# MOTIVATION FOR WEIGHT MANAGEMENT BEHAVIOURS: A SELF-DETERMINATION THEORY PERSPECTIVE

BY

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## ABSTRACT

According to self-determination theory (SDT; Ryan & Deci, 2000), the quality of support (autonomy support versus controlling) from important others is an important predictor of psychological need satisfaction, and subsequent engagement in health-conducive behaviours, such as physical activity and healthy eating. In this dissertation, four research studies grounded on SDT are presented. Results from these studies highlighted the important link between autonomy support and psychological need satisfaction. In turn, these studies showed that need satisfaction supported better psychological well-being and health-conducive behaviours. The findings also underscored the detrimental effects of controlling behaviours. For instance, such behaviours were found to be related to the thwarting of psychological needs, and in turn higher psychological ill-being and maladaptive outcomes, such as unhealthy eating behaviours. Motivation contagion effects were also examined in one study. The results suggested that practitioners' quality of support provided may vary as a function of their perceived motivation of a client. Findings from our studies have implications for researchers and important others (e.g. spouse) of individuals engaging in weight management. Possible areas for future research, such as the design of new interventions based on the tenets of SDT, are discussed.

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## LIST OF PAPERS, AND CONFERENCE PRESENTATIONS/ABSTRACTS

This dissertation is comprised of the following papers:

1. Ng, J. Y. Y., Ntoumanis, N., Thøgersen-Ntoumani, C., Deci, E. L., Ryan, R. M., Duda, J., & Williams, G. C. (2012). Self-determination theory applied to health contexts: A meta-analysis. *Perspectives on Psychological Science, 7*, 325-340.
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3. Ng, J. Y. Y., Ntoumanis, N., & Thøgersen-Ntoumani, C. (2012). *Autonomy support and control in weight management: What important others do and say matter.* Manuscript invited for resubmission.
4. Ng, J. Y. Y., Thøgersen-Ntoumani, C., & Ntoumanis, N. (2012). *Motivation contagion when instructing obese individuals: A test in exercise settings. Journal of Sport & Exercise Psychology, 34*, 525-538.

During the period of postgraduate study at the University of Birmingham, the following conference pr*esentations were given.*

1. *Ng, J. Y. Y. (2012*, August). *Self-determination theory applied to health contexts: a meta-analysis.* Poster presented at the 26th Conference of the European Health Psychology Society, Prague, Czech Republic.
2. Ng, J. Y. Y. (2012, May). *The brighter and darker sides of weight management: Are important others really helping?* Paper presented at The Psychological Aspects of Physical Activity and Health Across the Lifespan Conference, Birmingham, United Kingdom.
3. Ng, J. Y. Y. (2011, July). *The self-determination theory model of behaviour change: a meta-analysis of studies in health-related contexts*. Poster presented at the FEPSAC European Congress of Sport Psychology, Madeira, Portugal.
4. Ng, J. Y. Y. (2010, June). *Motivation to weight control: the influence of important others on diet and exercise behaviours, relapses and psychological well-being*. Poster presented at The Research Poster Conference of University of Birmingham, Birmingham, UK.

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# CHAPTER 1:

# GENERAL INTRODUCTION

## Background

Overweight and obesity have become a global epidemic. The proportion of overweight population has grown in many major countries world-wide, and is projected to rise (OECD, 2010). According to the World Health Organization (2010), overweight and obesity are risk factors associated with increased mortality and morbidity. In the UK, more than 60% of the population has been found to be overweight or obese in 2010 (OECD, 2011), with a projected rise to 70% by 2020 (OECD, 2010). As a result, health problems associated with overweight and obesity may result in increased medical costs of an extra £2 billion per year (Wang, McPherson, Marsh, Gortmaker, & Brown, 2011).

Researchers have shown that obesity is related to higher mortality rates (e.g., Adams et al., 2006; Orpana et al., 2009). Also, previous research has shown that a higher body mass index (BMI[1]) is associated with prevalence of cardiovascular diseases such as type II diabetes, higher blood pressure, and poorer health status (e.g., Mokdad et al., 2003; Sullivan, Morrato, Ghushchyan, Wyatt, & Hill, 2005). Moreover, other researchers have found that BMI was related to indicators of psychological ill-being, such as symptoms of depression and anxiety disorder (e.g., Crow, Eisenberg, Story, & Neumark-Sztainer, 2006; Petry, Barry, Pietrzak, & Wagner, 2008; Puppino et al., 2010). Apart from actual health indicators or outcomes, obesity is also related to reduced daily physical functioning capacities, increased discomfort in joints, lower energy levels, and reduced mobility (Kushner & Foster, 2000). Furthermore, obese individuals often receive unfair treatment, being stigmatised or even discriminated not only by people they encounter during their daily lives, but also health professionals (R. Puhl & Brownell, 2012; R. M. Puhl & Heuer, 2009).

[1] The BMI is a crude measure of body composition, and is calculated by dividing body weight (in kilograms) by the square of the height (in metres) of an individual. A higher index in non-athlete populations is usually interpreted as a higher degree of fatness. According to the World Health Organization, individuals with a BMI between 25 and 30 are classified as overweight; those with an index greater than 30 are classified as obese.

Numerous government initiatives have been implemented to address the growing problem of overweight and obesity (e.g., The Scottish Government, 2010). These initiatives place high importance on educating the public regarding the negative impacts of obesity and methods for weight loss. Nonetheless, factors at a more personal level, such as motivation, are overlooked or untapped through these initiatives. As a result, the proportion of overweight and obese population is still on an upward trend. Hence more effort may be required to address this problem also at a personal level – to identify factors that enhance or diminish individual efforts to weight management (referred to as the loss of excessive body weight or maintenance of a healthy body weight hereafter), and to implement these findings in order to improve the effectiveness of interventions designed to tackle the obesity epidemic.

**Weight Management Behaviours**

There are two main approaches to induce intentional weight loss, namely surgical (e.g., bariatric surgery) and behavioural. Behavioural change methods are more readily accessible to the general public (bariatric surgery is usually available to people having a BMI of 40 or more; National Institute for Health and Clinical Excellence, 2006), usually have a lower cost, do not have the risks associated with surgical methods, and could be incorporated within the daily lives of many people. In fact, most surgical approaches to weight loss also require patients to modify their behaviours (e.g., diet) after their surgeries. Hence, the study of antecedent factors to behavioural change is essential.

Amongst all non-surgical weight management behaviours, previous research has identified a few key behaviours that are important in terms of enhancing successful weight management. These include a controlled dietary intake and physical activity (Wing & Hill, 2001). However, individuals might be unable to adhere to the behavioural changes required for an extended period of time. Despite having clear guidelines for how successful weight management could be achieved, Wing and Hill (2001) suggested that only 20% of overweight or obese individuals trying to lose weight were able to maintain their body weight for at least

one year after they had succeeded in losing a portion of their initial weight. Therefore, the study of the motivation for weight management may be very important in terms of understanding sustained behavioural change, and hence the management of actual body weight.

**Motivation for Weight Management**

As successful weight management requires long-term adherence to associated behaviours such as controlled diets and being physically active. The motivation for weight management plays an important role in terms of determining the success or failure of such behaviours. There is also a need to identify contextual factors that might support or undermine the motivation towards these behaviours. By doing so, researchers may gain a better understanding of the mechanisms by which motivation might be altered, and therefore improve existing practices or design new interventions to help people manage their weight.

Researchers have utilised a number of psychological theories to study motivation towards weight management, or more generally health-related behaviours. Bandura's (1977) self-efficacy theory and Ajzen's (1991) theory of planned behaviour are amongst the theoretical frameworks commonly used by researchers in health-related contexts. Self-determination theory (SDT; Deci & Ryan, 1985b) is another theoretical framework frequently used by researchers in these contexts. Compared to other theories, SDT is the only motivational theory that highlights the importance of the basic psychological need for autonomy. Also, SDT is the only theory that differentiates quality from quantity of motivation, and provides an explanation of how different types of quality of motivation can lead to opposite outcomes. Further, SDT posits how dispositional factors and the social environment might affect motivation, and hence human behaviours. As one important variable being considered in this thesis concerns the interpersonal styles of clinicians, instructors, or any other important others, SDT is deemed an appropriate theoretical framework to be employed. SDT has been used as an underlying theoretical framework in previous studies within the

contexts of weight loss (e.g., Silva et al., 2011; Williams, Grow, Freedman, Ryan, & Deci, 1996), and also related behaviours such as physical activity engagement (e.g., Edmunds, Ntoumanis, & Duda, 2009; Markland, 2009) and dietary behaviours (e.g., Otis & Pelletier, 2008; Pelletier, Dion, Slovinec-D'Angelo, & Reid, 2004).

**Self-Determination Theory**

Proposed by Deci and Ryan (Deci & Ryan, 1985b, 2000; Ryan & Deci, 2000), SDT is a framework for the study of human motivation. Within SDT, rather than the quantity of motivation, a distinction between different qualities of motivation is made. Three psychological needs of competence, autonomy, and relatedness are central to SDT. According to the theory, the satisfaction or thwarting of these needs are determinants of behavioural outcomes, physical and psychological well-being. Furthermore, SDT also suggests how personal and social factors might affect the psychological needs. The tenets of SDT will be presented in further detail in the sections below.

**Basic Psychological Needs**

According to Ryan and Deci (2000), humans have three basic psychological needs, namely needs for *competence*, *autonomy*, and *relatedness*. Basic psychological needs, defined as "innate, organismic necessities… specify innate psychological nutriments that are essential for ongoing psychological growth, integrity, and well-being" (Deci & Ryan, 2000, p. 227), play a central role within SDT. When these needs are satisfied, beneficial behaviours and outcomes could be supported; in contrary, the thwarting of these needs would lead to undesired outcomes.

Competence refers to "feeling effective in one's ongoing interactions with the social environmental and experiencing opportunities to exercise and express one's capacities… [competence] is a felt sense of confidence and effectance in action" (Ryan & Deci, 2002, p. 7). In the context of weight management, an individual's need for competence may be satisfied if he or she successfully achieves previously set weight loss or maintenance goals. Another

basic need, the need for autonomy, is defined as "being the perceived origin or source of one's own behavior… concerns acting from interest and integrated values" (Ryan & Deci, 2002, p. 8). The need for autonomy could be satisfied if an exerciser genuinely feels it is his or her own decision to manage his or her body weight, and that the decision is not enforced by any external pressure or rewards. Finally, relatedness refers to "feeling connected to others, to caring for and being cared for by those others, to having a sense of belongingness both with other individuals and with one's community" (Ryan & Deci, 2002, p. 7). The need for relatedness could be satisfied, for example, when an individual feels a sense of companionship in his or her diet regimen, as there are other people who care about him or her.

Previous research has shown that the satisfaction of basic needs is associated with increased physical activity (e.g., Barbeau, Sweet, & Fortier, 2009; Edmunds, Ntoumanis, & Duda, 2007; Markland & Tobin, 2010; Rahman, Thøgersen-Ntoumani, Thatcher, & Doust, 2011), less binge eating or unhealthy eating behaviours (e.g., Schüler & Kuster, 2011; Thøgersen-Ntoumani, Ntoumanis, & Nikitaras, 2010), and improved psychological well-being (e.g., Edmunds et al., 2007; McDonough & Crocker, 2007; Rahman et al., 2011; Sebire, Standage, & Vansteenkiste, 2009). Ryan and Deci (2002) also suggested that the relation between basic need satisfaction and positive outcomes is universal, and should apply to individuals across all ages, genders, cultural backgrounds. Researchers have empirically tested the invariance of such relations between different genders and cultures (e.g., Adie, Duda, & Ntoumanis, 2008; Standage, Duda, & Ntoumanis, 2005; Taylor & Lonsdale, 2010). Results from these studies generally support the positive association between basic need satisfaction and positive outcomes across different groups of participants.

Psychological need thwarting, in contrast to need satisfaction, refers to the state in which the basic psychological needs are actively deprived or undermined (Deci & Ryan, 2000). For example, an individual's competence may be thwarted if he or she was made to feel incapable. Similarly, their autonomy or relatedness may be thwarted when undesirable

choices are forced upon them, or when they feel being rejected by others, respectively. According to Deci and Ryan (2000), need thwarting has negative impacts on people's health, vitality, and integrity. Within the context of weight loss, need thwarting may hence be related to unsuccessful weight management, or engagement in undesirable behaviours, such as dysfunctional eating. Unfortunately, extant studies within the context of weight management, or more generally health-related behaviours, did not include measures of need thwarting. Instead, low levels of need satisfaction were considered to be an indicator of need thwarting. Nonetheless, Bartholomew, Ntoumanis, Ryan, and Thøgersen-Ntoumani (2011) developed a scale to measure psychological need thwarting within the sport context. They also argued that need satisfaction and need thwarting are orthogonal constructs. That is, psychological needs could be (not) satisfied and (not) thwarted concurrently. Therefore, SDT-based research in weight management should also incorporate measures of both need satisfaction and thwarting, and examine how these constructs are related to outcomes associated with weight management.

**Behavioural Regulations**

Self-determination theory differs from other motivational theories by considering the *quality* of motivation, in addition to the *quantity*. Within SDT, motivation toward an activity is classified into different styles of regulatory processes along a continuum of varying degrees of perceived autonomy (see Figure 1). More autonomous forms of motivation, compared to controlled forms, are considered to be of a higher quality, as they are posited to be related to positive outcomes such as better adherence and psychological well-being. Specifically, motivation can be broadly classified into three types, namely *intrinsic motivation*, *extrinsic motivation*, and *amotivation*. Intrinsic motivation refers to the type of motivation that is "based in the inherent satisfaction of the behaviours per se, rather than in contingencies or reinforcements that are operationally separate from those activities" (Ryan & Deci, 2002, p. 11). It refers to doing an activity for the fun and enjoyment of the activity itself. In contrast,

extrinsically motivated behaviours are those engaged in order to obtain certain associated outcomes that are separable to the activity per se. Finally, amotivation represents "the state of lacking the intension to act" (Ryan & Deci, 2002, p. 17). When amotivated, individuals feel they are acting without reason.

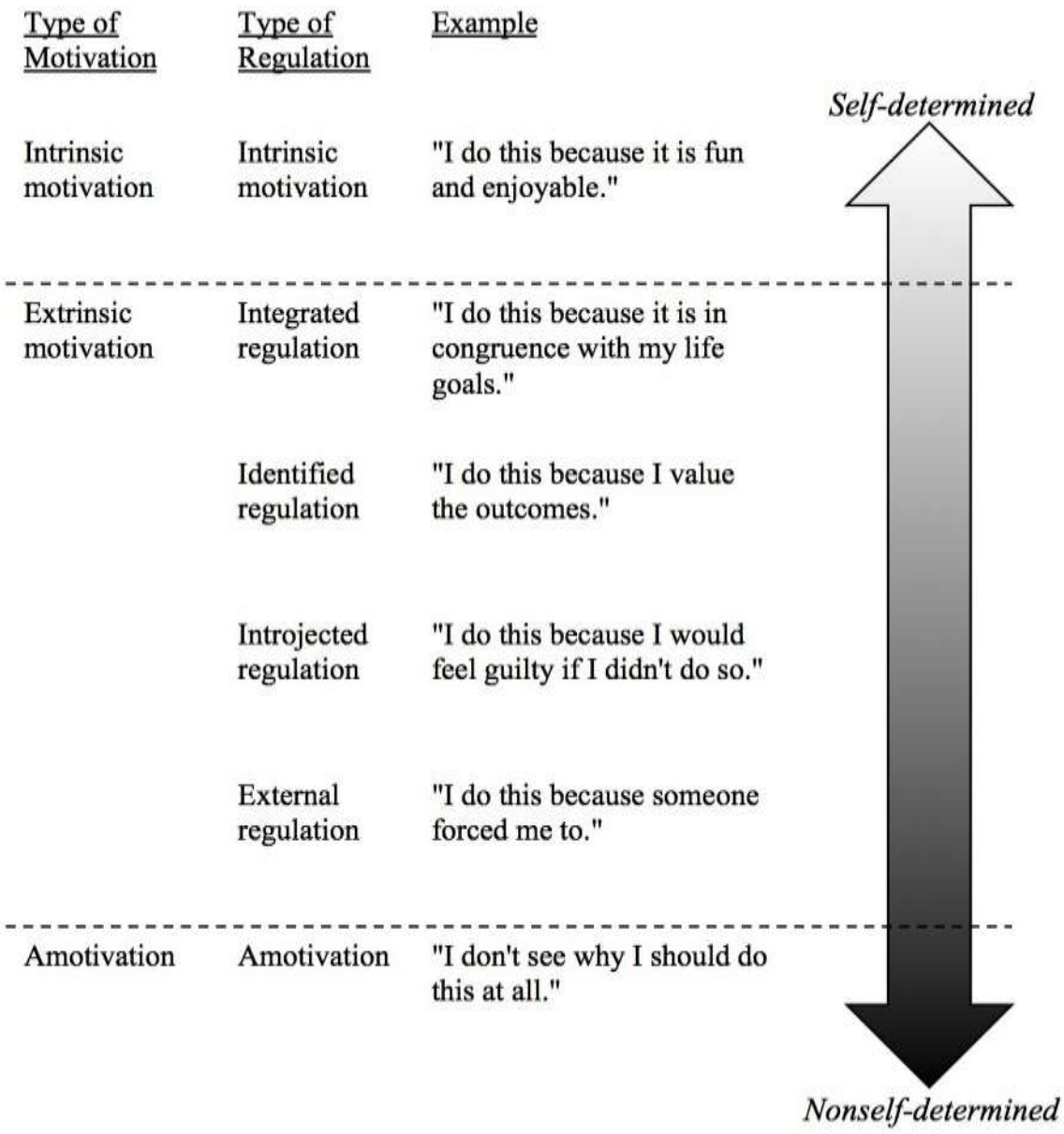


*Figure 1.1.* The self-determination theory continuum of different types of motivation and regulations.

Ryan and Deci (2002) further differentiated extrinsic motivation into four types of regulation of varying levels of perceived self-determination. *External regulation* is the least self-determined form of extrinsic motivation. It is defined as the motivation to obtain rewards, social approval or avoid punishment. In terms of weight management, this type of regulation is in operation when, for example, an individual attempts to lose weight because his spouse pressured him or her to do so. Another form of regulation is *introjected regulation*, and is evident when an individual engages in an action in order to avoid self-guilt or shame. For instance, when an individual goes on a diet because he or she would feel ashamed otherwise, this would be classified as a form of introjected regulation. It is considered to be a more internalised form of motivation compared to external regulation because the source of behaviour is within the self. However, both external regulation and introjected regulation represent controlled forms of motivation, because they are not considered to be a part of the integrated self (Ryan & Deci, 2002).

In contrast, *identified regulation* and *integrated regulation* are considered autonomous forms of extrinsic motivation. According to Ryan and Deci (2002), identified regulation "involves a conscious valuing of a behavioural goal or regulation, an acceptance of the behaviour as personally important". When acting out of identified regulation, an individual values the outcome of the action, and identifies the action as being personally important. For example, an individual with identified regulation would feel that maintaining a healthy body weight is important for his or her health, and therefore decides to exercise regularly and eat a healthy diet. Finally, with integrated regulation, identified forms of regulation are brought in line with personal goals, values, and identity of the individual. An individual may see him- or herself as a person who endorses a healthy lifestyle and body weight; he or she therefore stays physically active and maintain a healthy diet. This individual would be seen as having integrated regulation. This form of regulation represents the most autonomous form of extrinsic motivation.

Ryan and Deci (2002) underpinned that humans have an inborn tendency towards growth and intrinsic motivation. While we have physical needs for bodily functioning and development, we equivalently have psychological needs that have to be fulfilled to maintain optimal mental growth and operation. The satisfaction of basic needs act as nutrients for psychological functioning, and therefore support intrinsic motivation. However, many behaviours may not be inherently interesting and therefore are unlikely to be intrinsically motivating (e.g., maintaining a health diet). Nonetheless, Ryan and Deci suggested that need satisfaction would also support more autonomous forms of extrinsic motivation. Previous research has shown that need satisfaction is associated with more autonomous and less controlled forms of motivation (e.g., Hagger, Chatzisarantis, & Harris, 2006; Markland & Tobin, 2010; Puente & Anshel, 2010; Rahman et al., 2011; Silva, Markland, et al., 2010). Also, more autonomous forms of motivation were found to be associated with more physical activity behaviours (e.g., Annesi & Marti, 2011; Rahman et al., 2011), healthy eating behaviours (e.g., Otis & Pelletier, 2008; Shaikh, Vinokur, Yaroch, Williams, & Resnicow, 2011), and also indicators of psychological well-being including vitality and self-esteem (e.g., Rouse, Ntoumanis, Duda, Jolly, & Williams, 2011; Wilson & Rodgers, 2002). In contrast, amotivation was found to be related to less physical activity (e.g., Markland & Ingledew, 2007; Peddle, Plotnikoff, Wild, Au, & Courneya, 2008), less healthy dieting (e.g., Julien, Senecal, & Guay, 2009; Pelletier et al., 2004), and higher mental ill-being such as anxiety and depressive symptoms (e.g., Pelletier et al., 2004; Thøgersen-Ntoumani & Ntoumanis, 2006).

The predictive effects of controlled motivation towards behavioural outcomes are, however, less clear. With respect to physical activity, many researchers have found no relation between controlled motivation and self-reported behaviours (e.g., Mata et al., 2009; Williams, Gagne, Mushlin, & Deci, 2005). In terms of healthy eating, some researchers have found a positive relation between controlled motivation and behaviours (e.g., Williams et al., 2005), but others have null findings (e.g., Otis & Pelletier, 2008) or found these variables to

be inversely related (e.g., Julien et al., 2009). Nevertheless, controlled motivation was found to be related to more anxiety and depression (e.g., Pelletier et al., 2004; Thøgersen-Ntoumani & Ntoumanis, 2006), suggesting that controlled forms of motivation have adverse effects on psychological well-being.

Apart from adaptive behavioural and psychological outcomes, research has also shown that autonomous motivation is associated with actual weight loss. For example, Palmeira et al. (2007) examined the relation between weight changes and intrinsic motivation in 142 overweight women who took part in a weight control programme. Participants completed questionnaires containing measures of intrinsic motivation at the start and the end of the four-month programme. Body weight was also measured at both time points. Palmeira et al. found that changes in intrinsic motivation to exercise predicted weight loss over the four-month period. However, Palmeira et al. only included female participants. Also, they did not measure participants' extrinsic motivation. In another study, Silva et al. (2011) recruited 221 female exercisers who participated in exercise classes and weighed them over a three-year period. They showed that autonomous motivation, measured at two and three years from baseline, was associated with weight loss from baseline to a three-year follow up. In contrast, controlled motivation did not predict weight changes. Again, Silva et al. only included female exercisers in their study. Therefore, despite both studies showing that autonomous motivation predicted weight loss, it is unsure whether these findings are applicable to male individuals, or people who did not enrol in exercise programmes.

**Autonomy Support Versus Controlling Interpersonal Climate**

According to Deci and Ryan (2000), the perceived interpersonal styles of significant others, such as romantic partners or health practitioners, is an important antecedent of need satisfaction and thwarting, and different forms of motivation in relation to one's behaviour (e.g., managing weight by means of dieting). According to SDT, the interpersonal styles of these significant others could be broadly perceived as *autonomy supportive* or *controlling*.

The environment is more likely to be perceived as autonomy supportive when others take the perspective of the individual and provide information and opportunities to make choices (Williams, 2002). Furthermore, giving positive informational feedback, providing rationales, and supporting the individual's self-initiation for change are other behaviours that are considered to be autonomy supportive (Deci & Ryan, 1987; Williams et al., 2011). As these behaviours not only support individuals' need for autonomy, but also their competence and relatedness needs, autonomy support is also sometimes termed as need support (Teixeira, Carraça, Markland, Silva, & Ryan, 2012; Williams et al., 2011). An autonomy supportive climate enables individuals to feel more efficacious in their behaviours, being in control of their own actions, and also being cared for. As a result, their need satisfaction could be supported. By helping individuals take in behaviours as their own, an autonomy supportive climate would also foster more autonomous forms of motivation (Williams, 2002). Put into the context of weight management, a woman may perceive her husband to always acknowledge what she does in terms of dieting (competence satisfaction), encourages her to make her own decisions (autonomy satisfaction), and supports her decision to manage her weight (relatedness satisfaction). In turn, she enjoys her weight management regimen more (intrinsic motivation) and fully endorses the importance of managing her own weight (identified regulation). Consequently, she will more likely adhere to her regimen for a longer period of time, and therefore manage her weight more successfully.

Empirical studies have provided results that support the positive effects of perceived autonomy support in a context of weight management. Researchers have found that perceived autonomy support was associated with basic need satisfaction (e.g., Puente & Anshel, 2010; Silva, Markland, et al., 2010; Thøgersen-Ntoumani et al., 2010), autonomous motivation (e.g., Markland & Tobin, 2010; Russell & Bray, 2010), and other beneficial outcomes such as weight loss (e.g., Powers, Koestner, & Gorin, 2008; Silva et al., 2011) and psychological well-being (e.g., Edmunds et al., 2007; Rouse et al., 2011; Williams, Patrick, et al., 2009). For

example, one of the earliest studies was conducted by Williams et al. (1996). In the study, 128 severely obese individuals were recruited from a community hospital. Participants were then entered into a 26-week weight loss programme, which included weekly group meetings led by psychologists. Williams et al. showed that participants' perceived autonomy support predicted their autonomous motivation for weight loss, which in turn predicted higher attendance and more weight loss.

It is noteworthy that the degree of autonomy support can be manipulated with experimental studies showing that higher levels of perceived autonomy support may lead to better outcomes. For instance, Edmunds, Ntoumanis, and Duda (2008) compared perceived autonomy support, need satisfaction, and behavioural regulations of female participants in two exercise classes. Both classes were taught by the same instructor. She taught using her typical style in one of these classes ($n$ = 31; control group), and implemented a more autonomy supportive way of teaching in the other ($n$ = 25; experimental group). Independent observers blind to the conditions rated the instructor as more autonomy supportive when teaching the experimental group, compared to the control. At the end of the 10-week exercise programme, Edmunds et al. found that compared to the control group, participants in the experimental group showed higher levels of perceived autonomy support, need satisfaction, and positive affect. Participants in the experimental group also had higher attendance rates compared to the control group.

Similarly, Silva and colleagues (Silva et al., 2008; Silva, Vieira, et al., 2010) conducted a randomised controlled trial with overweight women trying to lose weight. Participants were recruited from the community to take part in a 12-month exercise programme, and were randomised into either an intervention group ($n$ = 123) or a control group ($n$ = 116). Participants in the intervention group were entered in a programme designed based on the tenets of SDT, and in particular highlighted the use of autonomy supportive behaviours. In contrast, the control group received a general health education programme. At

the end of the programme, participants in the intervention group lost more weight, reported higher levels of perceived autonomy support and autonomous motivation, and also exercised more. In a follow-up study, Silva et al. (2011) compared participants' long-term weight loss after the end of the intervention and the general education programmes. Specifically, 156 participants from the initial trials were weighed two years after the end of the initial programmes. Silva et al. found that participants in the intervention group lost significantly more weight compared to those in the control group. These findings suggest that perceived autonomy support could lead to adaptive physical and psychological outcomes in association with weight management.

In contrast to an autonomy supportive interpersonal style, a significant other could be perceived as controlling. A controlling interpersonal style is characterised by the use of pressure or contingent rewards or punishment to initiate behaviours (Williams, 2002). Other behaviours associated with a controlling style include using threats and humiliation, providing controlling feedback, imposing goals, and giving conditional regard (Bartholomew, Ntoumanis, & Thøgersen-Ntoumani, 2009; Deci & Ryan, 1987). When the interpersonal climate is controlling, individuals may feel less capable, more pressured to perform, and feel distanced by his or her significant other. Essentially, their needs for competence, autonomy, and relatedness may be thwarted. According to Deci and Ryan (2000), need thwarting may be related to controlled motivation, amotivation, or other undesirable outcomes. For example, a woman who is managing her weight may feel that her husband often tells her she will not succeed in managing her weight (competence thwarted), forcing her to eat foods that she does not like (autonomy thwarted), and argues with her over her regimen (relatedness thwarted). In turn, she feels pressured to stick to her diet (external), and sometimes feels a lack of motivation to continue (amotivation). Consequently, she may give up her weight management regimen, or take diet pills to manage her weight instead.

In the extant literature, no studies have examined the effects of a controlling interpersonal style on outcomes related to weight management. Instead, low levels of autonomy support were typically used to indicate the presence of controlling behaviours. However, researchers have argued that autonomy support and control should be considered as distinct constructs (Silk, Morris, Kanaya, & Steinberg, 2003). In terms of empirical research, Tessier, Sarrazin, and Ntoumanis (2008) showed that physical education teachers' provision of autonomy support was unrelated to uses of controlling behaviours. Bartholomew, Ntoumanis, Ryan, Bosch, & Thøgersen-Ntoumani (2011) showed, within a sport context, that although autonomy support and control were inversely associated, their relation was only moderate. Bartholomew, Ntoumanis, Ryan, Bosch, et al. (2011) also showed that the two constructs had different predictive effects in terms of psychological need satisfaction and thwarting. These findings, when applied to a context of weight management, may also hold true. For example, a husband may use a large variety of tactics to help his wife succeed in her weight management goals. Apart from explaining why that is important and acknowledging the negative feelings she has when she failed to meet her goals (autonomy support), he may also promise to get her a gift when she succeeds, or joke about her weight in front of others (controlling behaviours). That is, he could be perceived as autonomy supportive and

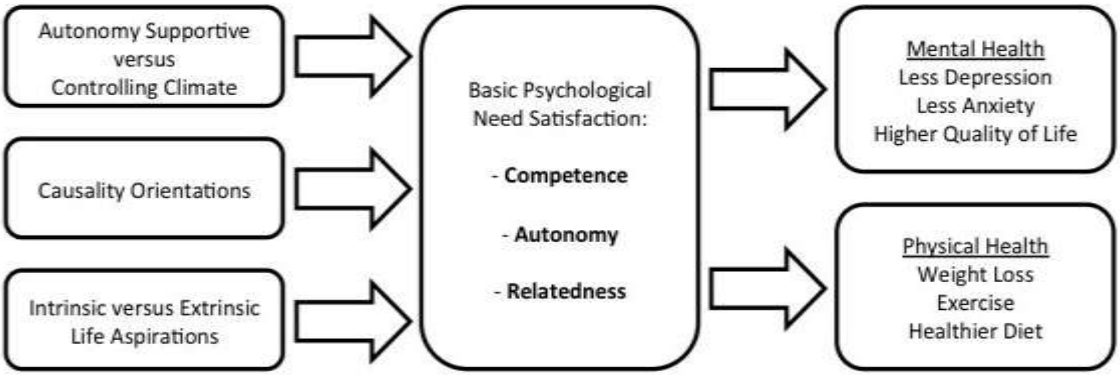


*Figure 1.2.* The self-determination theory model of health behaviour change adapted from Ryan et al. (2008).

controlling concurrently. Therefore, research in the context of weight management should also incorporate measures for controlling interpersonal styles, and examine its predictive effect for behaviours associated with management, as well as actual weight loss.

**Model of Health Behavioural Change**

Based on the tenets of SDT, Ryan, Patrick, Deci, and Williams (2008) proposed the SDT Model of Health Behavioural Change to emphasise the key components of the theory within health contexts, such as smoking abstinence, medication use, exercise, healthy dieting, and weight loss (Figure 2). Within the model, the satisfaction of the three basic needs is affected by three factors, namely perceived interpersonal climate, causality orientations, and life aspirations of individuals. Specifically, Ryan et al. suggested that a perceived autonomy supportive interpersonal style or climate would lead to higher levels of need satisfaction. On the contrary, a controlling style or climate would diminish need satisfaction. Secondly, personality differences in ways individuals orientate external events would also affect need satisfaction. Essentially, Deci and Ryan (1985a) suggested that all individuals have developed over time different perceptions of how behaviours are regulated. They may perceive behaviour to be initiated out of personal interests (autonomous orientation) or controlled reasons (controlled orientation). According to Ryan et al., individuals having a higher autonomous, relative to a controlled, orientation would more likely have their basic needs satisfied. The final factor that could affect need satisfaction pertains to the life aspirations of individuals. Kasser and Ryan (1993, 1996) proposed that individuals have two broad types of goals in life, or aspirations. Goals such as affiliation and personal growth are considered as intrinsic aspirations, while wealth and fame are examples of extrinsic aspirations. Ryan et al. suggested that the relative importance of these types of goals would affect perceptions of need satisfaction. Essentially, an individual's basic needs are more likely to be satisfied when they place more importance on intrinsic, relative to extrinsic life goals. In turn, when basic psychological needs are satisfied, Ryan et al. suggested that positive psychological (e.g., less

depressive symptoms and anxiety) and physical outcomes (e.g., more physical activity, eating a healthier diet, and more weight loss) will follow.

The SDT Model of Health Behavioural Change was drawn up based on research findings that used SDT as an underlying conceptual framework. However, there are several aspects within the model that are understudied. For instance, the sizes of effect of the relations in the model are unclear. For example, some researchers found a weak association between autonomy support and need satisfaction (e.g., Williams, Levesque, Zeldman, Wright, & Deci, 2003), while other researchers (e.g., Halvari, Halvari, Bjørnebekk, & Deci, 2010) found that these constructs are moderately to strongly correlated. Researchers have not attempted to identify whether the existence of such discrepancies is a result of measurement and sampling errors, or if these relations are moderated by other variables.

**Motivation Contagion Effect**

Another aspect that is understudied with Ryan et al.'s (2008) model concerns the directionality of the paths. Although the predictive paths in the model are unidirectional, researchers have found some evidence that some of these relations are, in fact, bidirectional. For example, Pelletier, Séguin-Lévesque, & Legault (2002) showed that students' motivation may influence how autonomy supportive or controlling a teacher might be. This is also known as the motivation contagion effect (Wild & Enzle, 2002). Specifically, Pelletier et al. found that when teachers perceived their students to be motivated for more controlled reasons, they will feel less autonomous in teaching, and also use more controlling behaviours while teaching students. Similar findings were found in other studies (e.g., Pelletier & Vallerand, 1996; Sarrazin, Tessier, Pelletier, Trouilloud, & Chanal, 2006). These findings may be important in the context of weight management. For instance, a husband may use more controlling behaviours to motivate his wife, who is managing her weight, if he feels that she is not enjoying her regimen. This, as mentioned in the sections above, may lead to undesirable outcomes, including failure to manage one's weight. However, these potential effects have

not been studied within the context of weight management, despite bearing important implications for both researchers and practitioners in the field, and therefore should be addressed.

**Objectives of Dissertation**

The objective of this dissertation is to address the gaps in the existent literature mentioned above. Specifically, there is a need to determine the sizes of effect between SDT-based constructs and health-related outcomes, incorporate the measurements of controlling behaviours and need thwarting in research, and also to examine whether motivation contagion effect exist within a context closely related to weight management.

In Study 1 (Chapter 2), a meta-analysis was conducted using data from all studies that measured SDT-based constructs within health care (e.g., smoking abstinence, diabetes treatment) or health promotion (e.g., physical activity, healthy eating) contexts. In this study, effect sizes retrieved from independent studies or datasets between SDT-based constructs, and between these constructs and related health outcomes, were recorded and synthesised. Moderation analyses were also conducted when the sizes of effect across studies were heterogeneous. Using the meta-analysed effect sizes, path analyses were conducted to test theoretical models based on SDT.

In Study 2 (Chapter 3), the SDT model of health behaviour change was examined in reference to behaviours related to weight management, namely physical activity engagement and diet behaviours. Participants with weight management goals (i.e., weight loss or maintenance) were recruited. Using a prospective design, participants reported their perceived interpersonal style of their important other, basic need satisfaction and thwarting, and outcomes including physical activity, eating behaviours, depressive symptoms, life satisfaction, and self-esteem. Participants completed questionnaires containing SDT-variables with respect to physical activity or diet, or both. After three months, they were asked to complete a questionnaire measuring the outcomes listed above. Using structural equation

modelling, we tested a model adapted from Ryan et al. (2008), with autonomy supportive and controlling behaviours predicting need satisfaction and thwarting, and in turn predicting the outcome variables measured.

Study 3 (Chapter 4) expanded our findings in Study 2 by incorporating behavioural regulations in the model we tested. Again, we recruited a community sample of participants who had weight management goals. Using a cross-sectional design, we asked participants to report their perceived interpersonal style of their important others, need satisfaction and thwarting, behavioural regulations, and behavioural outcomes including physical activity and eating behaviours. Contrasting to Study 2, we measured the SDT-variables with respect to perceptions towards weight management in general, instead of separately for physical activity and eating behaviours, in Study 3. Using structural equation modelling, we examined a model in which perceived autonomy support and controlling behaviours by important others predicted need satisfaction and thwarting, in turn predicting autonomous motivation, controlled motivation, and amotivation for weight management. Consequently, the behavioural regulations predicted the outcome behaviours.

In Study 4 (Chapter 5), the motivation contagion effect was examined within the context of exercise instruction in a gym setting, with reference to instructing obese individuals. The aim of the study was to explore whether sport and exercise students would use more (or less) autonomy supportive or controlling behaviours when asked to instruct a hypothetical exerciser who was perceived to have different levels of autonomous and controlled motivation for exercise. The relation between students' perception of autonomous motivation of the exerciser and their own motivation to instruct were examined. Furthermore, potential gender effects were explored.

# CHAPTER 2:

# SELF-DETERMINATION THEORY APPLIED TO HEALTH CONTEXTS:

# A META-ANALYSIS

**Abstract**

Behaviour change is more effective and lasting when patients are autonomously motivated. To examine this idea we identified 184 independent data sets from studies that utilized self-determination theory (SDT; Deci & Ryan, 2000) in health care and health promotion contexts. A meta-analysis evaluated relations between the SDT-based constructs of practitioner support for patient autonomy and patients' experience of psychological need satisfaction, as well as relations between these SDT constructs and indices of mental and physical health. Results showed (1) the expected relations among the SDT variables and (2) positive relations of psychological need satisfaction and autonomous motivation to beneficial health outcomes. Several variables (e.g., participants' age, study design) were tested as potential moderators when effect sizes were heterogeneous. Finally, using the meta-analyzed correlations, path analyses were used to test the interrelations among the SDT variables. Results suggested that SDT is a viable conceptual framework to study antecedents and outcomes of motivation for health-related behaviours.

## Introduction

Despite the continuous growth in both governmental and private health care expenditures (World Health Organization, 2010) the prevalence of chronic health problems in developed countries, such as the United States, is on the increase among all age, sex, ethnic, and income groups (Paez, Zhao, & Hwang, 2009). Most of these problems, such as obesity, type 2 diabetes, and cardiovascular diseases, could be alleviated by changes in lifestyle including abstaining from tobacco, eating a healthy diet, engaging in more physical activity, and taking recommended medications (e.g., to lower blood pressure or cholesterol; Chiuve, McCullough, Sacks, & Rimm, 2006; Yusuf et al., 2004). Notably, in terms of this latter health-related action, one third of all prescriptions written in the US are never filled and only half are continued over time as needed to yield the health benefits (Osterberg & Blaschke, 2005). Thus, understanding the motivation to engage in and adhere to health-conducive behaviours is of vital importance for the maintenance and improvement of people's health.

It is also the case that biomedical ethicists (Beauchamp & Childress, 2009) and new health care organizations around the world (Project of the ABIM Foundation, ACP-ASIM Foundation, & European Federation of Internal Medicine, 2002) adopted a new charter that raised the respect for patient autonomy and the elimination of social injustice to the highest level of priority for all health care practitioners. Previously, enhancing patient welfare had been considered the single-highest priority. This change means in part that health care practitioners are charged with the new goal of supporting patients' autonomy as well as the long-standing goal of enhancing patient welfare (physical and mental health, quality and length of life) in all encounters with their patients. The development of this new health care goal of respecting patients' autonomy, which health care practitioners are obligated to pursue (Beauchamp & Childress, 2009), along with the rising health care costs associated with poorly maintained health-promoting behaviours, point to the importance of a sound understanding of the health effects of supporting (vs. undermining) autonomy in health care

and health-promoting settings.

Self-determination theory (SDT; Deci & Ryan, 2000), a general theory of human motivation that has been applied in the health domain as well as others (e.g., education, work, sport), is the only theory of motivation that explicitly identifies autonomy as a human need that, when supported, facilitates more autonomous forms of behavioural regulation. SDT research accordingly focuses on patients' perceptions of practitioners' support for their autonomy (as well as the other basic psychological needs of competence and relatedness). Adaptive self-regulation of healthy behaviours (e.g., abstaining from tobacco, being more physically active, taking prescribed medications) is theorized to follow from the provision of greater autonomy support and satisfaction of the basic needs (e.g., Williams et al., 1996). Studies have also demonstrated that health care practitioners can be taught to be autonomy supportive (Williams & Deci, 2001; Williams, McGregor, et al., 2006). The present study used meta-analysis to quantitatively synthesize the relatively large volume of empirical studies in health care and health promotion contexts that have utilized SDT measures, and to specifically explicate the findings concerning the relations of support for patients' autonomy to psychological need satisfaction, autonomous self-regulation, and physical/mental health.

**Application of SDT in the Health Domain**

In the health domain, empirical work grounded in SDT has taken several forms including survey research, experimental studies, and clinical trials. Using cross-sectional (e.g., Edmunds et al., 2007; Halvari et al., 2010) and longitudinal survey-based studies (e.g., Hagger et al., 2006; Simoneau & Bergeron, 2003), research has typically examined relations between SDT-based constructs and outcome variables related to physical or mental health. Experimental field studies and clinical trials (e.g., Fortier, Sweet, O'Sullivan, & Williams, 2007; Niemiec, Ryan, Deci, & Williams, 2009) have typically trained health care practitioners to support the clients/patients' psychological needs and have documented significant changes in the latter's behavioural adherence, motivation, and well-being. Post-treatment follow-up

periods in such studies extend up to 24 months and have generally supported the long-term effects of the interventions. Ryan et al. (2008) described these studies using an SDT-based model of health behaviour change that explicates how SDT constructs interrelate and predict indices of mental and physical health (Figure 2.1). Three basic psychological needs, autonomy (feeling of being the origin of one's own behaviours), competence (feeling effective), and relatedness (feeling understood and cared for by others), capture a central place in the model (a list of SDT-based constructs together with their corresponding definitions, illustrative examples, and the most commonly used questionnaires to assess these constructs, is presented in Table 2.1). These three needs represent "psychological nutriments that are essential for ongoing psychological growth, integrity, and well-being" (Deci & Ryan, 2000, p. 229). Support and subsequent satisfaction of these needs provides a higher quality of psychological energy that is predicted to, and has been empirically confirmed to, motivate the initiation and long-term maintenance of health behaviours.

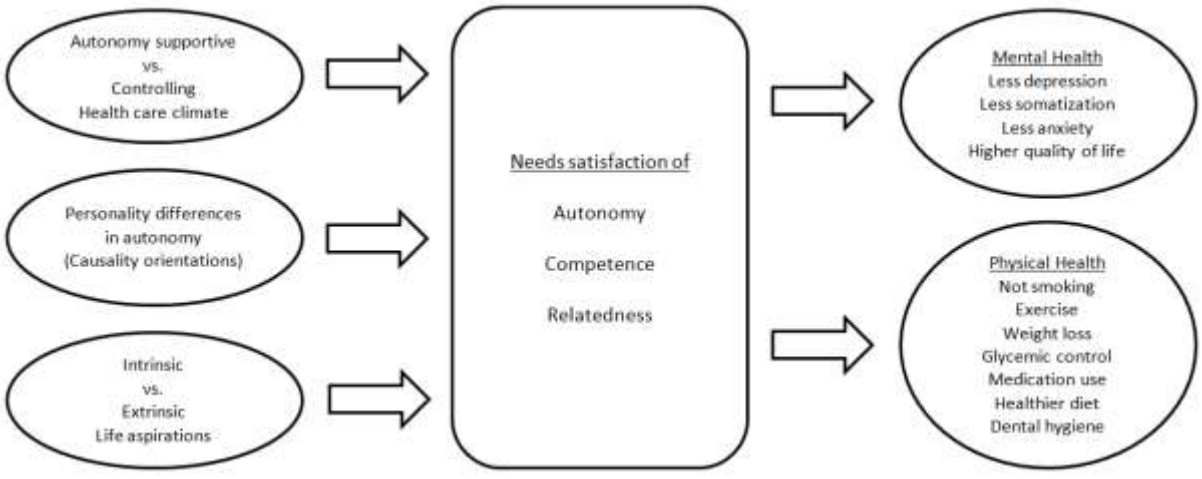


*Figure 2.1.* The SDT model of health behaviour change adapted from Ryan et al. (2008).

