avoid most of the irritations. Your body will give you clear messages if you are beyond your limits. If you "listen" carefully you won't get hurt.

(end of page 3 of the manual)

<u>Here are some reasons to remain inactive:</u>

"I don't have enough money to spend on exercising"

The cost of exercising might seem high to you, for example to join a gym or a club. However increasing the amount of time you spend walking, swimming at the beach, riding your bike or playing a sport with your friends won't cost you anything.

> *"Several months ago, I had a few extra kilos and my friends were telling me that I should lose some weight. I began walking in a fast pace for 10 minutes every afternoon with my friends. We were not tired after it and we had so much fun. Now, after two months we walk almost 30 minutes on most days of the week. I have seen the difference in my silhouette and I feel much better."*

Helen G., Athens.

(end of page 5 of the manual)

"I worry that I might get injured or be sick if I become physically active"

Most injuries that occur during exercise can be avoided by using proper equipment like sports shoes, light clothes when it's hot and warm clothes when it's cold. At the beginning it is very important that the intensity medium and as the days pass to increase duration and intensity by "listening" to your body. Είναι πολύ σημαντικό στο ξεκίνημα η ένταση να είναι μέτρια και όσο περνάνε οι μέρες να αυξάνεις την διάρκεια και την ένταση ¨ακούγοντας¨ το σώμα σου.

"I do not have the energy to be more active"

Many people think that they don't have enough energy to become active. The good news is, once you become a little more active, you will probably feel more energetic.

(end of page 6 of the manual)

<u>Here are some reasons to become active:</u>

It's fun!

There is a great variety of physical activities you can engage in to become active and enjoy your time. You can choose the activity you enjoy or combine some for variety. You can participate in a sport, ride a bike, dance or take a stroll at high pace with your friends.

Its good for your body

You can improve your physical appearance and figure. For example, people that want to loose weight manage it better when they combine a healthy diet with physical activities in their daily lives.

Want to burn 100 more calories today?

Walk fast for 15 minutes	30 calories
Climb up to flights of stairs	15 calories
Dance to your favourite fast song	25 calories
Ride your bike for 15 minutes	30 calories
Total	100 calories

Physical activity can improve your physical condition.

Your endurance and your strength can improve while your organs like your heart, lungs and muscles etc. train to work better. The result of all the above is the improvement of your physical condition, which helps you to accomplish your daily tasks with less effort.

You can make new friends

Usually at places where a lot of people exercise like gyms and stadiums you can meet new people of your age with similar interests. You can also participate in your favourite activities with the company of your friends.

<u>Here are some reasons to become active:</u>

Regular physical activity increases your confidence.

While your body become stronger, healthier and more good-looking it gives you a sense of pride and increases your self-confidence.

Regular physical activity can help to lower your stress.

Physical activity produce substances in our bodies that make us feel relaxed and relieve stress, for example exam stress. Thus, moderate (not very tiring) physical activity can help us to relax our nerves and the stress we carry.

Regular physical activity can help to lower melancholy.

It is normal some days to feel "down" and in this case we can alter our mood by doing some physical activity that we enjoy. During and after the activity we feel more happy and "up-beat".

(end of page 9 *of the manual*)

<u>The Pros and Cons of physical activity</u>

The following are some negative statements about being more active.

What is you opinion?

1. Regular physical activity would take too much of my time.

       (Circle one of the numbers below)

Totally   1   2   3   4   5   Totally
disagree   agree

2. At the end of the day I am too exhausted to be active.

       (Circle one of the numbers below)

Totally   1   2   3   4   5   Totally
disagree   agree

3. I would have less time for my family and friends if I become regularly active.

       (Circle one of the numbers below)

Totally   1   2   3   4   5   Totally
disagree   agree

Add up your numbers that you circled in the above 3 questions and calculate your total.

                             Total...............

This is your **Cons** score for physical activity.

(end of page 10 of the manual)

<u>The Pros and Cons of physical activity</u>

The following are some positive statements about being more active.

What is you opinion?

1. I would feel more confident if I become regularly active.

      (Circle one of the numbers below)

Totally   1   2   3   4   5   Totally
disagree   agree

2. I would feel less stressed if I become regularly active.

      (Circle one of the numbers below)

Totally   1   2   3   4   5   Totally
disagree   agree

3. I would feel more comfortable with my body if I become regularly active.

      (Circle one of the numbers below)

Totally   1   2   3   4   5   Totally
disagree   agree

Add up your numbers that you circled in the above 3 questions and calculate your total.

                         Total……………

This is your **Pros** score for physical activity.

To find our what your scores mean, read on the next page.

(end of page 11 of the manual)

In which questions did you get a higher score, those referring to the Cons or the Pros of physical activity?

If your "cons" score was higher, it would be better to think a little bit more about your physical activity. Over the next few weeks it would be good to make a list of all the positive things you can think about physical activity Additionally, it would do you good if you re-read this manual placing special attention to the section that describes the reasons to become physically active.

If your "pros" score was higher, you may want to begin reading articles about physical activity and exercise. You may also want to talk to active friends or family about why they are active and how they got started.

This manual was designed to help you think about your physical activity habits. We want you to have a balanced view of physical activity, knowing both the risks and the benefits. At this point, it's up to you to choose whether you would like to become more active.

Good Luck!

(end of page 12 of the manual)

Appendix H:

Letter of permission to use and reprint

the stages of change manuals

The Miriam Hospital
A Lifespan Partner

BROWN MEDICAL SCHOOL

Date: June 1, 2004

Address: Nikolaos Tzormpatzakis
            PE Teacher
            MSc in Sport & Recreation Management
            Candidate for PhD in PE and Sports
            Faragoulitaki 34
            71409, Iraklion
            Greece

Dear Mr. Tzormpatzakis

This letter grants you permission to use and reprint Dr. Bess Marcus'
exercise self-efficacy and stage of exercise change instruments for
research purposes only. Dr. Marcus requests that in any presentation,
manuscript, or written material, the original instruments should be cited
appropriately. Good luck with your dissertation. We wish you much
success!

You may also want to purchase her book entitled, *Motivating People to
Be Physically Active,* which is published by Human Kinetics and available
at www.humankinetics.com. The book includes all the measures she
developed along with their theoretical foundations and scoring. The book
also includes information on conducting interventions with various
populations.

Again, thank you for your inquiry and interest.

Sincerely,

Bess H. Marcus, Ph.D.
Professors of Community Health and Psychiatry & Human Behavior
Director, Centers for Behavioral and Preventive Medicine
The Miriam Hospital and Brown Medical School

**The Centers for
Behavioral and
Preventive Medicine**

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Tel 401 793-8003
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Bess H. Marcus, PhD
Director
Centers for Behavioral
and Preventive Medicine
The Miriam Hospital
Professor
Department of Psychiatry
and Human Behavior
Brown Medical School

Appendix I:

Transtheoretical model questionnaires

Ορισμός **συστηματικής σωματικής δραστηριότητας**:

Η **σωματική δραστηριότητα** περιλαμβάνει ασχολίες όπως γρήγορο περπάτημα, χορό, τρέξιμο, ποδηλασία, κολύμβηση, τένις ή οποιαδήποτε άλλη ασχολία ή άθλημα σε κάνει να κινείσαι, να αναπνέεις πιο γρήγορα, να ιδρώνεις έστω και λίγο και αυξάνει τους χτύπους της καρδιάς σου χωρίς να είναι απαραίτητα κουραστική. Οι δραστηριότητες που μας ενδιαφέρουν είναι αυτές που έχουν είτε **μέτρια ένταση** (όχι ιδιαίτερα κουραστικές) είτε **μεγάλη ένταση** (περισσότερο κουραστικές).