Table 2.1

*Summary of Self-Determination Theory Constructs Included in the Meta-Analysis*

| Construct | Definition | Examples | Frequently used measures |
|---|---|---|---|
| **Health care climate** | | | |
| Autonomy supportive climate | A treatment atmosphere that encourages individuals to engage in health-conducive behaviours for their own reasons, facilitates success in dealing with barriers to change, and conveys feelings of acceptance and respect. | "I feel understood and trusted by the physician;" "I am able to be open and share my feelings with the physician." | Health Care Climate Questionnaire (Williams et al., 1996). |
| Controlling climate[a] | A treatment atmosphere that controls people's behaviours through means such as offering tangible rewards or externally pressuring them toward practitioner valued behaviours or outcomes | "My physician tries to motivate me to exercise by promising to reward me if I do so. She is less accepting of me if I fail to do so." | |
| **Causality orientations** | | | |
| Autonomous orientation | An orientation reflecting individuals' engagement in behaviours based on interest and personal values. | "I wonder whether my new exercise regimen would be interesting and enjoyable." | General Causality Orientations Scale (Deci & Ryan, 1985a). |

| Construct | Definition | Examples | Frequently used measures |
|---|---|---|---|
| Controlled orientation | An orientation in which individuals engage in an activity focusing on external controls or directives. | "I wonder how much extra weight I could lose with this new exercise regimen." | |
| Impersonal orientation | An orientation in which individuals believe that attaining desired outcomes is beyond their control. | "What happens if I couldn't stick to this new exercise regimen?" | |
| **Life Aspirations** | | | |
| Intrinsic goals | Personal goals related to one's growth, community involvement, and meaningful relationships. | "It is important that I have good friends I can count on. It is also important that I help others improve their lives." | Aspiration Index (Kasser & Ryan, 1996). |
| Extrinsic goals | Personal goals related to wealth, fame, and image. | "Being financially successful and famous is very important to me." | |
| **Satisfaction of basic psychological needs** | | | |
| Autonomy | The perception of being the origin of one's own behaviour and experiencing volition in action. | "I feel free to exercise in my own way." | Psychological Need Satisfaction in Exercise Scale (Wilson, Rogers, Rodgers, & Wild, 2006); Basic Psychological Needs in Exercise Scale |
| Competence | The feeling of being effective in producing desired outcomes and exercising one's capacities. | "I feel capable and can overcome challenges when I exercise." | |

| Construct | Definition | Examples | Frequently used measures |
|---|---|---|---|
| Relatedness | Feeling of being respected, understood, and cared for by others. | "I feel close to my exercise companions." | (Vlachopoulos & Michailidou, 2006). |
| **Types of behavioural regulation** | | | |
| Intrinsic motivation | Motivation due to the inherent enjoyment derived from the behaviour itself. A facet of autonomous self-regulation. | "I exercise because it is fun and pleasurable." | Behavioural Regulation in Exercise Questionnaire (Markland & Tobin, 2004); Exercise Motivation Scale (Li, 1999). |
| Integrated regulation | Motivation to engage in behaviours which are in congruence with other central personal goals and values. A facet of autonomous self-regulation. | "I exercise because I consider exercise a fundamental part of who I am." | |
| Identified regulation | Motivation reflecting the personal value of the behaviour's outcomes. A facet of autonomous self-regulation. | "I exercise because I value the benefits of exercising." | |
| Introjected regulation | Motivation reflecting internal pressures such as contingent self-worth, guilt, shame, and need for external approval. A facet of controlled regulation. | "I exercise because I will feel guilty when I don't." | |
| External regulation | Motivation to comply with external pressures or rewards. A type of controlled regulation. | "I exercise because my physician says I should." | |

| Construct | Definition | Examples | Frequently used measures |
|---|---|---|---|
| Amotivation | The state of lacking intention to act. | "I can't see why I should bother exercising." | |
| Autonomous self-regulation | The composite of autonomous facets of self-regulation. | | Treatment Self-Regulation Questionnaire (Ryan, Plant, & O'Malley, 1995). |
| Controlled regulation | The composite of controlled facets of regulation. | | |

*Note* .[a] Only one study included in the meta-analysis assessed controlling health care climate using a scale developed by the authors.

As proposed by Ryan et al. (2008), satisfaction of three fundamental psychological needs of autonomy, competence, and relatedness leads to improved mental health (e.g., lower depression, anxiety, and higher quality of life) and health-conducive behaviours/physical health, referred to as "physical health" hereafter (tobacco abstinence, exercise, healthier diet, etc.). For instance, Halvari et al. (2010) showed that satisfaction of psychological needs was related to behaviours conducive to dental health (e.g., flossing) as well as attendance at dental clinics. Edmunds et al. (2007) found that satisfaction of the three needs was associated with life satisfaction, subjective vitality, positive affect, and levels of exercise among overweight individuals who participated in an exercise on referral programme.

In view of the importance of psychological needs satisfaction for health and optimal functioning, the SDT model identifies the contextual and personal factors that optimize such satisfaction. These factors are: an autonomy supportive health care climate, a high level of autonomy causality orientation, and intrinsic (relative to extrinsic) life aspirations. Aligned with medical professionalism and biomedical ethics, an autonomy supportive health care climate (e.g., taking the perspectives of patients, providing choices; Markland & Tobin, 2010; Williams, 2002) facilitates satisfaction of the basic psychological needs and respects patient choice, even when a patient chooses not to pursue recommended treatments. In contrast, a controlling health care climate thwarts people's need satisfaction through using tangible rewards or external pressure to move them toward specific outcomes (Ryan & Deci, 2000).

Personality differences in autonomy also have an effect on individuals' experience of satisfaction of their basic psychological needs. Deci and Ryan (1985a) proposed three types of causality orientations, namely, *autonomy orientation* which involves typically regulating behaviour on the basis of interest and personal values, *controlled orientation* which involves focusing on external controls or directives, and *impersonal orientation* which refers to experiences of acting beyond one's intentional control. Compared to those who are high in controlled or impersonal orientations, individuals high in autonomy orientation are more

likely to seek out opportunities that satisfy their basic psychological needs (e.g., Simoneau & Bergeron, 2003). Based on Ryan et al.'s (2008) model, it is expected that patients with greater autonomy orientations will be more motivated for positive health-related behaviour change.

The third predictor of psychological needs satisfaction within the SDT model of health behaviour change concerns the life aspirations of individuals. Kasser and Ryan (1996) suggested that humans have a combination of *intrinsic* (e.g., personal growth, community involvement, physical fitness) and *extrinsic aspirations* (e.g., wealth, fame, image). Ryan et al. (2008) posited that intrinsic aspirations are more congruent with well-being and healthy development compared to extrinsic ones, and hence are more likely to support satisfaction of the psychological needs. In line with this idea, studies have revealed lower mental and physical health outcomes when individuals emphasize more extrinsic aspirations (e.g. Kasser & Ryan, 1996). Also, when adolescents are relatively more extrinsic in their aspirations, they are more likely to engage in unhealthy behaviours such as smoking or using alcohol (Williams, Cox, Hedberg, & Deci, 2000).

Another central idea within SDT, which was not included in Ryan et al.'s (2008) model of health behaviour change, is the distinction between various types of motivation or behavioural regulation for specific behaviours or domains. These behavioural regulations are broadly classified as *autonomous self-regulation, controlled regulation,* and *amotivation* (Deci & Ryan, 2000). Autonomous self-regulation encompasses intrinsic motivation (motivation due to the inherent enjoyment derived from the behaviour itself), integrated regulation (engagement in behaviours which are congruent with other central personal goals and values), and identified regulation (motivation reflecting the personal value of the behaviour's outcomes). Controlled regulation concerns regulations reflecting a lower level of perceived autonomy and includes introjected regulation (motivation reflecting internal pressures such as contingent self-worth, guilt, shame, and feelings of approval) and external regulation (motivation to comply with external pressures or rewards). Lastly, amotivation

refers to the state of lacking any intention to act. Autonomous self-regulation has been shown to predict important health-related outcomes. For example, Silva et al. (2011) showed that autonomous self-regulation for exercise directly predicted moderate and vigorous physical activity as well as reduction in body weight. Williams, Rodin, Ryan, Grolnick, and Deci (1998) showed that autonomous self-regulation predicted medication adherence in adult outpatients, while Williams, Niemiec, Patrick, Ryan, and Deci (2009), in a randomized controlled trial focusing on autonomy support, found positive associations between an increase in autonomous self-regulation, abstinence from tobacco, and adherence to medication.

Within SDT, *internalization* refers to the active transformation of controlled regulation to more autonomous forms of self-regulation by personally endorsing the values of the corresponding behaviours. For example, an individual might initially stop smoking because of pressure from his/her doctor and family members (i.e., external regulation). Over time, however, he/she might endorse the benefits of not smoking and internalize his/her regulation to a more autonomous type (i.e., identified). Autonomous self-regulation is seen as an outcome of the processes of internalization, which facilitates behavioural engagement and its maintenance. Consequently, autonomous self-regulation holds critical implications for the health care domain. This is because individuals frequently engage in health behaviours that are not inherently interesting or enjoyable, or for which they have little knowledge and experience. However, if they are to maintain health and optimal functioning, it is necessary to internalize and personally value the health behaviours in question. Also, when people receive a new diagnosis, they are faced with new challenges and behaviours for which they do not have autonomous self-regulations or perceptions of competence in place (e.g., regulating the salt or eliminating sugar in their diets for new diagnoses of hypertension, or diabetes mellitus, respectively). These patients need to internalize regulations (e.g., endorse the importance of these dietary requirements) that will allow them to autonomously manage their conditions.

**The Present Study**

Although many studies have examined motivation for health-related behaviours using the SDT framework, no attempt has been made to systematically combine and quantify findings from these studies. A meta-analysis can offer evidence about whether SDT is a viable conceptual motivational framework to study personal and contextual factors that underpin health-related behaviours and associated outcomes. Such evidence can inform clinical practice and biomedical ethics regarding the goals of health care. Most of the studies have used one or more of the three independent variables (i.e., autonomy supportive health care climate, causality orientations, and life aspirations) shown in the SDT-based model proposed by Ryan et al. (2008), as well as one or more of the dependent variables (e.g., psychological need satisfaction, mental/physical health). Some of these studies have considered satisfaction of the three basic psychological needs shown in the Ryan et al. model as mediating variables, whereas others have focused on one type of motivation or behavioural regulation (usually autonomous self-regulation) as the mediator. The primary purpose of our meta-analysis was to calculate the effect sizes between indices of mental and physical health, autonomy supportive and controlling health care climates, psychological need satisfaction, and various types of self-regulation in health care and health promotion contexts.

Potential moderators of these effect sizes were identified and tested. According to Deci and Ryan (2000), the motivation processes described by SDT reflect universal tendencies; however, these can be constrained or subverted by a variety of factors. As a consequence, the association between SDT constructs and various outcomes might vary in strength as a function of such factors. In our meta-analysis, we looked at the potential moderating role of: study design (cross-sectional vs. prospective survey vs. experimental); study context (e.g., tobacco dependence treatment, diabetes care, dieting and weight loss, exercise and physical activity, medication adherence); whether or not participants were receiving treatment for health problems (treatment vs. non-treatment); and the age of

participants (below 18 years of age vs. 18 years of age and above). Moderation effects of gender and culture could not be examined in our meta-analysis, as most included studies had participants with mixed gender and ethnic backgrounds but did not provide separate statistics (needed for the meta-analysis) for these subgroups. Some of these individual (e.g., age) and contextual factors (e.g., study context) have been investigated in the SDT literature. Others (e.g., treatment vs. non-treatment) were created by us to reflect the diversity of contexts in which SDT has been studied in the health literature. Moderator analysis can be instrumental in identifying systematic differences within the meta-analysed effect sizes. The detection of such differences may have implications for the design of future SDT-based research studies.

The second purpose of our study was to use the meta-analysed correlation matrix as an input matrix for path analyses, to test an adaptation of Ryan et al.'s (2008) model (see Figure 2.2). We also tested a similar model (see Figure 2.3), developed by Williams et al. (Williams, McGregor, et al., 2006; Williams et al., 2002) specifically for health care settings, which focuses on autonomy supportive health care climate, individual differences in autonomy, perceived competence, and autonomous self-regulation. Path analysis and meta-analysis can complement each other (Viswesvaran & Ones, 1995) because path analysis captures interdependencies between several variables whereas meta-analysis can only examine the relation of two variables at a time. On the other hand, meta-analysis can serve to remove the

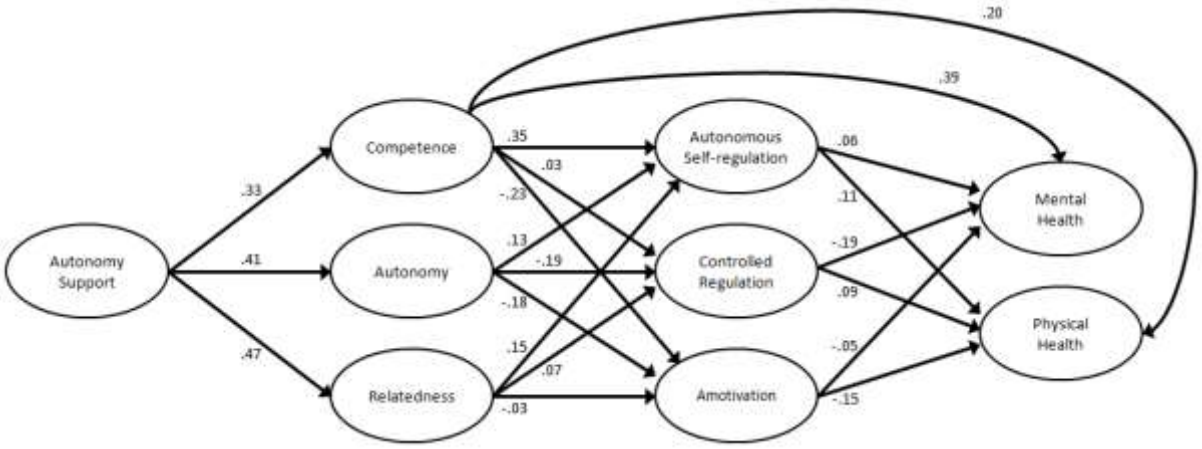


*Figure 2.2.* Path diagram of a broad SDT model using meta-analysed correlations ($n$ = 8,893). All paths are significant at $p < .05$; residual variances are omitted for presentation simplicity.

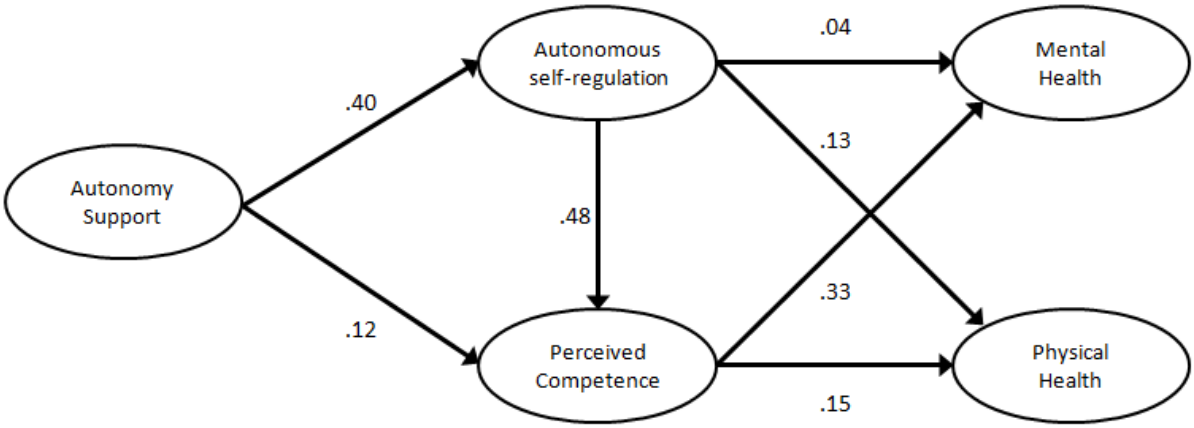


*Figure 2.3.* Path diagram of Williams et al.'s (2002, 2006) model using meta-analysed correlations ($n$ = 13,356). All paths are significant at $p < .05$; residual variances are omitted for presentation simplicity.

effects of artifacts from data (e.g., sampling error; see Methods for details) before the path analysis is conducted. Thus, our path analyses aimed to test the unique effects of each SDT variable, controlling for the presence of other SDT variables.

The third purpose of our study was to examine the effect sizes of relations among the SDT constructs themselves, namely autonomy supportive and controlling health care climates, causality orientations, life aspirations, psychological needs, and behavioural regulations. Moderator analyses were also conducted for heterogeneous effect sizes. Although we present all significant moderations in Appendix A, moderations of effect sizes involving *only* SDT constructs will not be discussed in this paper as our main focus is on the effect sizes related to the prediction of mental and physical health as a function of the targeted SDT constructs.

## Method

### Literature Search

A search of online databases (PsycINFO, PsycARTICLES, and PubMed) was conducted to identify studies that may be included in the meta-analysis, using a combination of SDT-related keywords (e.g., self-determination, autonomy, intrinsic motivation) and ones that define the context of interest (e.g., health, physical activity, glycemic control).

Furthermore, "citation searches", using the ISI Web of Knowledge, were conducted to identify publications that cited relevant SDT articles in the health domain which were not identified by our database searches. We also posted two messages on the SDT electronic mailing list, requesting authors to provide any unpublished data that included measures of SDT constructs in the health domain.

**Inclusion and Exclusion Criteria**

Using the above criteria, information on 184 independent data sets from 166 sources (157 journal articles, 4 theses/dissertations, 4 unpublished data sets, 1 paper under review) was included. Twenty one studies were excluded from the analyses because the corresponding authors were unable to provide information or did not respond to our request for such information. Examples of the health behaviours that the meta-analysed studies examined include physical activity, diabetes care, abstinence from tobacco, and weight control. We excluded studies that focused on competitive sport, school physical education, work motivation, and career choices for medical students. The information for all included studies are placed in Appendix B.

**Recording of Information**

The relations among the SDT constructs of autonomy supportive and controlling health care climates, causality orientations, life aspirations, psychological need satisfaction[2], behavioural regulations, and between each of these constructs and indicators of mental (e.g., depression, quality of life) and physical (e.g., physical activity, glycemic control) health were recorded. The zero-order correlation coefficient was chosen as the effect size to be considered

[2] Some studies referred to 'competence need satisfaction' and others to 'perceived competence'. Moderator analyses were conducted to examine whether the effects of each of these constructs with other SDT-variables were similar. Results showed that, with the exception of the effect sizes from competence need satisfaction/perceived competence to intrinsic motivation ($\rho$ = .55 and .71, respectively), all other effect sizes were similar. Thus, the effect sizes between the two competence constructs with other variables were combined.

as it was the most common metric presented in the studies. Hunter and Schmidt (2004) proposed the use of a reliability coefficient to correct for measurement errors within studies, so the Cronbach alphas for scale scores were also recorded[3]. Information such as the mean age of the participants, study design, and whether participants received treatment was also coded to allow moderator analyses to be conducted. For studies or cohorts with multiple measurements at different time points, a weighted average of the effect sizes between the same constructs at different times was recorded to avoid duplication of data from the same group of participants.

**Meta-Analysis of Coded Data**

The analytical procedures proposed by Hunter and Schmidt (2004) were employed to correct for sampling and measurement errors. This method adopts a random-effects model, which allows population effect sizes to vary across studies and provides estimates of these variations. For each effect size, an estimate of the true population correlation ($\rho$) was calculated. Using the criteria suggested by Cohen (1977), correlations above 0.50 are considered large; those between 0.30 and 0.50, moderate; and those between 0.10 and 0.30, small. The 95% confidence interval ($CI_{95}$) of each estimate was constructed around the true score correlation. If a $CI_{95}$ encompassed 0, then we considered that there was no relation between the two constructs. In order to address the file drawer problem (Rosenthal, 1979), the number of "lost" studies, reporting no effects, that would be needed to bring the meta-analysed correlations to a value of .10 (i.e., a small effect), was calculated using the formula provided by Hunter and Schmidt. We carried out this analysis when an effect size was obtained from at least 10 published studies ($k \geq 10$) with a corresponding $\rho > .10$. If the "fail-safe number" of studies is relatively large, it is reasonable to conclude that the calculated

[3] To measure most SDT constructs, the vast majority of the studies used one or two common scales, or their variants. Some of the most commonly used scales are presented in Table 1. Similar constructs from each scale (e.g., measures of intrinsic motivation) were combined across studies.

effect size is unlikely to be due to publication biases.

Total variances of the correlations were calculated, as well as those attributed only to sampling and measurement errors. The homogeneity of these variances was determined by the 75% rule recommended by Hunter and Schmidt (2004). Specifically, effect sizes were considered homogenous if 75% or more of the total variances were attributed to corrected artifacts (i.e., sampling and measurement errors). In cases where the homogeneity rule was not met, moderator analyses were conducted. Moderator analyses involved additional series of meta-analyses on the same set of correlations carried out separately across the levels of the moderator (e.g., study design). A variable was deemed a moderator if the $CIs_{95}$ of the separate effect sizes (e.g., the $CIs_{95}$ of the effect sizes between competence and external regulation across either two different types of study design) did not overlap (Hwang & Schmidt, 2011).

**Path Analysis**

Based on the yielded corrected meta-analysed correlations, path analyses using Mplus (Muthén & Muthén, 2008) were conducted to test a number of plausible SDT-based models (final models are shown in Figures 2.2 and 2.3). Consistent with previous meta-analyses that have also adopted follow-up path analyses (Viswesvaran & Ones, 1995), the harmonic mean of the sample sizes underpinning each effect size represented in the path models was used as the input sample size. Model fit was assessed using goodness-of-fit indices such as the comparative fit index (CFI), the root mean square error of estimation (RMSEA), and the standardized root mean squared residual (SRMR). Based on the recommendations of Hu and Bentler (1999), CFI values exceeding .95 indicates good model fit, while RMSEA and SRMR should not surpass values of .08 and .06 respectively.

## Results

### Effect Sizes Linking Autonomy Supportive and Controlling Health Care Climates, Psychological Needs Satisfaction, and Behavioural Regulations to Indices of Mental and Physical Health

Correlations reflecting the associations between the variables of autonomy supportive and controlling health care climates, psychological needs satisfaction, and behavioural regulations, and the outcomes of mental (e.g., vitality, depression) and physical (e.g., weight loss, tobacco abstinence) health indicators were meta-analysed (Table 2.2). Correlations between autonomy supportive health care climate and measures of positive mental health were positive (ranging from .22 to .37), whereas the correlations with indicators of negative mental health were negative (ranging from -.17 to -.23). Similarly, correlations of autonomy supportive health care climate with indicators of physical health were positive and ranged from .08 to .39. Thus, autonomy support (or respect for autonomy as per medical ethics) showed small to moderate relations to mental and physical health. The correlations of controlling health care climate with negative mental health was $\rho = .44$ and with positive physical health was $\rho = -.18$, but caution should be exerted as controlling health care climate was assessed in only one study.

Controlled forms of regulation and amotivation were negatively associated with indices of mental health ($\rho = -.28$ to $-.03$; with the exception of the effect size between introjected regulation and positive affect which was $\rho = .13$) and positively related to indicators of poorer mental health ($\rho = .13$ to $.46$). In terms of physical health, most but not all effect sizes between controlled regulation/amotivation and indices of physical health were in the predicted (negative or zero) direction ($\rho = -.26$ to $.18$). The $CI_{95}$ of some of these effect sizes encompassed zero (see Table 2.2), suggesting that the relation between some of the examined variables in the population is probably zero. None of the fail-safe numbers were substantially larger than the number of studies included. Hence when an effect was shown to

Table 2.2

*Meta-Analysed Correlations Between Autonomy Supportive and Controlling Health Care Climates, Basic Psychological Needs, Behavioural Regulations and Indicators of Mental and Physical Health*

| | AS | Con Climate | Aut | Com | Rel | IM | IG | ID | IJ | EX | AM | Aut Reg | Con Reg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Mental health** | | | | | | | | | | | | | |
| Depression | -.23 (5) | — | -.50[b] (1) | -.20 (6) | -.45[b] (1) | -.14 (2) | -.07 (2) | -.12[a] (3) | .24 (4) | .23 (4) | .13 (4) | -.06 (7) | .16 (2) |
| Anxiety | -.23 (4) | .44[b] (1) | -.23 (4) | -.32 (7) | -.30 (4) | -.24 (5) | -.33[b] (1) | -.13 (5) | .26 (5) | .30 (5) | .16 (4) | -.09 (3) | .46[b] (1) |
| Quality of life | .22 (2) | — | .40[b] (1) | .40 (2) | .38[b] (1) | .40 (2) | — | .33 (2) | -.03[a] (2) | -.21 (2) | -.28 (2) | .22[b] (1) | — |
| Vitality | .35 (4) | — | .35 (5) | .43 (5) | .38 (5) | .48 (3) | .35[b] (1) | .44 (3) | -.07 (3) | -.12[a] (3) | -.13 (2) | .26 (2) | — |
| Positive affect | .37 (4) | — | .35 (7) | .54 (7) | .53 (6) | .62 (7) | .45 (5) | .62 (7) | .13 (7) | -.16 (7) | -.20 (5) | — | — |
| Negative affect | -.17 (4) | — | -.32 (7) | -.33 (7) | -.28 (6) | -.28 (5) | -.05 (3) | -.09 (5) | .26 (5) | .36 (5) | .38 (3) | — | — |
| **Physical health** | | | | | | | | | | | | | |
| Smoking abstinence | .12 (4) | — | .11[b] (1) | .30 (3) | — | — | .11[b] (1) | .07[b] (1) | .05[b] (1) | -.05[b] (1) | .00[b] (1) | .16 (7) | .08 (3) |
| Exercise/Physical activity | .23 (30) | — | .15 (23) | .36 (30) | .14 (19) | .32 (51) | .26 (8) | .36 (48) | .18 (52) | -.03 (52) | -.24 (25) | .20 (16) | .01[a] (11) |

| | AS | Con Climate | Aut | Com | Rel | IM | IG | ID | IJ | EX | AM | Aut Reg | Con Reg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Weight loss | .28 (2) | — | .22[b] (1) | .22 (3) | — | .24 (4) | — | .30 (2) | .08[a] (2) | .00[a] (2) | — | .38 (3) | .02 (2) |
| Glycemic control | .08 (5) | — | — | .17 (4) | — | — | — | — | — | — | — | .14 (4) | .06[a] (2) |
| Medication adherence | .08 (2) | — | — | .17 (3) | — | — | — | — | — | — | — | .11 (4) | — |
| Healthy diet | .29 (3) | — | .13[a] (2) | .07[a] (2) | .14[a] (2) | .41 (4) | .67 (2) | .43 (4) | .16 (4) | .06[a] (4) | -.21[a] (4) | .41 (7) | .04[a] (8) |
| Dental hygiene | .39 (3) | -.18[b] (1) | .20[b] (1) | .53 (2) | .09[b] (1) | — | .35[b] (1) | .24[b] (1) | -.01[b] (1) | -.09[b] (1) | -.26[b] (1) | .23[b] (1) | — |

*Note.* AS = Autonomy supportive health care climate, Con Climate = Controlling health care climate; Aut = Autonomy need satisfaction, Com = Competence need satisfaction, Rel = Relatedness need satisfaction, IM = Intrinsic motivation, IG = Integrated regulation, ID = Identified regulation, IJ = Introjected regulation, EX = External regulation, AM = Amotivation, Aut Reg = Composite autonomous self-regulation (i.e., intrinsic motivation and identified regulation), Con Reg = Composite controlled regulation (i.e., introjected and external regulations). A dash (—) indicates that no studies included in the meta-analysis had measured the association between the corresponding constructs. The number of meta-analyzed studies (*k*) is presented in parentheses under the effect sizes.

[a]A true effect may not exist as the corresponding 95% confidence interval encompasses 0. [b]Effect size was obtained from one study only; no confidence intervals could be generated.

exist, it is unlikely that it was due to publication bias.

Also, as predicted by SDT, psychological needs and autonomous forms of self-regulation were positively related to indices of positive mental health (ρ = .22 to .62) and negatively related to indicators of negative mental health (ρ = -.05 to -.50). Similar results were found with physical health, with psychological needs and autonomous self-regulations correlating positively with health indices (ρ = .07 to .67) in the predicted directions. None of the $CIs_{95}$ of these effect sizes encompassed zero, apart from those between needs satisfaction and healthy diet (ρ = .07 to .14). With exceptions of the effect sizes between relatedness and exercise/physical activity (*k* = 19, fail-safe number = 8), as well as those between autonomy and exercise/physical activity (*k* = 23, fail-safe number = 12), the fail-safe numbers outnumbered the number of studies meta-analysed.

Moderation analyses were conducted with exercise/physical activity and diet behaviours as the only indicators of physical health. This was done because there were insufficient numbers of studies measuring autonomy supportive health care climate, psychological needs satisfaction, behavioural regulations, and the other health indicators to allow at least three studies at each level of the moderator. Also, only one study measured effect sizes between controlling health care climate and health indicators, hence moderation analyses on these relations could not be conducted. Of the three psychological needs, moderation effects were shown for autonomy only. Specifically, with respect to the effect sizes between autonomy and exercise/physical activity, both the design of studies and the treatment status of participants were moderators. Specifically, the effect sizes in experimental studies (ρ = .33, $CI_{95}$ = [.27, .39]) were larger than those in cross-sectional studies (ρ = .12, $CI_{95}$ = [.07, .17]) and prospective studies (ρ = .13, $CI_{95}$ = [.05, .21]). Also, the effect sizes in studies conducted with participants receiving treatments (ρ = .29, $CI_{95}$ = [.24, .34]) were larger than those in non-treatment settings (ρ = .12, $CI_{95}$ = [.08, .16]). With respect to behavioural regulations, the intrinsic motivation–physical activity relation was heterogeneous,

with effect sizes in treatment settings (ρ = .41, $CI_{95}$ = [.38, .45]) being stronger than those in non-treatment settings (ρ = .32, $CI_{95}$ = [.27, .37]). The relation between amotivation and physical activity was moderated by the age of participants. Effect sizes were negatively stronger in studies with younger participants (ρ = -.42, $CI_{95}$ = [-.54, -.30]) than with older participants (ρ = -.15, $CI_{95}$ = [-.19, -.12]). Furthermore, the composite[4] controlled regulation–healthy diet relation was positive in treatment settings (ρ = .12, $CI_{95}$ = [.07, .17]), but negative in non-treatment settings (ρ = -.15, $CI_{95}$ = [-.21, -.09]). Thus, controlled regulation predicted healthier diet in treatment settings, and worse diet in non-treatment studies.

**Combining Meta-Analysis and Path Analysis to Test SDT-Models of Health Behaviour**

The meta-analysed correlations were used to form an input matrix for path analyses. In terms of behavioural regulations, we used composite autonomous and controlled regulation instead of individual behavioural regulations. This was because in studies that reported composite regulation scores, effect sizes associated with these composites could not be separated into individual regulations (this would require access to the raw data of the studies). Thus, for studies that measured individual motivation regulations, we calculated (within each study) weighted means of effect sizes that corresponded to the autonomous (i.e., intrinsic, integrated, and identified regulations) and controlled (i.e., introjected and external regulations) composites. Weighted means were also used to derive effect sizes for composite mental and physical health outcomes (effect sizes for negative health indicators were reversed in sign). There were few or no studies that measured controlling health care climate, causality orientations, and life aspirations in conjunction with most of the other variables in the models being tested. Thus, these constructs were not included in the models.

We first tested a model in which autonomy supportive health care climate predicted

[4] The Treatment Self-Regulation Questionnaire (TSRQ; Ryan et al., 1995) is the most commonly used measure of self-regulation in treatment settings. The scale measures composite autonomous and controlled regulation without differentiating between individual behavioral regulations.

satisfaction of the needs for autonomy, competence, and relatedness, which in turn predicted autonomous and controlled regulation, as well as amotivation. Finally, the different types of behavioural regulations predicted mental and physical health. This model did not display a sufficiently good fit: $\chi^2$ (11) = 2187.92, $p < .01$, CFI = .90, RMSEA = .15, SRMR = .07. Based on studies by Williams et al. (2002, 2006), in which competence directly predicted health outcomes, we then tested a less restrictive model by freeing paths from competence to mental and physical health. Using the ΔCFI (CFI of less restrictive model minus CFI of more restrictive model) > .01 criterion put forward by Cheung and Rensvold (2002), which indicates that the less restrictive model fits better than the more restrictive nested model, the new less restrictive model showed an improved fit: $\chi^2$ (9) = 799.17, $p < .01$, CFI = .96, RMSEA = .10, SRMR = .04 (see Figure 2.2). The direct paths from competence to physical (β = .20) and mental health (β = .39) were low to moderate. The directions of all the paths in the model were in line with the tenets of SDT, although the sizes of some paths were smaller than the effect sizes reported in Tables 2.2 and 2.3 due to the intercorrelations between the predictors. We further tested two other plausible models by freeing paths from autonomy and relatedness, respectively, to mental and physical health. However, no substantial improvements in model fit were found (i.e., the ΔCFIs were not larger than .01), and hence these less parsimonious models were not accepted.

We then tested the model by Williams et al. (Williams, McGregor, et al., 2006; Williams et al., 2002) with autonomy supportive health care climate predicting perceived competence and autonomous self-regulation, which in turn predicted health outcomes (Figure 2.3). As the model by Williams et al. was initially proposed for health care treatment settings, we conducted the path analysis using effect sizes retrieved from studies confined to those settings. This model showed a good fit: $\chi^2$ (3) = 76.25, $p < .01$, CFI = .98, RMSEA = .07, SRMR = .03. Again, the directions of all paths in the model were in line with the tenets of SDT (see Figure 2.3).

Indirect effects from autonomy supportive health care climate to both mental and physical health were examined in both models. In the full SDT model, significant ($p < .01$) indirect effects were found from autonomy supportive health care climate to mental ($\beta = .16$) and physical health ($\beta = .12$). Similarly, in Williams et al.'s (2002) model, indirect effects from autonomy supportive health care climate to mental ($\beta = .12$) and physical health ($\beta = .10$) were also significant. Taken together, these results are consistent with the SDT model of health behaviour change suggesting that the health care climate affected perceived competence and autonomous self-regulation, which in turn predicted health behaviours and outcomes.

**Effect Sizes Between SDT-Based Constructs Only**

The effect sizes between autonomy supportive and controlling health care climates, causality orientations, life aspirations, psychological needs satisfaction, and behavioural regulations were generally in the direction predicted by SDT (Table 2.3). Moderate effect sizes were found between autonomy supportive health care climate and basic needs satisfaction ($\rho = .31$ to $.48$), and small to moderate effect sizes between autonomy supportive health care climate and autonomous self-regulation ($\rho = .21$ to $.42$). Small to large effect sizes from needs satisfaction to intrinsic life aspirations ($\rho = .22$ to $.53$) were detected. Also, the three psychological need satisfaction variables were found to relate positively with autonomous forms of self-regulation ($\rho = .22$ to $.59$), while negative effect sizes ($\rho = -.05$ to $-.35$) were detected between needs satisfaction with external regulation and amotivation. Effect sizes between introjected regulation and needs satisfaction ranged from .00 to .09. Further, the $CIs_{95}$ of the effect sizes of perceived competence–controlled regulation ($\rho = -.07$), autonomy–introjected regulation ($\rho = .00$), and relatedness–external regulation ($\rho = -.05$) encompassed zero. With exceptions of the effect sizes between perceived competence and external regulation ($k = 33$, fail-safe number = 15), as well as between relatedness and amotivation ($k = 14$, fail-safe number = 17), fail-safe numbers outnumbered the corresponding number of

Table 2.3

*Meta-Analysed Correlations Between SDT-Based Constructs Only*

| Construct | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Autonomy supportive health care climate | | 1 | 3 | 2 | 1 | 2 | 3 | 15 | 32 | 13 | 22 | 5 | 27 | 25 | 26 | 15 | 26 | 14 |
| 2. Controlling health care climate | -.57[b] | | — | — | — | — | — | 1 | 1 | 1 | 1 | — | 1 | 1 | 1 | 1 | 1 | 1 |
| 3. Autonomous orientation | .30 | — | | 8 | 4 | — | — | — | 1 | — | 3 | — | 3 | 3 | 3 | 1 | 4 | 4 |
| 4. Controlled orientation | .11 | — | .37 | | 4 | — | — | — | 1 | — | 2 | — | 3 | 3 | 3 | 1 | 1 | 1 |
| 5. Impersonal orientation | -.01[b] | — | .00[a] | .57 | | — | — | — | 1 | — | 2 | — | 3 | 3 | 3 | 1 | — | — |
| 6. Intrinsic goals | .16 | — | — | — | — | | 8 | 3 | 4 | 3 | 4 | 1 | 5 | 5 | 5 | 2 | 1 | — |
| 7. Extrinsic goals | -.10 | — | — | — | — | .40 | | 3 | 4 | 3 | 4 | 1 | 5 | 5 | 5 | 2 | 1 | — |
| 8. Autonomy need satisfaction | .42 | -.60[b] | — | — | — | .22 | -.03[a] | | 42 | 36 | 28 | 6 | 25 | 25 | 25 | 13 | 5 | 5 |
| 9. Competence need satisfaction | .31 | -.50[b] | .23[b] | .01[b] | -.31[b] | .33 | .13 | .59 | | 38 | 35 | 7 | 33 | 32 | 33 | 22 | 18 | 5 |
| 10. Relatedness need satisfaction | .48 | -.62[b] | — | — | — | .53 | .20 | .39 | .49 | | 24 | 6 | 23 | 22 | 23 | 14 | 2 | 1 |

| Construct | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 11. Intrinsic motivation | .42 | -.11[b] | .54 | .04[a] | -.35 | .47 | .09 | .46 | .59 | .41 | | 15 | 80 | 76 | 78 | 40 | 1 | 2 |
| 12. Integrated regulation | .21 | — | — | — | — | .30[b] | .22[b] | .36 | .46 | .22 | .78 | | 18 | 18 | 18 | 15 | 1 | 1 |
| 13. Identified regulation | .36 | .16[b] | .53 | .17 | -.13[a] | .47 | .27 | .38 | .50 | .34 | .85 | .89 | | 80 | 82 | 43 | 2 | 1 |
| 14. Introjected regulation | .09 | .29[b] | .35 | .31 | .05[a] | .32 | .41 | .00[a] | .09 | .08 | .23 | .50 | .51 | | 85 | 46 | 7 | 1 |
| 15. External regulation | -.02[a] | .31[b] | -.08[a] | .42 | .30 | .12 | .31 | -.24 | -.15 | -.05[a] | -.16 | .07 | -.03[a] | .49 | | 48 | 8 | 1 |
| 16. Amotivation | -.27 | .27[b] | -.06[b] | .20[b] | .13[b] | -.14 | .03[a] | -.32 | -.33 | -.21 | -.38 | -.32 | -.43 | .08 | .51 | | 10 | 4 |
| 17. Autonomous self-regulation | .39 | .03[b] | .50 | .27[b] | — | .23[b] | .17[b] | .22 | .41 | .43 | .66[b] | .72[b] | .70 | .40 | .13 | -.26 | | 26 |
| 18. Controlled regulation | .04[a] | .34[b] | -.09[a] | .47[b] | — | — | — | -.22 | -.07[a] | -.04[b] | .10[a] | -.29[b] | .01[b] | .60[b] | .56[b] | .44 | .28 | |

*Note.* Correlations corrected for both sampling and measurement errors are presented below the diagonal. The corresponding number of studies analyzed (*k*) are presented above the diagonal. A dash (—) indicates that no studies included in the meta-analysis had measured the association between the corresponding constructs.

[a]A true effect may not exist as the corresponding 95% confidence interval encompasses 0. [b]Effect size was obtained from one study only; no confidence intervals could be generated.

meta-analysed studies considerably.

## Discussion

In this research we compiled and systematically examined the empirical literature testing SDT in health care and health promotion settings. We specifically intended to estimate the effect sizes of the associations between key SDT constructs and various indicators of mental and physical health. Moderators of these effect sizes were also explored where appropriate. Lastly, drawing from the models of Ryan et al. (2008) and Williams et al. (2002), we used the meta-analysed effect sizes in path analyses to test the network of inter-relations between many of the variables included in the meta-analysis. Overall, the findings supported the value of SDT as a conceptual framework to study motivational processes and to plan interventions for improved health care and improved mental/physical health.

We identified 184 SDT-based studies in the health domain with independent data sets. This reflects the growing number of researchers utilizing this theory to understand and promote motivation for the adoption and maintenance of a healthy lifestyle. Moreover, the observed effect sizes were moderate in most cases and the overall pattern was in accordance with SDT. Autonomy supportiveness of the health care climates positively predicted higher levels of patient/client autonomy, competence, and relatedness within the health behaviour domain. That is, the provision of autonomy support was associated with greater needs satisfaction. In addition, the three psychological needs, as well as autonomous self-regulation, moderately to strongly predicted indicators of patient welfare, such as better mental health and higher levels of health behaviours, which are linked to physical health and length of life (e.g., abstinence from tobacco, being physically active, and taking prescribed medications). Taken together, SDT constructs predicted important outcomes across the biopsychosocial continuum in systems theory (Engel, 1977), from higher levels of personal well-being, down to markers of physiological and molecular health, including better glycemic control for patients with diabetes, healthier cholesterol, and lower levels of exposure to carcinogens in

smoke. These findings indicate that promoting patients' autonomy, which is now considered a critical health care outcome in its own right, happens also to promote better mental and physical health.

Another finding of this meta-analysis was that although controlled forms of regulation were hypothesized to be detrimental to health outcomes, introjected regulation was positively related to certain mental (e.g., positive affect) and physical (e.g., physical activity, healthy diet) health outcomes and behaviours. However, we also found a clear relation between introjected regulation and negative psychological outcomes such as depression and anxiety. These mixed effects of introjection suggest that while it may lead to the engagement of some positive health behaviours, at least over the short term, but such behavioural engagement may be accompanied by states of anxiety and dissatisfaction. There is evidence that introjected regulation, when it relates positively to positive outcomes, does so only for relatively short amounts of time (e.g., Pelletier, Fortier, Vallerand, & Brière, 2001). Thus, without discounting the occasional positive effect of this form of controlled regulation on the frequency of health-related behaviours, our findings support the promotion of autonomous self-regulation over controlled forms of regulation as the target of health care practitioners, researchers, policy makers, educators, parents, and significant others.

In terms of the effect sizes between pairs of SDT constructs, we found, as expected, positive relations between need satisfactions and autonomous forms of self-regulation. However, as indicated by the $CIs_{95}$ we calculated, low levels of need satisfactions were not always related to controlled regulation. Recent SDT-based research in other domains has made the case that need thwarting (i.e., the active undermining of basic need satisfaction) might be more appropriate to assess, as opposed to low levels of needs satisfaction, when non-optimal motivation patterns are under investigation (e.g., Bartholomew, Ntoumanis, Ryan, Bosch, et al., 2011), and has illustrated how controlling health care climates result in need thwarting, undermine motivation and contribute to ill-being.

The wide range of included studies also allowed moderation analyses to be conducted. Although we found that effect sizes between SDT constructs and health outcomes differed across different levels of moderators, most of these effects were similar in direction. One exception concerned the relation between controlled regulation and healthy diet behaviours, where we found a positive relation in treatment, but not in non-treatment, settings. The major difference between these settings is that individuals in treatment settings are guided by a clinician or instructor, whereas that is typically not the case in non-treatment settings. These findings suggest that although clinicians/instructors may successfully enhance autonomous self-regulation and create positive changes in individuals' behaviours, they might also stimulate controlled forms of regulation of those behaviours (i.e., feeling pressured by others or by guilt if they do not do the behaviours).

Another objective of this study was to test SDT-based models using path analyses. The results of these analyses supported the paths hypothesized by the theory, although some of the paths were smaller in magnitude than the effect sizes derived from the meta-analysed correlations due to the common variance shared between the predictors. In particular, paths from autonomous self-regulation to health outcomes were relatively small in both models; in contrast, competence explained a larger proportion of the variances of health outcomes. These path-analytic results highlight that the perception of being able to achieve these difficult-to-change health behaviours is imperative for making the change. In fact, several studies reviewed by Ryan et al. (2008) indicated that the link from autonomous self-regulation to health outcomes was often indirect, such that autonomous motivation was associated with increases in perceived competence, which in turn was associated with health outcomes (e.g., see Williams, McGregor, et al., 2006). Positive paths from need satisfaction of competence and relatedness to controlled regulation were also found, this was somewhat unexpected. According to Markland and Tobin (2010), when basic needs of competence and relatedness were not supported in an autonomy-supportive fashion, this may lead to introjected regulation,

which is a form of controlled motivation.