Ένα άτομο της ηλικίας σου για να θεωρείται **συστηματικά σωματικά δραστήριο** θα πρέπει να συμπληρώνει **τουλάχιστον 5 φορές την εβδομάδα από 1 ώρα μέτριας** σωματικής δραστηριότητας ή **τουλάχιστον 3 φορές την εβδομάδα από 20 λεπτά έντονης** σωματικής δραστηριότητας ή ένα συνδυασμό δραστηριοτήτων μέτριας και μεγάλης έντασης π.χ. τουλάχιστον 2.5 ώρες μέτριας και 30 λεπτά έντονης σωματικής δραστηριότητας.

Οι παραπάνω ώρες μπορεί να είναι είτε συνεχόμενες π.χ. 60 λεπτά τρέξιμο, είτε να είναι χωρισμένες σε μικρότερα χρονικά διαστήματα κατά τη διάρκεια της ημέρας π.χ. ένα εικοσάλεπτο γρήγορου βαδίσματος το πρωί, ένα δεκάλεπτο ποδηλασίας το απόγευμα και ένα τριαντάλεπτο χορού το βράδυ συμπληρώνουν τα 60 λεπτά σωματικής δραστηριότητας. **Μην υπολογίσεις τη σωματική δραστηριότητα κατά το μάθημα της Φυσικής Αγωγής (Γυμναστικής) επειδή έχει χαρακτήρα υποχρεωτικού μαθήματος.**

Ερώτηση 1:

Είσαι **συστηματικά σωματικά δραστήριος/α** σύμφωνα με τον παραπάνω ορισμό:

Διάβασε πρώτα **όλες** *τις παρακάτω* **απαντήσεις** *και μετά σημείωσε με Χ* **μόνο μία**, *η οποία σε αντιπροσωπεύει.*

☐ Όχι, δεν είμαι συστηματικά σωματικά δραστήριος/α, και δεν σκοπεύω να γίνω στους επόμενους 6 μήνες

☐ Όχι, δεν είμαι συστηματικά σωματικά δραστήριος/α, αλλά σκοπεύω να γίνω στους επόμενους 6 μήνες

☐ Όχι, δεν είμαι συστηματικά σωματικά δραστήριος/α, αλλά σκοπεύω να γίνω στις επόμενες 30 ημέρες

☐ Ναι, είμαι συστηματικά σωματικά δραστήριος/α, αλλά για λιγότερο από έξι μήνες

☐ Ναι, είμαι συστηματικά σωματικά δραστήριος/α για περισσότερο από έξι μήνες

ΕΡΩΤΗΜΑΤΟΛΟΓΙΟ ΔΙΑΔΙΚΑΣΙΩΝ ΑΛΛΑΓΩΝ

Αυτό το ερωτηματολόγιο ερευνά τις σκέψεις σου και τις πράξεις σου όταν κάνεις σωματικές δραστηριότητες.

Διάβασε τις παρακάτω προτάσεις, έπειτα θυμήσου τον **τελευταίο μήνα** και **βάλε σε κύκλο τον αριθμό** που εκφράζει το πόσο συχνά κατά τον ελεύθερο σου χρόνο (εκτός του χρόνου των μαθημάτων) καθένα από τα παρακάτω έχει συμβεί.

Χρησιμοποίησε την παρακάτω κλίμακα:

1 ποτέ   2 σπάνια   3 μερικές φορές   4 συχνά   5 πολύ συχνά

	1 ποτέ	2 σπάνια	3 μερικές φορές	4 συχνά	5 πολύ συχνά
1. Έχω στο μυαλό μου πληροφορίες που μου έχουν δώσει εμένα προσωπικά για τα οφέλη της σωματικής δραστηριότητας...........	1	2	3	4	5
2. Σκέφτομαι πληροφορίες από άρθρα και διαφημίσεις για το πως θα κάνω τη σωματική δραστηριότητα ένα τακτικό μέρος της ζωής μου.	1	2	3	4	5
3. Διαβάζω άρθρα ή βλέπω εκπομπές σχετικά με τη σωματική δραστηριότητα προσπαθώντας να μάθω περισσότερα για το θέμα.	1	2	3	4	5
4. Ψάχνω για πληροφορίες σχετικές με τη σωματική δραστηριότητα..	1	2	3	4	5
5. Προειδοποιήσεις σχετικές με τους κινδύνους της έλλειψης σωματικής δραστηριότητας με «αγγίζουν» συναισθηματικά............................	1	2	3	4	5
6. Δραματικές περιγραφές των βλαβερών συνεπειών της σωματικής αδράνειας με «αγγίζουν» συναισθηματικά.................................	1	2	3	4	5
7. Αντιδρώ συναισθηματικά σε προειδοποιήσεις σχετικές με τον σωματικά αδρανή τρόπο ζωής...	1	2	3	4	5
8. Νιώθω ότι θα ήμουν καλύτερο πρότυπο για τους άλλους αν ήμουν συστηματικά δραστήριος/α..	1	2	3	4	5
9. Αναρωτιέμαι πως επηρεάζει η σωματική μου αδράνεια τους ανθρώπους που ζουν κοντά μου..	1	2	3	4	5
10. Συνειδητοποιώ ότι θα μπορούσα να επηρεάσω άλλους να γίνουν πιο υγιείς αν ήμουν πιο σωματικά δραστήριος/α	1	2	3	4	5

	1 ποτέ	2 σπάνια	3 μερικές φορές	4 συχνά	5 πολύ συχνά

11. Μερικοί από τους κοντινούς μου φίλους ίσως να γίνονταν

    περισσότερο δραστήριοι αν γινόμουν κι εγώ..................................... 1   2   3   4   5

12. Πιστεύω στην ιδέα ότι η συστηματική δραστηριότητα θα με κάνει

    ένα υγιέστερο και ευτυχέστερο άτομο... 1   2   3   4   5

13. Σκέφτομαι σχετικά με το τι τύπος ανθρώπου θα γίνω

    αν συνεχίσω να είμαι δραστήριος/α 1   2   3   4   5

14. Απογοητεύομαι με τον εαυτό μου όταν δεν κάνω

    σωματικές δραστηριότητες.. 1   2   3   4   5

15. Θεωρώ ότι θα έχω περισσότερη αυτοπεποίθηση αν είμαι

    συστηματικά δραστήριος/α.. 1   2   3   4   5

16. Βρίσκω ότι η κοινωνία αλλάζει με τρόπους που κάνουν τη ζωή

    πιο εύκολη για κάποιον που κάνει σωματικές δραστηριότητες............ 1   2   3   4   5

17. Αντιλαμβάνομαι ολοένα και περισσότερους ανθρώπους να με

    ενθαρρύνουν να γίνω σωματικά δραστήριος/α αυτές τις μέρες......... 1   2   3   4   5

18. Παρατηρώ ότι περισσότεροι εργοδότες ενθαρρύνουν τους
εργαζομένους τους να γίνουν σωματικά δραστήριοι προσφέροντάς
τους σχετικές δραστηριότητες ή χρόνο για να τις κάνουν................... 1   2   3   4   5

19. Μαθαίνω ότι πολλά ιδιωτικά γυμναστήρια τώρα παρέχουν δωρεάν

    υπηρεσίες φύλαξης παιδιών (μπέιμπι-σίτινγκ) στα μέλη τους............. 1   2   3   4   5

20. Αντί να μένω σωματικά αδρανής, κάνω κάποια σωματική

    δραστηριότητα 1   2   3   4   5

21. Αντί να θεωρώ την σωματική δραστηριότητα απλώς σαν ένα ακόμη

    καθήκον που θα πρέπει να το βγάλω από τη μέση, προσπαθώ

    να την χρησιμοποιώ σαν τον ξεχωριστό μου χρόνο για να

    ξεκουράζομαι και να χαλαρώνω από τις έγνοιες της ημέρας............. 1   2   3   4   5

22. Όταν νιώθω κουρασμένος/η, κάνω σωματικές δραστηριότητες,

    ούτως ή άλλως, επειδή ξέρω ότι θα νιώσω καλύτερα μετά 1   2   3   4   5

23. Όταν είμαι σε υπερένταση, βρίσκω ότι οι σωματικές

    δραστηριότητες είναι ένας θαυμάσιος τρόπος για να

    απαλλαγώ από τις ανησυχίες μου. 1   2   3   4   5

	1 ποτέ	2 σπάνια	3 μερικές φορές	4 συχνά	5 πολύ συχνά

24. Έχω κάποιον στον οποίο μπορώ να στηριχτώ όταν έχω
προβλήματα με το να κάνω σωματικές δραστηριότητες..................... 1 2 3 4 5

25. Έχω έναν σωματικά δραστήριο γνωστό/η που με ενθαρρύνει να
κάνω σωματικές δραστηριότητες όταν δεν αισθάνομαι ικανός/η. 1 2 3 4 5

26. Έχω κάποιον που μου επισημαίνει τις δικαιολογίες μου
για να μην είμαι σωματικά δραστήριος/α. 1 2 3 4 5

27. Έχω κάποιον που μου δίνει συμβουλές σχετικά
με τις σωματικές μου δραστηριότητες. 1 2 3 4 5

28. Ανταμείβω τον εαυτό μου όταν είμαι σωματικά δραστήριος 1 2 3 4 5

29. Προσπαθώ να θέτω ρεαλιστικούς στόχους για τον εαυτό μου,
σχετικά με τη σωματική δραστηριότητα, αντί να περιμένω πάρα
πολλά με κίνδυνο να μην τα πετύχω. 1 2 3 4 5

30. Όταν είμαι σωματικά δραστήριος, συλλογίζομαι ότι φέρομαι καλά
στον εαυτό μου με το να προσέχω το σώμα μου. 1 2 3 4 5

31. Ανταμείβω με κάτι ωραίο τον εαυτό μου όταν κάνω προσπάθειες
να είμαι περισσότερο σωματικά δραστήριος/α........................... 1 2 3 4 5

32. Λέω στον εαυτό μου ότι είμαι ικανός/η να συνεχίσω να είμαι
σωματικά δραστήριος/α αν το επιθυμώ.................................... 1 2 3 4 5

33. Λέω στον εαυτό μου ότι αν προσπαθώ αρκετά σκληρά μπορώ
να συνεχίσω να είμαι σωματικά δραστήριος/α............................ 1 2 3 4 5

34. Δίνω υποσχέσεις στον εαυτό μου να είμαι σωματικά δραστήριος/α.. 1 2 3 4 5

35. Θυμίζω στον εαυτό μου ότι εγώ είμαι ο/η μόνος/η υπεύθυνος/η
για την υγεία μου και την καλή ζωή μου, και ότι μόνο εγώ μπορώ
να αποφασίσω αν θα είμαι σωματικά δραστήριος/α ή όχι. 1 2 3 4 5

36. Βάζω πράγματα γύρω-γύρω στο σπίτι μου, που μου θυμίζουν
να είμαι σωματικά δραστήριος/α.. 1 2 3 4 5

37. Διατηρώ πράγματα μέσα στο σχολείο μου, που μου θυμίζουν
να είμαι σωματικά δραστήριος/α.. 1 2 3 4 5

38. Απομακρύνω πράγματα που συνεισφέρουν
στην σωματική μου αδράνεια. 1 2 3 4 5

39. Αποφεύγω να περνώ πολύ χρόνο σε περιβάλλοντα που προωθούν
τη σωματική αδράνεια (καθιστική ζωή).................................... 1 2 3 4 5

ΕΡΩΤΗΜΑΤΟΛΟΓΙΟ ΑΥΤΟΠΕΠΟΙΘΗΣΗΣ

Αυτό το ερωτηματολόγιο ερευνά το πόση πίστη έχεις στον εαυτό σου όταν κάτι πηγαίνει στραβά με τη σωματική σου δραστηριότητα.

Διάβασε τις παρακάτω προτάσεις και **βάλε σε κύκλο τον αριθμό** που εκφράζει καλύτερα το πόση αυτοπεποίθηση έχεις ότι μπορείς να είσαι σωματικά δραστήριος στον ελεύθερο σου χρόνο (εκτός του χρόνου των μαθημάτων) σε κάθε μία από τις παρακάτω περιστάσεις.

Χρησιμοποίησε την παρακάτω κλίμακα:

1 Καθόλου   2 λίγο   3 μέτρια   4 πολύ   5 πάρα πολύ

	1 καθόλου	2 λίγο	3 μέτρια	4 μεγάλη	5 πολύ μεγάλη
Έχω την αυτοπεποίθηση ότι μπορώ να συμμετέχω συστηματικά σε σωματικές δραστηριότητες:					
1. Όταν είμαι κουρασμένος.	1	2	3	4	5
2. Όταν έχω κακή διάθεση	1	2	3	4	5
3. Όταν νομίζω ότι δεν έχω τον χρόνο	1	2	3	4	5
4. Όταν είμαι σε διακοπές	1	2	3	4	5
5. Όταν βρέχει ή χιονίζει	1	2	3	4	5

ΕΡΩΤΗΜΑΤΟΛΟΓΙΟ ΙΣΟΖΥΓΙΟΥ ΑΠΟΦΑΣΗΣ

Αυτό το ερωτηματολόγιο ερευνά τις θετικές και αρνητικές πλευρές της σωματικής δραστηριότητας.

Διάβασε τις παρακάτω προτάσεις και **βάλε σε κύκλο τον αριθμό** που εκφράζει καλύτερα πόσο σημαντική είναι **τώρα** για σένα η κάθε πρόταση σε σχέση με την απόφασή σου να είσαι σωματικά δραστήριος/α ή όχι στον ελεύθερό σου χρόνο (εκτός ωρών μαθημάτων).