We recognize that the tests of the conceptual process models of Ryan et al. (2008) and Williams et al., (2002) in this paper represent cross-sectional associations and, as such, cannot be used to infer causality. We acknowledge that the relations could be bi-directional. For example, we believe that a patient being more autonomously self-regulated could prompt a practitioner to be more autonomy supportive, and that a patient with better mental health would likely experience greater perceived competence for making a health behaviour change. Some of the studies in the meta-analysis were based on cross-sectional data, and others on longitudinal data which might suggest directionality but not causality. However, it is important to note that we also included several randomized clinical trials (e.g., Fortier, Sweet, et al., 2007; Williams, McGregor, et al., 2006; Williams, McGregor, Zeldman, Freedman, & Deci, 2004), whose findings do imply causality.

It is also important to underscore that autonomy is not invariantly pointing the individual to an outcome valued by practitioners. Perceived autonomy is about whether or not one values, and chooses to try to reach the outcome. Thus, some people can be volitionally non-adherent (e.g., "I am perfectly content to smoke"), and in line with medical ethics this needs to be respected as the individual has been both informed and empowered to make a reflective life choice (Beauchamp & Childress, 2009). Future studies might well examine autonomy for non-adherence and the role it plays in models of treatment processes and outcomes.

There are several health behaviour change theories other than SDT, perhaps the most prominent being self-efficacy theory (Bandura, 1997) and the theory of planned behaviour (Ajzen & Fishbein, 1980). The most important difference between SDT and each of these other approaches is that no other theory uses the concepts of autonomy and autonomy supportive health care climate, distinguishing them from control and controlling contexts. Much of the focus of the current meta-analysis was precisely on these variables, and the

results indicate that autonomy and autonomy support are indeed essential predictors of healthy behaviour and psychological well-being. According to SDT, autonomy results from internalization of behavioural regulations and values, and this internalization has been shown to be the basis for maintained change after treatment has ended (e.g., Silva et al., 2011).

Within the field of health behaviour change research, there has been a shift in focus from simply examining predictors of behavioural adoption to examining the determinants of long-term behavioural change. Although the current meta-analysis was not able to examine maintenance after the termination of treatment, a few studies have followed patients for up to 24 months after their interventions ended. For example, in studies of tobacco abstinence (Niemiec, Ryan, Deci, et al., 2009; Williams, Niemiec, et al., 2009) and weight loss (Silvia et al., 2011), autonomy supportive health care climate, autonomous self-regulation, perceived competence, and intrinsic aspirations did account for long-term positive health outcomes. Thus, future studies would do well to focus on the maintenance aspect of health behaviours because of the importance of this aspect for testing the tenets of SDT and policy making.

Furthermore, because the concept of autonomy is now considered an important outcome within medical ethics, the idea of respecting (i.e., supporting) autonomy is essentially being mandated for all physicians. The current meta-analysis makes clear that support for autonomy, in addition to being an ethical outcome, is in fact a useful approach for promoting patient welfare (i.e., physical and mental health), which is another of the three goals of medical ethics.

This meta-analysis also provides needed evidence for patient centeredness in health care (Street, Makoul, Arora, & Epstein, 2009). This is because the SDT constructs of perceived autonomy supportive health care climate, psychological need satisfaction, and autonomous self-regulation are all from the patients' perspective. Each of these constructs has been linked in our review to disease prevention, management of chronic disease, and improvement of quality of life. In particular, the associations between autonomy supportive

health care climate and better mental health, self-regulated behaviour, and quality of life deserve special attention because of the biomedical-ethics mandate to respect autonomy.

Finally, because the current findings support the development and implementation of SDT-based interventions to improve patient/client welfare, studies are needed which further explicate the mechanisms by which such interventions work. Such studies could determine the active components of the interventions, establish clinical criteria for the research measures, and identify what is needed to imbed SDT-based interventions in the health care system (e.g., health care worker training and organizational change). Comparative trials that could determine the relative effectiveness and costs of existing interventions and those based on SDT are also warranted. For example, one SDT intervention for treating tobacco dependence enhanced perceived autonomy and competence and increased abstinence with a cost-effectiveness of just over $400 per life year saved (or $1,200 per quality adjusted life year saved; Pesis-Katz, Williams, Niemiec, & Fiscella, 2011). This is a very favourable cost per life year gained when compared to other accepted tobacco interventions (around $3,500 per life year saved), health interventions for high blood pressure or cholesterol (over $5,000 per life year saved), or Papanicolaou smears to prevent cervical cancer (over $4,000 per life year saved; Tengs et al., 1995). This suggests that promoting patients' autonomy for healthy behaviour change not only leads to improved health but also could help to stem the tide of increasing health care costs.

In summary, this meta-analytic review of SDT-based studies yielded findings that showed that: 1) the relations of personal and contextual SDT constructs with each other and with important positive health outcomes are in the directions hypothesized by the theory; 2) these relations were generally consistent across different study designs, health behaviours, and treatment settings. These findings suggest that SDT can lay the basis for the development of interventions within health promotion and health care contexts. Efforts by educators, parents, employers, and public health-policy makers to promote healthy living might benefit

from including principles of SDT in delivering their messages. Further, health care practitioners, biomedical ethicists, health care educators, and insurers may also find that SDT provides useful guidelines about how interventions can be shaped to be more effective, and more cost-effective. Nevertheless, additional research is needed to confirm the causal nature of these relations (as this meta-analysis included many non-experimental studies). Further, the findings only represent the treatment issues and populations studied to date, so their generalisability to other areas of treatment or health promotion is unknown. Researchers should continue to work toward a fuller understanding of the mechanisms by which SDT-based interventions in various health settings can improve the length and quality of individuals' lives.

# CHAPTER 3:

# PREDICTING PSYCHOLOGICAL NEEDS AND WELL-BEING OF INDIVIDUALS ENGAGING IN WEIGHT MANAGEMENT: THE ROLE OF IMPORTANT OTHERS

**Abstract**

Using a self-determination theory (SDT) framework, we examined how significant others support or thwart psychological needs of people with weight management goals, and in turn affect their psychological well-being and weight control behaviours. A prospective design with two sets of questionnaires administered over a three-month period was used. 156 eligible participants (age = 31.01 ± 13.21 years) were asked to complete questionnaires of SDT-based constructs, weight management behaviours, and psychological well-being. Hypotheses were tested using Bayesian path analysis. Our results suggested that perceived autonomy support received from significant others was related to psychological need satisfaction and beneficial outcomes such as life satisfaction. In contrast, controlling behaviours by others were associated with need thwarting and maladaptive outcomes, such as unhealthy eating behaviours and higher levels of depressive symptoms. Our findings indicate that the quality of interactions between individuals engaged in weight management and their significant others matters in terms of predicting the psychological needs and well-being of the former.

## Introduction

Overweight and obesity were identified by the World Health Organization (2011) as risk factors for non-communicable diseases such as cardiovascular illnesses and type II diabetes. In 2009, more than 60% of the UK population was classified as overweight or obese (OECD, 2011). This percentage is predicted to increase, and as a result, health care costs associated with related diseases are estimated to rise by £2 billion per year (Wang et al., 2011). Although local governments, universities, and commercial companies have developed weight loss or maintenance (referred to as weight management hereafter) programmes to address the problem of overweight and obesity, research has shown that attrition rates from these programmes are rather high (Gill et al., 2012). Adherence to weight management behaviours, such as regular physical activity and a healthy diet, is imperative to successful weight loss or maintenance. In the current study, we examined how important others support or undermine engagement in these behaviours. Rather than examining the quantity of support provided, we were interested in how different types of support by significant others satisfy or thwart key psychological needs and subsequently lead to contrasting outcomes. To this end, self-determination theory (SDT; Deci & Ryan, 2000) was chosen as an appropriate framework for this study.

### Self-determination Theory

Proposed by Deci and Ryan (1985b, 2000), SDT provides a conceptual framework to explain both antecedents and consequences of personal motivation. Researchers have utilized SDT to study health-related behaviours, including weight management (for a recent meta-analysis, see Ng et al., 2012). Empirical research in this area has been influenced by Ryan, Patrick, Deci, and Williams' (2008) model which is an application of basic needs theory, one of the mini-theories of SDT, to the health-related contexts. Using the model, Ryan et al. described how contextual factors (e.g., perceived behaviours of others) may enhance individuals' satisfaction of three basic psychological needs. These are the need for autonomy

(i.e., being the origin of one's behaviour), competence (i.e., feeling effective), and relatedness (i.e., perception of being cared for by others). In turn, psychological need satisfaction leads to improved physical and psychological well-being, and promotes health-conducive behaviours including physical activity and a healthier diet.

Within SDT, one important antecedent of need satisfaction is an individual's perception of received autonomy support from the social environment. Autonomy support is characterized by behaviours such as provision of choices, meaningful rationale for task engagement, and acknowledgment of negative feelings (Deci & Ryan, 1987). In support of the tenets of SDT, Williams et al. (1996) found that participants' perceived received autonomy support from health-care providers was associated with participants' autonomous motivation (doing a behaviour for enjoyment or its valued outcomes) for weight loss, which in turn predicted attendance to a 6-month weight loss programme, weight loss during the programme, and maintenance of weight loss at a 23-month follow-up. In another study, Williams et al. (2006) found that participants' perceived received autonomy support from important others predicted autonomy and competence need satisfaction and lower fat and calorie intake five months later. Similarly, Silva et al. (2010) found that in a group of female participants attempting to lose weight, autonomy support by instructors predicted autonomy and competence need satisfaction, and in turn autonomous motivation and more physical activity.

In contrast to being autonomy supportive, Ryan and Deci (2000) also posited that the social environment can be controlling and thwart psychological need satisfaction, leading to low behavioural adherence and ill-being. Controlling behaviours, such as the use of contingent rewards, intimidation, and conditional acceptance have been found to thwart the needs of autonomy, competence, and relatedness, and lead to ill-being in the context of sport (Bartholomew, Ntoumanis, Ryan, Bosch, et al., 2011; Bartholomew, Ntoumanis, Ryan, & Thøgersen-Ntoumani, 2011). Studies in the sport domain have suggested that need

satisfaction and thwarting may be orthogonal constructs, and that psychological need thwarting is not equivalent to low levels of need satisfaction (e.g., Bartholomew, Ntoumanis, Ryan, & Thøgersen-Ntoumani, 2011). The evidence from this line of work suggests that need thwarting is a stronger predictor of ill-being and maladaptive behaviours, whereas need satisfaction is a stronger predictor of well-being and adaptive behaviours. In our current study we assessed simultaneously both need satisfaction and need thwarting.

Previous research has also examined the effects of having social support from important others on weight management outcomes. For instance, Wing and Jeffery (1999) found that participants who received support from friends or family members, compared to those who did not have the same support, had better adherence to a weight loss treatment programme and were more successful in maintaining their weight loss. In contrast, Beverly, Miller, and Wray (2008) found that excessive control by spouses may lead to lower self-control, or perceived lack of support in patients diagnosed with type II diabetes. From a SDT perspective, it is not only the extent of support by significant others (e.g., spouse, offspring, close friend) that matters but also the nature of that support (autonomy supportive vs. controlling). For instance, an individual could have a big network of family and friends supporting her weight management regimen (i.e., having high levels of social support), yet these significant others may not provide her with choices or meaningful rationales (i.e., autonomy support), but instead try to support her by exerting pressure (i.e., being controlling). As explained earlier, autonomy support and controlling support from significant others differentially predicts psychological needs, motivation, and behavioural/emotional investment of individuals undertaking a weight management programme.

**The Current Study**

The purpose of this study was to examine how important others' autonomy supportive and controlling behaviours might influence individuals' psychological need satisfaction/thwarting when engaged in weight management. Also, we investigated how

psychological needs predict exercise and diet behaviours, and psychological well/ill-being. Using a prospective design, we tested a SDT-based model of weight management. Previous studies have examined the effects of perceived received autonomy support on weight management outcomes and behaviours. However, no studies have looked at how controlling behaviours of important others may also affect these outcomes. Further, this is the first study within a weight management context that has simultaneously examined the effects of adaptive (e.g., need satisfaction) and maladaptive (e.g., need thwarting) factors at the level of psychological needs. The construct of need thwarting has not been previously examined within a context of weight management. Thus, our study advances previous literature by simultaneously examining multiple adaptive and maladaptive motivational factors at both the contextual and personal level.

In the current study, we specifically looked at the influence of the most prominent important other nominated by each participant. This is because Rouse et al. (2011) showed that different important others can have differential impact on motivation and well-being of clients enrolled in an exercise programme for weight reduction. Specifically, Rouse et al. found that the strength of relations between autonomy support and mental health and physical activity outcomes varied as a function of who provided the support (e.g., partner, physician, or offspring). We hypothesized that participants' perceived received autonomy support from important others would predict the satisfaction of the former's basic psychological needs. In contrast, controlling behaviours of important others would predict participants' psychological need thwarting. Based on the basic needs theory model by Ryan et al. (2008), we also hypothesized that psychological need satisfaction would predict the use of behaviours associated with weight management (more exercise and healthy eating, less unhealthy eating) and higher levels of psychological well-being (more life satisfaction and self-esteem, less depressive symptoms). In contrast, we hypothesized that need thwarting would predict less exercise and healthy eating behaviours, more unhealthy eating behaviours, and lower

psychological well-being (less life satisfaction and self-esteem, more depressive symptoms).

## Method

### Participants and Procedures

Participants were recruited from community settings in the United Kingdom using posters at fitness centres and messages sent through electronic mailing lists. Participants were eligible if they had been attempting to manage their body weight by engaging in exercise, diet, or both types of behaviours. They were informed that they had to complete two sets of questionnaires over a 3-month period to reduce participant burden, as long questionnaires have been shown to lead to lower participation rates and reduced quality of responses (Galesic & Bosnjak, 2009). Both paper and online questionnaires were made available to them. Four £50 vouchers were offered in a prize draw to participants who completed both sets of questionnaires. All procedures and questionnaires of the study were approved by the ethical review committee of the University of Birmingham.

A total of 207 individuals provided informed consent and returned the first set of questionnaires at baseline (T1). In this questionnaire, participants reported their weight management goal (i.e., lose *or* maintain weight), demographic variables, and their current body height and weight. Some respondents were trying to gain weight ($n$ = 14), and some were not attempting to lose or maintain body weight by exercising or dieting ($n$ = 37). Their responses were excluded from the analyses. The final sample constituted 156 participants (age = 31.01 ± 13.21 years, 80% were female, 65% were white). Of these participants, 73 had a weight loss goal and 83 had a weight maintenance goal.

The first set of questionnaires also included measures for perceived received autonomy support, controlling behaviours, need satisfaction, and need thwarting. Two sets of measures, one focused on exercising and one on dieting, were administered to all participants. Participants were asked to respond to either or both sets of measures, depending on what types of weight management behaviours they were engaging in. We received 129 sets of

response in reference to exercise, and 91 in reference to diet (i.e., 64 participants completed questionnaires in reference to both exercise and diet).

The second set of questionnaires was sent to participants three months after T1 (T2) either by post or by email. At T2, participants were asked to report their diet or exercise behaviours associated with weight management. They were also asked to report their feelings of life satisfaction and self-esteem (as indicators of psychological well-being), and depressive symptoms (to tap ill-being). Ninety eight questionnaires (63% of T1) were returned, corresponding to 80 sets of responses in reference to exercise and 57 in reference to diet (39 participants completed both sets of questionnaires).

**Measures**

**Autonomy support and controlling behaviours.** Participants were asked to nominate one "important other" who had the greatest impact on their weight management plans and behaviours. Participants who did not have such an important other were asked to skip this section of the questionnaire. They then reported their perceived received autonomy support and controlling behaviours from this important other. The Health Care Climate Questionnaire (HCCQ; Williams et al., 1996) was adapted to measure participants' perceived received autonomy support (Appendix C). Ten items from the original HCCQ that were relevant to the context of exercise and diet behaviours were used (e.g., "My important other listens to how I would like to do things"). Important others' controlling behaviours were measured by an adapted version of the Controlling Coach Behaviors Scale (CCBS; Bartholomew, Ntoumanis, & Thøgersen-Ntoumani, 2010). Items from the original sport-specific scale that captured relevant aspects of weight management behaviours were used (Appendix D). Six items were thus modified to measure controlling behaviours in this study (e.g., "My important other is less supportive of me when I don't stick to my diet regimen"). Responses for the two scales were made using a 7-point scale (from *strongly disagree* to *strongly agree*).

**Satisfaction of basic psychological needs.** Four items for autonomy (e.g., "I feel it is

my own decision to diet") and competence (e.g., "I can overcome challenges when I diet") need satisfaction from the Basic Needs Satisfaction in Sport Scale (Ng, Lonsdale, & Hodge, 2011) were modified to measure the corresponding constructs in terms of exercise and diet behaviours (Appendix E). Satisfaction of the need of relatedness was measured using four items adapted from Richer and Vallerand's (1998) scale (e.g., "With respect to my exercise engagement, I feel understood"; Appendix F). For all three needs, a 7-point scale was used (from *strongly disagree* to *strongly agree*).

**Psychological need thwarting.** The 12 items of the Psychological Need Thwarting Scale (Bartholomew, Ntoumanis, Ryan, & Thøgersen-Ntoumani, 2011) were modified to measure thwarting of autonomy (e.g., "I feel others push me to behave in certain ways"), competence (e.g., "Situations occur in which others make me feel incapable"), and relatedness (e.g., "I feel others reject me") with respect to exercise and diet behaviours (Appendix G). Responses were made using a 7-point scale (from *strongly disagree* to *strongly agree*).

**Exercise behaviours.** The Godin leisure-time exercise questionnaire (Godin & Shephard, 1985) was used to measure participants' exercise behaviours (Appendix H). Specifically, participants were asked to report the number of times they engaged in strenuous (e.g., running), moderate (e.g., brisk walking), and mild exercise (e.g., golf) for at least 15 minutes in the last seven days. Each type of physical activity was assigned a different metabolic equivalent of task (MET) weight (strenuous, 9; moderate, 5; mild, 3). The frequencies of the three types of activity were multiplied by their respective weights, and then summed to form a MET score of exercise behaviours.

**Healthy and unhealthy eating behaviours.** Participants' eating behaviours with respect to weight management were measured using a scale by Neumark-Sztainer, Story, Hannan, Perry, and Irving (2002; Appendix I). The scale measured both healthy (3 items; e.g., "Ate less sweets") and unhealthy (5 items; e.g., "Made yourself throw up") eating behaviours. Participants were asked to respond to how often they engaged in behaviours described in the

items using a 5-point scale (from *never* to *always*).

**Psychological well-being.** Life satisfaction was measured using a scale developed by Diener, Emmons, Larsen, and Griffin (1985; Appendix J). The five-item scale was designed to measure respondents' overall life satisfaction (e.g., "In most ways my life is close to my ideal"). A 7-point scale was used for responses for life satisfaction (from *strongly disagree* to *strongly agree*). To measure self-esteem, a scale developed by Rosenberg (1965; Appendix K) was used (10 items; e.g., "I feel I have a number of good qualities"). Responses for self-esteem were made using a 4-point scale (from *strongly disagree* to *strongly agree*).

**Psychological ill-being.** Participants' depressive symptoms were measured using the seven depression items from the Hospital Anxiety and Depression Scale (e.g., "I have lost interest in my appearance"; Zigmond & Snaith, 1983; Appendix L). Responses were given using 4-point scales (the anchors varied across items).

## Results

### Descriptive Statistics, Cronbach Alphas, and Correlations

Descriptive statistics and Cronbach alphas of all measured variables are presented in Table 3.1. Mean scores for autonomy support and need satisfaction (exercise and diet) were relatively high. The mean scores of exercise behaviours was 39.29, which is equivalent to more than five 15-minute sessions of moderate, or four 15-minute sessions of strenuous physical activity in a week. The mean scores for the other constructs were moderate. Cronbach alphas for healthy and unhealthy eating behaviours were low ($\alpha$ = .61 and .47). However, as the items of these two scales measured very distinct behaviours, the low alphas are not surprising. The Pearson correlation between need satisfaction of competence, autonomy, and relatedness was significant with reference to both exercise and diet (.25 to .66 for exercise, .55 to .76 for diet; $p < .01$). Similarly, psychological need thwarting of competence, autonomy, and relatedness was significantly associated with one another (.72 to .81 for exercise, .78 to .84 for diet; $p < .01$). To eliminate possible multicollinearity effects

in the path analyses, the unweighted means of satisfaction and thwarting of the three needs were used as scores for need satisfaction and need thwarting, respectively[5].

The full correlation matrix of all measured variables is presented in Table 3.2. With reference to exercise, autonomy support had a strong relation with need satisfaction as expected ($r = .57$, $p < .01$). Need satisfaction was positively related to life satisfaction ($r = .22$, $p = .048$), while need thwarting was negatively associated with life satisfaction ($r = -.29$, $p = .01$), self-esteem ($r = -.38$, $p < .01$), and positively with depressive symptoms ($r = .44$, $p < .01$). With respect to diet, autonomy support was strongly correlated with need satisfaction ($r = .63$, $p < .01$), and the relation between controlling behaviours and need thwarting was also strong ($r = .52$, $p < .01$). Need satisfaction was associated with life satisfaction ($r = .33$, $p = .01$), self-esteem ($r = .34$, $p < .01$), and negatively with depressive symptoms ($r = -.26$, $p = .047$). Need thwarting was positively correlated with unhealthy eating behaviours ($r = .40$, $p = .02$) and depressive symptoms ($r = .45$, $p < .01$), and negatively related to life satisfaction ($r = -.28$, $p = .04$) and self-esteem ($r = -.37$, $p < .01$).

With reference to exercise, 47% of participants nominated their spouses or romantic partners as the most influential important other, and 32% of participants nominated a close friend. With reference to diet, 71% nominated their spouses or romantic partners, while 15% of participants reported that one of their parents had the most impact on their diet behaviours. To examine whether results might have been biased due to participant dropout, we compared (using one-way ANOVAs) T1 scores of all measured variables for participants who

[5] We conducted two path analyses using the Bayesian estimator in Mplus, separately for exercise and diet, to determine whether there were differences between the paths from autonomy support to each of the three need satisfaction variables, and from controlling behaviours to each need thwarting variable. The CIs of the paths from autonomy support to autonomy, competence, and relatedness need satisfaction were compared. For both exercise and diet, the CIs were found to overlap substantially, suggesting no differences between the paths. This was also the case for the paths from controlling behaviours to each need thwarting variable.

Table 3.1

*Descriptive Statistics and Internal Reliability Coefficients of All Measured Variables*

| Variable | *N* | *M* | *SD* | Possible range | Skewness | Kurtosis | Cronbach's α |
|---|---|---|---|---|---|---|---|
| Exercise autonomy support | 75 | 5.61 | 0.86 | 1 – 7 | -1.00 | 0.85 | .88 |
| Exercise controlling behaviours | 75 | 3.18 | 0.96 | 1 – 7 | -0.28 | -0.13 | .67 |
| Exercise need satisfaction (combined) | 128 | 5.50 | 0.75 | 1 – 7 | -1.08 | 3.09 | .89 |
| Exercise competence satisfaction | 128 | 5.64 | 0.88 | 1 – 7 | -1.63 | 6.08 | .86 |
| Exercise autonomy satisfaction | 128 | 5.99 | 0.90 | 1 – 7 | -2.46 | 9.65 | .88 |
| Exercise relatedness satisfaction | 128 | 4.86 | 1.12 | 1 – 7 | -0.41 | -0.16 | .90 |
| Exercise need thwarting (combined) | 128 | 3.46 | 1.19 | 1 – 7 | 0.10 | -0.12 | .93 |
| Exercise competence thwarting | 128 | 3.65 | 1.42 | 1 – 7 | 0.11 | -0.45 | .85 |
| Exercise autonomy thwarting | 128 | 3.04 | 1.22 | 1 – 7 | 0.51 | 0.28 | .81 |
| Exercise relatedness thwarting | 128 | 3.68 | 1.26 | 1 – 7 | 0.01 | -0.52 | .77 |
| Diet autonomy support | 55 | 5.47 | 1.30 | 1 – 7 | -1.31 | 1.52 | .95 |
| Diet controlling behaviours | 55 | 2.79 | 1.42 | 1 – 7 | 0.97 | 0.67 | .87 |

| Variable | *N* | *M* | *SD* | Possible range | Skewness | Kurtosis | Cronbach's α |
|---|---|---|---|---|---|---|---|
| Diet need satisfaction (combined) | 91 | 5.12 | 1.17 | 1 – 7 | -1.22 | 1.74 | .93 |
| Diet competence satisfaction | 91 | 5.08 | 1.37 | 1 – 7 | -1.01 | 0.81 | .90 |
| Diet autonomy satisfaction | 91 | 5.71 | 1.28 | 1 – 7 | -1.60 | 2.96 | .91 |
| Diet relatedness satisfaction | 91 | 4.56 | 1.40 | 1 – 7 | -0.62 | 0.31 | .91 |
| Diet need thwarting (combined) | 91 | 3.13 | 1.43 | 1 – 7 | 0.47 | -0.63 | .95 |
| Diet competence thwarting | 91 | 3.31 | 1.59 | 1 – 7 | 0.25 | -0.87 | .90 |
| Diet autonomy thwarting | 91 | 2.90 | 1.54 | 1 – 7 | 0.64 | -0.48 | .89 |
| Diet relatedness thwarting | 91 | 3.19 | 1.47 | 1 – 7 | 0.41 | -0.71 | .85 |
| Exercise behaviours | 99 | 39.04 | 23.42 | – | 0.88 | 1.53 | – |
| Healthy eating behaviours | 41 | 3.83 | 0.83 | 1 – 5 | -0.49 | -0.42 | .61 |
| Unhealthy eating behaviours | 40 | 1.45 | 0.40 | 1 – 5 | 0.84 | 0.32 | .47 |
| Life satisfaction | 99 | 4.57 | 1.37 | 1 – 7 | -0.57 | -0.35 | .91 |
| Self-esteem | 99 | 2.86 | 0.55 | 1 – 4 | -0.07 | -0.32 | .91 |
| Depression | 99 | 2.05 | 0.50 | 1 – 4 | 1.16 | 1.62 | .80 |

Table 3.2

*Correlation Matrix of Self-Determination Theory Variables (T1) and Outcomes (T2)*

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Autonomy support (Exercise) | | | | | | | | | | | | | |
| 2. Controlling behaviours (Exercise) | -.15 | | | | | | | | | | | | |
| 3. Need satisfaction (Exercise) | .57** | .06 | | | | | | | | | | | |
| 4. Need thwarting (Exercise) | -.10 | .20 | -.16 | | | | | | | | | | |
| 5. Autonomy support (Diet) | .69** | -.05 | .56** | -.21 | | | | | | | | | |
| 6. Controlling behaviours (Diet) | .05 | .56** | -.03 | .55** | -.24 | | | | | | | | |
| 7. Need satisfaction (Diet) | .52** | .12 | .75** | -.29* | .63** | -.15 | | | | | | | |
| 8. Need thwarting (Diet) | -.06 | .25 | -.10 | .77** | -.32* | .52** | -.24* | | | | | | |
| 9. Exercise behaviours | -.10 | -.03 | -.09 | .06 | -.17 | .00 | -.06 | .19 | | | | | |
| 10. Healthy eating behaviours | -.09 | .09 | -.04 | .04 | -.02 | -.14 | -.09 | .10 | .36* | | | | |
| 11. Unhealthy eating behaviours | -.05 | .43 | .21 | .20 | .06 | .22 | .10 | .40* | .19 | .14 | | | |
| 12. Life satisfaction | .13 | .02 | .22* | -.29** | .21 | -.12 | .33* | -.28* | -.09 | .14 | -.17 | | |
| 13. Self-esteem | .25 | -.11 | .08 | -.38** | .35* | -.03 | .34** | -.37** | -.12 | -.11 | -.38* | .63** | |
| 14. Depressive symptoms | -.03 | .20 | -.02 | .44** | -.10 | .22 | -.26 * | .45** | .09 | .01 | .33 * | -.60** | -.71** |

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

completed T2 questionnaires versus those who did not complete the T2 assessments. No significant differences were found.

**Predicting Psychological Needs, Weight Management Behaviours, and Well/Ill-being**

Previous research has shown that structural equation modelling (SEM) based on Bayesian approach may produce more accurate results than maximum likelihood estimates when sample sizes are small (Asparouhov & Muthén, 2010; Lee & Song, 2004). Therefore, we conducted path analyses using the Bayesian approach to test our hypotheses. Analyses were conducted with Mplus 7 (Muthén & Muthén, 2008). Unweighted mean scale scores were used as observed variables in the analyses. Missing data were treated using a full-information estimation method so that all available data were used. Model fit was evaluated using posterior predictive checking (PPC; Gelman, Carlin, Stern, & Rubin, 2004). Specifically, a $\chi^2$ test is conducted to compare the observed data with model estimates. A 95% confidence interval for the PPC-$\chi^2$ is generated for each tested model (the actual $\chi^2$ value is not given by the software). A model is deemed well-fitting if its corresponding PPC-$\chi^2$ confidence interval encompasses 0, or equivalently has a Posterior Predictive *p*-value between .05 and .95 (Gelman et al., 2004). In the Bayesian SEM approach a 95% credibility interval (CI) is generated for each estimated parameter; the median was used as the point estimate. If the 95% credibility interval (CI) for that estimate did not encompass 0, a true relation between the variables would likely exist.

We tested models, separately for exercise and diet contexts, with autonomy support predicting need satisfaction, controlling behaviours predicting need thwarting, and need satisfaction/thwarting in turn predicting outcomes measured at T2 (Figures 3.1 & 3.2). The residuals between the behavioural outcomes (i.e., healthy and unhealthy eating behaviours), and those between psychological well-being outcomes (i.e., life satisfaction, self-esteem, and depressive symptoms) were allowed to correlate, as we hypothesised these variables to be related. Path coefficients and their corresponding CIs are shown in Figures 3.1 and 3.2.

In the model with reference to exercise, a good model fit was found: PCC-$\chi^2$ CI = (-26.13, 27.11), Posterior Predictive *p*-value = .51. In this model, autonomy support predicted need satisfaction (β = .52, CI = [.35, .66]) and controlling behaviours predicted need thwarting (β = .23, CI = [.00, .43]). Real effects were likely to exist from need thwarting to life satisfaction (β = -.26, CI = [-.44, -.05]), self-esteem (β = -.36, CI = [-.53, -.15]), and depressive symptoms (β = .42, CI = [.22, .58]). We also found indirect effects from controlling behaviours, via need thwarting, to depressive symptoms (β = .09, CI = [.00, .21]).

In terms of the model with reference to diet behaviours, the model fit was also good: PCC-$\chi^2$ CI = (-27.27, 34.23), Posterior Predictive *p*-value = .40. As hypothesized, autonomy support predicted need satisfaction (β = .58, CI = [.39, .73]) and controlling behaviours predicted need thwarting (β = .51, CI = [.29, .67]). The CIs of the paths from need satisfaction to life satisfaction (β = .26, CI = [.01, .47]) and self-esteem (β = .25, CI = [.01, .47]) did not encompass zero. Also, we found that need thwarting predicted unhealthy eating behaviours (β = .38, CI = [.05, .63]), self-esteem (β = -.30, CI = [-.52, -.05]), and depressive symptoms (β = .40, CI = [.14, .60]). We found an indirect effect from autonomy support via need satisfaction to life satisfaction (β = .15, CI = [.00, .33]) and self-esteem (β = .15, CI = [.01, .32]). Similarly, indirect effects from controlling behaviours, through need thwarting, to unhealthy eating behaviours (β = .20, CI = [.02, .43]), self-esteem (β = -.15, CI = [-.33, -.03]), and depressive symptoms (β = .20, CI = [.06, .39]) were different from zero[6,7].

[6] We also analyzed path models using maximum likelihood to examine whether the results would be similar. For both exercise ($\chi^2$[13] = 9.68, *p* = .72, CFI = 1.00, TLI = 1.05) and diet ($\chi^2$[18] = 22.64, *p* = .21, CFI =.96, TLI = .93) the models had good fit.

[7] Separate path analyses were conducted by controlling for participants' sex, age, weight management goal, or BMI. Path coefficients remained largely unchanged (median of changes was .004) compared to the initial model. With reference to diet, a small number of paths that were different from zero initially encompassed zero when control variables were included. This might be due to the small sample size for diet.

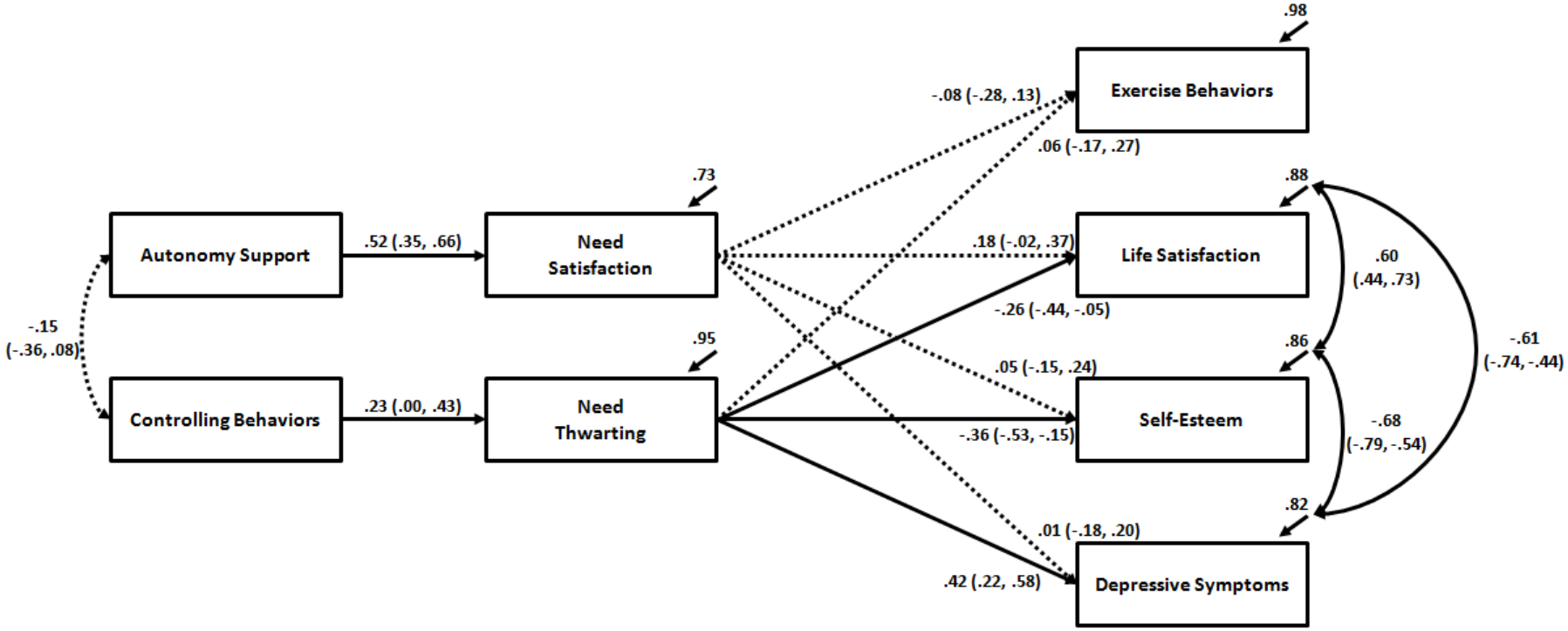


*Figure 3.1.* Structural equation model with reference to exercise ($n$ = 129). Standardized estimates are shown, and the corresponding 95% credibility intervals are presented in parentheses. Paths whose 95% credibility intervals do not encompass zero are indicated by solid lines.

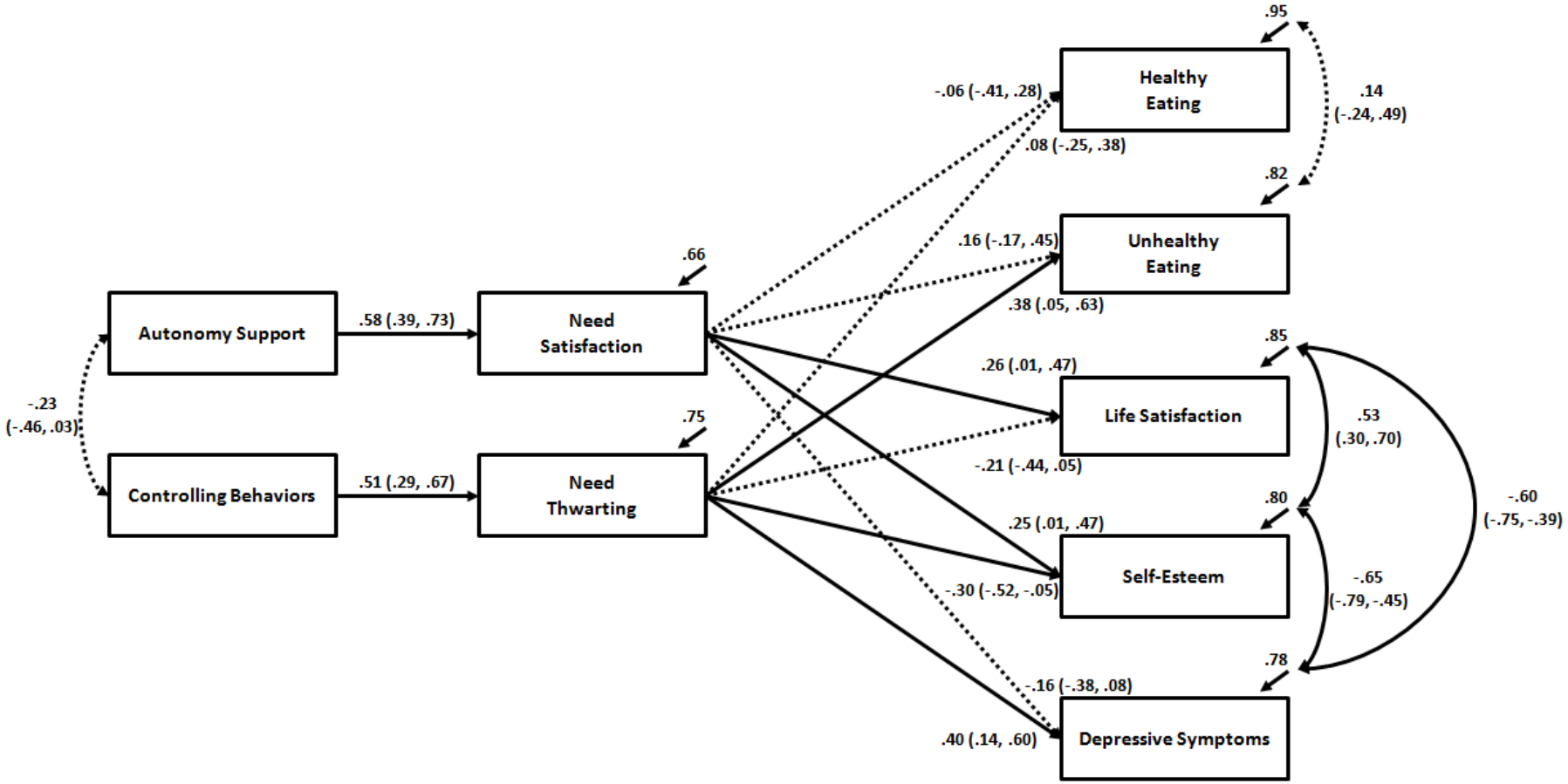


*Figure 3.2.* Structural equation model with reference to diet ($n$ = 91). Standardized estimates are shown, and the corresponding 95% credibility intervals are presented in parentheses. Paths whose 95% credibility intervals do not encompass zero are indicated by solid lines.

## Discussion

The purpose of this study was to examine how autonomy supportive and controlling behaviours from important others might affect individuals' psychological need satisfaction/thwarting when engaged in weight management. Furthermore, this study also investigated how psychological needs predict behaviours associated with weight management (i.e., exercise and healthy diet) and psychological well/ill-being. In line with our hypotheses, we found that autonomy support provided by important others predicted higher levels of need satisfaction in individuals with weight management goals. Also, when important others used more controlling behaviours, individuals reported higher levels of need thwarting. In terms of the predictive paths from need satisfaction/thwarting to behavioural and well-being outcomes, the results were mixed. In terms of behavioural outcomes, we only found that unhealthy eating behaviours were predicted by need thwarting. Inconsistent with our hypotheses, both need satisfaction and thwarting did not predict physical activity and healthy eating behaviours. The predictive paths from need satisfaction/thwarting to psychological well- and ill-being outcomes were in the directions we hypothesized. However, the CIs of paths from need satisfaction to life satisfaction (exercise), self-esteem (exercise), and depression (exercise and diet) encompassed zero. With reference to diet, the CI of the path from need thwarting to life satisfaction also included zero.

Our findings have implication for important others (e.g., spouse, close friends) who are trying to help individuals manage their weight. Important others should use more autonomy supportive behaviours (e.g., acknowledging negative feelings, providing rationales, and choices). In our study we found that when participants perceived that they received more autonomy support from their important other, their psychological needs were satisfied. In line with SDT, we also found that need satisfaction, with respect to diet behaviours, predicted life satisfaction. Although the corresponding CIs marginally encompassed zero, true effects may also exist from need satisfaction to life satisfaction (CI = [-.02, 37]) in reference to exercise

(the corresponding correlation coefficients was significant). In contrast, important others should avoid using controlling behaviours (e.g., contingent rewards, conditional regard) when helping others manage their weight, even if these behaviours are based on good intentions. In our study controlling behaviours predicted need thwarting. According to Deci and Ryan (2000), the thwarting of needs would lead to involvement in compensatory activities that undermine health and optimal human functioning. In our study need thwarting predicted lower life satisfaction (exercise), lower self-esteem (exercise and diet), more depressive symptoms (exercise and diet), and unhealthy eating behaviours (diet).

Our results also have implications for SDT-based research on weight management and perhaps health behaviours in general. Previous work has not examined the role of controlling behaviours and psychological need thwarting, and this study was the first to address this void in the literature with regard to weight management. Our findings suggest that these constructs do contribute independently to the prediction of weight management behaviours and psychological ill-being. Researchers have also shown that controlling behaviours may be related to eating disorders, such as anorexia and bulimia. For instance, Soenens et al. (2008) found that eating disorder patients reported higher levels of parental control. Thus, controlling behaviours of important others, and hence psychological need thwarting, appear to be important predictors of eating pathology. We also found that autonomy support and controlling behaviours are orthogonal constructs (factor correlations = -.15 and -.23 in reference to exercise and diet respectively, the corresponding CIs encompassed zero), and so are need satisfaction and thwarting (Pearson $r$ = -.16, $p$ = .07, and -.24, $p$ = .02, in reference to exercise and diet respectively). This pattern has also been observed in previous research in the sport domain (e.g., Bartholomew, Ntoumanis, Ryan, & Thøgersen-Ntoumani, 2011) and supports Bartholomew, Ntoumanis, Ryan, and Thøgersen-Ntoumani's (2011) arguments that need satisfaction and thwarting are not bi-polar constructs. Thus, we feel it is important that controlling behaviours and need thwarting are incorporated into future SDT-based research in

the health-related contexts.

Of all participants who completed both exercise- and diet-specific questionnaires regarding important others, 88% reported that the same individual had the most influence on both the exercise and diet behaviours. This may explain why the associations between important other's behaviours with respect to exercise and diet were high ($r$ = .69 to .56, $p$ < .01, for autonomy support and controlling behaviours respectively). Moreover, researchers have shown that motivational "spill-over" effects may exist between exercise and diet behaviours (Mata et al., 2009); we found strong correlations between need satisfaction/thwarting with respect to exercise and diet ($r$ = .75 to .77, $p$ < .01, for need satisfaction and thwarting respectively). This suggests that when individuals manage their weight by engaging in both exercise and diet behaviours, their need satisfaction/thwarting, and also their motivation, in reference to the two behaviours may be related.

**Limitations and Future Directions**

There are a few limitations to this study. For instance, although all participants were managing their weight, only a minority of them were either overweight or obese (about 37%). Nevertheless, our study was about weight management and not necessarily weight loss. Also, similar to other research on weight management (Williams et al., 1996), most participants in our study were female (about 80%). However, the proportion of overweight or obese men is also high – about 66% of males and 57% of females in UK were overweight or obese in 2009 (OECD, 2011). Moreover, for participants who indicated they were managing their weight by doing physical activity, some differences may exist between the types of exercise behaviours they engaged in and their sport participation history. These factors could be measured in future research as they might influence mean levels of physical activity.

The self-reported nature of weight management behaviours of participants is also a limitation of the study and might be a possible reason for the lack of prediction of exercise behaviours and healthy eating behaviours. For instance, previous research has shown that self-

reports of physical activity are prone to biases (Helmerhorst, Brage, Warren, Besson, & Ekelund, 2012). In our study, we found very high levels of self-reported physical activity, which may be a result of over-reporting. Such inaccuracies may lead to a possible floor effect, and hence account for the non-prediction of physical activity behaviours. Measures for healthy/unhealthy eating also tap only a few distinct behaviours; it is possible that participants might have utilized other dietary means to manage their weight, such as reducing portion sizes. However, currently there are no valid objective measures for dietary intake outside lab settings. Future research may incorporate daily diary measures for both exercise and eating behaviours. Although these are still self-reported measures, they may be more accurate when compared to questionnaires that require memory recall.

Apart from measurement issues, there may be other plausible explanations for our non-significant findings regarding physical activity and eating behaviours. For example, it is possible that other SDT constructs not measured in this study, such as different types of motivation, may be better suited in predicting these outcomes (Mata et al., 2009). In addition to other SDT constructs, behaviour intentions (based on the theory of planned behaviour; Conner, Norman, & Bell, 2002) and self-regulation cognitions (based on self-regulation theory; Kalavana, Maes, & De Gucht, 2010) were found in previous studies to predict behaviours related to weight management. These constructs might be better predictors of actual behavioural engagement in weight management contexts. Future studies may examine whether these variables might mediate the relations between need satisfaction/thwarting and weight management behaviours.

In the current study, we only asked participants to report behaviours of one important other; future research may examine how outcomes may differ when participants interact in their weight management efforts with important others with conflicting interpersonal styles. Finally, research has shown that low need satisfaction may cause participants to become more susceptible to temptations (Schüler & Kuster, 2011). Future research should investigate

whether controlling behaviours of important others and need thwarting may also affect participants' susceptibility to temptations. Despite these limitations, our results provide initial support for the importance of examining both adaptive and maladaptive motivation-related variables at the contextual and personal level in an effort to better understand and predict behavioural responses and affective experiences of individuals with weight maintenance goals.

# CHAPTER 4:

# AUTONOMY SUPPORT AND CONTROL IN WEIGHT MANAGEMENT:

# WHAT IMPORTANT OTHERS DO AND SAY MATTER

**Abstract**

Drawing from self-determination theory (Ryan & Deci, 2002), we examined how individuals' psychological needs, motivation, and behaviours (i.e., physical activity and eating) associated with weight management could be predicted by perceptions of their important others' autonomy supportive and controlling behaviours. Using a cross-sectional survey design, 235 participants (aged 27.39 ± 8.96 years) completed an online questionnaire. Structural equation modelling analysis showed that autonomy support by important others predicted need satisfaction and autonomous motivation for weight management, as well as physical activity and healthy eating behaviours. In contrast, controlling behaviours by important others predicted need thwarting, controlled motivation, and amotivation. In turn, controlled motivation predicted lower levels of physical activity. Amotivation was related to less healthy eating and more unhealthy eating behaviours. Significant indirect effects were also found from autonomy support and controlling behaviours to physical activity and eating behaviours, all in the expected directions. The findings support the importance of important others providing autonomy support and refraining from controlling behaviours in order to facilitate motivation and behaviours conducive to successful weight management.

## Introduction

There is a growing prevalence of overweight and obesity in many developed countries (OECD, 2011). Researchers have shown that these unhealthy statuses are related to other non-communicable health problems including diabetes, high blood pressure, and higher mortality (Adams et al., 2006; Mokdad et al., 2003). Overweight and obesity are also related to psychological ill-being, such as anxiety and depression (Petry et al., 2008; Puppino et al., 2010). Wing and Hill (2001) reviewed empirical evidence which shows that regular physical activity and eating a healthy diet are important behaviours for losing and/or maintaining body weight (both referred to as weight management hereafter). Many overweight/obese individuals engage in these weight management behaviours to reduce the impact of being overweight. Other individuals with healthy body weight also exercise or diet spontaneously to prevent becoming overweight. Nonetheless, the dropout rates from these activities are high (Gill et al., 2012).

The support of important others (e.g., spouse, close friends) can play an important role in facilitating adherence to and success of weight management (Elfhag & Rössner, 2005). The purpose of this study is to draw from a contemporary theoretical framework of motivation, namely self-determination theory (SDT; Ryan & Deci, 2002) and focus on the role of important others in terms of supporting or undermining motivation for weight management. Specifically, we compared the role of two very different styles of communication in predicting individuals' psychological need satisfaction and thwarting, motivation for weight management, physical activity and eating behaviours.

According to Deci and Ryan (2000), different interpersonal styles by important others may lead to contrasting outcomes in terms of motivation and behaviours. Deci and Ryan distinguished between interpersonal styles that are autonomy supportive and those that are controlling in nature. Autonomy support refers to a set of behaviours that nurtures and promotes one's sense of self-determination. It is characterized by behaviours such as

providing choice of activities, meaningful rationales, acknowledging and accepting negative feelings, and displaying patience to allow time for change. In contrast, behaviours that aim to induce changes in behaviour, thoughts and feelings by applying pressure or various contingencies are considered controlling. Examples include the use of contingent rewards, punishments, or pressure-inducing language (Bartholomew et al., 2009). An autonomy supportive style, relative to a controlling one, has been found to be associated with positive outcomes such as enjoyment, self-esteem, adherence to behaviours, and physical health (Deci & Ryan, 1987). In terms of weight management, Williams et al. (1996) and Powers et al. (2008) showed that participants' perceived autonomy supportive from their important others was associated with increased weight loss.

Autonomy supportive and controlling interpersonal styles have been shown to be differentially related to basic psychological needs and motivational regulations as proposed by SDT. Deci and Ryan (2000) suggested that three basic psychological needs, namely autonomy (i.e., feeling that one's behaviour is in concordance with self choices and values), competence (i.e., feeling capable), and relatedness (i.e., being cared for by others) are in operation. Deci and Ryan also distinguished between motivational regulations with varying degrees of perceived self-determination which can be broadly grouped into the dimensions of *autonomous motivation*, *controlled motivation*, and *amotivation* (Ryan & Deci, 2002). Autonomous motivation encompasses intrinsic motivation (i.e., doing a task for its inherent interest and enjoyment) and identified regulation (i.e., doing an activity in order to obtain valued outcomes). Controlled motivation includes introjected regulation (i.e., engaging in a behaviour to avoid internal pressures or to achieve contingent self-worth) and external regulation (i.e., acting under external pressure, tangible rewards or to obtain social approval). Amotivation refers to a state of lacking both autonomous and controlled motivation. This state occurs when needs are thwarted, and is also associated with the poorest behavioural and psychological outcomes (Deci & Ryan, 2000).

The three needs advanced by SDT play an imperative role in human functioning and psychological well-being. When they are satisfied, optimal human performance and autonomous motivation will be supported, which in turn lead to better adherence in behaviours and psychological well-being. In contrast, high levels of controlled motivation or amotivation will be experienced when these needs are thwarted. Controlled motivation and amotivation have been related to more maladaptive outcomes, such as lower persistence and psychological ill-being (Deci & Ryan, 2000).

As an illustration of the application of the SDT constructs to the context of weight management, consider a married woman who is trying to manage her weight. The husband may be perceived by his wife as autonomy supportive if he acknowledges and accepts her negative feelings in relation to weight management and highlights to her various options available. By doing so, his wife may feel more volitional in her weight management efforts (autonomy satisfaction), more capable of dealing with difficult situations (competence satisfaction), and feel cared for (relatedness satisfaction). In turn, she may enjoy and value her regimen (autonomous motivation), and will be more likely to adhere to her weight management behaviours. In contrast, a husband with a controlling interpersonal style may pressure his wife to stick to her regimen without making any changes, and may embarrass her in front of friends if she fails to meet her weight-related goals. Consequently, she may feel forced to behave in certain ways (autonomy thwarted), incapable of achieving her goals (competence thwarted), and rejected by her husband (relatedness thwarted). She may continue her regimen but only to gain her husband's approval (controlled motivation), or she might even completely lose interest in continuing (amotivation), with resultant undermining effects on her physical activity and eating behaviours

Within the context of weight management, empirical research has provided support for the tenets of SDT. For instance, Edmunds et al. (2007) found that need satisfaction predicted autonomous motivation, better adherence to physical activity, and psychological well-being in

a group of overweight and obese individuals. Williams et al. (1996) showed that participants with more autonomous motivation were more likely to attend a weight loss programme regularly. Silva et al. (2010) showed that in a group of overweight female participants who took part in a physical activity intervention, autonomy and competence need satisfaction predicted autonomous forms of motivation, which in turn predicted physical activity behaviours. Silva et al. (2011) further showed that autonomous motivation predicted physical activity one year after the intervention ended, and also weight loss two years after the end of the intervention period. Findings from these studies support the importance of need satisfaction and autonomous motivation within the context of weight management. However, inconsistent results were also found regarding the relations between need satisfaction and controlled motivation. For instance, Williams et al. (2005) found a positive association between controlled motivation and diet behaviours, but the opposite relation was reported by Julien et al. (2009). Further, controlling behaviours from important others and need thwarting were not measured in these studies. Controlling behaviours have been found to predict need thwarting and psychological ill-being in sport (Bartholomew, Ntoumanis, Ryan, Bosch, et al., 2011; Bartholomew, Ntoumanis, Ryan, & Thøgersen-Ntoumani, 2011). However, there is a lack of evidence on the association between controlling behaviours and other related constructs such as need thwarting, controlled motivation, and amotivation within a context of weight management.

**Current Study**

The aim of the current study is to examine how perceptions of important others' autonomy supportive and controlling behaviours might predict psychological needs, motivation, and weight management behaviours of individuals with weight management goals. Rouse et al. (2011) showed that different important others may have varying interpersonal styles, and may influence participants' motivation in different ways. Therefore, we asked participants to nominate the one most influential important other and then answer questions

regarding the autonomy supportive and controlling interpersonal style of that individual. Indicators of positive behavioural outcomes in this study were physical activity and healthy eating, as these have been identified as key behaviours for weight management (Wing & Hill, 2001). Unhealthy eating behaviours were also measured in this study as a maladaptive outcome with respect to weight management, as this behaviour has been previously found to predict long-term weight gain (Neumark-Sztainer et al., 2006).

Using structural equation modelling, and drawing from a SDT-based model of motivation processes (Vallerand, 1997), we hypothesized that perceived autonomy support from important others would predict higher levels of need satisfaction and lower levels of need thwarting. In contrast, we expected perceived controlling behaviours by important others to be related to less need satisfaction and more need thwarting. We further hypothesized that need satisfaction (thwarting) would predict more (less) autonomous forms of motivation and less (more) controlled motivation and amotivation. Finally, we also hypothesized that autonomous motivation would predict more adaptive (and less maladaptive) behavioural outcomes, while controlled motivation and amotivation would be related to less positive (and more negative) weight management behaviours.

## Method

### Participants and Procedures

Two hundred and thirty eight participants completed the questionnaire. Three participants were removed because they did not have an important other who influenced their weight management behaviours. The final 235 participants had a mean age of 27.39 years (*SD* = 8.96 years); 183 (77.9%) were female, and 156 (66.4%) of them were attempting to lose weight, with the rest trying to maintain their weight. The majority of participants were white (75.7%), followed by black (5.53%), Asian (5.11%), and Chinese (4.26%). Their self-reported BMI was 24.58, with 30% of them classified as either overweight or obese (i.e., BMI > 25). Participants were asked to nominate "the one individual who has the largest impact on your

weight management regimen" as their important other in this study. Most participants (54%) nominated their spouse or romantic partner as their important other. Close friends (21%), parents (18%), and trainers/dieticians (3%) were also identified.

Participants were eligible if they were attempting to manage their weight, and their efforts were influenced by an important other. We recruited using both traditional methods (e.g., posters) and social media (e.g., Facebook). Participants who completed the questionnaire were given the option of entering a prize draw for £20 (or equivalent) vouchers for online purchases. All participants provided informed consent online; web-based questionnaires were used to collect responses. All study procedures and questionnaires used were approved by an ethics committee of a British university.

**Measures**

Due to a lack of measures of SDT-variables specific to the context of weight management, we used adaptations of scales developed for related contexts. These include measures for autonomy support, controlling behaviours, need satisfaction and thwarting, and behavioural regulations. As the corresponding items were adapted from different contexts, we used Mplus (Muthén & Muthén, 2008) to conduct confirmatory factor analyses (CFAs) to examine the factorial structure of the scores.

**Autonomy support.** Perceived autonomy support from participants' nominated important other was measured using six items adapted from Williams, Lynch, et al.'s (2006) scale. The original scale was used to measure autonomy support by an important other with respect to one's diet to improve cholesterol levels. Items were modified to measure autonomy support with respect to weight management (e.g., "My important other listens to how I would like to do things regarding my weight loss plans"; Appendix C). Responses were given using a 7-point scale. We evaluated a one-factor model using CFA and a good fit was found: $\chi^2(9) = 10.27$, $p = .33$, Comparative Fit Index (CFI) = 1.00, Tucker-Lewis Index (TLI) = 1.00, Root Mean Square Error of Approximation (RMSEA) = .03, Standardized Root Mean Square

Residual (SRMR) = .02.

**Controlling behaviours.** Controlling behaviours of the nominated important other were measured using six items adapted from the Controlling Coach Behaviours Scale (Bartholomew et al., 2010). The sport-specific items were modified to reflect weight maintenance behaviours in this study (e.g., "My important other is less supportive of me when I don't stick to my weight loss plans; Appendix D). Responses were given using a 7-point scale. The initial one-factor CFA model did not fit well: $\chi^2(9) = 32.71$, $p < .001$, CFI = .92, TLI = .87, RMSEA = .11, SRMR = .06, with one item having a low factor loading (.37). This item ("My important other only praises me to make me keep up with my weight loss plans") was therefore removed from the model. The revised model had a good fit: $\chi^2(5) = 10.99$, $p = .05$, CFI = .98, TLI = .95, RMSEA = .07, SRMR = .03.

**Need satisfaction.** Need satisfaction was measured using 12 items modified from a scale developed in sport by Ng et al. (2011). Four items were used to tap autonomy (e.g., "I feel I am pursuing goals that are my own"), competence (e.g., "I feel capable") and relatedness (e.g., "there are people who care about me"), respectively, with reference to weight management (Appendix E). A 7-point response scale was used. The three-factor model had good model fit: $\chi^2(51) = 97.42$, $p < .001$, CFI = .96, TLI = .95, RMSEA = .06, SRMR = .05.

**Need thwarting.** Twelve items of the scale by Bartholomew, Ntoumanis, Ryan, and Thøgersen-Ntoumani (2011) were adapted to measure need thwarting of autonomy (four items; e.g., "I feel pushed to behave in certain ways"), competence (four items; e.g., "there are situations where I am made to feel inadequate"), and relatedness (four items; e.g., "I feel I am rejected") with respect to weight management (Appendix G). Responses were made using a 7-point scale. The three-factor model had a good fit: $\chi^2(51) = 83.71$, $p < .01$, CFI = .97, TLI = .96, RMSEA = .05, SRMR = .04.

**Behavioural regulations.** Items from the Behavioural Regulation in Exercise

Questionnaire (BREQ-2; Markland & Tobin, 2004) were adapted to measure participants' behavioural regulations to manage their weight. Items were intended to measure intrinsic motivation (four items; e.g., "being I enjoy [losing weight]"), identified regulation (four items; e.g., "because I value the benefits of losing weight"), introjected regulation (three items; e.g., "because I feel guilty when I don't try to lose weight"), external regulation (four items; e.g., "because other people say I should"), and amotivation (four items; e.g., "but I think doing it is a waste of time") with respect to weight management behaviours (Appendix M). Participants responded using a 5-point scale. We evaluated the factorial structure of the scale scores, and the five-factor model we examined did not fit well: $\chi^2(142) = 288.12$, $p < .001$, CFI = .93, TLI = .91, RMSEA = .07, SRMR = .08. An item in the identified regulation subscale (i.e., "because I get restless if I don't try to lose weight") had low factor loading (.32), and hence was eliminated. The revised model had good fit: $\chi^2(125) = 231.18$, $p < .001$, CFI = .95, TLI = .94, RMSEA = .06, SRMR = .05.

**Behavioural outcomes.** Exercise, healthy and unhealthy eating behaviours were used as indicators of behavioural outcomes. Exercise behaviours were measured using Godin and Shephard's (1985) Leisure-Time Exercise Questionnaire (Appendix H). Participants were asked to report the frequencies they engaged in strenuous, moderate, and mild exercises, respectively, in the last seven days (1 item for each type of intensity). The reported frequencies were multiplied by different metabolic equivalent values (strenuous, 9; moderate, 5; mild, 3) and summed to form a score for exercise behaviours. Eating behaviours were measured using a set of items developed by Neumark-Sztainer et al. (2002; Appendix I). Responses for items corresponding to healthy (three items; e.g., "ate less sweets") and unhealthy eating (five items; e.g., "skipped meals") were made using a 5-point scale.

## Results

### Preliminary Results

Descriptive statistics and Pearson correlations between the study variables are shown

in Tables 4.1 and 4.2, respectively. We compared the scores on all variables of participants who had weight loss goals ($n$ = 156) to those who had weight maintenance goals ($n$ = 79). Participants with weight loss goals reported more use of both healthy and unhealthy eating behaviours. No other significant differences were found. In terms of correlations between the variables, as hypothesized, autonomy support was associated with need satisfaction and autonomous motivation. Controlling behaviours were correlated with need thwarting, controlled motivation, and amotivation, as expected. Autonomous motivation was associated with physical activity and healthy eating behaviours. Also, controlled motivation was related to unhealthy eating. Moreover, amotivation was correlated negatively with healthy eating and positively with unhealthy eating behaviours. Autonomy support was weakly correlated to controlling behaviours, and need satisfaction was inversely and moderately related to need thwarting. In line with previous findings (Bartholomew, Ntoumanis, Ryan, & Thøgersen-Ntoumani, 2011; Bartholomew et al., 2010), these correlations indicate that these pairs of constructs are orthogonal.

**Structural Equation Model of Motivation and Weight Management Behaviours**

Structural equation modelling analysis was used to evaluate simultaneously the hypothesized relations between important other behaviours, basic psychological needs, motivation, and the behavioural outcomes (see our hypotheses). Our sample size was insufficiently large for an analysis using a full item indicator approach. Therefore, the single-indicator approach was used to correct for measurement error by fixing the proportion of measurement error to an a priori value (Hayduk, 1987, p. 120). In our study, we fixed the factor loading of the single indicator to the latent variable as the square root of the Cronbach alphas of the scores for the corresponding variables. Mean scale scores for autonomy support, controlling behaviours, need satisfaction, need thwarting, healthy and unhealthy eating behaviours were used as indicators of the respective factors. Koestner, Otis, Powers, Pelletier, and Gagnon (2008) argued that autonomous and controlled forms of motivation should not be

Table 4.1

*Descriptive Statistics of Measured Variables, Separated by Participants' Weight Management Goals*

| | | | Participant weight management goals | | | | | |
|---|---|---|---|---|---|---|---|---|
| | All participants ($n$ = 235) | | Lose weight ($n$ = 156) | | Maintain weight ($n$ = 79) | | | |
| | *M* | *SD* | *M* | *SD* | *M* | *SD* | *t* | *p* |
| 1. Age | 27.39 | 8.96 | 27.88 | 8.95 | 26.44 | 8.96 | 1.16 | .25 |
| 2. BMI | 24.58 | 5.62 | 24.96 | 5.45 | 23.82 | 5.91 | 1.45 | .15 |
| 3. Autonomy support | 4.31 | 1.56 | 4.39 | 1.61 | 4.17 | 1.48 | 1.00 | .32 |
| 4. Controlling behaviours | 2.51 | 1.37 | 2.63 | 1.38 | 2.29 | 1.33 | 1.76 | .08 |
| 5. Need satisfaction | 5.64 | 1.11 | 5.64 | 1.12 | 5.63 | 1.10 | 0.02 | .99 |
| 6. Need thwarting | 2.81 | 1.40 | 2.91 | 1.42 | 2.62 | 1.34 | 1.48 | .14 |
| 7. Autonomous motivation | 3.57 | 0.91 | 3.61 | 0.85 | 3.50 | 1.01 | 0.82 | .41 |
| 8. Controlled motivation | 2.34 | 0.97 | 2.41 | 1.03 | 2.18 | 0.84 | 1.83 | .07 |
| 9. Amotivation | 1.63 | 0.90 | 1.63 | 0.96 | 1.63 | 0.79 | 0.03 | .98 |
| 10. Physical activity | 42.69 | 28.58 | 42.74 | 29.63 | 42.60 | 26.60 | 0.04 | .97 |
| 11. Healthy eating behaviours | 3.36 | 0.88 | 3.49 | 0.79 | 3.09 | 0.98 | 3.15 | .00 |
| 12. Unhealthy eating behaviours | 1.39 | 0.62 | 1.49 | 0.71 | 1.20 | 0.28 | 4.52 | .00 |

Table 4.2

*Internal Consistencies and Pearson Correlations of Measured Variables*

| | Cronbach α | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Age | — | | | | | | | | | | | |
| 2. BMI | — | .03 | | | | | | | | | | |
| 3. Autonomy support | .91 | -.11 | .03 | | | | | | | | | |
| 4. Controlling behaviours | .83 | -.02 | .00 | .18** | | | | | | | | |
| 5. Need satisfaction | .93 | .10 | .00 | .38** | -.19** | | | | | | | |
| 6. Need thwarting | .94 | -.11 | -.05 | -.18** | .41** | -.41** | | | | | | |
| 7. Autonomous motivation | .87 | .01 | .01 | .13* | -.02 | .40** | -.09 | | | | | |
| 8. Controlled motivation | .86 | -.17** | .04 | -.08 | .42** | -.26** | .61** | .08 | | | | |
| 9. Amotivation | .88 | -.09 | -.04 | -.04 | .38** | -.24** | .52** | -.12 | .56* | | | |
| 10. Physical activity | — | -.11 | .01 | .02 | -.02 | .07 | -.08 | .18** | -.09 | -.04 | | |
| 11. Healthy eating behaviours | .65 | .18** | .01 | .07 | -.02 | .16* | -.05 | .29** | -.05 | -.20** | .09 | |
| 12. Unhealthy eating behaviours | .80 | .06 | .03 | .00 | .29** | -.12 | .36** | .05 | .36* | .43** | .12 | .11 |

*Note.* $N = 235$. * $p < .05$; ** $p < .01$.

aggregated into a single index of relative autonomy, as they have different predictive effects on behavioural outcomes. Therefore, in this study we contrasted between autonomous motivation (intrinsic motivation and identified regulation), controlled motivation (introjected and external regulation), and amotivation. The corresponding mean scale scores were used as indicators of these factors. Specifically, we examined a model in which autonomy support and controlling behaviours predicted need satisfaction and thwarting, which then predict autonomous motivation, controlled motivation, and amotivation. In turn, these behavioural regulations predicted physical activity, healthy and unhealthy eating behaviours (Figure 4.1). The behavioural outcomes of physical activity, healthy and unhealthy eating behaviours were controlled for participants' weight management goal (weight loss versus maintenance), age, and BMI. The residual variances of these outcomes were allowed to correlate in the model we tested.

The analysis was conducted with Mplus (Muthén & Muthén, 2008) using the MLR estimator. A good model fit was found: scaled $\chi^2(39) = 47.53$, $p = .16$, CFI = .98, TLI =.96, RMSEA = .03, SRMR = .05. As hypothesized, autonomy support predicted more need satisfaction and less need thwarting. Similarly, controlling behaviours predicted more need thwarting and less need satisfaction. In turn, need satisfaction predicted autonomous motivation, while need thwarting predicted controlled motivation and amotivation. As hypothesized, autonomous motivation predicted physical activity and healthy eating behaviours. Controlled motivation predicted less physical activity. Further, amotivation predicted less healthy eating and more unhealthy eating behaviours. We also found significant indirect effects from autonomy support to physical activity ($\beta = .06$, $p < .01$), healthy eating behaviours ($\beta = .09$, $p < .01$), and unhealthy eating behaviours ($\beta = -.09$, $p < .01$). Significant indirect effects were also found from controlling behaviours to healthy ($\beta = -.08$, $p = .04$) and unhealthy eating behaviours ($\beta = .19$, $p < .01$).

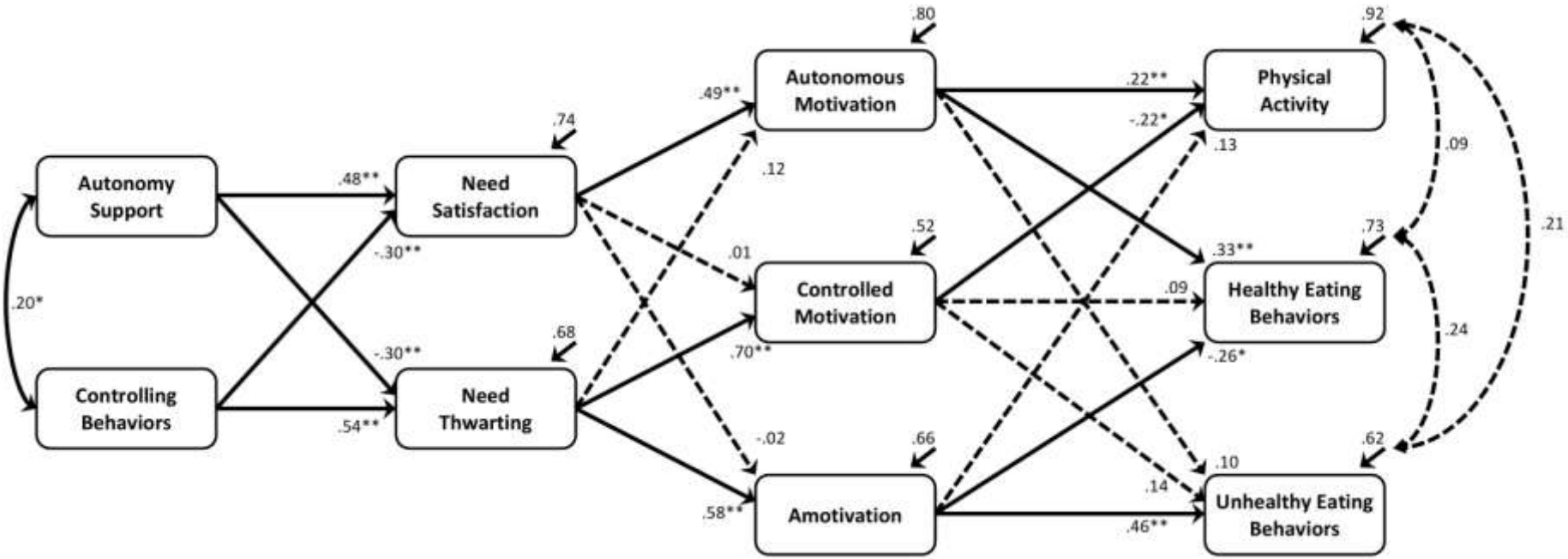


*Figure 4.1.* Structural equation model of self-determination theory-based constructs predicting behavioural outcomes associated with weight management.

* $p < .05$; ** $p < .01$. Dotted lines indicate non-significant path coefficients. Control variables were excluded in the figure for clarity purposes.

## Discussion

The purpose of this study was to examine how important others' interpersonal style might predict motivation and engagement in behaviours associated with weight management. As hypothesized, we found that autonomy supportive behaviours were associated with more adaptive motivational outcomes, namely higher need satisfaction and greater autonomous motivation. In turn, participants with higher levels on these motivational variables engaged in more physical activity and healthy eating behaviours, variables which have been shown to be associated with successful weight management (Wing & Hill, 2001). In contrast, when important others were perceived as controlling, participants had higher levels of need thwarting, and in turn had more controlled motivation and amotivation. Consequently, participants reported higher levels of maladaptive behavioural outcomes, including doing less physical activity, using less healthy eating behaviours and more unhealthy eating behaviours. In line with SDT, our results support the important positive role of perceived autonomy support in the context of weight management. Moreover, we also found preliminary evidence regarding the negative impact of having important others with a controlling interpersonal style.

Our findings have several implications. First, they suggest that controlling behaviours should be avoided because they could undermine adaptive motivation for weight regulation and result in unhealthy eating behaviours. For instance, a husband using contingent rewards to motivate his wife to lose weight may make his wife feel pressured to succeed, and therefore she may use extreme measures, such as skipping meals, to lose weight. Second, the small positive association between autonomy support and controlling behaviours (also found in other contexts such as education; e.g., Tessier et al., 2008) suggests that important others who are autonomy supportive may simultaneously use controlling behaviours. Hence, while these individuals should attempt to use more autonomy supportive behaviours such as acknowledging negative feelings or providing meaningful rationales, they should also consciously avoid being controlling, such as by using contingent rewards or intimidation.

Third, in line with previous research findings (Bartholomew, Ntoumanis, Ryan, & Thøgersen-Ntoumani, 2011; Bartholomew et al., 2010), we found that the association between need satisfaction and need thwarting is moderate (negatively; $r$ = -.41), suggesting that these constructs are not bipolar. For example, an individual may feel autonomous because it was his own decision to manage his weight. Nonetheless, his autonomy may be simultaneously thwarted when he feels pressured by his wife to eat certain foods he dislikes. In conclusion, the results point to the importance of assessing both controlling behaviours and need thwarting for a more complete understanding of how significant others impact on the motivation, physical activity, and eating behaviours of individuals with weight management goals. Some of the results we found were similar to those reported in previous research. For instance, using structural equation modelling, we found that controlled motivation predicted less physical activity, but did not predict healthy or unhealthy eating behaviours. Other researchers have also found that controlled motivation failed to predict behavioural outcomes (Silva, Markland, et al., 2010) and actual weight loss (Silva et al., 2011). It is possible that controlled motivation (e.g., feelings of guilt) sometimes facilitates weight management efforts; however over time, controlled motivation appears to be unrelated to behavioural persistence (Deci & Ryan, 2000; Pelletier et al., 2001). Further, a meta-analysis by Ng et al. (2012) showed that controlled motivation is associated with lower psychological well-being, and thus, should be avoided.

**Limitations and Future Directions**

There are a few limitations with this study that should be noted. First, many measures used were adapted from other contexts, including sport and exercise. To address this shortcoming, we examined the factorial validity of scores derived from all modified scales. The CFAs offered support for the factorial validity of most scales (with the exception of a couple of scales that required the deletion of a single item to have good model fit). However, new items or scales may be needed specifically for the context of weight management to

capture a broader scope of interpersonal behaviours and motivational experiences.

In our study we examined a structural model based on a SDT-model suggested by Vallerand (1997). However, some researchers have suggested that some of the hypothesized relations are bidirectional. For instance, Pelletier et al. (2002) showed that teachers' provision of autonomy support versus control was affected by their perception of their students' motivation. Specifically, Pelletier et al. found that teachers were more autonomy supportive and less controlling when they perceived that their students were more autonomously motivated. Similar mechanisms may operate within the context of weight management. For example, individuals who are more autonomously motivated to manage their weight may influence their important other to be more autonomy supportive. In contrast, important others may be more controlling when they perceive the individual to be motivated for controlled reasons. Further, some individuals have a stronger predisposition toward autonomy, that is, they have a higher tendency to orient themselves toward cues that support autonomous motivation (Williams et al., 1996). Thus, they may perceive the behaviours of important others to be more autonomy supportive. Future research would be required to examine these possible reciprocal mechanisms within weight management.

Due to the cross-sectional nature of this study, we were unable to examine how the measured variables predict actual weight loss (or weight maintenance), However, researchers have shown that certain weight management behaviours such as physical activity can provide health benefits irrespective of weight changes (King, Hopkins, Caudwell, Stubbs, & Blundell, 2009; Ortega et al., in press). Future research could adopt experimental designs to investigate how improving the interpersonal style of significant others (i.e., making it more autonomy supportive *and* less controlling) can predict changes in body weight, behaviours associated with weight management, and psychological well- and ill-being. Objective measures for physical activity and eating behaviours could also be incorporated to improve the accuracy of such measures.

Finally, participants reported perceived autonomy support and controlling behaviours of the most influential important other they were asked to nominate. Future research should examine how individuals' motivation might be affected when they are exposed to different, perhaps conflicting, styles of important others. Such research might lead to interventions that are more effective in promoting adaptive motivation and behaviours for weight management.

# CHAPTER 5:

# MOTIVATION CONTAGION WHEN INSTRUCTING OBESE INDIVIDUALS:

# A TEST IN EXERCISE SETTINGS

**Abstract**

We examined motivation contagion in a hypothetical exercise setting. Exercise science students ($n$ = 164) were provided with quotes of hypothetical male and female obese exercisers displaying different quality of motivation to start an exercise programme. We used a 3 (exerciser motivation) × 2 (exerciser gender) × 2 (student gender) between-subjects experimental design to examine students' (a) motivation to instruct, (b) interpersonal style, (c) perception of barrier efficacy of the exerciser, and (d) effort to identify factors that could maximize the effectiveness of an exercise programme for the exerciser. Results showed that students displayed less controlled motivation and rated the exerciser as more capable of overcoming barriers to exercise when they perceived the exerciser to be autonomously motivated. However, students, particularly females, reported more autonomy support and invested more effort toward female exercisers with controlled motivation. Our findings indicate that motivation contagion effects are plausible in exercise settings and may affect interactions between fitness instructors and obese clients.

## Introduction

Obesity is related to many chronic health conditions, such as type 2 diabetes and related cardiovascular diseases (Sullivan et al., 2005). The social context, especially instructors' interpersonal styles, can play a salient role in influencing exercisers' motivation and adherence (e.g., Edmunds et al., 2007). Extensive research has shown that many obese individuals feel stigmatized and report that they are treated disrespectfully by health professionals, including fitness instructors (Anderson & Wadden, 2004; R. M. Puhl & Heuer, 2009). Currently it is unknown whether beliefs and behaviours of health professionals toward obese individuals are partly influenced by their perceptions of the different motivations of the latter to engage (or not) in health-related behaviours. The effect of perceptions of others' motivation on the perceiver's own motivation and instructional style has been labelled motivation contagion (Wild & Enzle, 2002). Thus, in this study we were interested to explore the extent to which motivation contagion effects might be in operation when instructing obese clients with different motivations for exercise engagement.

We used the self-determination theory (SDT; Ryan & Deci, 2000) framework in this study. According to SDT, there are different interpersonal styles to instruct, but most SDT-based studies have distinguished between an autonomy supportive and a controlling interpersonal style. *Autonomy support* refers to behaviours that support individuals' psychological needs by providing meaningful rationales for engaging in an activity, acknowledging negative feelings, and offering choices (Deci, Eghrari, Patrick, & Leone, 1994). In contrast, *controlling behaviours* thwart psychological needs via the use of coercion, intimidation and conditional acceptance (Bartholomew et al., 2010). Studies in the exercise domain have indicated that perceived autonomy support may lead to higher adherence levels (e.g., Edmunds et al., 2008) and better mental health outcomes (e.g., Rouse et al., 2011). In contrast, controlling instructional behaviours have been associated with decreases in physical activity participation (e.g., Vansteenkiste, Simons, Soenens, & Lens, 2004).

Based on the tenets of SDT, motivation can be categorized into different types according to their underlying degree of self-determination. Intrinsic motivation (doing an activity for the enjoyment it provides), integrated regulation (performing an activity because it is congruent with personal goals and values), and identified regulation (engaging in an activity because it offers personally valued outcomes) are indices of *autonomous* motivation. Introjected regulation (acting to avoid internal pressures) and external regulation (acting as a result of external pressure or reward) are indices of non-autonomous or *controlled* motivation. Finally, *amotivation* refers to a state in which a person lacks both autonomous and controlled motivation. Previous research has shown that more autonomous forms of motivation are associated with efficacy to overcome exercise barriers (Thøgersen-Ntoumani & Ntoumanis, 2006), involvement in physical activity (Edmunds et al., 2008) and adherence to weight control behaviours (Silva et al., 2011).

**Motivation Contagion**

Stemming from the tenets of SDT, Wild and Enzle (2002) suggested that apart from the direct application of interpersonal support or control, one's motivation may be enhanced or undermined based on his/her perception of motivation of other people within the social environment. Individuals subconsciously draw on their perceptions of other people's motivation and self-generate expectations regarding their own quality of task involvement and engagement in an activity. These expectations will in turn shape their actual motivation toward the activity and, if they are in a position of authority, might influence their interpersonal style towards their subordinates in ways that are congruent with their expectations. For instance, previous research in the educational domain has documented that teachers' interpersonal style may be influenced by their perceptions of students' motivation. Pelletier and Vallerand (1996), Skinner and Belmont (1993), and Sarrazin et al. (2006) showed that when teachers perceived students to be more autonomously motivated, they offered them more autonomy support. In contrast, controlling behaviours were utilized when

students were perceived to have controlled motivation. Pelletier et al. (2002) and Taylor, Ntoumanis, and Standage (2008) replicated these findings and identified teacher self-determined motivation to instruct as a mediator in the instructional style-student motivation relationship.

**Gender Differences**

Previous research has examined gender differences in perceived receipt of autonomy support with mixed findings. For instance, Grolnick, Gurland, DeCourcey, and Jacob (2002) compared levels of autonomy support provided by mothers using both objective ratings by external raters and self-reports by their sons and daughters, and found no differences between sons and daughters. In contrast, Soenens and Vansteenkiste (2005) found that girls, compared to boys, reported higher levels of perceived autonomy support from their mothers. No studies have explored gender differences in perceived *provision* of autonomy support. However, research outside the SDT literature has suggested that males and females may have different orientations towards both seeking and providing support to others. For instance, when compared to men, women are more likely to seek and receive support from others. Women are also more ready to provide support to others, as such a behaviour is assumed to be accepted and appreciated (Barbee et al., 1993). In our study we were interested to explore whether the gender of the participant and the gender of the exerciser would moderate potential motivation contagion effects in terms of not only provided autonomy supportive/controlling motivational strategies but also with regard to instructors' motivation to instruct.

**The Current Study**

The overarching aim of the current study is to contribute to the motivation contagion literature by examining this process in a previously untested setting that has important public health ramifications (instructing obese exercisers). We also extended previous studies (e.g., Pelletier et al., 2002; Pelletier & Vallerand, 1996) by considering the possible, but overlooked, moderating role of gender, and by measuring variables that have not been previously assessed

in the extant literature, including non-self-reported outcomes. Specifically, we presented to exercise science students profiles of fictitious obese individuals with differing motivation for exercise adoption. We hypothesized that participants would report higher levels of autonomous (controlled) motivation to instruct when the hypothetical exerciser was perceived as autonomously (controlled) motivated to exercise (H1). Furthermore, we predicted that participants perceiving an exerciser to be autonomously (controlled) motivated would rate autonomy supportive (controlling) behaviours as more effective for motivating the individual to exercise (H2). Also, we hypothesized that participants would rate the autonomous exerciser as capable of overcoming barriers to exercise (H3) and would invest more effort in identifying factors that maximize the effectiveness of a training programme for that individual (H4).

## Methods

### Participants

Exercise science students ($n$ = 164; 102 males; $M$ age = 19.85 years, $SD$ = 1.83) from a British university participated for course credit. They were mainly white (93.90%); 10.98% had experience as gym instructors. The procedures of the study were approved by an ethical review committee of a British university. All participants provided written informed consent.

### Procedures

Participants were given a scenario in which they were instructors (hereby called instructors) at a gym and were presented with photos of three obese individuals who had recently signed up to this hypothetical gym. The hypothetical exercisers shown were male or female clients, middle-aged, white, and visibly obese with a purported BMI of 33. Instructors were provided with quotes given by these exercisers regarding their reasons to begin exercising. These quotes (see Appendix N) were intended to imply different types of motivation to exercise: autonomous (e.g., “it is important for me to lead a healthy lifestyle”), controlled (e.g., “my partner has been nagging me to start exercising for a long time”), and neutral reasons (e.g., “you can call that my New Year resolution”). Thus, instructors were

randomly allocated into one of 6 conditions (autonomous motivation, controlled motivation, neutral motivation × male exerciser, female exerciser). As a manipulation check, the instructors were asked to rate their perceptions of motivation of all three exercisers. Our design was a 3 (exerciser motivation) × 2 (exerciser gender) × 2 (instructor gender) between-subjects experimental design.

The scenarios referred to obese individuals at the beginning stages of an exercise programme in order to emulate a situation in which instructors are unfamiliar with the exercisers, and therefore motivation contagion effects are likely to be stronger. Similar strategies of introducing participants to strangers can be found in previous research on motivation contagion (e.g., Radel, Sarrazin, Legrain, & Wild, 2010).

The instructors then completed the remaining parts of the questionnaire by focusing on one of the exercisers, depending on the allocated condition. The target male and female exerciser was depicted with the same photo within each motivation condition. Instructors then performed an imagery exercise, using a pre-recorded script, in which they imaged themselves instructing the target exerciser in a gym. The imagery scripts were used to facilitate the vividness of the scenario. Following the imagery activity, we asked the instructors to rate the ease of mentally creating the images described in the script ("How easy was it for you to mentally create the images described in the scenario?"; Appendix O) using a 7-point scale (1 = *Very hard*, 7 = *Very easy*). They reported a mean score of 5.65, indicating that they generally found it easy to form images of the scenarios described in the scripts. Instructors then reported their own motivation towards instructing the target exerciser, the motivational strategies they believed would be effective to motivate the exerciser, and their perceptions of the efficacy of the exerciser to overcome barriers to exercise. Finally, instructors were asked to identify as many factors as possible that could maximize the effectiveness of an exercise programme designed for the exerciser. This was used as a proxy measure of instructors' investment of effort to instruct.

Previous research has shown that physically more attractive individuals may be perceived as more competent in various aspects of life (Eagly, Ashmore, Makhijani, & Longo, 1991). In order to eliminate the potential confounding effect of attractiveness, we asked in a pilot study 19 postgraduate students to rate the perceived attractiveness of the individuals portrayed in the photos. Results of a repeated measures ANOVA indicated that the perceived attractiveness ratings of the hypothetical exercisers were not significantly different ($p$ = .46, partial $\eta^2$ = .052).

**Measures**

**Perceived motivation of exercisers.** The Behavioural Regulations in Exercise Questionnaire (BREQ; Mullan, Markland, & Ingledew, 1997) was used to measure the perceived motivation of the exercisers. The original scale is a self-report measure of intrinsic motivation, identified regulation, introjected regulation and external regulation to exercise. In our study, we modified the items to measure the motivation of the hypothetical exerciser as perceived by the instructor (e.g., "because other people probably said he should"). Due to the fact that the instructors had to complete the scale with regard to all three exercisers, as well as due to the overall length of the whole questionnaire pack, only two items per subscale from the questionnaire were used (Appendix M). Items with the best face validity were chosen from the original scale. Autonomous motivation was represented by combined intrinsic motivation and identified regulation scores, and controlled motivation by combined introjected and external regulation scores. Amotivation was not measured in our study because we wanted to specifically contrast autonomous and controlled forms of motivation and because the scenario referred to clients who had already signed up to an exercise programme. Cronbach alphas for autonomous and controlled motivation in this study were .92 and .74, respectively.

**Motivation to instruct.** Instructors' intrinsic motivation, identified regulation, and external regulation to instruct were measured using an adapted version (e.g., "I would instruct

him/her because that would be fun") of the Situational Motivation Scale (Guay, Vallerand, & Blanchard, 2000) which taps intrinsic motivation, identified regulation, external regulation and amotivation (Appendix P). Guay et al. (2000) developed the scale to measure situational motivation towards an activity, such as that induced by an experimental manipulation. They also provided evidence supporting the reliability and construct validity of scale scores. The original questionnaire also included a subscale to measure amotivation. We did not include this subscale as we felt the construct was not applicable when the instructor meets a new exerciser.

**Motivational strategies.** Eight items from the Health Care Climate Questionnaire (HCCQ; Williams et al., 1996) and eight items from the Controlling Coach Behaviors Scale (CCBS; Bartholomew et al., 2010) were adapted to measure autonomy supportive (e.g., "Provide him/her with choices and options"; Appendix C) and controlling ("Promise to reward him/her but only if he/she did well"; Appendix D) motivational strategies to instruct the exercisers, respectively. Previous research (e.g., Fortier, Sweet, et al., 2007) has also adapted the HCCQ to measure perceived autonomy support in the exercise domain, and found results that supported the reliability and validity of the scale scores. The CCBS was originally developed to measure controlling behaviours in the sport domain. Validation studies showed that scale scores were associated with those of other constructs in ways that were in line with SDT predictions (e.g., Bartholomew, Ntoumanis, Ryan, Bosch, et al., 2011). In our study, instructors were told that they were not asked to rate which strategies were generally more appropriate, but should rate them according to their perceived effectiveness for the target exerciser.

**Perceived efficacy.** Instructors rated their perceptions of the target exerciser's barrier efficacy using eight items adapted from the Self-efficacy for Exercise Behaviors Scales (Sallis, Pinski, Grossman, Patterson, & Nader, 1988; Appendix Q). The scale has been used in previous SDT-based studies (e.g., Teixeira et al., 2006) and its scores have been associated

with those of autonomous motivation to exercise. The original items were modified to measure the barrier efficacy of the exerciser as perceived by the instructor (e.g., "Stick to his/her exercise programme after a long, tiring day at work").