Χρησιμοποίησε την παρακάτω κλίμακα:

	1 καθόλου σημαντική	2 λίγο σημαντική	3 μέτρια σημαντική	4 πολύ σημαντική	5 πάρα πολύ σημαντική
1. Θα έχω περισσότερη ενεργητικότητα για τους κοντινούς μου ανθρώπους αν είμαι περισσότερο δραστήριος/α	1	2	3	4	5
2. Η συστηματική σωματική δραστηριότητα θα με βοηθήσει να ανακουφιστώ από την υπερένταση.	1	2	3	4	5
3. Θα νιώθω περισσότερη αυτοπεποίθηση αν είμαι συστηματικά δραστήριος/α.	1	2	3	4	5
4. Θα κοιμάμαι πιο καλά αν είμαι συστηματικά δραστήριος/α	1	2	3	4	5
5. Θα νιώθω πιο ωραία με τον εαυτό μου αν κρατήσω την υπόσχεσή μου να είμαι συστηματικά δραστήριος/α.	1	2	3	4	5
6. Θα μου αρέσει καλύτερα το σώμα μου αν είμαι συστηματικά δραστήριος/α	1	2	3	4	5
7. Θα είναι πιο εύκολο για μένα να κάνω καθημερινές ασχολίες αν είμαι συστηματικά δραστήριος/α.	1	2	3	4	5
8. Θα νιώθω λιγότερο άγχος και στρες αν είμαι συστηματικά δραστήριος/α	1	2	3	4	5
9. Θα αισθάνομαι περισσότερο άνετα με το σώμα μου αν είμαι συστηματικά δραστήριος/α.	1	2	3	4	5
10. Η συστηματική σωματική δραστηριότητα θα με βοηθήσει να έχω μια πιο θετική άποψη για τη ζωή.	1	2	3	4	5

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ΕΡΩΤΗΜΑΤΟΛΟΓΙΟ ΙΣΟΖΥΓΙΟΥ ΑΠΟΦΑΣΗΣ

Αυτό το ερωτηματολόγιο ερευνά τις θετικές και αρνητικές πλευρές της σωματικής δραστηριότητας.

Διάβασε τις παρακάτω προτάσεις και **βάλε σε κύκλο τον αριθμό** που εκφράζει καλύτερα πόσο σημαντική είναι **τώρα** για σένα η κάθε πρόταση σε σχέση με την απόφασή σου να είσαι σωματικά δραστήριος/α ή όχι στον ελεύθερό σου χρόνο (εκτός ωρών μαθημάτων).

Χρησιμοποίησε την παρακάτω κλίμακα:

	1 καθόλου σημαντική	2 λίγο σημαντική	3 μέτρια σημαντική	4 πολύ σημαντική	5 πάρα πολύ σημαντική

11. Νομίζω ότι θα είμαι πολύ κουρασμένος για να κάνω τις καθημερινές μου δουλειές μετά τις σωματικές δραστηριότητες... 1 2 3 4 5

12. Θα το βρω δύσκολο να βρω μια σωματική δραστηριότητα που θα μου αρέσει και δεν θα επηρεάζεται από τον κακό καιρό. 1 2 3 4 5

13. Νιώθω άβολα όταν κάνω σωματικές δραστηριότητες γιατί λαχανιάζω και η καρδιά μου χτυπάει πολύ γρήγορα. 1 2 3 4 5

14. Η συστηματική σωματική δραστηριότητα θα πάρει πολύ από το χρόνο μου... 1 2 3 4 5

15. Θα έχω λιγότερο χρόνο για τους κοντινούς μου ανθρώπους αν κάνω συστηματικά σωματικές δραστηριότητες. 1 2 3 4 5

16. Στο τέλος της ημέρας είμαι πολύ εξαντλημένος για να κάνω σωματικές δραστηριότητες. 1 2 3 4 5

Παρακαλώ συμπλήρωσε όσα από τα παρακάτω στοιχεία έχεις διαθέσιμα:

Ονοματεπώνυμο...

Έτος γέννησης....................

Διεύθυνση κατοικίας...ΤΚ.................

Τηλέφωνο σταθερό...

Τηλέφωνο κινητό...

E-mail..

Appendix J:

English version of transtheoretical model questionnaires

STAGES OF CHANGE QUESTIONNAIRE

Definition of **regular physical activity**:

Regular physical activity includes activities like fast walking, dancing, jogging, bicycling, swimming, tennis or any other activity or sport that makes you move, increases your breathing rate, causes you to break a sweat and raises your heart-beats, without having to be tiring. Of our interest are those that have **moderate intensity** (not very tiring) or **vigorous intensity** (more tiring).

A person of your age to be considered **physically active regularly** has to accumulate **1 hour of moderate** physical activity **at least 5 times per week** or **20 minutes of vigorous** physical activity **at least 3 times per week** or a combination of physical activities of moderate and vigorous intensity, for example, 2.5 hours of moderate and 30 minutes of vigorous physical activity.

The above hours can either be continuous, for example, 60 minutes of jogging, or divided into smaller bouts during the day, for example, 20 minutes of fast walking in the morning, 10 minutes of bicycling in the afternoon and 30 minutes of dancing in the night add up to 60 minutes of daily physical activity. **You should not include the time spent exercising during the class of Physical Education in school because it is obligatory.**

Question 1:

Are you **physically active regularly** according to the definition above?

First **r**ead **all** the **answers** below and then mark with *X only one, that applies to you.*

☐ No, I am not physically active regularly, and I do not intend to become in the next 6 months.

☐ No, I am not physically active regularly, but I intend to become in the next 6 months.

☐ No, I am not physically active regularly, but I intend to become in the next 30 days.

☐ Yes, I am physically active regularly but for less than 6 months.

☐ Yes, I am physically active regularly for more than 6 months.

PROCESSES OF CHANGE QUESTIONNAIRE

This questionnaire looks at what you have thought about or done when you do physical activities.

Read the following sentences, then recall the **previous month** and **circle the number** of times during leisure time activity (outside of class time) that each of the following items has occurred.

Use the following scale:

1 never   2 not often   3 some times   4 often   5 very often

	1 never	2 not often	3 some times	4 often	5 very often
1. I recall information people have personally given me on the benefits of exercise…………....................................	1	2	3	4	5
2. I think about information from articles and advertisements on how to make exercise a regular part of my life……….	1	2	3	4	5
3. I read articles or watch TV shows about exercise in an attempt to learn more about it. ………………………………	1	2	3	4	5
4. I look for information related to physical activity…………...	1	2	3	4	5
5. Warnings about health hazards of physical inactivity move me emotionally…………………………………………	1	2	3	4	5
6. Dramatic portrayals of the evils of physical inactivity move me emotionally…………...............................………	1	2	3	4	5
7. I react emotionally to warnings about an inactive lifestyle…	1	2	3	4	5
8. I feel I would be a better role model for others if I exercised regularly ....……………	1	2	3	4	5
9. I wonder how my inactivity affects those people who are close to me……………...	1	2	3	4	5
10. I realize that I might be able to influence others to be healthier if I would exercise more ....…………...	1	2	3	4	5

	1 never	2 not often	3 some times	4 often	5 very often

11. Some of my close friends might become more physically active
    if I would................................…………………………………… 1   2   3   4   5

12. I am considering the idea that regular physical activity would
    make me a healthier, happier person to be around………………. 1   2   3   4   5

13. I think about the type of person I will be if I keep being
    physically active……………...…….... 1   2   3   4   5

14. I get frustrated with myself when I am not physically active........... 1   2   3   4   5

15. I consider the fact that I would feel more confident if I was
    regularly physically active.. 1   2   3   4   5

16. I find society changing in ways that make it easier for the
    physically active person.………………………………………….. 1   2   3   4   5

17. I am aware of more and more people encouraging me to be
    physically active these days..………………………………………… 1   2   3   4   5

18. I notice that more businesses are encouraging their employees to
    exercise by offering fitness courses and time off to work out.............. 1   2   3   4   5

19. I am aware that many health clubs now provide free baby-sitting
    services to their members...............… ………………………………... 1   2   3   4   5

20. Instead of remaining inactive, I engage in some physical activity…... 1   2   3   4   5

21. Rather than viewing physical activity as simply another task
    to get out of the way, I try to use it as my special time to relax and
    recover from the day's worries...........…………………………........ 1   2   3   4   5

22. When I feel tired, I make myself do physical activities anyway
    because I know I will feel better afterwards.............………………….. 1   2   3   4   5

23. When I'm feeling tense, I find physical activity as a great way
    to relieve my worries...………………… 1   2   3   4   5

	1 never	2 not often	3 some times	4 often	5 very often

24. I have someone on whom I can depend when I am having

problems with participating in physical activities...................

1 2 3 4 5

25. I have a healthy who encourages me to be physically active

when I don't feel up to it..

1 2 3 4 5

26. I have someone who points out my excuses for not being

physically active. ....

1 2 3 4 5

27. I have someone who provides feedback about

my physical activities...

1 2 3 4 5

28. I reward myself when I am physically active...........................

1 2 3 4 5

29. I try to set realistic goals for myself about physical activity
rather than setting myself up for failure by expecting too much.....

1 2 3 4 5

30. When I am physically active, I tell myself that I'm being good
to myself by taking care of my body in this way. ....

1 2 3 4 5

31. I do something nice for myself for making efforts to be

more physically active...

1 2 3 4 5

32. I tell myself I am able to keep being physically active if I want to.....

1 2 3 4 5

33. I tell myself that if I try hard enough I can keep being

physically active..

1 2 3 4 5

34. I make commitments to being physically active..........................

1 2 3 4 5

35. I remind myself that I am the only one who is responsible for
my health and well-being, and that only I can decide whether
or not I will be physically active...

1 2 3 4 5

36. I put things around my home to remind me of being physically active..

1 2 3 4 5

37. I keep things around my place of work that remind me

of being physically active..

1 2 3 4 5

38. I remove things that contribute to my physical inactivity...........................

1 2 3 4 5

39. I avoid spending long periods of time in environments

that promote inactivity (sedentary life)....................................

1 2 3 4 5

SELF-EFFICACY QUESTIONNAIRE

This questionnaire looks at how confident you are (faith you have in yourself) to be physically active when other things get in the way.

Read the following sentences and **circle the number** which best expresses how confident you are that you can be physically active in your leisure time activity (outside of class time) in each of the following circumstances.

Use the following scale:

1 not at all   2 a little   3 moderately   4 very   5 completely

I am confident I can participate in physical activities regularly when:

	1 not at all	2 a little	3 moderately	4 very	5 completely
1. I am tired. …..................................……………………	1	2	3	4	5
2. I am in a bad mood………………………………………..	1	2	3	4	5
3. I feel I don't have the time……………………………	1	2	3	4	5
4. I am on vacation……………………………………	1	2	3	4	5
5. It is raining or snowing..…..	1	2	3	4	5

DECISIONAL BALANCE QUESTIONNAIRE

This questionnaire looks at positive and negative aspects of physical activity.

Read the following items and **circle the number** that indicates better how important each statement is **now** for you with respect to your decision to be physically active or not in your leisure time (outside of class time).

Use the following scale:

	1 not at all important	2 a little important	3 moderately important	4 very important	5 extremely important
1. I would have more energy for my family and friends if I were physically active regularly........................ ….	1	2	3	4	5
2. Regular physical activity would help me relieve tension. ....…………………	1	2	3	4	5
3. I would feel more confident if I was physically active regularly……………………....................	1	2	3	4	5
4. I would sleep more soundly if I was physically active regularly……………………....................	1	2	3	4	5
5. I would feel good about myself if I kept my commitment to be physically active regularly…….	1	2	3	4	5
6. I would like my body better if I were physically active regularly..….....	1	2	3	4	5
7. It would be easier for me to perform routine physical tasks if I was physically active regularly..........................	1	2	3	4	5
8. I would feel less stressed if I was physically active regularly..	1	2	3	4	5
9. I would feel more comfortable with my body if I was physically active …..................................……...	1	2	3	4	5
10. Regular physical activity would help me have a more positive outlook on life..............................………………....	1	2	3	4	5

	1 not at all important	2 a little important	3 moderately important	4 very important	5 extremely important

11. I think I would be too tired to do my daily work
    after physical activities ……………………………… 1 2 3 4 5
12. It would be difficult to find a physical activity that
    I enjoy that is not affected by bad weather. ....………… 1 2 3 4 5
13. I feel uncomfortable when I do physical activities
    because I get out of breath and my heart beats very fast. 1 2 3 4 5
14. Regular physical activity would take too much of my time. 1 2 3 4 5
15. I would have less time for my family and friends
    if I am physically active regularly. .... …………. 1 2 3 4 5
16. At the end of the day, I am too exhausted to do
    physical activities …………………… 1 2 3 4 5

Please fill in as much of the following information you have available:

Name and surname...

Date of birth....................

Residence......................................No........................Postal code.................

Phone...

Mobile phone...

E-mail………………………………………………………………..

Thanks for your cooperation

Appendix K:

Letter and informed consent for the concurrent validation of the stages of change questionnaire

Τζωρμπατζάκης Νικόλαος (MSc)

Καθηγητής Φυσικής Αγωγής

Υποψήφιος Διδάκτορας του Πανεπιστημίου Hull

Θερίσσου 34, 713 04 Ηράκλειο, Τηλ. 2810 371051

Αγαπητοί γονείς,

Στα πλαίσια της έρευνας με θέμα «**Διαχρονική έρευνα παρέμβασης για την προώθηση του σωματικά δραστήριου τρόπου ζωής σε μαθητές της 2ας Τάξης Ενιαίων Λυκείων του Νομού Ηρακλείου**» που διεξάγω μετά από έγκριση του Τμήματος Ερευνών του Παιδαγωγικού Ινστιτούτου του Υπουργείου Εθνικής Παιδείας και Θρησκευμάτων με την υπ'αριθμό 6/2004 πράξη σας στέλνω αυτό το γράμμα για να δώσετε την έγγραφη συναίνεσή σας για την συμμετοχή του παιδιού σας στην διαδικασία εγκυροποίησης των ερωτηματολογίων της έρευνας.