**Effort to instruct.** Instructors were asked to list up to 30 factors (e.g., psychological, physiological) which might help maximize the effectiveness of the exercise programme for the target exerciser (Appendix R). Instructors were allowed to use resources from the internet to complete the task and were not given a time limit. The total number of factors (factors deemed irrelevant were deleted, e.g., "train with a clear head") they identified was used as a non-self-report measure of their investment of effort to instruct the exerciser.

### Data analyses

Internal consistencies of scale scores were evaluated using Cronbach alphas. Pearson correlations were calculated to examine associations between measured constructs. To evaluate group differences between experimental manipulations, analysis of variance (ANOVA) or multivariate analysis of variance (MANOVA) were used. Significant group differences were followed up by simple effects tests (Tabachnick & Fidell, 2007).

## Results

### Preliminary Results

Descriptive statistics, Cronbach alphas, and Pearson correlation between constructs are presented in Tables 5.1 and 5.2.

### Manipulation Check

Two repeated measures ANOVAs, with the three hypothetical individuals as the within-subject factor, were conducted as manipulation checks. We first compared the ratings for perceived autonomous motivation. The main effect was significant: $F(2, 326) = 389.44$, $p < .001$, partial $\eta^2 = .705$. Instructors rated the exerciser portrayed as autonomously (controlled) motivated to have the most (least) autonomous motivation. We then compared the ratings for perceived controlled motivation. The effect was again significant: $F(2, 326) = 413.12$, $p$

Table 5.1

*Descriptive Statistics and Cronbach Alphas of Measured Variables in Study 4*

| | | Neutral Condition | | Autonomous Condition | | Controlled Condition | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Possible Range | *M* | *SD* | *M* | *SD* | *M* | *SD* | α | *F*(2,152) | Partial $\eta^2$ |
| 1. Intrinsic motivation to instruct | 1 – 7 | 5.19 | 1.04 | 5.52 | 0.73 | 5.29 | 1.04 | .79 | 1.70 | .022 |
| 2. Identified regulation to instruct | 1 – 7 | 5.25 | 0.94 | 5.08 | 0.81 | 5.22 | 0.90 | .60 | 0.64 | .008 |
| 3. External regulation to instruct | 1 – 7 | 4.68 | 0.91 | 4.18 | 0.94 | 4.61 | 1.14 | .71 | 3.67* | .046 |
| 4. Autonomy supportive behaviours | 1 – 7 | 5.94 | 0.57 | 5.93 | 0.48 | 5.97 | 0.57 | .59 | 0.94 | .001 |
| 5. Controlling behaviours | 1 – 7 | 3.10 | 0.93 | 2.79 | 0.83 | 3.06 | 0.88 | .73 | 1.67 | .021 |
| 6. Perceived barrier efficacy of target exerciser | 1 – 5 | 2.41 | 0.69 | 3.18 | 0.42 | 2.34 | 0.70 | .85 | 23.98** | .240 |
| 7. Investment of effort to instruct | 1 – 30 | 8.04 | 4.75 | 11.11 | 4.54 | 11.91 | 4.79 | – | 10.17** | .118 |

Note. * $p < .05$; ** $p < .01$.

Table 5.2

*Pearson Correlations Between Measured Variables*

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| 1. Perceived autonomous motivation of target exerciser | | | | | | | | |
| 2. Perceived controlled motivation of target exerciser | -.55* | | | | | | | |
| 3. Intrinsic motivation to instruct | .18* | -.10 | | | | | | |
| 4. Identified regulation to instruct | -.02 | .07 | .58* | | | | | |
| 5. External regulation to instruct | -.13 | .16* | -.29* | .09 | | | | |
| 6. Autonomy supportive behaviours | -.02 | .04 | .26* | .26* | -.07 | | | |
| 7. Controlling behaviours | -.02 | .13 | -.13 | -.07 | .02 | -.28* | | |
| 8. Perceived barrier efficacy of target exerciser | .53* | -.25* | .21* | .01 | -.19* | -.08 | -.12 | |
| 9. Investment of effort to instruct | -.01 | .12 | .20* | .10 | -.18* | .26* | -.05 | .14 |

*Note*. * $p < .05$.

< .001, partial $\eta^2$ = .717. Instructors rated the exerciser portrayed as autonomously (controlled) motivated to have the least (most) controlled motivation. These results suggest that the scenarios were successful in inducing different perceptions of the exercisers' motivation.

**Instructor Motivation (H1)**

A three-way (Condition × Target exerciser's gender × Instructor's gender) MANOVA[8] was conducted with instructors' intrinsic motivation, identified regulation, and external regulation as dependent variables. No interaction effects were found, but a multivariate main effect for condition was significant: $\lambda = .916$, $F(6, 300) = 2.24$, $p = .039$, partial $\eta^2 = .043$. The univariate statistics showed there was a main effect of condition on external regulation (Table 5.1). Simple effects contrasts indicated that instructors in the autonomous condition had lower values of external regulation compared to both the neutral and controlled conditions.

**Instructional Strategies (H2)**

A three-way MANOVA was conducted to examine differences on two dependent variables, namely autonomy supportive and controlling instructional behaviours with regard to the target exerciser. The interactions of condition by exerciser's gender ($\lambda = .889$, $F[4, 302] = 4.58$, $p = .001$, partial $\eta^2 = .057$), as well as exerciser's gender by instructor's gender ($\lambda = .947$, $F[2, 151] = 4.25$, $p = .016$, partial $\eta^2 = .053$) were significant. Univariate tests indicated a significant condition by exerciser's gender interaction effect on autonomy supportive behaviours: $F(2, 152) = 8.80$, $p < .001$, partial $\eta^2 = .104$. The interaction effect

[8] Given that past research (e.g., Chambliss, Finley, & Blair, 2004) has shown a strong implicit antifat bias among fitness instructors and exercise science students, we assessed participants' beliefs regarding weight loss (Stotland & Zuroff, 1990) and biases against overweight individuals (Crandall, 1994). Results of two 2-way (Condition × Exerciser's gender) ANOVAs showed no between group differences in these ratings. Thus, these variables were not used as covariates in the analyses.

between the exerciser's and instructor's genders was also significant for autonomy supportive behaviours ($F[1, 152] = 7.42$, $p = .007$, partial $\eta^2 = .047$).

Tests of simple effects were conducted to explore the significant interactions. Regarding the interaction between condition and exerciser's gender (Figure 5.1), the instructors rated autonomy supportive behaviours as *less* effective when instructing a male exerciser who was controlled as opposed to autonomous or neutral in his motivation. In contrast, the instructors rated autonomy supportive behaviours as *more* effective when instructing a female exerciser who was controlled as opposed to autonomous or neutral in her motivation. The difference in autonomy support scores between male and female exercisers with controlled motivation was significant.

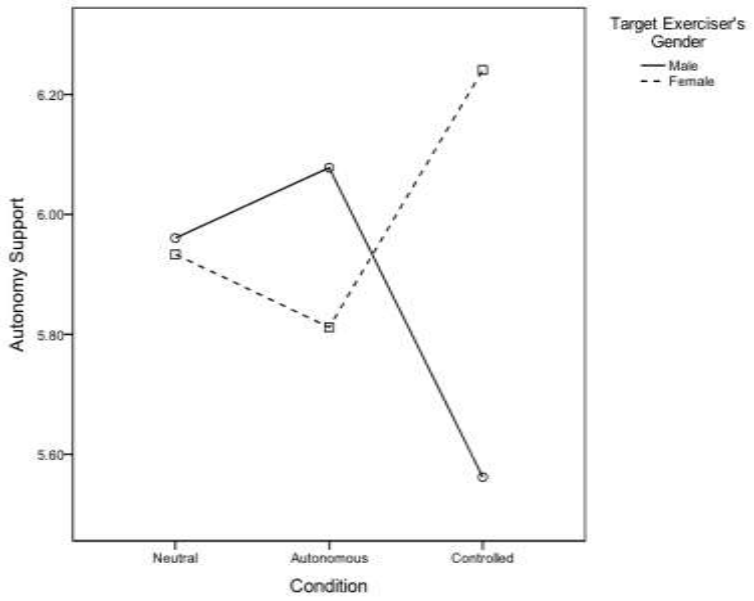


*Figure 5.1.* Gender differences in instructors' perceived effectiveness of provision of autonomy support across different conditions.

As for the interaction between the genders of the exerciser and the instructor (Figure 5.2), it was found that female instructors rated autonomy support as more effective for female than male exercisers. Ratings of autonomy support effectiveness for female exercisers were higher when given by female as opposed to male instructors.

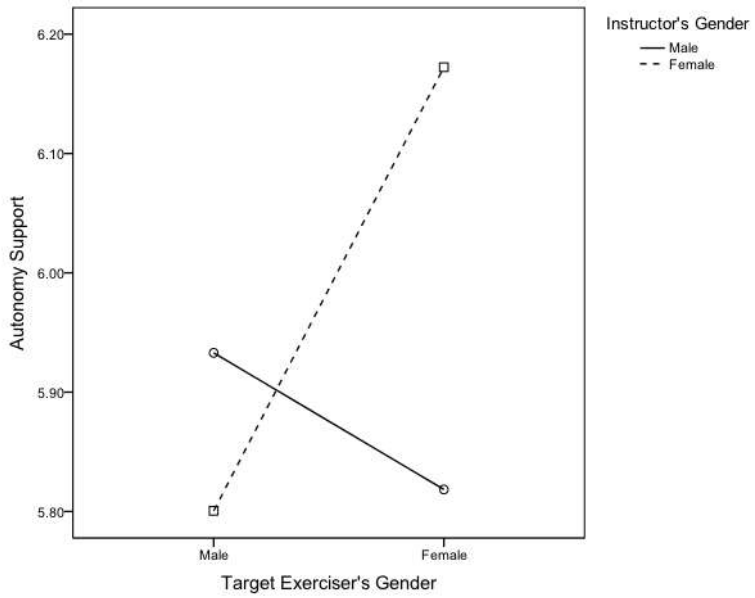


*Figure 5.2.* Gender differences in instructors' perceived effectiveness of autonomy support to male and female exercisers.

**Barrier efficacy (H3)**

A three-way (Condition × Exerciser's gender × Instructor's gender) ANOVA was conducted on instructors' perception of the target exerciser's ability to overcome barriers to exercise. The assumption of equal variances was violated, thus a more stringent test ($p < .01$) was used to infer significance. There were no significant interaction effects, but a main effect for condition was found (see Table 5.1). Simple effects contrasts showed that instructors felt the autonomously motivated exerciser was more likely to overcome barriers compared to the exerciser portrayed with controlled or neutral motivation.

**Effort (H4)**

A three-way ANOVA was conducted on the effort invested by the instructors to identify factors that could maximize the effectiveness of the exercise programme for the target exerciser. The more stringent test ($p$ <.01) was utilized as the equality of variance assumption was violated. A significant condition by exerciser's gender interaction was found: $F(2, 152) = 14.09$, $p < .001$, partial $\eta^2 = .156$ (Figure 5.3). When the target exerciser was perceived as neutral or controlled in their motivation, levels of effort were higher when the exerciser was female than male. In contrast, when the exerciser was perceived to be autonomously motivated, levels of effort were higher when the exerciser was male than female.

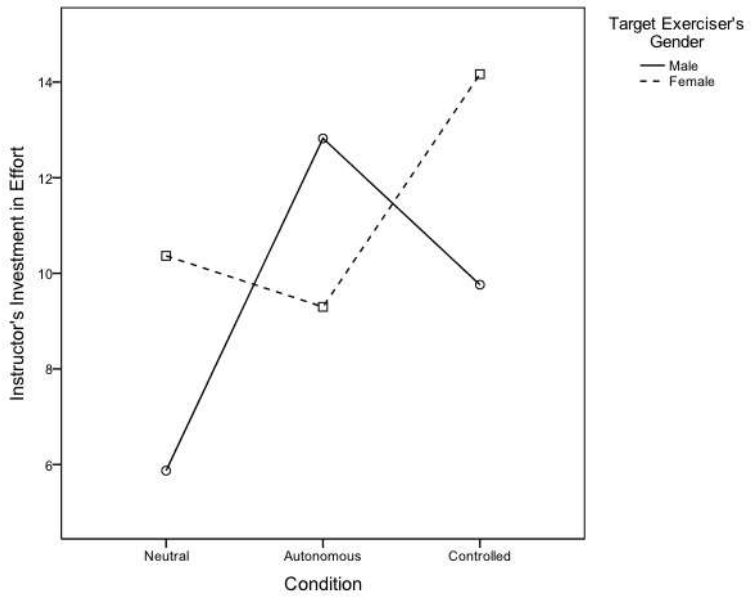


*Figure 5.3.* Gender differences in instructors' effort investment across different conditions.

## Discussion

This study builds on and extends work on motivation contagion by showing how gender and instructors' perceptions of obese individuals' motivation could affect the

instructors' motivation, efficacy beliefs and instructional style. Our first hypothesis (H1), which stated that instructors' own motivation might be influenced by their perceptions of the motivation of the exerciser, was partially supported: Instructors showed lower (higher) levels of external regulation when instructing an exerciser with autonomous (controlled) motivation. Further, we also hypothesized that instructors would rate the autonomous exerciser as being more capable of overcoming barriers to exercise (H3). Our findings supported this hypothesis, as instructors felt that the autonomously (as opposed to controlled) motivated exerciser was more likely to overcome barriers to exerciser.

Hypotheses 2 and 4 were only partly supported. We predicted instructors in the autonomous condition to rate autonomy supportive behaviours as more effective for motivating the exerciser (H2), and to invest more effort in identifying factors to maximize the effectiveness of a training programme for that individual (H4). Our results indicated that perceptions of exerciser autonomous motivation did result in high ratings of instructor autonomy support and effort investment. However, this was the case only in reference to a male exerciser. For a female exerciser an unexpected (opposite) effect was found with perceptions of controlled motivation resulting in higher ratings of autonomy support and effort investment. Further, higher ratings of autonomy support to the female exerciser were more likely to be provided by female than male instructors.

Our findings make important conceptual and practical additions to the motivation contagion literature by showing that obese individuals who are perceived to be motivated by external pressures or contingencies are likely to create expectations that result in their instructors (a) feeling not optimally motivated to instruct them, (b) being doubtful about the exercisers' ability to maintain their exercise behaviour, (c) rating, paradoxically, as less effective for these individuals motivational strategies that are considered in the SDT literature to be universally adaptive and effective, and (d) investing less effort to identify factors that are important for the success of a tailored exercise programme. Instructor training

programmes need to emphasize the interplay between instructor and exerciser motivation and highlight the importance of supporting overweight exercisers who appear less self-determined to exercise. The observed motivation contagion effects demonstrate that observers are sensitive to interpersonal cues that carry information regarding actors' motivation. Such cues have the potential to affect the observers' own motivation and interpersonal style toward the actors, possibly via the formation of expectations with regard to quality of task engagement and automatic goal inferences (e.g., Hassin, Aarts, & Ferguson, 2005; Wild & Enzle, 2002). The extent to which such expectations and inferences persist over time and how they can be modified is currently unknown.

Importantly for the motivation contagion literature, some of our findings did not apply to the hypothetical female exerciser for whom an opposite pattern was observed. Specifically, instructors rated autonomy supportive behaviours to be more effective, and invested more effort for female exercisers who were portrayed to be motivated for extrinsic reasons. Barbee et al. (1993) suggested that gender role expectations make it easier for females than males to activate social support when needed. This might partly explain why instructors in our study were more willing to provide autonomy support and invest effort to the female exerciser who was perceived to be struggling with motivation issues.

Our study has a number of strengths. First, previous research has shown that obese individuals are sometimes treated unfairly or disrespectfully by health professionals (Anderson & Wadden, 2004). Our findings showed that such biases might partly operate via motivation-related mechanisms (motivation contagion). Whether motivation contagion effects might be partly responsible for why instructors, or more generally health professionals, are unsuccessful in helping obese individuals adhere to physical activities is an interesting research question that could be pursued by future research. Also, to our knowledge, this was the first study that looked at motivation contagion effects with reference to exercise instruction. Further, we explored moderation effects of gender which have been overlooked in

the motivation contagion literature. In addition, we measured outcome variables that have not been previously assessed in that literature, including a non-self-reported outcome to reduce common method variance (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003).

In contrast, the use of hypothetical instructor-exerciser scenarios is a limitation of this work. Future studies could be conducted in actual exercise settings utilizing attendance records and observer ratings of instructor interpersonal styles. The use of a shortened form of the BREQ to measure perceived motivation of exercisers and the fact that we did not measure all types of regulations within the SDT-continuum with respect to both the perceived motivation of the hypothetical exerciser and in terms of motivation to instruct (for reasons given earlier) could be perceived by some as potential limitations of this study. Researchers should consider incorporating measures for these omitted constructs (i.e., integrated regulation for exercise and introjected regulation for instructing) in future research. In our study, we looked at the potential moderating effect of gender. Other demographic variables (e.g., age, ethnicity) should also be examined as moderators in future studies. Further, only a small proportion of participants had actual experiences as fitness instructors. As many exercise science students work as gym instructors when they graduate, it was important to examine how they might respond to the hypothetical situations we created as it is very likely that they will encounter similar situations in their future employment. From a conceptual perspective, the strength of motivation contagion might differ as a function of the experience of the observer in a given context (perhaps it will be stronger with novices, as the majority of participants were in our study). This has to be empirically tested. Replicating our work with experienced certified instructors would be a means of addressing this interesting research question. In view of the significant public health implications of obesity, our results indicate the need for more research on the bidirectional nature of the obese exerciser motivation-instructor motivation relationship.

# CHAPTER 6:

# GENERAL DISCUSSIONS

**Overview of Studies**

In Study 1 (Chapter 2), a meta-analysis was conducted using methods proposed by Hunter and Schmidt (2004) on studies that measured SDT-based variables (e.g., autonomy support, need satisfaction, behavioural regulations), and outcomes associated with better psychological (e.g., higher quality of life) and physical well-being (e.g., weight loss). Meta-analytical techniques were used to synthesise research findings in a rigorous way, which could eliminate common errors in individual empirical studies, such as sampling and measurement errors (Glass, 1976; Hunter & Schmidt, 2004). In terms of the meta-analysed effect sizes, our findings generally supported the tenets of SDT. Specifically, our findings indicated that perceived autonomy support, need satisfaction of competence, autonomy, and relatedness, and autonomous forms of motivation were associated with indicators of better psychological and physical health, as well as health-conducive behaviours, such as physical activity and smoking abstinence. In contrast, we found that amotivation was related to lower psychological and physical health, and also engagement in health-related behaviours. In terms of the effect sizes between controlled motivation and health outcomes, some of our results were somewhat unexpected. Specifically, we found that introjected regulation, a form of controlled motivation, was positively related to smoking abstinence, physical activity, and healthy diet behaviours. Although the meta-analysed effect sizes were small, contrary to our hypotheses, our results suggest that controlled forms of motivation may support engagement in health-related behaviours. From a practical perspective, the effect of controlled motivation may be salient during the initiation of health behaviours, when the motivation for the behaviours has not been internalised. Pressure from important others or feelings of guilt, for example, may be a strong source of motivation to help individuals abstain from unhealthy behaviours such as overeating. Nevertheless, we found that controlled motivation was related to indicators of lower psychological health, and therefore should not be promoted as a long-term solution to sustain health behaviours. Further, according to SDT, the positive outcomes

of controlled motivation are likely to be short-lived, and long-term adherence can be achieved only when behaviours are motivated by autonomous reasons.

The effect sizes between SDT-based variables were also meta-analysed. As expected, the directions of the effect between these variables were in line with tenets of SDT. For instance, we found that autonomy support was positively associated with basic need satisfaction and autonomous forms of motivation. As hypothesised, need satisfaction was also found to be positively related to autonomous forms of motivation, and negatively associated with controlled motivation, except introjected regulation. We found that the effect sizes between need satisfaction and introjected regulation were either small, or a real effect may not exist.

An advantage of conducting a meta-analysis is that it allows testing for moderators that may affect the relations between variables. In our study we conducted a series of moderator analyses to test whether the effect sizes were homogenous across studies that used different study designs, were based on different settings or contexts, and included participants of different age groups. We found that moderators may affect some of the meta-analysed effect sizes. Nevertheless, we found that these relations differed in terms of the magnitude of effects, but their directions across the different groups were generally consistent to the tenets of SDT.

Another aim of Study 1 was to test SDT-based models using structural equation modelling. We examined two structural models by using matrices of meta-analysed correlations as input. We first examined a model based on Ryan et al.'s (2008) SDT model of health behavioural change. As hypothesised, we found that perceived autonomy support predicted satisfaction of the three basic needs. In turn, satisfaction of these needs were positively related to autonomous motivation, and inversely related to amotivation. Satisfaction of autonomy predicted lower levels of controlled motivation, but weak, positive paths were found from competence and relatedness satisfaction to controlled motivation. This was

slightly unexpected, as we hypothesised that the satisfaction of all three needs would negatively predict controlled motivation. Both autonomous and controlled motivation predicted indicators of physical health and health-conducive behaviours. In contrast, amotivation negatively predicted physical health and health behaviours. In terms of indicators of psychological well-being, we found that they were predicted positively by autonomous motivation. On the contrary, both controlled motivation and amotivation negatively predicted indicators of psychological well-being. Direct paths from competence satisfaction to both psychological and physical health outcomes were found, suggesting that feelings of competence may directly predict some of these outcomes.

Based on a model suggested by Williams et al. (2002), we conducted a second path analysis. In this model, perceived autonomy support directly predicted autonomous motivation and the need for competence, which in turn predicted health-related behaviours and outcomes. Williams et al. presented this model for studies conducted within treatment settings. Therefore, when evaluating this model, we only used meta-analysed effect sizes that were based on studies in such settings only. Consistent to our hypotheses, we found that autonomy support positively predict competence need satisfaction and autonomous motivation, and in turn predicted higher levels of psychological well-being, physical health, and health-conducive behaviours.

The results of our meta-analysis showed that, after correcting for sampling and measurement errors, despite some unexpected results regarding introjected regulation, findings in the extant literature have generally supported the tenets of SDT within health contexts. The amount of studies that were included also suggested that SDT is a widely used theoretical framework for research in health-related contexts. The results of Study 1 showed that autonomy support and autonomous motivation had a small to moderate effect with actual weight loss, and engagement in behaviours that are associated with weight management (i.e., physical activity and healthy eating). We also found that there was only one study included in

the meta-analysis which included measures for controlling behaviours (Halvari et al., 2010), and none of them had measured need thwarting. According to Deci and Ryan (2000), the conceptual variables of interpersonal control and psychological need thwarting are important in terms of predicting psychological ill-being and maladaptive behaviours. Therefore, these conceptual variables were incorporated in Studies 2 to 4 of this dissertation.

Using a prospective design, the aim of Study 2 of this dissertation was to examine the tenets of SDT within the context of weight management. To extend previous research in this area, we included measures for controlling behaviours and need thwarting, and examined how these variables predict outcomes associated with psychological well-being and health-related behaviours. Also, we measured the constructs corresponding to physical activity and dieting behaviours separately, and examined whether the hypothesised relations were found with respect to both sets of behaviours. Specifically, based on Ryan et al.'s (2008) SDT model of health behavioural change, we examined how perceived autonomy support from participants' important other predict participants' need satisfaction, in turn predicting engagement in behaviours conducive to weight management (i.e., physical activity, healthy and unhealthy eating behaviours) and indicators of psychological well- and ill-being (i.e., depressive symptoms, life satisfaction, and self-esteem). Furthermore, we examined how controlling behaviours of these significant others may lead to participants' need thwarting, and consequently undermine the measured behavioural outcomes and psychological health indicators. In this study, we measured SDT-based variables for physical activity and eating behaviours separately. Essentially, participants were first asked to report whether they were engaging in physical activity or dieting, or both, to manage their body weight. At the first time point, participants were asked to complete questionnaires measuring perceived important other behaviours and basic need satisfaction/thwarting corresponding to physical activity or dieting, or both. Three months later, participants were asked to report the frequency of weight management behaviours they engaged in (physical activity and/or healthy and unhealthy

eating). They also completed questionnaires measuring indicators of psychological well- and ill-being at the second time point.

Using structural equation modelling, we tested models, separately in relation to physical activity and eating behaviours, in which perceived important other behaviours predicted need satisfaction and thwarting, and in turn predicting the measured outcomes. In terms of the model with reference to physical activity, we found that autonomy support predicted need satisfaction, while controlling behaviours predicted need thwarting. Both of these findings were in line with SDT. We also found that need thwarting predicted lower life satisfaction, lower self-esteem, and more depressive symptoms. However, unexpectedly both need satisfaction and need thwarting did not predict physical activity behaviours. Teixeira, Carraça et al. (2012) argued that need satisfaction may not facilitate physical activity directly, but instead indirectly via autonomous motivation. Similarly, it is possible that need thwarting does not directly undermine physical activity. Rather, the undermining effect may operate indirectly via controlled motivation and/or amotivation. In terms of the model with reference to dieting, similar results were found. Essentially, autonomy support and controlling behaviours of important others was found to predict need satisfaction and need thwarting, respectively. In this model, need satisfaction also predicted life satisfaction, but did not predict healthy eating behaviours as hypothesised. In contrast, need thwarting was found to predict unhealthy eating behaviours, lower levels of life satisfaction, and more depressive symptoms. These findings generally supported Ryan et al.'s (2008) model. Furthermore, similar to work conducted in the sport domain (Bartholomew, Ntoumanis, Ryan, & Thøgersen-Ntoumani, 2011), our findings suggested that need satisfaction and need thwarting are orthogonal constructs that have different predictive effects with the outcome variables. Similarly, we found that perceived autonomy supportive and controlling behaviours from important others may not be two sides of the same coin. Again, this replicated results in the sport domain (Bartholomew et al., 2010), suggesting that autonomy supportive and

controlling behaviours are not bipolar constructs.

In Study 2, we also examined the relation between SDT-based constructs corresponding to physical activity and diet (e.g., between need satisfaction for physical activity and need satisfaction for dieting). Strong associations were found between these variables, suggesting that a spill-over effect may exist (Mata et al., 2009). Also, we found some unexpected results in this study. For example, although need satisfaction and thwarting predicted psychological well-being outcomes, they did not predict exercise and healthy eating behaviours in the two structural models we tested, respectively. This may be because the basic needs only support the measured behavioural outcomes indirectly via different types of motivation (i.e., autonomous, controlled, and amotivation).

Drawing from the results of Study 2, the aim of Study 3 was to examine whether the relation between important other's behaviours and behavioural outcomes associated with weight management is mediated by basic need satisfaction/thwarting, as well as different types of motivation. Due to the possible spill-over effect, we also combined the measures with respect to physical activity and diet behaviours to ones regarding general weight management. Specifically, in Study 3, we asked individuals with weight management goals to report their perceived behaviours of important others, and examined how that might be related to need satisfaction and thwarting. Participants were asked to report these variables with respect to general weight management, but not separately for physical activity and dieting. Participants also reported their levels of behavioural regulations (i.e., autonomous motivation, controlled motivation, and amotivation) for managing their weight, and their behavioural engagements in physical activity, healthy and unhealthy eating.

Using structural equation modelling, we found, in Study 3, that autonomy support by important others predicted higher levels of need satisfaction and lower levels of need thwarting. In contrast, perceived controlling behaviours by important others predicted lower levels of need satisfaction and higher levels of need thwarting. As hypothesised, we found

that need satisfaction in turn predicted autonomous forms of motivation, whereas need thwarting predicted controlled motivation and amotivation. We further examined the relations between different types of behavioural regulations and the behavioural outcomes. In line with SDT, we found that autonomous motivation predicted physical activity and healthy eating behaviours. Controlled motivation, however, negatively predicted physical activity. Further, we found that amotivation predicted less healthy eating behaviours, and more unhealthy eating behaviours. Indirect effects from autonomy support and controlling behaviours to the behavioural outcomes were also examined. We found indirect effects from autonomy support to physical activity (positively), healthy (positively), and unhealthy (negatively) eating behaviours. Controlling behaviours, in contrast, had indirect effects on healthy (negatively) and unhealthy (positively) eating behaviours. Similar to our findings in Study 2, our results in Study 3 suggest that autonomy support and controlling behaviours should be considered as orthogonal variables. In fact, we found a weak, positive association between these two variables in Study 3. Similar to Study 2 and other similar studies, we found a moderate and negative correlation between need satisfaction and need thwarting, suggesting that these two constructs should be not considered as variables lying at two ends of the same continuum.

Our findings in Study 3 showed that perceived autonomy support from an important other could lead to engagement in more adaptive, and less maladaptive, behaviours for weight management. In contrast, when the important other is perceived as controlling, individuals may engage in less adaptive, and more maladaptive, behaviours to manage their weight. Taking together the findings from the two studies, we found strong support regarding the importance of perceived autonomy supportive in relation to behaviours that might lead to successful weight management, and also psychological well-being of individuals. In Studies 2 and 3, we also found possible detrimental effects when an important other was perceived as controlling.

Therefore, it is important to study what factors or mechanisms may affect how

autonomy supportive and controlling individuals might be in a context that is related to weight management. One possible mechanism concerns the motivation contagion effect (Wild & Enzle, 2002). In an education setting, Pelletier et al. (2002) showed that students' autonomous motivation as perceived by teachers was related to the teachers' autonomous motivation to teach, and in turn the autonomy support they provided to students. In Study 4, we examined this possible effect within a hypothetical gym setting. Using an experimental design, we asked undergraduate students in a sports science degree to visualise themselves to be in the roles of an instructor in the gym, with the task of instructing hypothetical obese exercisers who just began exercising. We showed pictures of three hypothetical exercisers beginning to exercise in the gym. We manipulated students' perception of the motivation of these exercisers by showing students quotes by the exercisers which we created. Essentially, one of the exercisers was portrayed to be motivated for autonomous reasons, and another was depicted to be high in controlled motivation. The third exerciser had neutral reasons (e.g., being the New Year resolution) to exercise. Students rated, as our manipulations intended, the three hypothetical exercisers to have different levels of autonomous and controlled forms of motivation. We then asked students to rate their motivation to instruct the exerciser, autonomy supportive and controlling behaviours they felt would be most useful to motivate the exerciser, and perceived barrier efficacy of the exerciser. We also asked students to list strategies that may motivate the exerciser, and used this as a pseudo measure of effort investment by the students. We compared these variables across different experimental conditions (i.e., the perceived motivation of the exerciser), gender of the exerciser, and gender of the student/instructor.

The results from Study 4 showed that students had lower levels of extrinsic regulation to instruct exercisers when they perceived the exerciser to be motivated for autonomous reasons, compared to exercisers perceived as having neutral or controlled motivation. Also as hypothesised, students rated the exerciser with more autonomous motivation to have the

highest barrier efficacy, while the exerciser with controlled motivation had the lowest efficacy. Unexpectedly, we found that the gender of the exerciser and the student had effects on perceived usefulness of autonomy supportive strategies. When the exerciser was male, students felt autonomy supportive behaviours were less useful for the exerciser with more controlled motivation, compared to the exerciser with neutral or autonomous motivation. However, when the exerciser was female, students rated autonomy supportive behaviours as more useful for the exercise who was motivated for controlled reasons, compared to the other two motives. We also found that female students rated autonomy supportive behaviours as more useful when provided to female, compared to male, exercisers. Further, we found that when the exerciser was portrayed as being a female, rather than male, students exerted more effort in the task in the neutral or controlled motivation condition. Oppositely, when the exercise was autonomously motivated, students' exerted less effort with a female exerciser, compared to her male counterpart. Taken together, findings from Study 4 suggested that the motivation contagion effects found by Pelletier et al. (2002) may be in operation in a context of physical activity instruction. However, the gender of the exerciser and the student/instructor may moderate these effects.

**Practical Implications**

The findings from four studies described in this dissertation have practical implications for both health practitioners and people trying to support important others engage in health-conducive behaviours. These implications are closely related to strategies or behaviours one should exercise when attempting to help other individuals achieve better health outcomes. Although Studies 2 to 4 were conducted in a specific context (i.e., weight management and exercising in a gym), based on our results from Study 1, the tenets of SDT appear to be invariant across different domains. Hence the same principles should apply to other health-related contexts.

In Study 1, we showed that in line with tenets of SDT, psychological need satisfaction

of competence, autonomy, and relatedness are predictors of psychological well-being, physical health, and engagement in health-conducive behaviours. Practitioners should therefore provide support for patients' (or clients') psychological needs. In particular, competence satisfaction was found to be directly related to indicators of psychological and physical health. Therefore, practitioners could, for example, support patients' need of competence by conveying confidence in their ability to change, and to help them set goals that are challenging, yet achievable. Also, to support the needs for autonomy, practitioners should provide rationales for making changes, and provide choices when possible. Practitioners should respect and support patient autonomy, even in situations where patients are volitionally non-adherent (Beauchamp & Childress, 2009). Finally, practitioners should show care for their patients and acknowledge their negative feelings, as these behaviours would support patients' need for relatedness.

In terms of behavioural regulations to engage in health-related behaviours, we found that controlled motivation is sometimes related to positive behavioural change and improvements in physical health. For instance, when an individual begins a new regimen, he or she may not fully understand or endorse the importance of the required behavioural changes. Some pressure from the practitioner may improve the individual's adherence. However, autonomous motivation has been found in other studies to predict long-term health outcomes, while controlled motivation did not (e.g., Silva et al., 2011). Furthermore, we found that controlled motivation is often associated with higher levels of psychological ill-being. Therefore, although practitioners may see short-term improvements in behavioural adherence in their patients when applying pressure or even inducing self-guilt, they should be alarmed that these strategies are unlikely to be effective in the long run, and may lead to patients' feelings of depression and anxiety. Instead, practitioners should avoid inducing controlled motivation in patients, and should try to promote more autonomous motivation, as this type of motivation has been found to be related to long-term adherence and better

psychological health.

In Studies 2 to 3, we found that perceived behaviours of important others could affect individuals' psychological well-being and engagement in behaviours associated with weight management. An important other, when trying to help his or her partner, a family member, or a friend manage his or her weight, should therefore try to be more autonomy supportive. That is, important others should try to acknowledge and accept negative feelings of the individual who is associated with weight management, providing him or her with choices of ways to become more physically active or eat healthier, and show care for him or her. In contrast, we found that controlling behaviours by important others are associated with maladaptive behaviours to achieve weight management, and also higher levels of psychological ill-being, such as depressive symptoms. Therefore, important others should also avoid using strategies such as applying pressure on the individual to manage his or her weight, using rewards or punishments that are contingent on the individual's weight management outcomes, or giving him or her conditional regard, such as only when his or her weight management goals were met. Previously, researchers (e.g., Powers et al., 2008) have only advocated the importance of the provision of autonomy support. Nonetheless, results from these two studies showed that more uses of autonomy supportive may not necessarily imply less uses of controlling behaviours. In fact, in Study 3 these two types of behaviours were positively, albeit weakly, related. Important others should hence be aware that being autonomy supportive may not be enough; controlling behaviours should be reduced to support another individual to foster long-term behavioural change, and hence health outcomes.

In Study 4, we found that gym instructors' motivation and instruction style might be affected by their perceived motivation of the exercisers they had to instruct. Essentially, when instructors perceived the exerciser to be motivated for controlled reasons, they might perceive the exerciser to have lower self-efficacy to remain physically active, and therefore less likely to adhere to exercising. In turn, instructors might feel more controlled in terms of their own

motivation to instruct, and consequently would find instructing in a more controlling manner to be more effective. As found in Studies 2 and 3, the use of controlling behaviours could lead to less engagement in adaptive behaviours and high levels of psychological ill-being. Instructors should therefore be vigilant in terms of the behaviours they use, especially when interacting with an obese exerciser who seemingly is receiving treatment or engaging in health-related behaviours for controlled reasons. Training programmes for instructors should also highlight the potential difficulties when instructing these individuals.

Based on the findings of the presented studies, some examples of behaviours of important others that should be encouraged, and those that should be avoided, in order to support an individual's weight management efforts are presented in Table 6.1. Potential outcomes of these behaviours reported in the literature (some of which were also found in this dissertation) are also presented.

Table 6.1

*Behaviours that should be Encouraged or Avoided When Supporting an Individual's Weight Management Efforts*

| Behaviours | Potential outcomes |
|---|---|
| *Behaviours that should be <u>encouraged</u>* | |
| • Provide choices and meaningful rationales when suggesting changes to improve weight management;<br>• Give positive feedback, and convey confidence in his/her ability to succeed;<br>• Listen to the individual, and try to understand his/her perspectives before suggesting changes;<br>• Acknowledge negative feelings the individual might have, and care for him/her as a person | Individual having more self-determined forms of motivation; better adherence to weight management behaviours, such as exercise and diet; higher life satisfaction and self-esteem; success in weight management |
| *Behaviours that should be <u>avoided</u>* | |
| • Giving negative feedback that may imply lack of ability or effort;<br>• Promising or using rewards that are contingent on success;<br>• Intentionally inducing feelings of self-guilt;<br>• Showing less support when individual is not doing as well as they would have liked;<br>• Intentionally embarrass him/her for lack of success | Individuals having more controlled motivation, or lacking any motivation; lower adherence to weight management behaviours; more depression and anxiety; failure to manage weight |

**Limitations and Future Directions**

In this dissertation, we presented four studies that examined different tenets of SDT. Using a combination of research designs, our findings generally support the propositions of the theory. Nevertheless, these studies have some limitations, and are discussed below. Also, the findings of our studies, or the limitations within, may lead to new grounds for potential future research. These future directions for research are also discussed in this section of the dissertation.

Researchers designing SDT-based interventions have examined the long-term effects of interventions or clinical trials, over a period of time after the end of the treatment given (e.g., Niemiec, Ryan, Patrick, Deci, & Williams, 2009; Silva et al., 2011). Findings of these studies showed that perceived autonomy support and autonomous motivation may be important in fostering long-term behavioural changes that could lead to improvement in health. We have argued in Study 1 that interventions based on SDT may be more cost-effective than some existing interventions. To further improve the effectiveness of interventions, future research may combine interventions based on SDT together with other techniques that have been found to be useful in supporting health behavioural change. For instance, research has shown that self-monitoring is a useful technique to improve adherence to physical activity and dieting behaviours (Burke, Wang, & Sevick, 2011; Michie, Abraham, Whittington, McAteer, & Gupta, 2009). Future research should examine whether the combination of SDT-based methods and self-monitoring techniques could further improve the effectiveness of interventions. Motivational interviewing (MI) is another technique that was often linked with SDT-based interventions, and was incorporated with some of these interventions (e.g., Fortier, Hogg, et al., 2007; Silva et al., 2008). Researchers (e.g., Deci & Ryan, 2012; Teixeira, Silva, Mata, Palmeira, & Markland, 2012) have acknowledged the similarities between the approaches using MI and SDT-based interventions. For instance, the promotion of autonomy and volition are key aspects of both sets of techniques. However,

Deci and Ryan (2012) highlighted that certain aspects of MI may foster not only autonomous, but also controlled forms of motivation. Further research may be required to depict the differences between the two approaches, and examine how the two approaches would lead to differences in outcomes such as need satisfaction/thwarting and autonomous/controlled motivation.

Another area of possible future research is to explore other means of providing interventions. In terms of non-SDT-based studies, researchers have shown that techniques using modern methods of communications may extend the reach, and reduce costs, of behavioural change interventions. For instance, researchers have conducted systematic reviews and meta-analyses on the effectiveness of weight management or physical activity promotion interventions using text messages (Fjeldsoe, Marshall, & Miller, 2009), computers (Reed, Schifferdecker, Rezaee, O'Connor, & Larson, 2012), or the internet (Davies, Spence, Vandelanotte, Caperchione, & Mummery, 2012; van den Berg, Schoones, & Vliet Vlieland, 2007) as means for communication. The results of these reviews and meta-analyses have shown that these new communications methods could lead to small and short-term changes in behaviours or health outcomes such as weight loss. Krukowski, Tilford, Harvey-Berino, and West (2011) have also shown that weight loss interventions delivered through the internet were more cost-effective compared to traditional face-to-face methods. However, very few studies (e.g., Patrick et al., 2011) have incorporated these new communication methods within the SDT framework. More research is required to examine whether adopting a SDT approach could improve the effect of existing interventions provided through these means of communication. Future research should also evaluate the effectiveness and cost-effectiveness of these types of interventions based on SDT, both as an addition or a replacement of existing face-to-face methods.

In terms of weight management interventions based on SDT, studies in the extant literature have mainly focused on adults. Therefore, another possible avenue of future

research is to design weight management interventions for children or adolescents. Such interventions may be important as the prevalence of childhood and adolescent obesity had been found to be very high (Deckelbaum & Williams, 2012). Researchers have shown that childhood obesity is associated with negative physical (e.g., asthma, hypertension) and psychological (e.g., depression, eating disorders) health outcomes (Ebbeling, Pawlak, & Ludwig, 2002). Charney, Goodman, McBride, Lyon, and Pratt (1976) found that childhood obesity is a strong predictor of obesity during adulthood. Therefore, tackling the problem of obesity at a younger age in individuals may be an effective way to reduce the prevalence of obesity in the future. Weight management interventions based on SDT could hence be extended to school settings. In fact, researchers have conducted SDT-based interventions for promoting leisure time physical activity in school settings (e.g., Chatzisarantis & Hagger, 2009) and found them to be effective. Researchers should evaluate whether similar interventions could lead to sustained weight control in children and adolescents.

In terms of Studies 2 to 4, one general limitation concerns the measurement of variables included in the studies. For instance, in Studies 2 and 3, we extended previous SDT-based research in weight management by also measuring controlling behaviours of important others and psychological need thwarting. In line with previous findings by Bartholomew and colleagues (Bartholomew, Ntoumanis, Ryan, & Thøgersen-Ntoumani, 2011; Bartholomew, Ntoumanis, & Thøgersen-Ntoumani, 2011) in the sport domain, we found that these variables may provide extra predictive power with respect to controlled motivation, amotivation, and psychological ill-being. Nevertheless, measures for these constructs specific to the context of interest may not be readily available to researchers. No existing measurement scales for these variables in a context of weight management were developed. Therefore in Studies 2 and 3, existing scales designed for other contexts (e.g., sport) were adapted. Although we did examine the factorial validity of scores from these adapted scales in Study 3, and found the expected factor structure, further research may be required to investigate the construct validity

of scores derived from these scales. Alternatively, researchers may need to develop new measurement scales that are better suited to their specific context of interest.

Another limitation concerning the measurement of SDT-based variables was that measures for integrated regulation were not included in Studies 3 and 4. In these studies, the behavioural regulation of participants were measured using adapted questionnaires that did not include subscales tapping integrated regulation (Guay et al., 2000; Markland & Tobin, 2004). According to Ryan and Deci (2002), integrated regulation is the most autonomous form of extrinsic motivation, and shares qualities with intrinsic motivation. As behaviours such as dieting, or weight management in general, may not be inherently interesting, integrated regulation may be a strong predictor of behavioural adherence. Nonetheless, this type of behavioural regulation was not measured in our studies and is therefore a limitation. In fact, other researchers have developed integrated regulation subscales for the exercise domain (e.g., McLachlan, Spray, & Hagger, 2011; Wilson, Rodgers, Loitz, & Scime, 2006). This type of behavioural regulation should also be included in future SDT-based weight management research.

In Studies 2 and 3, our goal was to examine how SDT-based variables predicted behaviours associated with weight management and psychological well- and ill-being. One associated limitation of our studies was that the behavioural outcomes measured (i.e., physical activity, healthy and unhealthy eating behaviours) were self-reported. Future research may adopt other measures, such as using accelerometry (Helmerhorst et al., 2012) or activity/eating diaries to improve the accuracy of the outcome measures. Also, we did not examine how these variables predict actual changes in body weight. Although weight loss was found to be predicted by autonomous motivation in previous studies (e.g., Silva et al., 2011), its relation with perceived controlling behaviours by others and need thwarting has not been studied. Also, Silva et al. (2011) found that controlled motivation of their participants did not predict weight loss. In Study 3, we found that amotivation predicted less healthy eating and

more unhealthy eating behaviours, suggesting that amotivation may be a variable that may predict the success or failure or weight management. As we found that amotivation may be a consequence of perceived interpersonal control by important others, future research in weight management should therefore measure the full motivation continuum (i.e., including amotivation) in terms of reasons to manage one's weight.