Συγκεκριμένα, θα ζητηθεί από το παιδί σας να συμπληρώσει το ερωτηματολόγιο σταδίων αλλαγών της έρευνας. Τα αποτελέσματα θα συγκριθούν με ένα ημερολόγιο δραστηριοτήτων που θα συμπληρώσει κατά τη διάρκεια 4 ημερών μίας εβδομάδας και με τα δεδομένα ενός καρδιοσυχνόμετρου με τη μορφή ρολογιού που θα φοράει τις ίδιες μέρες για να μετράει τους παλμούς της καρδιάς του.

Η όλη διαδικασία είναι εντελώς ακίνδυνη και θα γίνει και με τη σύμφωνη γνώμη και του παιδιού σας, φυσικά. Παρακαλώ, αν συμφωνείτε να συμπληρώσετε την δήλωση συναίνεσης.

Με τιμή

Νικόλαος Τζωρμπατζάκης

Έγγραφη δήλωση συναίνεσης

Τόπος...

Ημερομηνία...................../........../..............

Ονοματεπώνυμο...

Συναινώ για τη συμμετοχή του παιδιού μου .... στην διαδικασία εγκυροποίησης των ερωτηματολογίων της έρευνας με θέμα «**Διαχρονική έρευνα παρέμβασης για την προώθηση του σωματικά δραστήριου τρόπου ζωής σε μαθητές της 2ας Τάξης Ενιαίων Λυκείων του Νομού Ηρακλείου**» που διεξάγει ο Νικόλαος Τζωρμπατζάκης.

Ο/Η Δηλών

Υπογραφή

Appendix L:

Concurrent validation of the stages of change questionnaire with

heart rate monitoring and activity diaries

Table AL.1. Stages of Change, weekly Physical Activity and Heart Rate Monitoring

results in each of the 17 eligible students

No	SOC	Weekly PA	HRM results (Active >100% Inactive < 100%)
1.	C	Inactive	39%
2.	C	Inactive	6%
3.	M	Active	109%
4.	M	Active	113 %
5.	C	Inactive	46%
6.	**C**	**Active**	**230%**
7.	C	Inactive	55%
8.	C	Inactive	69%
9.	C	Inactive	9%
10.	**M**	Active	**56%**
11.	**A**	Active	**46%**
12.	M	Active	148%
13.	**M**	**Inactive**	**23%**
14.	M	Active	146%
15.	M	Active	113%
16.	PC	Inactive	56%
17.	PC	Inactive	9%

Note: Miss-matches between the three columns are highlighted in bold characters

Appendix M:

Tau(s) tables from latent transition analysis of the whole sample

Table AM.1. Tau(s) of the whole sample

IG	PC ^{M2}	C ^{M2}	PR ^{M2}	A ^{M2}	M ^{M2}	CG	PC ^{M2}	C ^{M2}	PR ^{M2}	A ^{M2}	M ^{M2}
PC^{M1}	0.26	0.27	0.10	0.33	0.04	PC^{M1}	0.66	0.04	0.15	0.16	
C ^{M1}		0.53		0.47		C ^{M1}		0.64	0.28	0.07	
PR ^{M1}		0.11	0.13	0.76		PR ^{M1}	0.06	0.13	0.24	0.42	0.15
A ^{M1}	0.02	0.04	0.55	0.34	0.05	A ^{M1}	0.08	0.04	0.24	0.65	
M ^{M1}		0.04			0.96	M ^{M1}	0.04		0.16	0.10	0.70

IG	PC ^{M3}	C ^{M3}	PR ^{M3}	A ^{M3}	M ^{M3}	CG	PC ^{M3}	C ^{M3}	PR ^{M3}	A ^{M3}	M ^{M3}
PC ^{M2}	0.43		0.57			PC ^{M2}	0.69	0.07	0.19		0.05
C ^{M2}	0.10	0.90				C ^{M2}		1.00			
PR ^{M2}		0.45	0.26	0.29		PR ^{M2}	0.10	0.44	0.11	0.19	0.16
A ^{M2}		0.51	0.24	0.25		A ^{M2}	0.25	0.37	0.13	0.16	0.09
M ^{M2}	0.02	0.23	0.02	0.04	0.69	M ^{M2}	0.03	0.20	0.12	0.05	0.60

IG	PC ^{M4}	C ^{M4}	PR ^{M4}	A ^{M4}	M ^{M4}	CG	PC ^{M4}	C ^{M4}	PR ^{M4}	A ^{M4}	M ^{M4}
PC ^{M3}	0.84	0.16				PC ^{M3}	0.71	0.23		0.06	
C ^{M3}	0.14	0.15	0.26	0.45		C ^{M3}	0.11	0.17		0.49	0.23
PR ^{M3}			0.35	0.65		PR ^{M3}		0.31	0.28	0.26	0.15
A ^{M3}		1.00				A ^{M3}		0.39	0.61		
M ^{M3}		0.02	0.11		0.87	M ^{M3}				0.10	0.90

Appendix N:

Within-group and within-gender differences of the processes of change

Table AN.1. Within-group and within-gender differences in the consciousness raising among all four measurements

Consciousness raising	n	IG	n	CG	n	IG boys	n	CG boys	n	IG girls	n	CG girls
Pre-intervention	262	**2.94**	401	2.88	117	**2.87**	169	2.71	145	**2.99**	232	3.00
Post- intervention	233	**3.31ᵃ**	337	2.99	98	**3.24ᶜ**	138	2.88	135	**3.38ᵈ**	199	3.07
1 year after interv .	209	**3.17ᵇ**	270	3.06	87	3.15	107	3.01	122	**3.19ᵉ**	163	3.09
2 years after interv .	96	3.17	86	3.16	37	3.06	22	3.05	59	3.25	64	3.19
Friedman test	$\chi^2(3)$=**13.86** **p=0.00**		$\chi^2(3)$=0.26 p=0.97		$\chi^2(3)$=3.08 p=0.38		$\chi^2(3)$=1.19 p=0.75		$\chi^2(3)$=**13.16** **p=0.00**		$\chi^2(3)$=1.10 p=0.78	

ᵃ*Wilcoxon test (pre- vs. post-intervention) z = -6.51, p = 0.000, r = 0.30*

ᵇ*Wilcoxon test (post- vs. one year after intervention) z = -3.09, p = 0.002, r = 0.15*

ᶜ*Wilcoxon test (pre- vs. post-intervention) z = -3.97, p = 0.000, r = 0.26*

ᵈ*Wilcoxon test (pre- vs. post-intervention) z = -5.19, p = 0.000, r = 0.30*

ᵉ*Wilcoxon test (post- vs. one year after intervention) z = -2.77, p = 0.006, r = 0.17*

Table AN.2. Within-group and within-gender differences in the dramatic relief among all four measurements

Dramatic relief	n	IG	n	CG	n	IG boys	n	CG boys	n	IG girls	n	CG girls
Pre-intervention	262	3.23	401	**3.31**	117	3.07	169	3.10	145	3.36	232	3.47
Post- intervention	233	3.39	337	**3.20**[a]	98	3.24	138	3.05	135	3.51	199	3.31
1 year after intervention	209	3.46	270	**3.29**	87	3.15	107	3.11	122	3.57	163	3.40
2 years after intervention	96	3.51	86	**3.57**[b]	37	3.32	22	3.25	59	3.63	64	3.68
Friedman test	$\chi^2(3)=6.48$ $p=0.09$		$\chi^2(3)=7.02$ $p=0.07$		$\mathbf{\chi^2(3)=11.26}$ $\boldsymbol{p=0.01}$		$\chi^2(3)=4.49$ $p=0.21$		$\chi^2(3)=4.20$ $p=0.24$		$\chi^2(3)=4.79$ $p=0.19$	

[a]*Wilcoxon test (pre- vs. post-intervention) z = -2.69, p = 0.007, r = 0.10*

[b]*Wilcoxon test (post- vs. one year after intervention) z = -2.60, p = 0.009, r = 0.20*

Table AN.3. Within-group and within-gender differences in the environmental re-evaluation among all four measurements

Environmental re-evaluation	n	IG	n	CG	n	IG boys	n	CG boys	n	IG girls	n	CG girls
Pre-intervention	262	**2.85**	401	2.79	117	2.85	169	2.75	145	2.85	232	2.81
Post- intervention	233	**3.00^a**	337	2.83	98	3.01	138	2.88	135	3.00	199	2.80
1 year after intervention	209	2.93	270	2.79	87	3.01	107	2.83	122	2.88	163	2.76
2 years after intervention	96	2.86	86	2.85	37	2.87	22	2.65	59	2.85	64	2.92
Friedman test	**$\chi^2(3)$=8.05**		$\chi^2(3)$=0.43		$\chi^2(3)$=2.44		$\chi^2(3)$=4.37		$\chi^2(3)$=7.76		$\chi^2(3)$=0.57	
	p=0.045		p=0.93		p=0.49		p=0.22		p=0.51		p=0.90	

^{a}Wilcoxon test (pre- vs. post-intervention) z = -2.67, p = 0.008, r = 0.12

Table AN.4. Within-group and within-gender differences in the self-re-evaluation among all four measurements

Self-re-evaluation	n	IG	n	CG	n	IG boys	n	CG boys	n	IG girls	n	CG girls
Pre-intervention	262	3.75	401	**3.75**	117	3.69	169	3.65	145	**3.79**	232	**3.83**
Post- intervention	233	**3.85**	337	**3.65**[b]	98	3.70	138	3.65	135	**3.95**[c]	199	**3.65**[d]
1 year after intervention	209	**3.73**[a]	270	3.59	87	3.61	107	3.57	122	3.81	163	3.60
2 years after intervention	96	3.76	86	3.79	37	3.52	22	3.63	59	3.92	64	3.84
Friedman test	$\chi^2(3)=2.97$ $p=0.40$		$\chi^2(3)=1.92$ $p=0.59$		$\chi^2(3)=1.55$ $p=0.67$		$\chi^2(3)=5.46$ $p=0.14$		$\chi^2(3)=3.49$ $p=0.32$		$\chi^2(3)=3.01$ $p=0.39$	

[a]*Wilcoxon test (post- vs. one year after intervention) z = -2.74, p = 0.006, r = 0.13*

[b]*Wilcoxon test (pre- vs. post-intervention) z = -2.90, p = 0.004, r = 0.11*

[c]*Wilcoxon test (pre- vs. post-intervention) z = -2.54, p = 0.011, r = 0.15*

[d]*Wilcoxon test (pre- vs. post-intervention) z = -3.13, p = 0.002, r = 0.15*

Table AN.5. Within-group and within-gender differences in the social liberation among all four measurements

Social Liberation	n	IG	n	CG	n	IG boys	n	CG boys	n	IG girls	N	CG girls
Pre-intervention	262	**2.69**	401	**2.55**	117	**2.70**	169	2.54	145	**2.69**	232	2.56
Post- intervention	233	**3.01^a**	337	**2.69^c**	98	**3.08^e**	138	2.69	135	**2.97^f**	199	2.69
1 year after intervention	209	**2.75^b**	270	2.65	87	2.71	107	2.72	122	**2.78^g**	163	2.60
2 years after intervention	96	2.68	86	**2.47^d**	37	2.64	22	2.34	59	2.70	64	2.52
Friedman test	$\chi^2(3)$=10.78 p=0.013		**$\chi^2(3)$=8.14** **p=0.043**		$\chi^2(3)$=4.23 p=0.24		$\chi^2(3)$=4.98 p=0.17		$\chi^2(3)$=8.07 p=0.045		$\chi^2(3)$=4.39 p=0.22	

[a]Wilcoxon test (pre- vs. post-intervention) z = -5.65, p = 0.000, r = 0.26

[b]Wilcoxon test (post- vs. one year after intervention) z = -4.94, p = 0.000, r = 0.24

[c]Wilcoxon test (pre- vs. post-intervention) z = -2.97, p = 0.003, r = 0.11

[d]Wilcoxon test (two years after- vs. post-intervention) z = -3.02, p = 0.003, r = 0.23

[e]Wilcoxon test (pre- vs. post-intervention) z = -4.44, p = 0.000, r = 0.29

[f]Wilcoxon test (pre- vs. post-intervention) z = -3.65, p = 0.000, r = 0.21

[g]Wilcoxon test (post- vs. one year after intervention) z = -3.21, p = 0.001, r = 0.20

Table AN.6. Within-group and within-gender differences in the counter-condition among all four measurements

Counter-condition	n	IG	n	CG	n	IG boys	n	CG boys	n	IG girls	n	CG girls
Pre-intervention	262	**3.43**	401	**3.44[c]**	117	**3.36**	169	**3.38**	145	**3.48**	232	**3.48**
Post- intervention	233	**3.60[a]**	337	**3.33[d]**	98	**3.61[e]**	138	**3.30**	135	**3.59**	199	**3.35[h]**
1 year after intervention	209	**3.31[b]**	270	3.18	87	**3.27[f]**	107	**3.28**	122	**3.34[g]**	163	**3.12[i]**
2 years after intervention.	96	3.48	86	3.36	37	3.52	22	3.38	59	3.46	64	3.35
Friedman test		$\chi^2(3)=8.90$ **p=0.031**		$\chi^2(3)=10.14$ **p=0.02**		$\chi^2(3)=2.20$ p=0.53		$\chi^2(3)=1.50$ p=0.68		$\chi^2(3)=8.61$ **p=0.035**		$\chi^2(3)=10.03$ p=0.18

[a]*Wilcoxon test (pre- vs. post-intervention) z = -2.95, p = 0.003, r = 0.14*

[b]*Wilcoxon test (post- vs. one year after intervention) z = -4.88, p = 0.000, r = 0.24*

[c]*Wilcoxon test (pre- vs. post-intervention) z = -2.72, p = 0.007, r = 0.10*

[d]*Wilcoxon test (post- vs. one year after intervention) z = -3.15, p = 0.002, r = 0.14*

[e]*Wilcoxon test (pre- vs. post-intervention) z = -3.04, p = 0.002, r = 0.20*

[f]*Wilcoxon test (post- vs. one year after intervention) z = -3.43, p = 0.001, r = 0.24*

[g]*Wilcoxon test (one year- vs. two years after intervention) z = -3.49, p = 0.000, r = 0.21*