Another limitation of Studies 2 and 3 concerns the nomination of a single important other. We asked participants to nominate only the most influential important other in terms of their weight management regimen, because different important others may have different autonomy supportive or controlling styles (Rouse et al., 2011). However, a person who is trying to manage his or her weight is likely to receive help or support from more than one important other. Significant others such as one's spouse, parents, children, trainers, or dieticians may all have an impact on the motivation of the individual. It is possible that some of these important others may be more autonomy supportive (or controlling) than others. In an extreme, hypothetical case, an individual may be exposed to two important others (e.g., father and mother) who have conflicting styles. Future research may investigate how the general interpersonal factors would be perceived as in such situations, and how they might be related to psychological need satisfaction and thwarting. Research should also explore whether other factors (e.g., causaulity orientations; Williams et al., 1996) may also affect psychological need and different types of behavioural regulations for weight management. These types of research may lead to the development of new interventions that may improve the effectiveness of existing ones.

Another possible avenue for future intervention studies is to design interventions for both individuals who have weight management goals and their important others. Researchers have shown that interventions may be more effective when participants were recruited together with other significant others (Wing & Jeffery, 1999). Wing and Jeffery (1999) showed that when participants were joined by important others, compared to participants who

joined the programme alone, they were able to lose more body weight, and was more likely to complete the treatment programme. The long-term effect of weight maintenance was not examined in the study. Nevertheless, by incorporating tenets of SDT, important others could also be taught how to be more autonomy supportive and less controlling. Such an intervention may be more effective to foster long-term weight loss and maintenance.

One limitation of Study 4 was that our results suggested that motivation contagion effect is present only when the target exerciser is male. When the exerciser was female, we found that participants rated autonomy support to be more effective when she was portrayed to be motivated for controlled reason. Our results suggest that motivation contagion effect may be moderated by other factors, such as gender. Apart from the gender effects we found, researchers have identified other possible factors, such as empathy (Hojat et al., 2002), that may lead to differential treatment, and hence may moderate motivation effects. For instance, Pelletier et al. (2002) found, in an education setting, that apart from perceived motivation of students, teachers' perception of constraints at work also influenced their self-determination to teach. Applied in a gym setting, instructors may also have perceptions of constraint or pressure from supervisors. Therefore, future research should include measures for perceived pressure from supervisors, and examine whether the perceived pressure from above (i.e., superordinates) or below (i.e., exerciser) may influence instructors' motivation and their use of motivating behaviours. Other variables that may potentially affect the results, such as experience or causality orientations of instructors, may also be explored. Results from these studies may have implication for training programmes for future gym instructors, and also theoretical developments in the area of motivation contagion.

**Conclusions**

Findings from studies presented in this dissertation have shown that SDT is a viable theoretical framework for the study of motivation for health-related behaviours. Findings of these studies have expanded the extant literature in a few ways. For instance, we provided a

better understanding of the mechanisms in which factors such as important other's behaviours may affect psychological well-being and behavioural outcomes in relation to health-related behaviours. Based on our findings, we have made suggestions for future research directions. One important avenue of future research is to design cost-effective interventions based on SDT that can foster individual's autonomous motivation for health related behaviours, and hence make a positive impact on their psychological and physical health.

# APPENDICES

**Appendix A**
**Summary of Significant Moderation Effects in Study 1**

| Relation | *k* | Total sample size | ρ | $SD_\rho$ | 95% Confidence interval | | Percentage of variance attributed to sampling and measurement errors |
|---|---|---|---|---|---|---|---|
| | | | | | Lower bound | Upper bound | |
| Autonomy – Physical activity | 23 | 6253 | .15 | .09 | .10 | .19 | 37.20 |
| - Cross-sectional | 12 | 4287 | .12 | .06 | .07 | .17 | |
| - Prospective | 5 | 1094 | .13 | .06 | .05 | .21 | |
| - Experimental | 6 | 872 | .33 | .00 | .27 | .39 | |
| - Treatment | 5 | 1058 | .29 | .00 | .24 | .34 | |
| - Non-treatment | 18 | 5195 | .12 | .07 | .08 | .16 | |
| Intrinsic motivation – Physical activity | 51 | 13912 | .32 | .16 | .28 | .37 | 11.73 |
| - Treatment | 4 | 940 | .41 | .00 | .38 | .45 | |
| - Non-treatment | 47 | 12972 | .32 | .17 | .27 | .37 | |
| Amotivation – Physical activity | 25 | 10258 | -.24 | .15 | -.30 | -.17 | 12.77 |
| - Age > 18 years | 21 | 7070 | -.15 | .04 | -.19 | -.12 | |
| - Age < 18 years | 4 | 3188 | -.42 | .12 | -.54 | -.30 | |
| Controlled regulation – Healthy diet | 8 | 3229 | .04 | .12 | -.09 | .18 | 17.50 |
| - Treatment | 4 | 2077 | .12 | .02 | .07 | .17 | |
| - Non-treatment | 4 | 1152 | -.15 | .04 | -.21 | -.09 | |

| Relation | *k* | Total sample size | ρ | $SD_\rho$ | 95% Confidence interval | | Percentage of variance attributed to sampling and measurement errors |
|---|---|---|---|---|---|---|---|
| | | | | | Lower bound | Upper bound | |
| Autonomy – Intrinsic motivation | 28 | 7430 | .46 | .20 | .38 | .53 | 8.85 |
| - Cross-sectional | 16 | 5447 | .43 | .17 | .35 | .51 | |
| - Experimental | 8 | 796 | .72 | .17 | .58 | .86 | |
| Autonomy – External regulation | 25 | 6780 | -.24 | .12 | -.30 | -.19 | 27.94 |
| - Prospective | 4 | 1187 | -.22 | .00 | -.25 | -.19 | |
| - Experimental | 7 | 777 | -.39 | .00 | -.48 | -.31 | |
| Autonomous orientation – Controlled orientation | 8 | 3061 | .37 | .21 | .22 | .52 | 8.00 |
| - Treatment | 3 | 894 | .64 | .19 | .39 | .89 | |
| - Non-treatment | 5 | 2167 | .27 | .09 | .17 | .36 | |
| Intrinsic motivation – Introjected regulation | 76 | 22929 | .23 | .17 | .19 | .27 | 14.79 |
| - Treatment | 3 | 701 | .42 | .13 | .27 | .57 | |
| - Non-treatment | 73 | 22228 | .23 | .16 | .19 | .27 | |
| Intrinsic motivation – motivation | 40 | 12785 | -.38 | .22 | -.46 | -.31 | 7.92 |
| - Age > 18 years | 35 | 11753 | -.36 | .22 | -.44 | -.28 | |
| - Age < 18 years | 5 | 1032 | -.58 | .10 | -.69 | -.48 | |

| Relation | *k* | Total sample size | ρ | $SD_\rho$ | 95% Confidence interval | | Percentage of variance attributed to sampling and measurement errors |
|---|---|---|---|---|---|---|---|
| | | | | | Lower bound | Upper bound | |
| Identified regulation – External regulation | 82 | 24305 | -.03 | .20 | -.08 | .01 | 12.22 |
| - Age > 18 years | 66 | 21230 | -.06 | .19 | -.11 | -.01 | |
| - Age < 18 years | 16 | 3075 | .15 | .20 | .06 | .25 | |
| Introjected regulation – External regulation | 85 | 27034 | .49 | .19 | .45 | .54 | 9.77 |
| - Age > 18 years | 70 | 24081 | .47 | .18 | .43 | .52 | |
| - Age < 18 years | 15 | 2953 | .67 | .16 | .57 | .78 | |

*Note.* *k* = number of studies, ρ = population effect size, $SD_\rho$ = standard deviation of ρ after variances attributed to sampling and measurement errors were removed.

**Appendix B**
**Summary of Meta-Analysed Studies in Study 1**

| Article | Type of publication | Context | Study design | Total number of participants | Mean age of participants | Participants receiving treatment | SDT-Constructs measured |
|---|---|---|---|---|---|---|---|
| Bagøien & Halvari, 2005 | J | Exercise/ Physical activity | CS | 231 | 16.6 | N | Com, IM, IG, IJ, EX |
| Barbeau, Sweet, & Fortier, 2009 | J | Exercise/ Physical activity | P | 118 | 18.9 | Y | Com, Aut, Rel, AutReg, ConReg |
| Berg, Cox, Mahnken, Greiner, & Ellerbeck, 2008 | J | Smoking abstinence | CS | 750 | 47.2 | Y | AM, AutReg |
| Brickell & Chatzisarantis, 2007 | J | Exercise/ Physical activity | P | 162 | 23.1 | N | IM, ID, IJ, EX |
| Brickell, Chatzisarantis, & Pretty, 2006 | J | Exercise/ Physical activity | P | 162 | 23.2 | N | AS, AutReg, ConReg |
| Brunet & Sabiston, 2009 | J | Exercise/ Physical activity | CS | 381 | 18.6 | N | Com, Aut, Rel, IM, ID, IJ, EX, AM |
| Brunet & Sabiston, 2011 | J | Exercise/ Physical activity | CS | 547 | 27.3 | N | IM, ID, IJ, EX |
| Chan & Hagger, 2010 | R | Rehabilitation | CS | 207 | 37.2 | Y | AS, AutReg |
| Chan, Lonsdale, Ho, Yung, & Chan, 2009 | J | Rehabilitation | CS | 115 | 25.2 | Y | AS, AutReg, ConReg |
| Chan, Hagger, & Spray, 2011 | J | Rehabilitation | CS | 298 | 24.8 | Y | AS, AutOri, ConOri, AutReg, ConReg |
| Chatzisarantis & Biddle, 1998 | J | Exercise/ Physical activity | CS | 102 | 40.0 | N | IM, ID, EX |
| Chatzisarantis & Hagger, 2009 | J | Exercise/ Physical activity | I | 215 | 14.8 | N | AS |
| Chatzisarantis, Hagger, & Brickell, 2008 | J | Exercise/ Physical activity | P | 235 | 20.2 | N | AS |
| Chatzisarantis, Hagger, & Smith, 2007 | J | Exercise/ Physical activity | CS | 342 | 14.2 | N | AS |
| Chatzisarantis, Hagger, Biddle, & Karageorghis, 2002 | J | Exercise/ Physical activity | CS | 168 | 13.5 | N | IM, ID, IJ, EX |

| Article | Type of publication | Context | Study design | Total number of participants | Mean age of participants | Participants receiving treatment | SDT-Constructs measured |
|---|---|---|---|---|---|---|---|
| Chatzisarantis, Hagger, Wang, & Thøgersen-Ntoumani, 2009 | J | Exercise/ Physical activity | CS | 231 | 14.2 | N | AS |
| Chawla, Neighbors, Logan, Lewis, & Fossos, 2009 | J | Alcohol consumption | CS | 818 | 18.1 | N | AutOri, ConOri |
| Custers, Westerhof, Kuin, & Riksen-Walraven, 2010 | J | Nursing home care | CS | 88 | 78.6 | N | Com, Aut, Rel |
| Daley & Duda, 2006 | J | Exercise/ Physical activity | CS | 409 | 19.9 | N | IM, ID, IJ, EX, AM |
| Davidson-Harden, 2009 | T/D | Smoking abstinence | E | 56 | 21.6 | N | AS, AutReg, ConReg |
| De Ridder, De Wit, & Adriaanse, 2009 | J | Eating behaviour | CS | 142 | 19.8 | N | IM, ConReg |
| Duncan, Hall, Wilson, & Jenny, 2010 | J | Exercise/ Physical activity | CS | 1079 | 24.2 | N | IM, IG, ID, IJ, EX, AM |
| Dyrlund & Wininger, 2006 | J | Exercise/ Physical activity | CS | 189 | 20.6 | N | Com, Aut, Rel, IM |
| Edmunds, Ntoumanis, & Duda, 2006a; Edmunds, Ntoumanis, & Duda, 2006b | J | Exercise/ Physical activity | CS | 369 | 31.9 | N | AS, Com, Aut, Rel, IM, IG, ID, IJ, EX, AM |
| Edmunds, Ntoumanis, & Duda, 2007 | J | Exercise/ Physical activity | I | 49 | 45.0 | Y | AS, Com, Aut, Rel, IM, ID, IJ, EX, AM |
| Edmunds, Ntoumanis, & Duda, 2008 | J | Exercise/ Physical activity | E | 56 | 21.3 | N | AS, Com, Aut, Rel, IM, IG, ID, IJ, EX, AM |
| Fortier, Kowal, Lemyre, & Orpana, 2009 | J | Exercise/ Physical activity | CS/P | 258 | 51.4 | N | AutReg, ConReg |
| Fortier, Sweet, O'Sullivan, & Williams, 2007 | J | Exercise/ Physical activity | E | 120 | 47.3 | N | AS, Com, AutReg |

| Article | Type of publication | Context | Study design | Total number of participants | Mean age of participants | Participants receiving treatment | SDT-Constructs measured |
|---|---|---|---|---|---|---|---|
| Frederick & Ryan, 1993 | J | Exercise/ Physical activity | CS | 376 | 39.6 | N | Com, IM |
| Fuemmeler, et al., 2006 | J | Eating behaviour | E | 755 | 49.7 | Y | AutReg, ConReg |
| Gay, 2009 | T/D | Exercise/ Physical activity | P | 311 | 45.8 | N | Com, Aut, Rel, IM, ID, IJ, EX, AM |
| Gensichen, et al., 2009 | J | Diabetes care | P | 3897 | > 18 | Y | AS |
| Georgiadis, Biddle, & Chatzisarantis, 2001 | J | Exercise/ Physical activity | CS | 350 | 30.8 | N | IM, ID, IJ, EX |
| Georgiadis, Biddle, & Stavrou, 2006 | J | Weight control | P | 256 | 33.9 | Y | AutReg, ConReg |
| Gillison, Standage, & Skevington, 2006 | J | Exercise/ Physical activity | CS | 580 | 14.0 | N | IntG, ExtG, IM, ID, IJ, EX, AM |
| Hagger, Chatzisarantis, & Harris, 2006 | J | Exercise; Eating behaviour | P | 511 | 24.7 | N | Com, Aut, Rel, IM, ID, IJ, EX |
| Hagger, Chatzisarantis, Barkoukis, Wang, & Baranowski, 2005 | J | Exercise/ Physical activity | CS | 551 | 14.5 | N | AutReg, ConReg |
| Hagger, Chatzisarantis, Culverhouse, & Biddle, 2003 | J | Exercise/ Physical activity | CS | 295 | 14.5 | N | AS, IM, ID, IJ, EX |
| Hagger, et al., 2007 | J | Exercise/ Physical activity | CS | 432 | 14.0 | N | AS, IM, ID, IJ, EX |
| Hagger, et al., 2009 | J | Exercise/ Physical activity | CS | 840 | 14.2 | N | IM, ID, IJ, EX, AM |
| Halvari & Halvari, 2006 | J | Dental treatment | E | 86 | 27.3 | N | Com, AutReg |
| Halvari, Halvari, Bjørnebekk, & Deci, 2010 | J | Dental treatment | CS | 208 | 25.4 | N | AS, ConCli, Com, Aut, Rel, IG, ID, IJ, EX, AM |
| Halvari, Ulstad, Bagøien, & Skjesol, 2009 | J | Exercise/ Physical activity | CS | 190 | 21.7 | N | AS, Com, AutReg |
| Hove, Parkhill, Neighbors, McConchie, & Fossos, 2010 | J | Alcohol consumption | CS | 313 | 18.3 | N | AutOri, ConOri |

| Article | Type of publication | Context | Study design | Total number of participants | Mean age of participants | Participants receiving treatment | SDT-Constructs measured |
|---|---|---|---|---|---|---|---|
| Ingledew & Ferguson, 2007 | J | Risky sexual behaviours | CS | 277 | 18.9 | N | AutReg, ConReg |
| Ingledew & Markland, 2008 | J | Exercise/ Physical activity | CS | 252 | 40.4 | N | IM, ID, IJ, EX, AM |
| Ingledew, Markland, & Ferguson, 2009 | J | Exercise/ Physical activity | CS | 174 | 22.5 | N | IntG, ExtG, IM, ID, IJ, EX |
| Ingledew, Markland, & Sheppard, 2004 | J | Exercise/ Physical activity | CS | 182 | 36.4 | N | IM, ID, IJ, EX |
| Jolly, et al., 2009 | J | Exercise/ Physical activity | E | 347 | 49.2 | N | AS, Com, Aut, Rel, IM, ID, IJ, EX, AM |
| Julien, Senecal, & Guay, 2009 | J | Diabetes care | P | 365 | 56.8 | N | AS, AM, AutReg, ConReg |
| Kasser & Ryan, 1999 | J | Nursing home care | CS | 50 | 83.0 | N | AS, AutReg, |
| Kennedy, Goggin, & Nollen, 2004 | J | Medication use | CS | 201 | 40.0 | Y | AS, Com, AutReg |
| Klag, Creed, & O'Callaghan, 2010 | J | Substance abuse | CS | 350 | 31.4 | Y | AS, Com, Aut, Rel, AutReg, ConReg, AM |
| Knee & Neighbors, 2002 | J | Alcohol consumption | CS | 127 | 22.1 | N | ConOri |
| Levesque, et al., 2007 | J | Smoking; Eating; & Exercise | CS | 2732 | 45.8 | N | Com, IJ, EX, AM |
| Levy & Cardinal, 2004 | J | Exercise/ Physical activity | E | 126 | 46.8 | N | Com, Aut, Rel, IM, IG, ID, IJ, EX, AM |
| Levy, Polman, & Borkoles, 2008 | J | Rehabilitation | P | 70 | 32.5 | Y | AS |
| Li, 1999 | J | Exercise/ Physical activity | CS | 598 | 21.4 | N | IM, IG, ID, IJ, EX, AM |
| Lonsdale, et al., 2010 | U | Rehabilitation | E | 28 | 46.6 | Y | Com, AutReg, ConReg, AM |
| Lutz, Karoly, & Okun, 2008 | J | Exercise/ Physical activity | CS | 535 | 20.1 | N | AutReg |

| Article | Type of publication | Context | Study design | Total number of participants | Mean age of participants | Participants receiving treatment | SDT-Constructs measured |
|---|---|---|---|---|---|---|---|
| Lutz, Lochbaum, & Turnbow, 2003 | J | Exercise/ Physical activity | E | 240 | 20.3 | N | IM, IG, IJ, EX, AM |
| Lynam, et al., 2009 | J | Medication use | CS | 189 | > 18 | Y | AutReg |
| Markland & Ingledew, 2007 | J | Exercise/ Physical activity | CS | 98 | 16.9 | N | IM, ID, IJ, EX, AM |
| Markland & Tobin, 2004 | J | Exercise/ Physical activity | CS | 201 | 54.9 | N | IM, ID, IJ, EX, AM |
| Markland & Tobin, 2010 | J | Exercise/ Physical activity | CS | 133 | 54.5 | N | AS, Com, Aut, Rel, IM, ID, IJ, EX, AM |
| Markland, 1999 | J | Exercise/ Physical activity | CS | 146 | 31.5 | N | Com, Aut, IM |
| Markland, 2009 | J | Exercise/ Physical activity | CS | 19 | 21.0 | N | IM, ID, IJ, EX, AM |
| Mata, et al., 2009 | J | Weight control | E | 239 | 38.0 | N | AutOri, IM, AutReg, ConReg |
| McDonough & Crocker, 2007 | J | Exercise/ Physical activity | CS | 558 | 45.1 | N | Com, Aut, Rel, IM, ID, IJ, EX |
| McLachlan & Hagger, 2010 | J | Exercise/ Physical activity | CS | 142 | 29.4 | N | IM, IG, ID, IJ, EX, AM |
| McNelis, 2008 | T/D | Exercise/ Physical activity | CS | 118 | 42.9 | N | AS, Com, Rel, IM, ID, IJ, EX |
| Milne, Wallman, Gordon, & Courneya, 2008 | J | Exercise/ Physical activity | E | 58 | 55.1 | N | Com, Aut, Rel, IM, ID, IJ, EX, AM |
| Milne, Wallman, Guilfoyle, Gordon, & Courneya, 2008 | J | Exercise/ Physical activity | CS | 558 | 59.0 | N | AS, Com, IM, ID, IJ, EX, AM |
| Moreno, González-Cutre, Sicilia, & Spray, 2010 | J | Exercise/ Physical activity | CS | 727 | 32.5 | N | Com, IM, ID, IJ, EX, AM |
| Moreno, Martínez Galindo, González-Cutre, & Marcos, 2009 | J | Exercise/ Physical activity | CS | 779 | 33.0 | N | IM, ID, IJ, EX, AM |

| Article | Type of publication | Context | Study design | Total number of participants | Mean age of participants | Participants receiving treatment | SDT-Constructs measured |
|---|---|---|---|---|---|---|---|
| Moreno Murcia, San Román, Galindo, Alonso, & González-Cutre, 2008 | J | Exercise/ Physical activity | CS | 394 | 21.6 | N | Com, Aut, Rel, IM |
| Moreno-Murcia, Coll, & Cervello-Gimeno, 2008 | J | Exercise/ Physical activity | CS | 513 | 25.9 | N | IM, ID, IJ, EX, AM |
| Murcia, Gimeno, & Camacho, 2007 | J | Exercise/ Physical activity | CS | 311 | 33.0 | N | IM, ID, IJ, EX, AM |
| Muyor, Águila, Sicilia, & Orta, 2009 | J | Exercise/ Physical activity | CS | 727 | 32.6 | N | IM, ID, IJ, EX, AM |
| Neighbors, Larimer, Geisner, & Knee, 2004 | J | Alcohol consumption | CS | 204 | 19.0 | N | ConOri |
| Neighbors, Lewis, Bergstrom, & Larimer, 2006 | J | Alcohol consumption | E | 214 | 19.6 | N | ConOri |
| Neighbors, Walker, & Larimer, 2003 | J | Alcohol consumption | CS | 560 | 19.2 | N | AutOri, ConOri |
| Ng & Ntoumanis, 2010 | U | Exercise/ Physical activity | CS | 546 | 32.1 | N | Com, Aut, Rel, IM, ID, IJ, EX, AM |
| Niemiec, Ryan, Deci, & Williams, 2009 | J | Smoking abstinence | E | 1006 | > 18 | N | IntG |
| Niemiec, Ryan, Patrick, Deci, & Williams, 2009 | J | Smoking abstinence | E | 703 | > 18 | N | AutReg, ConReg |
| Otis & Pelletier, 2008 | J | Eating behaviour | CS | 198 | 20.5 | N | IM, IG, ID, IJ, EX |
| Palmeira, et al., 2007 | J | Weight control | I | 142 | 38.3 | Y | Com, IM |
| Pavey & Sparks, 2009 | J | Smoking; Alcohol consumption | CS | 256 | 21.6 | N | Aut, AutReg, ConReg |
| Pavey & Sparks, 2010 | J | Alcohol consumption | CS | 321 | 21.8 | N | Aut, AutReg |
| Peddle, Plotnikoff, Wild, Au, & Courneya, 2008 | J | Exercise/ Physical activity | CS | 413 | 60.0 | Y | Com, Aut, Rel, IM, ID, IJ, EX, AM |
| Pelletier & Dion, 2007 | J | Eating behaviour | CS | 447 | 22.5 | N | AutOri, AutReg, ConReg |
| Pelletier, Dion, Slovinec-D'Angelo, & Reid, 2004 | J | Eating behaviour | CS | 339 | 22.5 | N | IM, IG, ID, IJ, EX, AM |

| Article | Type of publication | Context | Study design | Total number of participants | Mean age of participants | Participants receiving treatment | SDT-Constructs measured |
|---|---|---|---|---|---|---|---|
| Pihu, Hein, Koka, & Hagger, 2008 | J | Exercise/ Physical activity | CS | 399 | 14.7 | N | IM |
| Piko & Keresztes, 2006 | J | Exercise/ Physical activity | CS | 1109 | 16.5 | N | IntG, ExtG |
| Powers, Koestner, & Gorin, 2008 | J | Weight control | P | 73 | 19.5 | N | AS, AutReg |
| Puente & Anshel, 2010 | J | Exercise/ Physical activity | CS | 238 | 20.4 | N | AS, Com, Aut, IM, ID, IJ, EX |
| Quested & Duda, 2010 | J | Exercise/ Physical activity | CS | 392 | 18.7 | N | AS, Com, Aut, Rel |
| Rose, Markland, & Parfitt, 2001 | J | Exercise/ Physical activity | CS | 305 | 34.9 | N | AutOri, ConOri, ImpOri, IM, ID, IJ, EX |
| Rose, Parfitt, & Williams, 2005 | J | Exercise/ Physical activity | CS | 184 | 34.0 | N | AutOri, ConOri, ImpOri, IM, ID, IJ, EX |
| Russell & Bray, 2009 | J | Exercise/ Physical activity | P | 68 | 64.9 | N | Com, Aut, Rel, IM, ID, IJ, EX, AM |
| Russell & Bray, 2010 | J | Exercise/ Physical activity | P | 53 | 62.8 | Y | AS, AutReg, ConReg |
| Ryan, Frederick, Lepes, Rubio, & Sheldon, 1997 | J | Exercise/ Physical activity | CS | 155 | 19.5 | N | Com, IM |
| Ryan, Plant, & O'Malley, 1995 | J | Alcohol consumption | CS | 98 | 31.6 | Y | AutReg, ConReg |
| Sabiston, Brunet, Castonguay, Bessette, & Fergusson, 2010 | U | Exercise/ Physical activity | CS | 205 | 18.9 | N | IM, ID, IJ, EX, AM |
| Sabiston, Brunet, Kowalski, et al., 2010 | J | Exercise/ Physical activity | CS | 389 | 29.8 | N | IM, ID, IJ, EX |
| Sebire, Standage, & Vansteenkiste, 2008 | J | Exercise/ Physical activity | CS | 312 | 34.4 | N | IntG, ExtG, Com, Aut, Rel, IM, ID, IJ, EX |
| Sebire, Standage, & Vansteenkiste, 2009 | J | Exercise/ Physical activity | CS | 410 | 41.3 | N | IntG, ExtG, Com, Aut, Rel, IM, ID, IJ, EX |

| Article | Type of publication | Context | Study design | Total number of participants | Mean age of participants | Participants receiving treatment | SDT-Constructs measured |
|---|---|---|---|---|---|---|---|
| Shaikh, Vinokur, Yaroch, Williams, & Resnicow, 2011 | J | Eating behaviour | E | 1021 | 45.8 | Y | AutReg, ConReg |
| Shamloo & Cox, 2010 | J | Alcohol consumption | CS | 94 | 20.2 | N | IntG, ExtG |
| Shigaki, et al., 2010 | J | Diabetes care | CS | 77 | 63.0 | Y | Com, AutReg, ConReg |
| Silva, et al., 2011 | J | Weight control | E | 221 | 37.6 | N | AS, IJ, EX, AutReg |
| Silva, Markland, et al., 2010 | J | Weight control | E | 239 | 37.6 | Y | AS, Com, Aut, IM, ID, IJ, EX |
| Silva, Vieira, et al., 2010 | J | Weight control | E | 239 | 37.6 | N | AS, Com, Aut, IM, ID, IJ, EX |
| Simoneau & Bergeron, 2003 | J | Substance abuse | P | 251 | 35.6 | Y | AutOri, ConOri, ImpOri, Com |
| Solloway, Solloway, & Joseph, 2006 | J | Smoking abstinence | E | 48 | > 18 | Y | Com, AutReg |
| Spofford, 2009 | T/D | Mental illness treatment | CS | 142 | 34.2 | Y | AutReg, ConReg |
| Standage, Sebire, & Loney, 2008 | J | Exercise/ Physical activity | CS | 52 | 22.2 | N | IM, ID, IJ, EX |
| Sweet, et al., 2009 | J | Diabetes care | E | 234 | 53.0 | Y | IM, ID, IJ, EX |
| Teixeira, et al., 2006 | J | Exercise/ Physical activity | I | 136 | 48.1 | Y | AutReg |
| Teixeira, et al., 2009 | J | Weight control | E | 239 | 37.6 | Y | Com, IM |
| Thøgersen-Ntoumani & Fox, 2007 | J | Exercise/ Physical activity | CS | 696 | 43.0 | N | IM, ID, IJ, EX |
| Thøgersen-Ntoumani & Ntoumanis, 2006 | J | Exercise/ Physical activity | CS | 375 | 38.7 | N | ID, IJ, EX, AM |
| Thøgersen-Ntoumani, Ntoumanis, & Nikitaras, 2008 | J | Exercise/ Physical activity | CS | 173 | 70.2 | N | AM |
| Thøgersen-Ntoumani, Ntoumanis, & Nikitaras, 2010 | J | Weight control | CS | 601 | 13.7 | N | AS, IntG, ExtG, Com, Aut, Rel |

| Article | Type of publication | Context | Study design | Total number of participants | Mean age of participants | Participants receiving treatment | SDT-Constructs measured |
|---|---|---|---|---|---|---|---|
| Vazou-Ekkekakis & Ekkekakis, 2009 | J | Exercise/ Physical activity | E | 1155 | 11.3 | N | Aut, IM |
| Vierling, Standage, & Treasure, 2007 | J | Exercise/ Physical activity | CS | 237 | 12.1 | N | AS, Com, Aut, Rel, IM, ID, IJ, EX |
| Vlachopoulos & Karavani, 2009 | J | Exercise/ Physical activity | CS | 388 | 27.8 | N | AS, Com, Aut, Rel |
| Vlachopoulos & Michailidou, 2006 | J | Exercise/ Physical activity | CS | 504 | 28.9 | N | Com, Aut, Rel |
| Wang & Biddle, 2001 | J | Exercise/ Physical activity | CS | 2510 | 12.9 | N | Com, AM, AutReg, ConReg |
| Wang, Chia, Quek, & Liu, 2006 | J | Exercise/ Physical activity | CS | 198 | 22.1 | N | Com, AutReg |
| Ward, Wilkinson, Graser, & Prusak, 2008 | J | Exercise/ Physical activity | E | 122 | < 18 | N | IM, ID, EX, AM |
| Webber, Tate, Ward, & Bowling, 2010 | J | Weight control | E | 66 | 50.1 | N | AutReg, ConReg |
| Wild, Cunningham, & Ryan, 2006 | J | Substance abuse | CS | 300 | 36.6 | Y | ID, IJ, EX |
| Williams, Cox, Hedberg, & Deci, 2000 | J | Smoking; Alcohol & substance abuse | CS | 291 | < 18 | N | AS, IntG, ExtG |
| Williams, Freedman, & Deci, 1998 | J | Diabetes care | E | 128 | 54.5 | Y | AS, AutReg, ConReg |
| Williams, Gagne, Mushlin, & Deci, 2005 | J | Chest pain treatment | P | 252 | 55.2 | Y | AS, AutOri, AutReg, ConReg |
| Williams, Gagne, Ryan, & Deci, 2002 | J | Smoking abstinence | E | 239 | 43.1 | Y | AS, AutReg |
| Williams, Grow, Freedman, Ryan, & Deci, 1996 | J | Weight control | I | 128 | 43.0 | Y | AS, AutOri |
| Williams, Levesque, Zeldman, Wright, & Deci, 2003 | J | Smoking abstinence | P | 220 | 50.2 | Y | AS, Com, Aut |

| Article | Type of publication | Context | Study design | Total number of participants | Mean age of participants | Participants receiving treatment | SDT-Constructs measured |
|---|---|---|---|---|---|---|---|
| Williams, Lynch, & Glasgow, 2007 | J | Diabetes care | E | 866 | 64.4 | Y | AS, Com |
| Williams, Lynch, et al., 2006; Williams, McGregor, et al., 2006; Williams, Niemiec, Patrick, Ryan, & Deci, 2009 | J | Smoking; Eating behaviour | E | 865 | 45.7 | Y | AS, Com, AutReg, ConReg |
| Williams, McGregor, Zeldman, Freedman, & Deci, 2004 | J | Diabetes care | E | 159 | 55.9 | Y | AS, Com, AutReg |
| Williams, Patrick, Niemiec, Ryan, et al., 2011 | J | Smoking abstinence | E | 798 | > 18 | Y | AS, IntG, ExtG, Com, IG, ID, IJ, EX, AM, AutReg |
| Williams, Patrick, Niemiec, Williams, et al., 2009 | J | Diabetes care | CS | 1783 | 64.6 | Y | AS, Com, AutReg, ConReg |
| Williams, Rodin, Ryan, Grolnick, & Deci, 1998 | J | Medication use | P | 126 | 56.3 | Y | AS, AutReg, ConReg |
| Wilson & Muon, 2008 | J | Exercise/ Physical activity | CS | 251 | 19.5 | N | Com, Aut, Rel |
| Wilson & Rodgers, 2002 | J | Exercise/ Physical activity | P | 114 | 26.0 | N | IM, ID, IJ, EX |
| Wilson & Rodgers, 2004 | J | Exercise/ Physical activity | CS | 232 | 20.9 | N | AS, IM, ID, IJ, EX, AM |
| Wilson & Rogers, 2008 | J | Exercise/ Physical activity | P | 279 | 29.0 | N | Com, Aut, Rel. IM, ID, IJ, EX |
| Wilson, Blanchard, Nehl, & Baker, 2006 | J | Exercise/ Physical activity | CS | 440 | 56.0 | N | AutReg, ConReg |
| Wilson, Longley, Muon, Rodgers, & Murray, 2006 | J | Exercise/ Physical activity | P | 50 | 36.0 | N | Com, Aut, Rel |

| Article | Type of publication | Context | Study design | Total number of participants | Mean age of participants | Participants receiving treatment | SDT-Constructs measured |
|---|---|---|---|---|---|---|---|
| Wilson, Mack, Blanchard, & Gray, 2009 | J | Exercise/ Physical activity | CS | 143 | 28.5 | N | Com, Aut, Rel |
| Wilson, Rodgers, & Fraser, 2002 | J | Exercise/ Physical activity | CS | 500 | 32.7 | N | Com, Aut, Rel, IM, ID, IJ, EX |
| Wilson, Rodgers, Blanchard, & Gessell, 2003 | J | Exercise/ Physical activity | I | 53 | 41.8 | N | Com, Aut, Rel, IM, ID, IJ, EX |
| Wilson, Rodgers, Fraser, & Murray, 2004 | J | Exercise/ Physical activity | CS | 276 | 20.6 | N | IM, ID, IJ, EX, AM |
| Wilson, Rodgers, Hall, & Gammage, 2003 | J | Exercise/ Physical activity | CS | 165 | 20.7 | N | IM, ID, IJ, EX |
| Wilson, Rodgers, Loitz, & Scime, 2006 | J | Exercise/ Physical activity | CS | 478 | 27.2 | N | Com, Aut, Rel, IM, IG, ID, IJ, EX |
| Wilson, Rogers, Rodgers, & Wild, 2006 | J | Exercise/ Physical activity | CS | 581 | 21.7 | N | Com, Aut, Rel |
| Wininger, 2007 | J | Exercise/ Physical activity | CS | 143 | 21.2 | N | IM, IG, ID, IJ, EX, AM |
| Wu & Hwang, 2000 | J | Mental illness treatment | CS | 353 | 33.6 | Y | AutOri, ConOri, ImpOri |
| Zeldman, Ryan, & Fiscella, 2004 | J | Substance abuse | CS | 74 | 41.2 | Y | AS, AutReg, ConReg |
| Zoffmann & Lauritzen, 2006 | J | Diabetes care | E | 50 | 36.4 | Y | AS, AM, AutReg, ConReg |
| Zuroff, et al., 2007 | J | Mental illness treatment | E | 95 | 42.0 | Y | AS, AutReg, ConReg |

*Note.* J = journal article; T/D = thesis/dissertation; U = unpublished data set; R = paper under review; CS = cross-sectional; P = perspective; E = experimental; I = interventional; AS = autonomy supportive health care climate; ConCli = controlling health care climate; AutOri = autonomy orientation; ConOri = controlled orientation; ImpOri = impersonal orientation; IntG = intrinsic life goals; ExtG = extrinsic life goals; Com = competence; Aut = autonomy; Rel = relatedness; IM = intrinsic motivation; IG = integrated regulation; ID = identified regulation; IJ = introjected regulation; EX = external regulation; AutReg = autonomous self-regulation; ConReg = controlled regulation; AM = amotivation. The table contains information included in the meta-analysis, and may differ to those presented in the papers due to availability.

**References of Studies Included in Meta-Analysis**


Bagøien, T. E., & Halvari, H. (2005). Autonomous motivation: Involvement in physical activity, and perceived sport competence: Structural and mediator models. *Perceptual and Motor Skills, 100*, 3-21. doi:10.2466/pms.100.1.3-21

Barbeau, A., Sweet, S. N., & Fortier, M. (2009). A path-analytic model of self-determination theory in a physical activity context. *Journal of Applied Biobehavioral Research, 14*, 103-118. doi:10.1111/j.1751-9861.2009.00043.x

Berg, C. J., Cox, L. S., Mahnken, J. D., Greiner, K. A., & Ellerbeck, E. F. (2008). Correlates of self-efficacy among rural smokers. *Journal of Health Psychology, 13*, 416-421. doi:10.1177/1359105307088144

Brickell, T., & Chatzisarantis, N. L. D. (2007). Using self-determination theory to examine the motivational correlates and predictive utility of spontaneous exercise implementation intentions. *Psychology of Sport and Exercise, 8*, 758-770. doi:10.1016/j.psychsport.2006.11.001

Brickell, T. A., Chatzisarantis, N. L. D., & Pretty, G. M. (2006). Autonomy and control: Augmenting the validity of the theory of planned behaviour in predicting exercise. *Journal of Health Psychology, 11*, 51-63. doi:10.1177/1359105306058847

Brunet, J., & Sabiston, C. M. (2009). Social physique anxiety and physical activity: A self-determination theory perspective. *Psychology of Sport and Exercise, 10*, 329-335. doi:10.1016/j.psychsport.2008.11.002

Brunet, J., & Sabiston, C. M. (2011). Exploring motivation for physical activity across the adult lifespan. *Psychology of Sport and Exercise, 12,* 99-105. doi:10.1016/j.psychsport.2010.09.006

Chan, D. K., & Hagger, M. S. (2010). *Motivation matters: How police officers prevent and recover from occupational injury - An application of the trans-contextual model*. Manuscript submitted for publication.

Chan, D. K., Lonsdale, C., Ho, P. Y., Yung, P. S., & Chan, K. M. (2009). Patient motivation and adherence to post-surgery rehabilitation exercise recommendations: The influence of physiotherapists' autonomy supportive behaviors. *Archives of Physical Medicine and Rehabilitation, 90*, 1977-1982. doi:10.1016/j.apmr.2009.05.024

Chan, D. K.-C., Hagger, M. S., & Spray, C. M. (2011). Treatment motivation for rehabilitation after a sport injury: Application of the trans-contextual model. *Psychology of Sport and Exercise, 12,* 83-92. doi:10.1016/j.psychsport.2010.08.005

Chatzisarantis, N. L. D., & Biddle, S. J. H. (1998). Functional significance of psychological variables that are included in the theory of planned behaviour: A self-determination theory approach to the study of attitudes, subjective norms, perceptions of control and intentions. *European Journal of Social Psychology, 28*, 303-322. doi:10.1002/(SICI)1099-0992(199805/06)28:3<303::AID-EJSP853>3.3.CO;2-Y

Chatzisarantis, N. L. D., & Hagger, M. S. (2009). Effects of an intervention based on self-determination theory on self-reported leisure-time physical activity participation. *Psychology and Health, 24*, 29-48. doi:10.1080/08870440701809533

Chatzisarantis, N. L. D., Hagger, M. S., Biddle, S. J. H., & Karageorghis, C. (2002). The cognitive processes by which perceived locus of causality predicts participation in physical activity. *Journal of Health Psychology, 7*, 685-699. doi:10.1177/1359105302007006872

Chatzisarantis, N. L. D., Hagger, M. S., & Brickell, T. (2008). Using the construct of perceived autonomy support to understand social influence within the theory of planned behavior. *Psychology of Sport and Exercise, 9*, 27-44. doi:10.1016/j.psychsport.2006.12.003

Chatzisarantis, N. L. D., Hagger, M. S., & Smith, B. (2007). Influences of perceived autonomy support on physical activity within the theory of planned behavior. *European Journal of Social Psychology, 37*, 934-954. doi:10.1002/ejsp.407

Chatzisarantis, N. L. D., Hagger, M. S., Wang, C. K. J., & Thøgersen-Ntoumani, C. (2009). The effects of social identity and perceived autonomy support on health behaviour within the theory of planned behaviour. *Current Psychology, 28*, 55-68. doi:10.1007/s12144-009-9043-4

Chawla, N., Neighbors, C., Logan, D., Lewis, M. A., & Fossos, N. (2009). Perceived approval of friends and parents as mediators of the relationship between self-determination and drinking. *Journal of Studies on Alcohol and Drugs, 70*, 92-100.

Custers, A. F. J., Westerhof, G. J., Kuin, Y., & Riksen-Walraven, M. (2010). Need fulfillment in caring relationships: Its relation with well-being of residents in somatic nursing homes. *Aging & Mental Health, 14*, 731-739. doi:10.1080/13607861003713133

Daley, A. J., & Duda, J. L. (2006). Self-determination, stage of readiness to change for exercise, and frequency of physical activity in young people. *European Journal of Sport Science, 6*, 231-243. doi:10.1080/17461390601012637

Davidson-Harden, J. (2009). *Predicting smoking behaviour among pregnant smokers using the reasons model and self-determination theory.* Doctoral dissertation, University of Waterloo. Retrieved from http://uwspace.uwaterloo.ca/handle/10012/3637

De Ridder, D., De Wit, J., & Adriaanse, M. A. (2009). Making plans for healthy diet: The role of motivation and action orientation. *European Journal of Social Psychology, 39*, 622-630. doi:10.1002/ejsp.560

Duncan, L. R., Hall, C. R., Wilson, P. M., & Jenny, O. (2010). Exercise motivation: A cross-sectional analysis examining its relationships with frequency, intensity, and duration of exercise. *International Journal of Behavioral Nutrition and Physical Activity, 7*(7). Retrieved from http://www.ijbnpa.org/content/pdf/1479-5868-7-7.pdf

Dyrlund, A. K., & Wininger, S. R. (2006). An evaluation of barrier efficacy and cognitive evaluation theory as predictors of exercise attendance. *Journal of Applied Biobehavioral Research, 11*, 133-146. doi:10.1111/j.1751-9861.2007.00001.x

Edmunds, J., Ntoumanis, N., & Duda, J. L. (2006a). A test of self-determination theory in the exercise domain. *Journal of Applied Social Psychology, 36*, 2240-2265. doi:10.1111/j.0021-9029.2006.00102.x

Edmunds, J., Ntoumanis, N., & Duda, J. L. (2006b). Examining exercise dependence symptomatology from a self-determination perspective. *Journal of Health Psychology, 11*, 887-903. doi:10.1177/1359105306069091

Edmunds, J., Ntoumanis, N., & Duda, J. L. (2007). Adherence and well-being in overweight and obese patients referred to an exercise on prescription scheme: A self-determination theory perspective. *Psychology of Sport and Exercise, 8*, 722-740. doi:10.1016/j.psychsport.2006.07.006

Edmunds, J., Ntoumanis, N., & Duda, J. L. (2008). Testing a self-determination theory-based teaching style intervention in the exercise domain. *European Journal of Social Psychology, 38*, 375-388. doi:10.1002/ejsp.463

Fortier, M. S., Kowal, J., Lemyre, L., & Orpana, H. M. (2009). Intentions and actual physical activity behavior change in a community-based sample of middle-aged women: Contributions from the theory of planned behavior and self-determination theory. *International Journal of Sport and Exercise Psychology, 9*, 46-67. doi:10.1080/1612197X.2009.9671892

Fortier, M. S., Sweet, S. N., O'Sullivan, T., & Williams, G. C. (2007). A self-determination process model of physical activity adoption in the context of a randomized controlled trial. *Psychology of Sport and Exercise, 8*, 741-757. doi:10.1016/j.psychsport.2006.10.006

Frederick, C. M., & Ryan, R. M. (1993). Differences in motivation for sport and exercise and their relations with participation and mental health. *Journal of Sport Behavior, 16*, 124-146.

Fuemmeler, B. F., Mâsse, L. C., Yaroch, A. L., Resnicow, K., Campbell, M. K., Carr, C., . . . Williams, A. (2006). Psychosocial mediation of fruit and vegetable consumption in the body and soul effectiveness trial. *Health Psychology, 25*, 474-483. doi:10.1037/0278-6133.25.4.474

Gay, J. L. (2009). *Testing self-determination theory and the roles of the social and physical environments in an adult beginning exerciser population* (Doctoral dissertation, University of South Carolina).

Gensichen, J., Von Korff, M., Rutter, C. M., Seelig, M. D., Ludman, E. J., Lin, E. H. B., . . . Katon, W. J. (2009). Physician support for diabetes patients and clinical outcomes. *BMC Public Health, 9*(367). Retrieved from http://www.biomedcentral.com/1471-2458/9/367

Georgiadis, M. M., Biddle, S. J. H., & Chatzisarantis, N. L. D. (2001). The mediating role of self-determination in the relationship between goal orientations and physical self-worth in Greek exercisers. *European Journal of Sport Science, 1*, 1-9. doi:10.1080/17461390100071502

Georgiadis, M. M., Biddle, S. J. H., & Stavrou, N. A. (2006). Motivation for weight-loss diets: A clustering, longitudinal field study using self-esteem and self-determination theory perspectives. *Health Education Journal, 65*, 53-72. doi:10.1177/0017896906066067

Gillison, F. B., Standage, M., & Skevington, S. M. (2006). Relationships among adolescents' weight perceptions, exercise goals, exercise motivation, quality of life and leisure-time exercise behaviour: A self-determination theory approach. *Health Education Research, 21*, 836-847. doi:10.1093/her/cyl139

Hagger, M., Chatzisarantis, N. L. D., Hein, V., Soos, I., Karsai, I., Lintunen, T., & Leemans, S. (2009). Teacher, peer and parent autonomy support in physical education and leisure-time physical activity: A trans-contextual model of motivation in four nations. *Psychology and Health, 24*, 689-711. doi:10.1080/08870440801956192

Hagger, M. S., Chatzisarantis, N. L. D., Barkoukis, V., Wang, C. K. J., & Baranowski, J. (2005). Perceived autonomy support in physical education and leisure-time physical activity: A cross-cultural evaluation of the trans-contextual model. *Journal of Educational Psychology, 97*, 376-390. doi:10.1037/0022-0663.97.3.376

Hagger, M. S., Chatzisarantis, N. L. D., Culverhouse, T., & Biddle, S. J. H. (2003). The processes by which perceived autonomy support in physical education promotes leisure-time physical activity intentions and behavior: A trans-contextual model. *Journal of Educational Psychology, 95*, 784-795. doi:10.1037/0022-0663.95.4.784

Hagger, M. S., Chatzisarantis, N. L. D., & Harris, J. (2006). From psychological need satisfaction to intentional behavior: Testing a motivational sequence in two behavioral contexts. *Personality and Social Psychology Bulletin, 32*, 131-148. doi:10.1177/0146167205279905

Hagger, M. S., Chatzisarantis, N. L. D., Hein, V., Pihu, M., Soós, I., & Karsai, I. (2007). The perceived autonomy support scale for exercise settings (PASSES): Development, validity, and cross-cultural invariance in young people. *Psychology of Sport and Exercise, 8*, 632-653. doi:10.1016/j.psychsport.2006.09.001

Halvari, A. E. M., & Halvari, H. (2006). Motivational predictors of change in oral health: An experimental test of self-determination theory. *Motivation and Emotion, 30*, 295-306. doi:10.1007/s11031-006-9035-8

Halvari, A. E. M., Halvari, H., Bjørnebekk, G., & Deci, E. L. (2010). Motivation and anxiety for dental treatment: Testing a self-determination theory model of oral self-care

behaviour and dental clinic attendance. *Motivation and Emotion, 34*, 15-33. doi:10.1007/s11031-010-9154-0

Halvari, H., Ulstad, S. O., Bagøien, T. E., & Skjesol, K. (2009). Autonomy support and its links to physical activity and competitive performance: Mediations through motivation, competence, action orientation and harmonious passion, and the moderator role of autonomy support by perceived competence. *Scandinavian Journal of Educational Research, 53*, 533-555. doi:10.1080/00313830903302059

Hove, M. C., Parkhill, M. R., Neighbors, C., McConchie, J. M., & Fossos, N. (2010). Alcohol consumption and intimate partner violence perpetration among college students: The role of self-determination. *Journal of Studies on Alcohol and Drugs, 71*, 78-85.

Ingledew, D. K., & Ferguson, E. (2007). Personality and riskier sexual behaviour: Motivational mediators *Psychology and Health, 22*, 291-315. doi:10.1080/14768320600941004

Ingledew, D. K., & Markland, D. (2008). The role of motives in exercise participation. *Psychology and Health, 23*, 807-828. doi:10.1080/08870440701405704

Ingledew, D. K., Markland, D., & Ferguson, E. (2009). Three levels of exercise motivation. *Applied Psychology: Health and Well-Being, 1*, 336-355. doi:10.1111/j.1758-0854.2009.01015.x

Ingledew, D. K., Markland, D., & Sheppard, K. E. (2004). Personality and self-determination of exercise behaviour. *Personality and Individual Differences, 36*, 1921-1932. doi:10.1016/j.paid.2003.08.021

Jolly, K., Duda, J. L., Daley, A., Eves, F. F., Mutrie, N., Ntoumanis, N., . . . Williams, G. C. (2009). Evaluation of a standard provision versus an autonomy promotive exercise referral programme: Rationale and study design. *BMC Public Health, 9*(176). Retrieved from http://www.biomedcentral.com/content/pdf/1471-2458-9-176.pdf

Julien, E., Senecal, C., & Guay, F. (2009). Longitudinal relations among perceived autonomy support from health care practitioners, motivation, coping strategies and dietary compliance in a sample of adults with type 2 diabetes. *Journal of Health Psychology, 14*, 457-470. doi:10.1177/1359105309102202

Kasser, V. G., & Ryan, R. M. (1999). The relation of psychologial needs for autonomy and relatedness to vitality, well-being and mortality in a nursing home. *Journal of Applied Social Psychology, 29*, 935-954. doi:10.1111/j.1559-1816.1999.tb00133.x

Kennedy, S., Goggin, K., & Nollen, N. (2004). Adherence to HIV medications: Utility of the theory of self-determination. *Cognitive Therapy and Research, 28*, 611-628. doi:10.1023/B:COTR.0000045568.95219.e2

Klag, S. M.-L., Creed, P., & O'Callaghan, F. (2010). Early motivation, well-being, and treatment engagement of chronic substance users undergoing treatment in a therapeutic community setting. *Substance Use & Misuse, 45*, 1112-1130. doi:10.3109/10826080903499562

Knee, C. R., & Neighbors, C. (2002). Self-determination, perception of peer pressure, and drinking among college students. *Journal of Applied Social Psychology, 32*, 522-543. doi:10.1111/j.1559-1816.2002.tb00228.x

Levesque, C. S., Williams, G. C., Elliot, D., Pickering, M. A., Bodenhamer, B., & Finley, P. J. (2007). Validating the theoretical structure of the Treatment Self-Regulation Questionnaire (TSRQ) across three different health behaviors. *Health Education Research, 22*, 691-702. doi:10.1093/her/cyl148

Levy, A. R., Polman, R. C. J., & Borkoles, E. (2008). Examining the relationship between perceived autonomy support and age in the context of rehabilitation adherence in sport. *Rehabilitation Psychology, 53*, 224-230. doi:10.1037/0090-5550.53.2.224

Levy, S. S., & Cardinal, B. J. (2004). Effects of a self-determination theory-based mail-mediated intervention on adults' exercise behavior. *American Journal of Health Promotion, 18*, 345-349.

Li, F. (1999). The Exercise Motivation Scale: Its multifaceted structure and construct validity. *Journal of Applied Sport Psychology, 11*, 97-115. doi:10.1080/10413209908402953

Lonsdale, C., Murray, A., Tenant Humphries, M., McDonough, S., Williams, G. C., & Hurley, D. (2010, June). *Testing a theory-based intervention designed to increase chronic low back pain patients' adherence to physiotherapists' recommendations: A pilot study.* Paper presented at the North American Society for the Psychology of Sport and Physical Activity Conference, Tucson, AZ.

Lutz, R., Lochbaum, M., & Turnbow, K. (2003). The role of relative autonomy in post-exercise affect responding. *Journal of Sport Behavior, 26*, 137-154.

Lutz, R. S., Karoly, P., & Okun, M. A. (2008). The why and the how of goal pursuit: Self-determination, goal process cognition, and participation in physical exercise. *Psychology of Sport and Exercise, 9*, 559-575. doi:10.1016/j.psychsport.2007.07.006

Lynam, I., Catley, D., Goggin, K., Rabinowitz, J. L., Gerkovich, M. M., Williams, K., & Wright, J. (2009). Autonomous regulation and locus of control as predictors of antiretroviral medication adherence. *Journal of Health Psychology, 14*, 578-586. doi:10.1177/1359105309103577

Markland, D. (1999). Self-determination moderates the effects of perceived competence on intrinsic motivation in an exercise setting. *Journal of Sport & Exercise Psychology, 21*, 351-361.

Markland, D. (2009). The mediating role of behavioural regulations in the relationship between perceived body size discrepancies and physical activity among adult women. *Hellenic Journal of Psychology, 6*, 169-182.

Markland, D., & Ingledew, D. K. (2007). The relationships between body mass and body image and relative autonomy for exercise among adolescent males and females. *Psychology of Sport and Exercise, 8*, 836-853. doi:10.1016/j.psychsport.2006.11.002

Markland, D., & Tobin, V. (2004). A modification to the Behavioural Regulation in Exercise Questionnaire to include an assessment of amotivation. *Journal of Sport & Exercise Psychology, 26*, 191-196.

Markland, D., & Tobin, V. J. (2010). Need support and behavioural regulations for exercise among exercise referral scheme clients: The mediating role of psychological need satisfaction. *Psychology of Sport and Exercise, 11*, 91-99. doi:10.1016/j.psychsport.2009.07.001

Mata, J., Silva, M. N., Vieira, P. N., Carraça, E. V., Andrade, A. M., Coutinho, S. R., . . . Teixeira, P. J. (2009). Motivational "spill-over" during weight control: Increased self-determination and exercise intrinsic motivation predict eating self-regulation. *Health Psychology, 28*, 709-716. doi:10.1037/a0016764

McDonough, M. H., & Crocker, P. R. E. (2007). Testing self-determined motivation as a mediator of the relationship between psychological needs and affective and behavioral outcomes. *Journal of Sport & Exercise Psychology, 29*, 645-663.

McLachlan, S., & Hagger, M. S. (2010). Associations between motivational orientations and chronically accessible outcomes in leisure-time physical activity: Are appearance-related outcomes controlling in nature? *Research Quarterly for Exercise and Sport, 81*, 102-107.

McNelis, K. L. (2008). *The application of self-determination theory to an athletic club setting: The role of need support, autonomous self-regulation, perceived competence, and relatedness in exercise persistence* (Doctoral dissertation, University of Rochester).

Milne, H. M., Wallman, K. E., Gordon, S., & Courneya, K. S. (2008). Impact of a combined resistance and aerobic exercise program on motivational variables in breast cancer

survivors: A randomized controlled trial. *Annals of Behavioral Medicine, 36*, 158-166. doi:10.1007/s12160-008-9059-2

Milne, H. M., Wallman, K. E., Guilfoyle, A., Gordon, S., & Courneya, K. S. (2008). Self-determination theory and physical activity among breast cancer survivors. *Journal of Sport & Exercise Psychology, 30*, 23-38.

Moreno, J. A., González-Cutre, D., Sicilia, Á., & Spray, C. M. (2010). Motivation in the exercise setting: Integrating constructs from the approach–avoidance achievement goal framework and self-determination theory. *Psychology of Sport and Exercise, 11*, 542-550. doi:10.1016/j.psychsport.2010.06.003

Moreno, J. A., Martínez Galindo, C., González-Cutre, D., & Marcos, P. (2009). Perfiles motivacionales de practicantes en el medio acuático frente al medio terrestre [Motivational profiles of aquatic versus terrestrial exercisers]. *Revista Internacional de Medicina y Ciencias de la Actividad Física y el Deporte 9*, 201-216.

Moreno Murcia, J. A., San Román, M. L. d., Galindo, C. M., Alonso, N., & González-Cutre, D. (2008). Peers' influence on exercise enjoyment: A self-determination theory approach. *Journal of Sports Science and Medicine, 7*, 23-31.

Moreno-Murcia, J. A., Coll, D. G.-C., & Cervello-Gimeno, E. (2008). Motivación y salud en la práctica físicodeportiva: Diferencias según el consumo de alcohol y tabaco [Motivation and health in physical-sport practice: Differences depending on the consumption of alcohol and tobacco]. *International Journal of Clinical and Health Psychology, 8*, 483-494.

Murcia, J. A. M., Gimeno, E. C., & Camacho, A. M. (2007). Measuring self-determination motivation in a physical fitness setting: Validation of the Behavioral Regulation in Exercise Questionnaire-2 (BREQ-2) in a Spanish sample. *Journal of Sports Medicine and Physical Fitness, 47*, 366-374.

Muyor, J. M., Águila, C., Sicilia, A., & Orta, A. (2009). Análisis de la motivación autodeterminada en usuarios de centros deportivos [Assessing user's motivation in sport ceters]. *Revista Internacional de Medicina y Ciencias de la Actividad Física y el Deporte, 9*, 67-80.

Neighbors, C., Larimer, M. E., Geisner, I. M., & Knee, C. R. (2004). Feeling controlled and drinking motives among college students: Contingent self-esteem as a mediator. *Self and Identity, 3*, 207-224. doi:10.1080/13576500444000029

Neighbors, C., Lewis, M. A., Bergstrom, R. L., & Larimer, M. E. (2006). Being controlled by normative influences: Self-determination as a moderator of a normative feedback alcohol intervention. *Health Psychology, 25*, 571-579. doi:10.1037/0278-6133.25.5.571

Neighbors, C., Walker, D. D., & Larimer, M. E. (2003). Expectancies and evaluations of alcohol effects among college students: Self-determination as a moderator. *Journal of Studies on Alcohol and Drugs, 64*, 292-300.

Ng, J. Y. Y., & Ntoumanis, N. (2010). *Needs satisfaction and exercise motivation of participants in a free gym usage scheme*. Unpublished raw data.

Niemiec, C. P., Ryan, R. M., Deci, E. L., & Williams, G. C. (2009). Aspiring to physical health: The role of aspirations for physical health in facilitating long-term tobacco abstinence. *Patient Education and Counseling, 74*, 250-257. doi:10.1016/j.pec.2008.08.015

Niemiec, C. P., Ryan, R. M., Patrick, H., Deci, E. L., & Williams, G. C. (2009). The energization of health-behavior change: Examining the associations among autonomous self-regulation, subjective vitality, depressive symptoms, and tobacco abstinence. *The Journal of Positive Psychology, 5*, 122-138. doi:10.1080/17439760903569162

Otis, N., & Pelletier, L. G. (2008). Women's regulation styles for eating behaviors and outcomes: The mediating role of approach and avoidance food planning. *Motivation and Emotion, 32*, 55-67. doi:10.1007/s11031-008-9083-3

Palmeira, A. L., Teixeira, P. J., Branco, T. L., Martins, S. S., Minderico, C. S., Barata, J. T., . . . Sardinha, L. B. (2007). Predicting short-term weight loss using four leading health behavior change theories. *International Journal of Behavioral Nutrition and Physical Activity, 4*(14). Retrieved from http://www.ijbnpa.org/content/pdf/1479-5868-4-14.pdf

Pavey, L., & Sparks, P. (2009). Reactance, autonomy and paths to persuasion: Examining perceptions of threats to freedom and informational value. *Motivation and Emotion, 33*, 277-290. doi:10.1007/s11031-009-9137-1

Pavey, L. J., & Sparks, P. (2010). Autonomy and reactions to health-risk information. *Psychology and Health, 25*, 855-872. doi:10.1080/08870440902929528

Peddle, C. J., Plotnikoff, R. C., Wild, T. C., Au, H.-J., & Courneya, K. S. (2008). Medical, demographic, and psychosocial correlates of exercise in colorectal cancer survivors: An application of self-determination theory. *Supportive Care in Cancer, 16*, 9-17. doi:10.1007/s00520-007-0272-5

Pelletier, L. G., & Dion, S. C. (2007). An examination of general and specific motivational mechanisms for the relations between body dissatisfaction and eating behaviors. *Journal of Social and Clinical Psychology, 26*, 303-333. doi:10.1521/jscp.2007.26.3.303

Pelletier, L. G., Dion, S. C., Slovinec-D'Angelo, M., & Reid, R. (2004). Why do you regulate what you eat? Relationships between forms of regulation, eating behaviors, sustained dietary behavior change, and psychological adjustment. *Motivation and Emotion, 28*, 245-277. doi:10.1023/B:MOEM.0000040154.40922.14

Pihu, M., Hein, V., Koka, A., & Hagger, M. S. (2008). How students' perceptions of teachers' autonomy-supportive behaviours affect physical activity behaviour: an application of the trans-contextual model. *European Journal of Sport Science, 8*, 193-204. doi:10.1080/17461390802067679

Piko, B. F., & Keresztes, N. (2006). Physical activity, psychosocial health and life goals among youth. *Journal of Community Health, 31*, 136-145. doi:10.1007/s10900-005-9004-2

Powers, T. A., Koestner, R., & Gorin, A. A. (2008). Autonomy support from family and friends and weight loss in college women. *Families, Systems, & Health, 26*, 404-416. doi:10.1037/1091-7527.26.4.404

Puente, R., & Anshel, M. H. (2010). Exercisers' perceptions of their fitness instructor's interacting style, perceived competence, and autonomy as a function of self-determined regulation to exercise, enjoyment, affect, and exercise frequency. *Scandinavian Journal of Psychology, 51*, 38-45. doi:10.1111/j.1467-9450.2009.00723.x

Quested, E., & Duda, J. L. (2010). Exploring the social-environmental determinants of well- and ill-being in dancers: A test of basic needs theory. *Journal of Sport & Exercise Psychology, 32*, 39-60.

Rose, E. A., Markland, D., & Parfitt, G. (2001). The development and initial validation of the Exercise Causality Orientations Scale. *Journal of Sports Sciences, 19*, 445-462. doi:10.1080/026404101300149393

Rose, E. A., Parfitt, G., & Williams, S. (2005). Exercise causality orientations, behavioural regulation for exercise and stage of change for exercise: exploring their relationships. *Psychology of Sport and Exercise, 6*, 399-414. doi:10.1016/j.psychsport.2004.07.002

Russell, K. L., & Bray, S. R. (2009). Self-determined motivation predicts independent, home-based exercise following cardiac rehabilitation. *Rehabilitation Psychology, 54*, 150-156. doi:10.1037/a0015595

Russell, K. L., & Bray, S. R. (2010). Promoting self-determined motivation for exercise in cardiac rehabilitation: The role of autonomy support. *Rehabilitation Psychology, 55*, 74-80. doi:10.1037/a0018416

Ryan, R. M., Frederick, C. M., Lepes, D., Rubio, N., & Sheldon, K. M. (1997). Intrinsic motivation and exercise adherence. *International Journal of Sport Psychology, 28*, 335-354.

Ryan, R. M., Plant, R. W., & O'Malley, S. (1995). Initial motivations for alcohol treatment: Relations with patient characteristics, treatment involvement, and dropout. *Addictive Behaviors, 20*, 279-297. doi:10.1016/0306-4603(94)00072-7

Sabiston, C. M., Brunet, J., Castonguay, A., Bessette, N., & Fergusson, L. (2010). Unpublished raw data.

Sabiston, C. M., Brunet, J., Kowalski, K. C., Wilson, P. M., Mack, D. E., & Crocker, P. R. E. (2010). The role of body-related self-conscious emotions in motivating women's physical activity. *Journal of Sport & Exercise Psychology, 32*, 417-437.

Sebire, S. J., Standage, M., & Vansteenkiste, M. (2008). Development and validation of the Goal Content for Exercise Questionnaire. *Journal of Sport & Exercise Psychology, 30*, 353-377.

Sebire, S. J., Standage, M., & Vansteenkiste, M. (2009). Examining intrinsic versus extrinsic exercise goals: Cognitive, affective, and behavioral outcomes. *Journal of Sport & Exercise Psychology, 31*, 189-210.

Shaikh, A. R., Vinokur, A. D., Yaroch, A. L., Williams, G. C., & Resnicow, K. (2011). Direct and mediated effects of two theoretically based interventions to increase consumption of fruits and vegetables in the Healthy Body Healthy Spirit trial. *Health Education & Behavior, 38*, 492-501. doi:10.1177/1090198110384468

Shamloo, Z. S., & Cox, W. M. (2010). The relationship between motivational structure, sense of control, intrinsic motivation and university students' alcohol consumption. *Addictive Behaviors, 35*, 140-146. doi:10.1016/j.addbeh.2009.09.021

Shigaki, C., Kruse, R. L., Mehr, D., Sheldon, K. M., Ge, B., Moore, C., & Lemaster, J. (2010). Motivation and diabetes self-management. *Chronic Illness, 6*, 202-214. doi:10.1177/1742395310375630

Silva, M. N., Markland, D., Carraça, E. V., Vieira, P. N., Coutinho, S. R., Minderico, C. S., . . . Teixeira, P. J. (2011). Exercise autonomous motivation predicts three-year weight loss in women. *Medicine and Science in Sports and Exercise, 43*, 728-737. doi:10.1249/MSS.0b013e3181f3818f

Silva, M. N., Markland, D., Vieira, P. N., Coutinho, S. R., Carraça, E. V., Palmeira, A. L., . . . Teixeira, P. J. (2010). Helping overweight women become more active: Need support and motivational regulations for different forms of physical activity. *Psychology of Sport and Exercise, 11*, 591-601. doi:10.1016/j.psychsport.2010.06.011

Silva, M. N., Vieira, P. N., Coutinho, S. R., Minderico, C. S., Matos, M. G., Sardinha, L. B., & Teixeira, P. J. (2010). Using self-determination theory to promote physical activity and weight control: A randomized controlled trial in women. *Journal of Behavioral Medicine, 33*, 110-122. doi:10.1007/s10865-009-9239-y

Simoneau, H., & Bergeron, J. (2003). Factors affecting motivation during the first six weeks of treatment. *Addictive Behaviors, 28*, 1219-1241. doi:10.1016/S0306-4603(02)00257-5

Solloway, V., Solloway, K., & Joseph, A. (2006). A hypnotherapy for smoking intervention investigates the effects of autonomy support on motivation, perceived competence and smoking abstinence. *European Journal of Clinical Hypnosis, 7*, 26-40.

Spofford, C. M. (2009). *The role of motivation to change in the treatment of obsessive-compulsive disorder* (Doctoral dissertation, University of Massachusetts Amherst).

Standage, M., Sebire, S. J., & Loney, T. (2008). Does exercise motivation predict engagement in objectively assessed bouts of moderate-intensity exercise?: A self-determination theory perspective. *Journal of Sport & Exercise Psychology, 30*, 337-352.

Sweet, S. N., Fortier, M. S., Guérin, E., Tulloch, H., Sigal, R. J., Kenny, G. P., & Reid, R. D. (2009). Understanding physical activity in adults with type 2 diabetes after completing an exercise intervention trial: A mediation model of self-efficacy and autonomous motivation. *Psychology, Health and Medicine, 14*, 419-429. doi:10.1080/13548500903111806

Teixeira, P. J., Going, S. B., Houtkooper, L. B., Cussler, E. C., Metcalfe, L. L., Blew, R. M., . . . Lohman, T. G. (2006). Exercise motivation, eating, and body image variables as predictors of weight control. *Medicine and Science in Sports and Exercise, 38*, 179-188. doi:10.1249/01.mss.0000180906.10445.8d

Teixeira, P. J., Silva, M. N., Coutinho, S. R., Palmeira, A. L., Mata, J., Vieira, P. N., . . . Sardinha, L. B. (2009). Mediators of weight loss and weight loss maintenance in middle-aged women. *Obesity, 18*, 725-735. doi:10.1038/oby.2009.281

Thøgersen-Ntoumani, C., & Fox, K. R. (2007). Exploring the role of autonomy for exercise and its relationship with mental well-being: A study with non-academic university employees. *International Journal of Sport and Exercise Psychology, 5*, 227-239. doi:10.1080/1612197X.2007.9671833

Thøgersen-Ntoumani, C., & Ntoumanis, N. (2006). The role of self-determined motivation in the understanding of exercise-related behaviours, cognitions and physical self-evaluations. *Journal of Sports Sciences, 24*, 393-404. doi:10.1080/02640410500131670

Thøgersen-Ntoumani, C., Ntoumanis, N., & Nikitaras, N. (2008). Typologies of Greek inactive older adults based on reasons for abstaining from exercise and conditions for change. *Journal of Sports Sciences, 26*, 1341-1350. doi:10.1080/02640410802165715

Thøgersen-Ntoumani, C., Ntoumanis, N., & Nikitaras, N. (2010). Unhealthy weight control behaviours in adolescent girls: A process model based on self-determination theory. *Psychology and Health, 25*, 535-550. doi:10.1080/08870440902783628

Vazou-Ekkekakis, S., & Ekkekakis, P. (2009). Affective consequences of imposing the intensity of physical activity: Does the loss of perceived autonomy matter? *Hellenic Journal of Psychology, 6*, 125-168.

Vierling, K. K., Standage, M., & Treasure, D. C. (2007). Predicting attitudes and physical activity in an "at-risk" minority youth sample: A test of self-determination theory. *Psychology of Sport and Exercise, 8*, 795-817. doi:10.1016/j.psychsport.2006.12.006

Vlachopoulos, S. P., & Karavani, E. (2009). Psychological needs and subjective vitality in exercise: A cross-gender situational test of the needs universality hypothesis. *Hellenic Journal of Psychology, 6*, 207-222.

Vlachopoulos, S. P., & Michailidou, S. (2006). Development and initial validation of a measure of autonomy, competence, and relatedness in exercise: The Basic Psychological Needs in Exercise Scale. *Measurement in Physical Education and Exercise Science, 10*, 179-201. doi:10.1207/s15327841mpee1003_4

Wang, C. K. J., & Biddle, S. J. H. (2001). Young people's motivational profiles in physical activity: A cluster analysis. *Journal of Sport & Exercise Psychology, 23*, 1-22.

Wang, C. K. J., Chia, Y. H. M., Quek, J. J., & Liu, W. C. (2006). Patterns of physical activity, sedentary behaviours and psychological determinants among singaporean school children. *International Journal of Sport and Exercise Psychology, 4*, 227-249. doi:10.1080/1612197X.2006.9671797

Ward, J., Wilkinson, C., Graser, S. V., & Prusak, K. A. (2008). Effects of choice on student motivation and physical activity behavior in physical education. *Journal of Teaching in Physical Education, 27*, 385-398.

Webber, K. H., Tate, D. F., Ward, D. S., & Bowling, J. M. (2010). Motivation and its relationship to adherence to self-monitoring and weight loss in a 16-week internet behavioral weight loss intervention. *Journal of Nutrition Education and Behavior, 42*, 161-167. doi:10.1016/j.jneb.2009.03.001

Wild, T. C., Cunningham, J. A., & Ryan, R. M. (2006). Social pressure, coercion, and client engagement at treatment entry: A self-determination theory perspective. *Addictive Behaviors, 31*, 1858-1872. doi:10.1016/j.addbeh.2006.01.002

Williams, G. C., Cox, E. M., Hedberg, V. A., & Deci, E. L. (2000). Extrinsic life goals and health-risk behaviors in adolescents. *Journal of Applied Social Psychology, 30*, 1756-1771. doi:10.1111/j.1559-1816.2000.tb02466.x

Williams, G. C., Freedman, Z. R., & Deci, E. L. (1998). Supporting autonomy to motivate patients with diabetes for glucose control. *Diabetes Care, 21*, 1644-1651. doi:10.2337/diacare.21.10.1644

Williams, G. C., Gagne, M., Mushlin, A. I., & Deci, E. L. (2005). Motivation for behavior change in patients with chest pain. *Health Education, 105*, 304-321. doi:10.1108/09654280510602516

Williams, G. C., Gagne, M., Ryan, R. M., & Deci, E. L. (2002). Facilitating autonomous motivation for smoking cessation. *Health Psychology, 21*, 40-50. doi:10.1037//0278-6133.21.1.40

Williams, G. C., Grow, V. M., Freedman, Z. R., Ryan, R. M., & Deci, E. L. (1996). Motivational predictors of weight loss and weight-loss maintenance. *Journal of Personality and Social Psychology, 70*, 115-126. doi:10.1037/0022-3514.70.1.115

Williams, G. C., Levesque, C., Zeldman, A., Wright, S., & Deci, E. L. (2003). Health care practitioners' motivation for tobacco-dependence counseling. *Health Education Research, 18*, 538-553. doi:10.1093/her/cyf042

Williams, G. C., Lynch, M., & Glasgow, R. E. (2007). Computer-assisted intervention improves patient-centered diabetes care by increasing autonomy support. *Health Psychology, 26*, 728-734. doi:10.1037/0278-6133.26.6.728

Williams, G. C., Lynch, M. F., McGregor, H. A., Ryan, R. M., Sharp, D., & Deci, E. L. (2006). Validation of the "Important Other" Climate Questionnaire: Assessing autonomy support for health-related change. *Families, Systems, & Health, 24*, 179-194. doi:10.1037/1091-7527.24.2.179

Williams, G. C., McGregor, H. A., Sharp, D., Levesque, C. S., Kouides, R. W., Ryan, R. M., & Deci, E. L. (2006). Testing a self-determination theory intervention for motivating tobacco cessation: Supporting autonomy and competence in a clinical trial. *Health Psychology, 25*, 91-101. doi:10.1037/0278-6133.25.1.91

Williams, G. C., McGregor, H. A., Zeldman, A., Freedman, Z. R., & Deci, E. L. (2004). Testing a self-determination theory process model for promoting glycemic control through diabetes self-management. *Health Psychology, 23*, 58-66. doi:10.1037/0278-6133.23.1.58

Williams, G. C., Niemiec, C. P., Patrick, H., Ryan, R. M., & Deci, E. L. (2009). The importance of supporting autonomy and perceived competence in facilitating long-term tobacco abstinence. *Annals of Behavioral Medicine, 37*, 315-324. doi:10.1007/s12160-009-9090-y

Williams, G. C., Patrick, H., Niemiec, C. P., Ryan, R. M., Deci, E. L., & McGregor Lavigne, H. (2011). The Smoker's Health Project: A self-determination theory intervention to facilitate maintenance of tobacco abstinence. *Contemporary Clinical Trials, 32,* 535-543. doi:10.1016/j.cct.2011.03.002

Williams, G. C., Patrick, H., Niemiec, C. P., Williams, L. K., Divine, G., Lafata, J. E., . . . Pladevall, M. (2009). Reducing the health risks of diabetes: How self-determination theory may help improve medication adherence and quality of life. *The Diabetes Educator, 35*, 484-492. doi:10.1177/0145721709333856

Williams, G. C., Rodin, G. C., Ryan, R. M., Grolnick, W. S., & Deci, E. L. (1998). Autonomous regulation and long-term medication adherence in adult outpatients. *Health Psychology, 17*, 269-276. doi:10.1037/0278-6133.17.3.269

Wilson, P. M., Blanchard, C. M., Nehl, E., & Baker, F. (2006). Predicting physical activity and outcome expectations in cancer survivors: An application of self-determination theory. *Psycho-Oncology, 15*, 567-578. doi:10.1002/pon.990

Wilson, P. M., Longley, K., Muon, S., Rodgers, W. M., & Murray, T. C. (2006). Examining the contributions of perceived psychological need satisfaction to well-being in exercise. *Journal of Applied Biobehavioral Research, 11*, 243-264. doi:10.1111/j.1751-9861.2007.00008.x

Wilson, P. M., Mack, D. E., Blanchard, C. M., & Gray, C. E. (2009). The role of perceived psychological need satisfaction in exercise-related affect. *Hellenic Journal of Psychology, 6*, 183-206.

Wilson, P. M., & Muon, S. (2008). Psychometric properties of the exercise identity scale: A preliminary study. *International Journal of Sport and Exercise Psychology, 6*, 115-131. doi:10.1080/1612197X.2008.9671857

Wilson, P. M., & Rodgers, W. M. (2002). The relationship between exercise motives and physical self-esteem in female exercise participants: An application of self-determination theory. *Journal of Applied Biobehavioral Research, 7*, 30-43. doi:10.1111/j.1751-9861.2002.tb00074.x

Wilson, P. M., & Rodgers, W. M. (2004). The relationship between perceived autonomy support, exercise regulations and behavioral intentions in women. *Psychology of Sport and Exercise, 5*, 229-242. doi:10.1016/S1469-0292(03)00003-7

Wilson, P. M., Rodgers, W. M., Blanchard, C. M., & Gessell, J. (2003). The relationship between psychological needs, self-determined motivation, exercise attitudes, and physical fitness. *Journal of Applied Social Psychology, 33*, 2373-2392. doi:10.1111/j.1559-1816.2003.tb01890.x

Wilson, P. M., Rodgers, W. M., & Fraser, S. N. (2002). Examining the psychometric properties of the Behavioral Regulation in Exercise Questionnaire. *Measurement in Physical Education and Exercise Science, 6*, 1-21. doi:10.1207/S15327841MPEE0601_1

Wilson, P. M., Rodgers, W. M., Fraser, S. N., & Murray, T. C. (2004). Relationships between exercise regulations and motivational consequences in university students. *Research Quarterly for Exercise and Sport, 75*, 81-91.

Wilson, P. M., Rodgers, W. M., Hall, C. R., & Gammage, K. L. (2003). Do autonomous exercise regulations underpin different types of exercise imagery? *Journal of Applied Sport Psychology, 15*, 294-306. doi:10.1080/714044198

Wilson, P. M., Rodgers, W. M., Loitz, C. C., & Scime, G. (2006). "It's who I am... Really!" The importance of integrated regulation in exercise contexts. *Journal of Applied Biobehavioral Research, 11*, 79-104. doi:10.1111/j.1751-9861.2006.tb00021.x

Wilson, P. M., & Rogers, W. T. (2008). Examining relationships between psychological need satisfaction and behavioural regulations in exercise. *Journal of Applied Biobehavioral Research, 13*, 119-142. doi:10.1111/j.1751-9861.2008.00031.x

Wilson, P. M., Rogers, W. T., Rodgers, W. M., & Wild, T. C. (2006). The Psychological Need Satisfaction in Exercise Scale. *Journal of Sport & Exercise Psychology, 28*, 231-251.

Wininger, S. R. (2007). Self-determination theory and exercise behavior: An examination of the psychometric properties of the Exercise Motivation Scale. *Journal of Applied Sport Psychology, 19*, 471-486. doi:10.1080/10413200701601466

Wu, C.-Y., & Hwang, M.-T. (2000). Evaluating motivational deficits in individuals with mental illness: the Chinese General Causality Orientations Scale. *Occupational Therapy International, 7*, 57-77. doi:10.1002/oti.107

Zeldman, A., Ryan, R. M., & Fiscella, K. (2004). Motivation, autonomy support, and entity beliefs: Their role in methadone maintenance treatment. *Journal of Social and Clinical Psychology, 23*, 675-696. doi:10.1521/jscp.23.5.675.50744

Zoffmann, V., & Lauritzen, T. (2006). Guided self-determination improves life skills with Type 1 diabetes and A1C in randomized controlled trial. *Patient Education and Counseling, 64*, 78-86. doi:10.1016/j.pec.2005.11.017

Zuroff, D. C., Koestner, R., Moskowitz, D. S., McBride, C., Marshall, M., & Bagby, M. (2007). Autonomous motivation for therapy: A new common factor in brief treatments for depression. *Psychotherapy Research, 17*, 137-147. doi:10.1080/10503300600919380

**Appendix C**
**The Adapted Health Care Climate Questionnaire**

Items were adapted from Williams, Grow, Freedman, Ryan, and Deci (1996). Items were modified to measure perceived autonomy support from an important other with respect to exercise, diet (Study 2), and general weight management (Study 3).

**Versions used in Study 2:**
With respect to my exercise/diet regimen…

| | Strongly Disagree | | | | | | Strongly Agree |
|---|---|---|---|---|---|---|---|
| 1. I feel understood by my important other | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 2. My important other makes sure I really understand the goals of my regimen | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 3. I am able to be open with my important other | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 4. My important other tries to understand how I see things before suggesting new ways to do things | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 5. I feel that my important other cares about me as a person | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 6. My important other listens to how I would like to do things | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 7. My important other conveys confidence in my ability to do well | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 8. I feel that my important other accepts me | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 9. I feel able to share my feelings with my important other | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 10. I feel a lot of trust in my important other | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

**Version used in Study 3:**
With respect to my weight loss/maintenance plans…

| | Strongly Disagree | | | | | | Strongly Agree |
|---|---|---|---|---|---|---|---|
| 1. I feel that my important other has provided me with choices and options about my weight loss/maintenance plans | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 2. My important other tries to understand how I see my weight loss/maintenance plans before suggesting any changes | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 3. My important other listens to how I would like to do things regarding my weight loss/maintenance plans | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 4. My important other conveys confidence in my ability to make changes regarding my weight loss/maintenance plans | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 5. My important other encourages me to ask questions about my weight loss/maintenance plans | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 6. I feel my important other understands how I see things with respect to my weight loss/maintenance plans | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

In Study 4, items were modified to measure autonomy supportive strategies to instruct the hypothetical exerciser.

**Version used in Study 4:**

To what extent would you agree that the following behaviours from you as a fitness instructor would be effective, in terms of the exerciser adhering to his/her exercise regimen, given his/her motivation to start exercising?

| | Strongly Disagree | | | | | | Strongly Agree |
|---|---|---|---|---|---|---|---|
| 1. Encourage her to ask questions | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 2. Provide her with choices and options | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 3. Ensure she understood about her weight condition and what she needed to do | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 4. Try to understand how she saw things before suggesting a new way to do things | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 5. Listen to how she would like to do things | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 6. Convey confidence in her ability to make changes | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 7. Answer questions raised by her fully and carefully | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 8. Care for her as a person | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

**Appendix D**
**The Adapted Controlling Coach Behaviors Scale**

Items were adapted from Bartholomew, Ntoumanis, and Thøgersen-Ntoumani (2010). Items were modified to measure controlling behaviours of an important other with respect to exercise, diet (Study 2), and general weight management (Study 3).

**Versions used in Study 2:**
With respect to my exercise regimen/diet regimen …

| | Strongly Disagree | | | | | | Strongly Agree |
|---|---|---|---|---|---|---|---|
| 1. My important other is less supportive of me when I don't stick to my exercise/diet regimen | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 2. My important other is less accepting of me if I have disappointed him/her in terms of my exercise/diet regimen | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 3. My important other tries to motivate me to exercise/diet by promising to reward me if I do so | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 4. My important other embarrasses me in front of others if I do not stick to my exercise/diet regimen | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 5. My important other lectures me to make me exercise/diet | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 6. My important other only praises me to make me keep up with my exercise/diet regimen | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

**Version used in Study 3:**
With respect to my weight loss/maintenance plans…

| | Strongly Disagree | | | | | | Strongly Agree |
|---|---|---|---|---|---|---|---|
| 1. My important other is less supportive of me when I don't stick to my weight loss/maintenance plans | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 2. My important other only praises me to make me keep up with my weight loss/maintenance plans | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 3. My important other embarrasses me in front of others if I do not stick to my weight loss/maintenance plans | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 4. My important other lectures me to make me stick to my weight loss/maintenance plans | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 5. My important other tries to motivate me by promising to reward me if I stick to my weight loss/maintenance plans | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 6. My important other is less accepting of me if I have disappointed him/her in terms of my weight loss/maintenance plans | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

In Study 4, items were modified to measure autonomy supportive strategies to instruct the hypothetical exerciser.

**Version used in Study 4:**

To what extent would you agree that the following behaviours from you as a fitness instructor would be effective, in terms of the exerciser adhering to his/her exercise regimen, given his/her motivation to start exercising?

| | Strongly Disagree | | | | | | Strongly Agree |
|---|---|---|---|---|---|---|---|
| 1. Promise to reward her if she came back to the gym for the next session | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 2. Try to make her feel guilty if she did not stick to her exercise regimen | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 3. Show less support/sympathy for her if she failed to exercise regularly | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 4. Tell her that she should feel guilty if she missed an exercise session | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 5. Distance myself from her if she didn't make the effort to see things my way | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 6. Pay her less attention if she didn't follow my instructions | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 7. Promise to reward her but only if she did well | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 8. Threaten to punish her (e.g., do extra sit-ups) to ensure that she did her exercises | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

**Appendix E**
**The Adapted Basic Needs Satisfaction in Sport Scale**

Items were adapted from Ng, Lonsdale, and Hodge (2012). Items were modified to measure psychological need satisfaction with respect to exercise, diet (competence and autonomy only; Study 2), and general weight management (competence, autonomy, and relatedness; Study 3).

**Versions used in Study 2:**
Please indicate how much you agree or disagree with each statement

| | Strongly Disagree | | | | | | Strongly Agree |
|---|---|---|---|---|---|---|---|
| 1. I feel effective when I exercise/diet | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 2. I can overcome challenges when I exercise/diet | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 3. I feel it is my own decision to exercise/diet | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 4. I feel I exercise/diet willingly | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 5. I feel capable when I exercise/diet | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 6. I am capable of completing exercise goals/reaching diet goals that are challenging to me | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 7. When exercising/dieting, I feel I am pursuing goals that are my own | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 8. I choose to exercise/diet according to my own free will | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

**Versions used in Study 3:**
Please indicate the degree you agree with the following sentences by referring to *how you generally feel* with respect to your weight loss/maintenance efforts.

| | Strongly Disagree | | | | | | Strongly Agree |
|---|---|---|---|---|---|---|---|
| 1. I feel capable | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 2. There are people who care about me | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 3. I feel effective | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 4. I feel close to other people | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 5. There are people who I can trust | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 6. I can overcome challenges | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 7. I feel it is my own decisions to make the effort to lose/maintain weight | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 8. I have a close relationship with other people | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 9. I feel I make efforts to lose/maintain weight willingly | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 10. I am capable of completing weight loss/maintenance goals that are challenging to me | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 11. I make efforts to lose/maintain weight according to my own free will | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 12. I feel I am pursuing goals that are my own | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

**Appendix F**
**The Adapted Need for Relatedness Scale**

Items were adapted from Richer and Vallerand (1998). Items were modified to measure relatedness need satisfaction with respect to exercise, diet (Study 2).

**Versions used in Study 2:**
Please indicate how much you agree or disagree with each statement

| | Strongly Disagree | | | | | | Strongly Agree |
|---|---|---|---|---|---|---|---|
| 1. With respect to my exercise engagement, I feel supported | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 2. With respect to my exercise engagement, I feel valued | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 3. With respect to my exercise engagement, I feel listened to | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 4. With respect to my exercise engagement, I feel understood | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

**Appendix G**
**The Adapted Psychological Need Thwarting Scale**

Items were adapted from Bartholomew, Ntoumanis, Ryan, and Thøgersen-Ntoumani (2011). Items were modified to measure psychological need thwarting with respect to exercise, diet (Study 2), and general weight management (Study 3).

**Versions used in Study 2:**
In exercise/diet…

| | Strongly Disagree | | | | | | Strongly Agree |
|---|---|---|---|---|---|---|---|
| 1. I feel other people are jealous of me when I lose weight | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 2. I feel others push me to behave in certain ways | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 3. Situations occur in which others make me feel incapable | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 4. I feel others can be dismissive of me | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 5. I feel other people dislike me | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 6. I feel others reject me | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 7. I feel inadequate because others did not give me opportunities to fulfil my potential in terms of my exercise/diet goals | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 8. I feel others prevent me from making choices | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 9. I feel others pressure me to agree with the exercise/diet regimen I am provided | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 10. There are situations where others make me feel inadequate | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 11. I feel others force me to follow decisions made for me | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 12. There are times when others tell me things that make me feel incompetent | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

**Version used in Study 3:**

With respect to your weight loss/maintenance plans …

| | Strongly Disagree | | | | | | Strongly Agree |
|---|---|---|---|---|---|---|---|
| 1. There are situations where I am made to feel inadequate | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 2. I feel inadequate because I am not given opportunities to fulfill my potential in terms of weight loss/maintenance | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 3. I feel forced to follow decisions made for me | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 4. I feel pushed to behave in certain ways | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 5. I feel I am rejected | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 6. Situations occur in which I am made to feel incapable | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 7. I feel people are envious when I achieve success | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 8. There are times when I am told things that make me feel incompetent | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 9. I feel other people dislike me | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 10. I feel prevented from making choices with regard to my weight loss/maintenance regimen | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 11. I feel under pressure to agree with a specific plan | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 12. I feel others can be dismissive of me | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

**Appendix H**
**The Godin Leisure-Time Exercise Questionnaire**

The scale was developed by Godin and Shephard (1985). It was used as a measure for physical activity in Studies 2 and 3.

Considering a 7-Day period (a week), how many times on average do you do the following kinds of exercise for more than 15 minutes during your free time?

| | *Please write down the number* |
|---|---|
| a) Strenuous exercise (heart beats rapidly)<br>e.g. running, jogging, aerobic dancing, hockey, football, rugby, squash, basketball, netball, vigorous swimming, vigorous long distance bicycling, or any other physical activities of similar intensity | |
| b) Moderate exercise (not exhausting)<br>e.g. fast walking, cricket, tennis, easy bicycling, volleyball, badminton, easy swimming, popular and folk dancing, or any other physical activities of similar intensity | |
| c) Mild exercise (minimal effort)<br>e.g. yoga, archery, bowling, lawn bowling, croquet, golf, horseback riding, easy walking, or any other physical activities of similar intensity | |

**Appendix I**
**The Healthy and Unhealthy Eating Scale**

The scale was developed by Neumark-Sztainer, Story, Hannan, Perry, and Irving (2002). It was used as a measure for healthy and unhealthy eating behaviours in Studies 2 and 3.