[h]*Wilcoxon test (pre- vs. post-intervention) z = -2.72, p = 0.006, r = 0.13*

[i]*Wilcoxon test (post- vs. one year after intervention) z = -3.18, p = 0.001, r = 0.16*

Table AN.7. Within-group and within-gender differences in the Helping Relationships among all four measurements

Helping Relationships	n	IG	n	CG	n	IG boys	n	CG boys	n	IG girls	n	CG girls
Pre-intervention	262	**2.82**	401	**2.72**	117	**2.95**	169	**2.68**	145	**2.72**	232	2.75
Post- intervention	233	**3.18^a**	337	**2.87^d**	98	**3.36^e**	138	**2.93^i**	135	**3.04^h**	199	2.83
1 year after intervention	209	**3.01^b**	270	2.80	87	**3.05^f**	107	**2.91**	122	2.98	163	2.73
2 years after intervention	96	**2.69^c**	86	2.55	37	**2.68^g**	22	**2.14^{j,k}**	59	2.69	64	2.70
Friedman test		$\chi^2(3)$=**16.04** **p=0.001**		$\chi^2(3)$=5.21 p=0.16		$\chi^2(3)$=**12.20** **p=0.007**		$\chi^2(3)$=**9.29** **p=0.03**		$\chi^2(3)$=5.76 p=0.12		$\chi^2(3)$=1.26 p=0.74

^{a}Wilcoxon test (pre- vs. post-intervention) $z = -5.67$, $p = 0.000$, $r = 0.26$
^{b}Wilcoxon test (post- vs. one year after intervention) $z = -2.93$, $p = 0.003$, $r = 0.14$
^{c}Wilcoxon test (post- vs. two years after intervention) $z = -3.53$, $p = 0.000$, $r = 0.25$
^{d}Wilcoxon test (pre- vs. post-intervention) $z = -2.60$, $p = 0.009$, $r = 0.10$
^{e}Wilcoxon test (pre- vs. post-intervention) $z = -4.42$, $p = 0.000$, $r = 0.29$
^{f}Wilcoxon test (post- vs. one year after intervention) $z = -3.31$, $p = 0.001$, $r = 0.24$
^{g}Wilcoxon test (post- vs. two years after intervention) $z = -3.17$, $p = 0.002$, $r = 0.37$
^{h}Wilcoxon test (pre- vs. post-intervention) $z = -3.66$, $p = 0.000$, $r = 0.21$
^{i}Wilcoxon test (pre- vs. post-intervention) $z = -2.97$, $p = 0.003$, $r = 0.16$
^{j}Wilcoxon test (one year after- vs. two years after intervention) $z = -2.79$, $p = 0.005$, $r = 0.42$
^{k}Wilcoxon test (post- vs. two years after intervention) $z = -2.75$, $p = 0.006$, $r = 0.41$

Table AN.8. Within-group and within-gender differences in the reinforcement management among all four measurements

Reinforcement management	n	IG	n	CG	n	IG boys	n	CG boys	n	IG girls	n	CG girls
Pre-intervention	262	**3.49**	401	**3.49**	117	**3.49**	169	3.42	145	3.50	232	**3.53**
Post- intervention	233	**3.65**[a]	337	**3.40**[b]	98	**3.69**[c]	138	3.45	135	3.63	199	**3.37**[d]
1 year after intervention	209	3.48	270	3.40	87	3.45	107	3.49	122	3.50	163	3.34
2 years after intervention	96	3.55	86	3.59	37	3.47	22	3.59	59	3.60	64	3.70
Friedman test	$\chi^2(3)=5.45$ $p=0.14$		$\chi^2(3)=0.88$ $p=0.83$		$\chi^2(3)=1.94$ $p=0.59$		$\chi^2(3)=3.58$ $p=0.31$		$\chi^2(3)=4.13$ $p=0.25$		$\chi^2(3)=4.71$ $p=0.20$	

[a]*Wilcoxon test (pre- vs. post-intervention) z = -2.91, p = 0.004, r = 0.13*

[b]*Wilcoxon test (pre- vs. post-intervention) z = -2.81, p = 0.005, r = 0.11*

[c]*Wilcoxon test (pre- vs. post-intervention) z = -2.56, p = 0.010, r = 0.17*

[d]*Wilcoxon test (pre- vs. post-intervention) z = -2.94, p = 0.003, r = 0.14*

Table AN.9. Within-group and within-gender differences in the self-liberation among all four measurements

Self-liberation	n	IG	n	CG	n	IG boys	n	CG boys	n	IG girls	n	CG girls
Pre-intervention	262	**3.65**	401	3.64	117	**3.58**	169	3.54	145	3.71	232	3.72
Post- intervention	233	**3.82^a**	337	3.56	98	**3.85^c**	138	3.48	135	3.80	199	3.61
1 year after intervention	209	**3.59^b**	270	3.51	87	**3.48^d**	107	3.56	122	3.67	163	3.48
2 years after intervention	96	3.72	86	3.65	37	3.59	22	3.53	59	3.81	64	3.69
Friedman test		$\chi^2(3)=16.10$ **p=0.001**		$\chi^2(3)=1.12$ p=0.77		$\chi^2(3)=6.80$ **p=0.08**		$\chi^2(3)=2.07$ p=0.56		$\chi^2(3)=12.34$ **p=0.006**		$\chi^2(3)=1.13$ p=0.77

^{a}*Wilcoxon test (pre- vs. post-intervention) z = -3.06, p = 0.002, r = 0.14*

^{b}*Wilcoxon test (pre- vs. post-intervention) z = -3.92, p = 0.000, r = 0.19*

^{c}*Wilcoxon test (post- vs. one year after-intervention) z = -3.16, p = 0.002, r = 0.21*

^{d}*Wilcoxon test (pre- vs. post-intervention) z = -3.50, p = 0.000, r = 0.25*

Table AN.10. Within-group and within-gender differences in the stimulus control among all four measurements

Stimulus control	n	IG	n	CG	n	IG boys	n	CG boys	n	IG girls	n	CG girls
Pre-intervention	262	2.78	401	2.79	117	2.84	169	2.74	145	2.73	232	**2.82**
Post- intervention	233	**2.79**	337	2.73	98	**2.94**	138	2.75	135	2.68	199	2.71[c]
1 year after intervention	209	**2.55**[a]	270	2.64	87	**2.57**[b]	107	2.81	122	2.53	163	2.53
2 years after intervention	96	3.72	86	2.54	37	2.59	22	2.46	59	2.44	64	2.57
Friedman test		$\chi^2(3)=6.36$ p=0.10		$\chi^2(3)$**=13.22** ***p*=0.004**		$\chi^2(3)$=2.51 p=0.47		$\chi^2(3)$=6.54 p=0.09		$\chi^2(3)$=4.71 p=0.19		$\chi^2(3)$**=8.34** ***p*=0.04**

[a]*Wilcoxon test (post- vs. one year after-intervention) z = -3.98, p = 0.000, r = 0.19*

[b]*Wilcoxon test (post- vs. one year after-intervention) z = -3.29, p = 0.001, r = 0.23*

[c]*Wilcoxon test (pre- vs. post-intervention) z = -2.89, p = 0.004, r = 0.13*