During the past month, did you do any of the following to lose weight or keep from gaining weight?

| | Never | A little | Sometimes | A lot | Always |
|---|---|---|---|---|---|
| 1. Made yourself throw up | 1 | 2 | 3 | 4 | 5 |
| 2. Ate more fruits and vegetables | 1 | 2 | 3 | 4 | 5 |
| 3. Skipped meals | 1 | 2 | 3 | 4 | 5 |
| 4. Ate less sweets | 1 | 2 | 3 | 4 | 5 |
| 5. Taken diet pills | 1 | 2 | 3 | 4 | 5 |
| 6. Fasted (not eaten) for a day or more | 1 | 2 | 3 | 4 | 5 |
| 7. Ate less high-fat foods | 1 | 2 | 3 | 4 | 5 |
| 8. Taken laxatives or water pills | 1 | 2 | 3 | 4 | 5 |

**Appendix J**
**Life Satisfaction Scale**

The scale was developed by Diener, Emmons, Larsen, and Griffin (1985). It was used as a measure for overall life satisfaction in Study 2.

Please indicate to what extent you agree with the following statements.

| | Strongly disagree | | | Neither agree or disagree | | | Strongly agree |
|---|---|---|---|---|---|---|---|
| 1. In most ways my life is close to my ideal | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 2. The conditions of my life are excellent | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 3. I am satisfied with my life | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 4. So far I have gotten the important things I want in life | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 5. If I could live my life over, I would change almost nothing | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

**Appendix K**
**Self-Esteem Scale**

The scale was developed by Rosenberg (1965). It was used as a measure for self-esteem in Study 2.

Please indicate to what extent you agree with the following statements.

| | Strongly disagree | Disagree | Agree | Strongly agree |
|---|---|---|---|---|
| 1. I feel that I am a person of worth, at least on an equal plane with others | 1 | 2 | 3 | 4 |
| 2. I feel that I have a number of good qualities | 1 | 2 | 3 | 4 |
| 3. All in all, I am inclined to feel that I am a failure | 1 | 2 | 3 | 4 |
| 4. I am able to do things as well as most other people | 1 | 2 | 3 | 4 |
| 5. I feel I do not have much to be proud of | 1 | 2 | 3 | 4 |
| 6. I take a positive attitude toward myself | 1 | 2 | 3 | 4 |
| 7. On the whole, I am satisfied with myself | 1 | 2 | 3 | 4 |
| 8. I wish I could have more respect for myself | 1 | 2 | 3 | 4 |
| 9. I certainly feel useless at times | 1 | 2 | 3 | 4 |
| 10. At times I think I am no good at all | 1 | 2 | 3 | 4 |

**Appendix L**
**Hospital Anxiety and Depression Scale**

The scale was developed by Zigmond and Snaith (1983). The depressions subscale was used as a measure for depressive symptoms in Study 2.

Please read each item and place a tick in the box opposite the reply which comes closest to how you have been feeling **in the last TWO weeks.** (Please tick one box for each question)

| |
|---|
| 1. I still enjoy the things I used to enjoy<br>☐ Definitely as much ☐ Not quite as much ☐ Only a little ☐ Hardly at all |
| 2. I can laugh and see the funny side of things<br>☐ As much as I always could ☐ Not quite as much now<br>☐ Definitely not so much now ☐ Not at all |
| 3. I feel cheerful<br>☐ Not at all ☐ Not often ☐ Sometimes ☐ Most of the times |
| 4. I feel as if I am slowed down<br>☐ Nearly all the time ☐ Sometimes ☐ Very often ☐ Not at all |
| 5. I have lost interest in my appearance<br>☐ Definitely ☐ I may not take quite as much care<br>☐ I don't take so much care as I should ☐ I take just as much care as ever |
| 6. I look forward with enjoyment to things<br>☐ As much as ever I did ☐ Rather less than I used to<br>☐ Definitely less than I used to ☐ Hardly at all |
| 7. I can enjoy a good book or radio or TV programme<br>☐ Often ☐ Sometimes ☐ Not often ☐ Very seldom |

**Appendix M**
**Behavioural Regulation in Exercise Questionnaire**

Items were adapted from Markland and Tobin (2004) and Mullan, Markland, and Ingledew (1997). In Study 3, Items were modified to measure behavioural regulations with respect to weight management. In Study 4, items were modified to measure the perceived motivation of the hypothetical exercisers.

**Version used in Study 3:**
I try to lose/maintain weight…

| | Not true for me | | | | Very true for me |
|---|---|---|---|---|---|
| 1. but I think doing it is a waste of time | 1 | 2 | 3 | 4 | 5 |
| 2. because I feel ashamed if I fail to do so | 1 | 2 | 3 | 4 | 5 |
| 3. because It's important to me | 1 | 2 | 3 | 4 | 5 |
| 4. because my friends/family/partner say I should | 1 | 2 | 3 | 4 | 5 |
| 5. but I don't see the point in doing so | 1 | 2 | 3 | 4 | 5 |
| 6. because I value the benefits of losing/maintaining weight | 1 | 2 | 3 | 4 | 5 |
| 7. because I enjoy it | 1 | 2 | 3 | 4 | 5 |
| 8. because I think it is important to lose/maintain weight | 1 | 2 | 3 | 4 | 5 |
| 9. because I feel under pressure from my friends/family to do so | 1 | 2 | 3 | 4 | 5 |
| 10. because I get pleasure and satisfaction from doing it | 1 | 2 | 3 | 4 | 5 |
| 11. but I don't see why I should have to do that | 1 | 2 | 3 | 4 | 5 |
| 12. because other people say I should | 1 | 2 | 3 | 4 | 5 |
| 13. because it's fun | 1 | 2 | 3 | 4 | 5 |
| 14. because I feel like a failure if I haven't done so in a while | 1 | 2 | 3 | 4 | 5 |
| 15. because others will not be pleased with me if I don't | 1 | 2 | 3 | 4 | 5 |
| 16. because I get restless if I don't try to lose/maintain weight | 1 | 2 | 3 | 4 | 5 |
| 17. because I feel guilty when I don't try to lose/maintain weight | 1 | 2 | 3 | 4 | 5 |
| 18. because I find it pleasurable | 1 | 2 | 3 | 4 | 5 |
| 19. but I can't see why I should bother doing that | 1 | 2 | 3 | 4 | 5 |

**Version used in Study 4:**

Based on what you learnt about the exerciser, how likely do you think the reasons below explain why he/she would begin his/her exercise regimen at the gym?

| | Not very likely | | | | Very likely |
|---|---|---|---|---|---|
| 1. because others would probably not be pleased with her if he/she didn't | 1 | 2 | 3 | 4 | 5 |
| 2. because he/she probably values the benefits of exercise | 1 | 2 | 3 | 4 | 5 |
| 3. because he/she would probably feel guilty if he/she didn't exercise | 1 | 2 | 3 | 4 | 5 |
| 4. because he/she would probably feel it's important to him/her to exercise regularly | 1 | 2 | 3 | 4 | 5 |
| 5. because other people probably said he/she should | 1 | 2 | 3 | 4 | 5 |
| 6. because he/she would probably get pleasure and satisfaction from participating in exercise | 1 | 2 | 3 | 4 | 5 |
| 7. because he/she would probably enjoy his/her exercise sessions | 1 | 2 | 3 | 4 | 5 |
| 8. because he/she would probably feel ashamed if he/she didn't | 1 | 2 | 3 | 4 | 5 |

**Appendix N**
**Quotes of Hypothetical Exercisers in Study 4**

These quotes were showed to participants to manipulate their perceptions of the motivation of the hypothetical exercisers.

**Autonomous condition:**
*"I used to enjoy exercising, but I've never had time to do any after my kids were born. As a result, I've put on a lot of weight. I've read a lot lately about how obesity could lead to diabetes or things like that and how exercise is important to fight obesity. I know I am obese, and I feel I should act sooner rather than later. Hopefully I would enjoy exercising just like the old days, but in any case, nothing is more important than one's health; that's how I see it now. It is important for me to lead a healthy lifestyle."*

**Controlled condition:**
*"Yes I'm obese, and for that reason my partner, my children and my GP have been nagging me to start exercising for a long time – ever since my weight started accumulating a few years ago. They pressured me to sign up at my local gym so that's what I did. I think I will feel guilty for letting them down if I didn't do it. Now that I've done this, perhaps they would think more positive of me. I've never been fond of exercising, so I am quite apprehensive."*

**Neutral condition:**
*"I never exercised on a regular basis for various reasons. As you get older you tend to accumulate the pounds. Many people around me have started exercising regularly, so I thought I might as well give it a try myself. You can call that my New Year resolution, I suppose."*

**Appendix O**
**Ease of Imagery Scale**

Items were created to measure the ease of imagery in Study 4.

| | Very hard | | | | | | Very easy |
|---|---|---|---|---|---|---|---|
| 1. In general, how easy was it for you to create the images described in the scenario? | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 2. How easy was it for you to create the images of the environment in the gym? | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 3. How easy was it for you to create the images of the exerciser's reactions? | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 4. How easy was it for you to create the images of your own feelings towards the exerciser's reactions? | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

**Appendix P**
**Situational Motivation Scale**

Items were adapted from Guay, Vallerand, and Blanchard (2000). Items were modified to measure participant's motivation to instruct in Study 4.

Please rate how much each item corresponds to how you think or feel. You may relate to the feelings you had during the imagery activity.
*We are not asking about your general motivation as a gym instructor, but the reasons to instruct the exerciser specifically.*

| | Does not correspond at all | | | | | | Corresponds exactly |
|---|---|---|---|---|---|---|---|
| 1. Because I would feel good when instructing her | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 2. Because I feel that I would have to do it as a gym instructor | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 3. Because I would be doing it for my own good as a gym instructor | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 4. Because I wouldn't have any choice | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 5. Because I think it would be pleasant | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 6. Because it would be my personal decision | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 7. Because I believe it would be important for me as a gym instructor | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 8. Because it would be fun | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 9. Because I am supposed to do it as a gym instructor | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 10. Because I think instructing her would be good for me | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 11. Because I think it would be interesting | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 12. Because it is something that I would have to do as a gym instructor | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

**Appendix Q**
**Self-Efficacy for Exercise Behaviors Scales**

Items were adapted from Sallis, Pinkski, Grossman, Patterson, and Nader (1988). Items were modified to measure the barrier efficacy of the exerciser as perceived by the participant in Study 4.

Based on the exerciser's motivation, how likely do you think it is for him/her to do the following?

| | I'm sure he/she could not do it | | | | I'm sure he/she could do it |
|---|---|---|---|---|---|
| 1. Stick to his/her exercise programme after a long, tiring day at work | 1 | 2 | 3 | 4 | 5 |
| 2. Exercise even if he/she is feeling depressed | 1 | 2 | 3 | 4 | 5 |
| 3. Stick to his/her exercise programme when he/she has household chores to attend to | 1 | 2 | 3 | 4 | 5 |
| 4. Stick to his/her exercise programme even when he/she has excessive demands at work | 1 | 2 | 3 | 4 | 5 |
| 5. Get up early, even on weekends, to exercise | 1 | 2 | 3 | 4 | 5 |
| 6. Stick to his/her exercise programme when his/her family is demanding more time from him/her | 1 | 2 | 3 | 4 | 5 |
| 7. Stick to his/her exercise programme when social obligations are very time consuming | 1 | 2 | 3 | 4 | 5 |
| 8. Stick to his/her exercise programme when undergoing a stressful life change (e.g., divorce, death in the family, moving house) | 1 | 2 | 3 | 4 | 5 |

**Appendix R**
**Task Given as Measure for Investment of Effort in Study 4**

The following task was given to participants in Study 4. The number of factors identified was used as a measure for effort investment to instruct.

*Finally, what factors (physiological, psychological, etc) would you consider as important in terms of maximising the effectiveness of the exercise programme for the exerciser, especially regarding the management of his/her own weight?*

*List your answers in bullet points below, and make sure you give only one factor in each bullet point. You may browse the web for more ideas if you wish. You may list up to 30 factors.*

## REFERENCES


Adams, K. F., Schatzkin, A., Harris, T. B., Kipnis, V., Nouw, T., Ballard-Barbash, R., . . . Leitzmann, M. F. (2006). Overweight, obesity, and mortality in a large prospective cohort of persons 50 to 71 years old. *New England Journal of Medicine, 355*, 763-778. doi:10.1016/j.jvs.2006.10.010

Adie, J. W., Duda, J. L., & Ntoumanis, N. (2008). Autonomy support, basic need satisfaction and the optimal functioning of adult male and female sport participants: A test of basic needs theory. *Motivation and Emotion, 32*, 189-199. doi:10.1007/s11031-008-9095-z

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*, 179-211. doi:10.1016/0749-5978(91)90020-T

Ajzen, I., & Fishbein, M. (1980). *Understanding attitudes and predicting social behavior*. Englewood Cliffs: Prentice-Hall.

Ames, C. (1992). Achievement goals, motivational climate, and motivational processes. In G. C. Roberts (Ed.), *Motivation in sport and exercise* (pp. 161-176). Champaign, IL: Human Kinetics.

Anderson, D. A., & Wadden, T. A. (2004). Bariatric surgery patients' views of their physicians' weight-related attitudes and practices. *Obesity Research, 12*, 1587-1595. doi:10.1038/oby.2004.198

Annesi, J. J., & Marti, C. N. (2011). Path analysis of exercise treatment-induced changes in psychological factors leading to weight loss. *Psychology and Health, 26*, 1081-1098. doi:10.1080/08870446.2010.534167

Asparouhov, T., & Muthén, B. (2010). *Bayesian analysis of latent variable models using Mplus*. Retrieved from http://www.statmodel2.com/download/BayesAdvantages18.pdf

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review, 84*, 191-215. doi:10.1037//0033-295X.84.2.191

Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York, NY: Freeman.

Barbeau, A., Sweet, S. N., & Fortier, M. (2009). A path-analytic model of self-determination theory in a physical activity context. *Journal of Applied Biobehavioral Research, 14*, 103-118. doi:10.1111/j.1751-9861.2009.00043.x

Barbee, A. P., Cunningham, M. R., Winstead, B. A., Derlega, V. J., Gully, M. R., Yankeelov, P. A., & Druen, P. B. (1993). Effects of gender role expectations on the social support process. *Journal of Social Issues, 49*, 175-190. doi:10.1111/j.1540-4560.1993.tb01175.x

Bartholomew, K. J., Ntoumanis, N., Ryan, R. M., Bosch, J. A., & Thøgersen-Ntoumani, C. (2011). Self-determination theory and diminished functioning: The role of interpersonal control and psychological need thwarting. *Personality and Social Psychology Bulletin, 37*, 1459-1473. doi:10.1177/0146167211413125

Bartholomew, K. J., Ntoumanis, N., Ryan, R. M., & Thøgersen-Ntoumani, C. (2011). Psychological need thwarting in the sport context: Assessing the darker side of athletic experience. *Journal of Sport & Exercise Psychology, 33*, 75-102.

Bartholomew, K. J., Ntoumanis, N., & Thøgersen-Ntoumani, C. (2009). A review of controlling motivational strategies from a self-determination theory perspective: Implications for sports coaches. *International Review of Sport and Exercise Psychology, 2*, 215-233. doi:10.1080/17509840903235330

Bartholomew, K. J., Ntoumanis, N., & Thøgersen-Ntoumani, C. (2010). The controlling interpersonal style in a coaching context: Development and initial validation of a psychometric scale. *Journal of Sport & Exercise Psychology, 32*, 193-216.

Bartholomew, K. J., Ntoumanis, N., & Thøgersen-Ntoumani, C. (2011). Self-determination theory and the darker side of athletic experience: The role of interpersonal control and need thwarting. *Sport and Exercise Psychology Review, 7*, 23-27.

Beauchamp, T. L., & Childress, J. F. (2009). *Principles of biomedical ethics* (6th ed.). New York, NY: Oxford University Press.

Beverly, E. A., Miller, C. K., & Wray, L. A. (2008). Spousal support and food-related behavior change in middle-aged and older adults living with Type 2 Diabetes. *Health Education and Behavior, 35*, 707-720. doi:10.1177/1090198107299787

Burke, L. E., Wang, J., & Sevick, M. A. (2011). Self-monitoring in weight loss: A systematic review of the literature. *Journal of the American Dietetic Association, 111*, 92-102. doi:10.1016/j.jada.2010.10.008

Chambliss, H. O., Finley, C. E., & Blair, S. N. (2004). Attitudes toward obese individuals among exercise science students. *Medicine and Science in Sports and Exercise, 36*, 468-474. doi:10.1249/01.MSS.0000117115.94062.E4

Charney, E., Goodman, H. C., McBride, M., Lyon, B., & Pratt, R. (1976). Childhood antecedents of adult obesity. Do chubby infants become obese adults? *The New England journal of medicine, 295*, 6. doi:10.1056/NEJM197607012950102

Chatzisarantis, N. L. D., & Hagger, M. S. (2009). Effects of an intervention based on self-determination theory on self-reported leisure-time physical activity participation. *Psychology and Health, 24*, 29-48. doi:10.1080/08870440701809533

Cheung, G. W., & Rensvold, R. B. (2002). Evaluating goodness-of-fit indexes for testing measurement invariance. *Structural Equation Modeling, 9*, 233-255. doi:10.1207/S15328007SEM0902_5

Chiuve, S. E., McCullough, M. L., Sacks, F. M., & Rimm, E. B. (2006). Healthy lifestyle factors in the primary prevention of coronary heart disease among men: Benefits among users and nonusers of lipid-lowering and antihypertensive medications. *Circulation, 114*, 160-167. doi:10.1161/CIRCULATIONAHA.106.621417

Cohen, J. (1977). *Statistical power analysis for the behavioral sciences* (revised ed.). New York: Academic Press.

Conner, M., Norman, P., & Bell, R. (2002). The theory of planned behavior and healthy eating. *Health Psychology, 21*, 194. doi:10.1037//0278-6133.21.2.194

Crandall, C. S. (1994). Prejudice against fat people: Ideology and self-interest. *Journal of Personality and Social Psychology, 66*, 882-894. doi:10.1037/0022-3514.66.5.882

Crow, S., Eisenberg, M. E., Story, M., & Neumark-Sztainer, D. (2006). Psychosocial and behavioral correlates of dieting among overweight and non-overweight adolescents. *Journal of Adolescent Health, 38*, 569-574. doi:10.1016/j.jadohealth.2005.05.019

Davies, C. A., Spence, J. C., Vandelanotte, C., Caperchione, C. M., & Mummery, W. K. (2012). Meta-analysis of internet-delivered interventions to increase physical activity levels. *International Journal of Behavioral Nutrition and Physical Activity, 9:52*. doi:10.1186/1479-5868-9-52

Deci, E. L., Eghrari, H., Patrick, B. C., & Leone, D. R. (1994). Facilitating internalization: The self-determination theory perspective. *Journal of Personality, 62*, 119-142. doi:10.1111/j.1467-6494.1994.tb00797.x

Deci, E. L., & Ryan, R. M. (1985a). The general causality orientations scale: Self-determination in personality. *Journal of Research in Personality, 19*, 109-134. doi:10.1016/0092-6566(85)90023-6

Deci, E. L., & Ryan, R. M. (1985b). *Intrinsic motivation and self-determination in human behavior*. New York: Plenum Press.

Deci, E. L., & Ryan, R. M. (1987). The support of autonomy and the control of behavior. *Journal of Personality and Social Psychology, 53*, 1024-1037. doi:10.1037/0022-3514.53.6.1024

Deci, E. L., & Ryan, R. M. (2000). The "what" and "why" of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry, 11*, 227-268. doi:10.1207/S15327965PLI1104_01

Deci, E. L., & Ryan, R. M. (2012). Self-determination theory in health care and its relations to motivational interviewing: a few comments. *International Journal of Behavioral Nutrition and Physical Activity, 9:24*. doi:10.1186/1479-5868-9-24

Deckelbaum, R. J., & Williams, C. L. (2012). Childhood obesity: the health issue. *Obesity Research, 9*, 239S-243S. doi:10.1038/oby.2001.125

Diener, E., Emmons, R. A., Larsen, R. J., & Griffin, S. (1985). The Satisfaction With Life Scale. *Journal of Personality Assessment, 49*, 71-75. doi:10.1207/s15327752jpa4901_13

Eagly, A. H., Ashmore, R., Makhijani, M., & Longo, L. (1991). What is beautiful is good, but...: A meta-analytic review of research on the physical attractiveness stereotype. *Psychological Bulletin, 110*, 109-128. doi:10.1037/0033-2909.110.1.109

Ebbeling, C. B., Pawlak, D. B., & Ludwig, D. S. (2002). Childhood obesity: public-health crisis, common sense cure. *The Lancet, 360*, 473-482. doi:10.1016/S0140-6736(02)09678-2

Edmunds, J., Ntoumanis, N., & Duda, J. L. (2007). Adherence and well-being in overweight and obese patients referred to an exercise on prescription scheme: A self-determination theory perspective. *Psychology of Sport and Exercise, 8*, 722-740. doi:10.1016/j.psychsport.2006.07.006

Edmunds, J., Ntoumanis, N., & Duda, J. L. (2008). Testing a self-determination theory-based teaching style intervention in the exercise domain. *European Journal of Social Psychology, 38*, 375-388. doi:10.1002/ejsp.463

Edmunds, J., Ntoumanis, N., & Duda, J. L. (2009). Helping your clients and patients take ownership over their exercise: Forstering exercise adoption, adherence, and associated well-being. *ACSM's Health & Fitness Journal, 13*, 20-25.

Elfhag, K., & Rössner, S. (2005). Who succeeds in maintaining weight loss? A conceptual review of factors associated with weight loss maintenance and weight regain. *Obesity Reviews, 6*, 67-85. doi:10.1111/j.1467-789X.2005.00170.x

Engel, G. L. (1977). The need for a new medical model: A challenge for biomedicine. *Science, 196*, 129-136. doi:10.1126/science.847460

Fjeldsoe, B. S., Marshall, A. L., & Miller, Y. D. (2009). Behavior change interventions delivered by mobile telephone short-message service. *American Journal of Preventive Medicine, 36*, 165-173. doi:10.1016/j.amepre.2008.09.040

Fortier, M. S., Hogg, W., O'Sullivan, T. L., Blanchard, C., Reid, R. D., Sigal, R. J., . . . Beaulac, J. (2007). The physical activity counselling (PAC) randomized controlled trial: Rationale, methods, and interventions. *Applied Physiology, Nutrition and Metabolism, 32*, 1170-1185. doi:10.1139/H07-075

Fortier, M. S., Sweet, S. N., O'Sullivan, T., & Williams, G. C. (2007). A self-determination process model of physical activity adoption in the context of a randomized controlled trial. *Psychology of Sport and Exercise, 8*, 741-757. doi:10.1016/j.psychsport.2006.10.006

Galesic, M., & Bosnjak, M. (2009). Effects of questionnaire length on participation and indicators of response quality in a web survey. *Public Opinion Quarterly, 73*, 349-360. doi:10.1093/poq/nfp031

Gelman, A., Carlin, J. B., Stern, H. S., & Rubin, D. B. (2004). *Bayesian data analysis* (2nd ed.). Boca Raton: Chapman & Hall/CRC.

Gill, R. S., Karmali, S., Hadi, G., Al-Adra, D. P., Shi, X., & Birch, D. W. (2012). Predictors of attrition in a multidisciplinary adult weight management clinic. *Canadian Journal of Surgery, 55*, 239-243.

Glass, G. V. (1976). Primary, secondary, and meta-analysis of research. *Educational Researcher, 5*, 3-8.

Godin, G., & Shephard, R. J. (1985). A simple method to assess exercise behavior in the community. *Canadian Journal of Applied Sport Sciences, 10*, 141-146.

Grolnick, W. S., Gurland, S. T., DeCourcey, W., & Jacob, K. (2002). Antecedents and consequences of mothers' autonomy support: An experimental investigation. *Developmental Psychology, 38*, 143-155. doi:10.1037//0012-1649.38.1.143

Guay, F., Vallerand, R. J., & Blanchard, C. (2000). On the assessment of situational intrinsic and extrinsic motivation: The Situational Motivation Scale (SIMS). *Motivation and Emotion, 24*, 175-213. doi:10.1023/A:1005614228250

Hagger, M. S., & Chatzisarantis, N. L. D. (2009). Integrating the theory of planned behaviour and self-determination theory in health behaviour: A meta-analysis. *British Journal of Health Psychology, 14*, 275-302. doi:10.1348/135910708X373959

Hagger, M. S., Chatzisarantis, N. L. D., & Harris, J. (2006). From psychological need satisfaction to intentional behavior: Testing a motivational sequence in two behavioral contexts. *Personality and Social Psychology Bulletin, 32*, 131-148. doi:10.1177/0146167205279905

Halvari, A. E. M., Halvari, H., Bjørnebekk, G., & Deci, E. L. (2010). Motivation and anxiety for dental treatment: Testing a self-determination theory model of oral self-care behaviour and dental clinic attendance. *Motivation and Emotion, 34*, 15-33. doi:10.1007/s11031-010-9154-0

Hassin, R. R., Aarts, H., & Ferguson, M. J. (2005). Automatic goal inferences. *Journal of Experimental Social Psychology, 41*, 129-140. doi:10.1016/j.jesp.2004.06.008

Hayduk, L. A. (1987). *Structural equation modeling with LISREL: essentials and advances*. Baltimore, MD: Johns Hopkins University Press.

Helmerhorst, H. J. F., Brage, S., Warren, J., Besson, H., & Ekelund, U. (2012). A systematic review of reliability and objective criterion-related validity of physical activity questionnaires. *International Journal of Behavioral Nutrition and Physical Activity, 9:103*. doi:10.1186/1479-5868-9-103

Hojat, M., Gonnella, J. S., Mangione, S., Nasca, T. J., Veloski, J. J., Erdmann, J. B., . . . Magee, M. (2002). Empathy in medical students as related to academic performance, clinical competence and gender. *Medical Education, 36*, 522-527. doi:10.1046/j.1365-2923.2002.01234.x

Hu, L.-t., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling, 6*, 1-55. doi:10.1080/10705519909540118

Hunter, J. E., & Schmidt, F. L. (2004). *Methods of meta-analysis: correcting error and bias in research findings* (2nd ed.). Thousand Oaks, CA: Sage Publications, Inc.

Hwang, M. I., & Schmidt, F. L. (2011). Assessing moderating effect in meta-analysis: A re-analysis of top management support studies and suggestions for researchers. *European Journal of Information Systems, 20*, 693-702. doi:10.1057/ejis.2011.12

Julien, E., Senecal, C., & Guay, F. (2009). Longitudinal relations among perceived autonomy support from health care practitioners, motivation, coping strategies and dietary compliance in a sample of adults with type 2 diabetes. *Journal of Health Psychology, 14*, 457-470. doi:10.1177/1359105309102202

Kalavana, T. V., Maes, S., & De Gucht, V. (2010). Interpersonal and self-regulation determinants of healthy and unhealthy eating behavior in adolescents. *Journal of Health Psychology, 15*, 44-52. doi:10.1177/1359105309345168

Kasser, T., & Ryan, R. M. (1993). A dark side of the American dream: Correlates of financial success as a central life aspiration. *Journal of Personality and Social Psychology, 65*, 410-422. doi:10.1037/0022-3514.65.2.410

Kasser, T., & Ryan, R. M. (1996). Further examining the American dream: Differential correlates of intrinsic and extrinsic goals. *Personality and Social Psychology Bulletin, 22*, 280-287. doi:10.1177/0146167296223006

King, N. A., Hopkins, M., Caudwell, P., Stubbs, R. J., & Blundell, J. E. (2009). Beneficial effects of exercise: Shifting the focus from body weight to other markers of health. *British Journal of Sports Medicine, 43*, 924-927. doi:10.1136/bjsm.2009.065557

Koestner, R., Otis, N., Powers, T. A., Pelletier, L., & Gagnon, H. (2008). Autonomous motivation, controlled motivation, and goal progress. *Journal of Personality, 76*,

1201-1230. doi:10.1111/j.1467-6494.2008.00519.x

Krukowski, R. A., Tilford, J. M., Harvey-Berino, J., & West, D. S. (2011). Comparing behavioral weight loss modalities: Incremental cost-effectiveness of an internet-based versus an in-person condition. *Obesity, 19*, 1629-1635. doi:10.1038/oby.2010.341

Kushner, R. F., & Foster, G. D. (2000). Obesity and quality of life. *Nutrition, 16*, 947-952. doi:10.1016/S0899-9007(00)00404-4

Lee, S.-Y., & Song, X.-Y. (2004). Evaluation of the Bayesian and maximum likelihood approaches in analyzing structural equation models with small sample sizes. *Multivariate Behavioral Research, 39*, 653-686. doi:10.1207/s15327906mbr3904_4

Li, F. (1999). The Exercise Motivation Scale: Its multifaceted structure and construct validity. *Journal of Applied Sport Psychology, 11*, 97-115. doi:10.1080/10413209908402953

Markland, D. (2009). The mediating role of behavioural regulations in the relationship between perceived body size discrepancies and physical activity among adult women. *Hellenic Journal of Psychology, 6*, 169-182.

Markland, D., & Ingledew, D. K. (2007). The relationships between body mass and body image and relative autonomy for exercise among adolescent males and females. *Psychology of Sport and Exercise, 8*, 836-853. doi:10.1016/j.psychsport.2006.11.002

Markland, D., & Tobin, V. (2004). A modification to the Behavioural Regulation in Exercise Questionnaire to include an assessment of amotivation. *Journal of Sport & Exercise Psychology, 26*, 191-196.

Markland, D., & Tobin, V. J. (2010). Need support and behavioural regulations for exercise among exercise referral scheme clients: The mediating role of psychological need satisfaction. *Psychology of Sport and Exercise, 11*, 91-99. doi:10.1016/j.psychsport.2009.07.001

Mata, J., Silva, M. N., Vieira, P. N., Carraça, E. V., Andrade, A. M., Coutinho, S. R., . . . Teixeira, P. J. (2009). Motivational "spill-over" during weight control: Increased self-

determination and exercise intrinsic motivation predict eating self-regulation. *Health Psychology, 28*, 709-716. doi:10.1037/a0016764

McDonough, M. H., & Crocker, P. R. E. (2007). Testing self-determined motivation as a mediator of the relationship between psychological needs and affective and behavioral outcomes. *Journal of Sport & Exercise Psychology, 29*, 645-663.

McLachlan, S., Spray, C., & Hagger, M. S. (2011). The development of a scale measuring integrated regulation in exercise. *British Journal of Health Psychology, 16*, 722-743. doi:10.1348/2044-8287.002009

Michie, S., Abraham, C., Whittington, C., McAteer, J., & Gupta, S. (2009). Effective techniques in healthy eating and physical activity interventions: a meta-regression. *Health Psychology, 28*, 690-701. doi:10.1037/a0016136

Mokdad, A. H., Ford, E. S., Bowman, B. A., Dietz, W. H., Vinicor, F., Bales, V. S., & Marks, J. S. (2003). Prevalence of obesity, diabetes, and obesity-related health risk factors, 2001. *The Journal of the American Medical Association, 289*, 76-79. doi:10.1001/jama.289.1.76

Mullan, E., Markland, D., & Ingledew, D. K. (1997). A graded conceptualisation of self-determination in the regulation of exercise behaviour: Development of a measure using confirmatory factor analytic procedures. *Personality and Individual Differences, 23*, 745-752. doi:10.1016/s0191-8869(97)00107-4

Muthén, B., & Muthén, L. (2008). *Mplus user guide*. Los Angeles, CA: Muthén and Muthén.

National Institute for Health and Clinical Excellence. (2006). *Obesity: Guidance on the prevention, identification, assessment and management of overweight and obesity in adults and children* (NICE clinical guideline 43). Retrieved from http://www.nice.org.uk/nicemedia/live/11000/30365/30365.pdf.

Neumark-Sztainer, D., Story, M., Hannan, P. J., Perry, C. L., & Irving, L. M. (2002). Weight-related concerns and behaviors among overweight and nonoverweight adolescents.

*Archives of Pediatrics and Adolescent Medicine, 156*, 171-178.

Neumark-Sztainer, D., Wall, M., Guo, J., Story, M., Haines, J., & Eisenberg, M. (2006). Obesity, disordered eating, and eating disorders in a longitudinal study of adolescents: How do dieters fare 5 years later? *Journal of the American Dietetic Association, 106*, 559-568. doi:10.1016/j.jada.2006.01.003

Ng, J. Y. Y., Lonsdale, C., & Hodge, K. (2011). The Basic Needs Satisfaction in Sport Scale (BNSSS): Instrument development and initial validity evidence. *Psychology of Sport and Exercise, 12*, 257-264. doi:10.1016/j.psychsport.2010.10.006

Ng, J. Y. Y., Ntoumanis, N., Thøgersen-Ntoumani, C., Deci, E. L., Ryan, R. M., Duda, J., & Williams, G. C. (2012). Self-determination theory applied to health contexts: A meta-analysis. *Perspectives on Psychological Science, 7*, 325-340. doi:10.1177/1745691612447309

Niemiec, C. P., Ryan, R. M., Deci, E. L., & Williams, G. C. (2009). Aspiring to physical health: The role of aspirations for physical health in facilitating long-term tobacco abstinence. *Patient Education and Counseling, 74*, 250-257. doi:10.1016/j.pec.2008.08.015

Niemiec, C. P., Ryan, R. M., Patrick, H., Deci, E. L., & Williams, G. C. (2009). The energization of health-behavior change: Examining the associations among autonomous self-regulation, subjective vitality, depressive symptoms, and tobacco abstinence. *The Journal of Positive Psychology, 5*, 122-138. doi:10.1080/17439760903569162

Ntoumanis, N. (2001). Empirical links between achievement goal theory and self-determination theory in sport. *Journal of Sports Sciences, 19*, 397-409. doi:10.1080/026404101300149357

OECD. (2010). *Obesity and the economics of prevention: fit not fat*: OECD Publishing.

OECD. (2011). OECD health statistics [Database]. Retrieved from

http://stats.oecd.org/Index.aspx?DataSetCode=HEALTH_LVNG

Orpana, H. M., Berthelot, J.-M., Kaplan, M. S., Feeny, D. H., McFarland, B., & Ross, N. A. (2009). BMI and mortality: Results from a national longitudinal study of Canadian adults. *Obesity, 18*, 214-218. doi:10.1038/oby.2009.191

Ortega, F. B., Lee, D.-c., Katzmarzyk, P. T., Ruiz, J. R., Sui, X., Church, T. S., & Blair, S. N. (in press). The intriguing metabolically healthy but obese phenotype: Cardiovascular prognosis and role of fitness. *European Heart Journal*. doi:10.1093/eurheartj/ehs174

Osterberg, L., & Blaschke, T. (2005). Drug therapy: Adherence to medication. *New England Journal of Medicine, 353*, 487-497.

Otis, N., & Pelletier, L. G. (2008). Women's regulation styles for eating behaviors and outcomes: The mediating role of approach and avoidance food planning. *Motivation and Emotion, 32*, 55-67. doi:10.1007/s11031-008-9083-3

Paez, K. A., Zhao, L., & Hwang, W. (2009). Rising out-of-pocket spending for chronic conditions: A ten-year trend. *Health Affairs, 28*, 15-25. doi:10.1377/hlthaff.28.1.15

Palmeira, A. L., Teixeira, P. J., Branco, T. L., Martins, S. S., Minderico, C. S., Barata, J. T., . . . Sardinha, L. B. (2007). Predicting short-term weight loss using four leading health behavior change theories. *International Journal of Behavioral Nutrition and Physical Activity, 4:14*. doi:10.1186/1479-5868-4-14

Patrick, K., Calfas, K. J., Norman, G. J., Rosenberg, D., Zabinski, M. F., Sallis, J. F., . . . Dillon, L. (2011). Outcomes of a 12-month web-based intervention for overweight and obese men. *Annals of Behavioral Medicine, 42*, 391-401. doi:10.1007/s12160-011-9296-7

Peddle, C. J., Plotnikoff, R. C., Wild, T. C., Au, H.-J., & Courneya, K. S. (2008). Medical, demographic, and psychosocial correlates of exercise in colorectal cancer survivors: An application of self-determination theory. *Supportive Care in Cancer, 16*, 9-17. doi:10.1007/s00520-007-0272-5

Pelletier, L. G., Dion, S. C., Slovinec-D'Angelo, M., & Reid, R. (2004). Why do you regulate what you eat? Relationships between forms of regulation, eating behaviors, sustained dietary behavior change, and psychological adjustment. *Motivation and Emotion, 28*, 245-277. doi:10.1023/B:MOEM.0000040154.40922.14

Pelletier, L. G., Fortier, M. S., Vallerand, R. J., & Brière, N. M. (2001). Associations among perceived autonomy support, forms of self-regulation, and persistence: A prospective study. *Motivation and Emotion, 25*, 279-306. doi:10.1023/A:1014805132406

Pelletier, L. G., Séguin-Lévesque, C., & Legault, L. (2002). Pressure from above and pressure from below as determinants of teachers' motivation and teaching behaviors. *Journal of Educational Psychology, 94*, 186-196. doi:10.1037/0022-0663.94.1.186

Pelletier, L. G., & Vallerand, R. J. (1996). Supervisors' beliefs and subordinates' intrinsic motivation: A behavioral confirmation analysis. *Journal of Personality and Social Psychology, 71*, 331-340. doi:10.1037/0022-3514.71.2.331

Pesis-Katz, I., Williams, G. C., Niemiec, C. P., & Fiscella, K. (2011). Cost-effectiveness of intensive tobacco dependence intervention based on self-determination theory. *American Journal of Managed Care, 17*, e393-e398.

Petry, N. M., Barry, D., Pietrzak, R. H., & Wagner, J. A. (2008). Overweight and obesity are associated with psychiatric disorders: Results from the National Epidemiologic Survey on Alcohol and Related Conditions. *Psychosomatic Medicine, 70*, 288-297. doi:10.1097/PSY.0b013e3181651651

Podsakoff, P. M., MacKenzie, S. B., Lee, J.-Y., & Podsakoff, N. P. (2003). Common method biases in behavioral research: A critical review of the literature and recommended remedies. *Journal of Applied Psychology, 88*, 879-903. doi:10.1037/0021-9010.88.5.879

Powers, T. A., Koestner, R., & Gorin, A. A. (2008). Autonomy support from family and friends and weight loss in college women. *Families, Systems, & Health, 26*, 404-416.

doi:10.1037/1091-7527.26.4.404

Project of the ABIM Foundation, ACP-ASIM Foundation, & European Federation of Internal Medicine. (2002). Medical professionalism in the new millennium: A physician charter. *Annals of Internal Medicine, 136*, 243-246.

Puente, R., & Anshel, M. H. (2010). Exercisers' perceptions of their fitness instructor's interacting style, perceived competence, and autonomy as a function of self-determined regulation to exercise, enjoyment, affect, and exercise frequency. *Scandinavian Journal of Psychology, 51*, 38-45. doi:10.1111/j.1467-9450.2009.00723.x

Puhl, R., & Brownell, K. D. (2012). Bias, discrimination, and obesity. *Obesity Research, 9*, 788-805. doi:10.1038/oby.2001.108

Puhl, R. M., & Heuer, C. A. (2009). The stigma of obesity: A review and update. *Obesity, 17*, 941-964. doi:10.1038/oby.2008.636

Puppino, F. S., de Wit, L. M., Bouvy, P. F., Stignen, T., Cuijpers, P., Penninx, B. W. J. H., & Zitman, F. G. (2010). Overweight, obesity, and depression: A systematic review and meta-analysis of longitudinal studies. *Archives of General Psychiatry, 67*, 220-229. doi:10.1001/archgenpsychiatry.2010.2

Radel, R., Sarrazin, P., Legrain, P., & Wild, T. C. (2010). Social contagion of motivation between teacher and student: Analyzing underlying processes. *Journal of Educational Psychology, 102*, 577-587. doi:10.1037/a0019051

Rahman, R. J., Thøgersen-Ntoumani, C., Thatcher, J., & Doust, J. (2011). Changes in need satisfaction and motivation orientation as predictors of psychological and behavioural outcomes in exercise referral. *Psychology and Health, 26*, 1521-1539. doi:10.1080/08870446.2010.538849

Reed, V. A., Schifferdecker, K. E., Rezaee, M. E., O'Connor, S., & Larson, R. J. (2012). The effect of computers for weight loss: A systematic review and meta-analysis of

randomized trials. *Journal of General Internal Medicine, 27*, 99-108. doi:10.1007/s11606-011-1803-9

Richer, S. F., & Vallerand, R. J. (1998). Construction et validation de l'échelle du sentiment d'appartenance sociale (ÉSAS) [Construction and validaton of the ÉSAS the relatedness feelings scale]. *European Review of Applied Psychology 48*, 129-137.

Rosenberg, M. (1965). *Society and the adolescent self-image*. Princeton, NJ: Princeton University Press.

Rosenthal, R. (1979). The "file drawer problem" and tolerance for null results. *Psychological Bulletin, 86*, 638-641. doi:10.1037/0033-2909.86.3.638

Rouse, P. C., Ntoumanis, N., Duda, J. L., Jolly, K., & Williams, G. C. (2011). In the beginning: Role of autonomy support on the motivation, mental health and intentions of participants entering an exercise referral scheme. *Psychology and Health, 26*, 729-749. doi:10.1080/08870446.2010.492454

Russell, K. L., & Bray, S. R. (2010). Promoting self-determined motivation for exercise in cardiac rehabilitation: The role of autonomy support. *Rehabilitation Psychology, 55*, 74-80. doi:10.1037/a0018416

Ryan, R. M., & Deci, E. L. (2000). The darker and brighter sides of human existence: Basic psychological needs as a unifying concept. *Psychological Inquiry, 11*, 319-338. doi:10.1207/S15327965PLI1104_03

Ryan, R. M., & Deci, E. L. (2002). Overview of self-determination theory: An organismic-dialectical perspective. In E. L. Deci & R. M. Ryan (Eds.), *Handbook of Self-determination Research* (pp. 3-33). Rochester, NY: The University of Rochester Press.

Ryan, R. M., Patrick, H., Deci, E. L., & Williams, G. C. (2008). Facilitating health behaviour change and its maintenance: Interventions based on self-determination theory. *The European Health Psychologist, 10*, 2-5.

Ryan, R. M., Plant, R. W., & O'Malley, S. (1995). Initial motivations for alcohol treatment:

Relations with patient characteristics, treatment involvement, and dropout. *Addictive Behaviors, 20*, 279-297. doi:10.1016/0306-4603(94)00072-7

Sallis, J. F., Pinski, R. B., Grossman, R. M., Patterson, T. L., & Nader, P. R. (1988). The development of self-efficacy scales for health related diet and exercise behaviors. *Health Education Research, 3*, 283-292. doi:10.1093/her/3.3.283

Sarrazin, P. G., Tessier, D. P., Pelletier, L. G., Trouilloud, D. O., & Chanal, J. P. (2006). The effects of teachers' expectations about students' motivation on teachers' autonomy-supportive and controlling behaviors. *International Journal of Sport and Exercise Psychology, 4*, 283-301. doi:10.1080/1612197X.2006.9671799

Schüler, J., & Kuster, M. (2011). Binge eating as a consequence of unfulfilled basic needs: The moderating role of implicit achievement motivation. *Motivation and Emotion, 35*, 89-97. doi:10.1007/s11031-010-9200-y

Sebire, S. J., Standage, M., & Vansteenkiste, M. (2009). Examining intrinsic versus extrinsic exercise goals: Cognitive, affective, and behavioral outcomes. *Journal of Sport & Exercise Psychology, 31*, 189-210.

Shaikh, A. R., Vinokur, A. D., Yaroch, A. L., Williams, G. C., & Resnicow, K. (2011). Direct and mediated effects of two theoretically based interventions to increase consumption of fruits and vegetables in the Healthy Body Healthy Spirit trial. *Health Education & Behavior, 38*, 492-501. doi:10.1177/1090198110384468

Silk, J. S., Morris, A. S., Kanaya, T., & Steinberg, L. (2003). Psychological control and autonomy granting: Opposite ends of a continuum or distinct constructs? *Journal of Research on Adolescence, 13*, 113-128. doi:10.1111/1532-7795.1301004

Silva, M. N., Markland, D., Carraça, E. V., Vieira, P. N., Coutinho, S. R., Minderico, C. S., . . . Teixeira, P. J. (2011). Exercise autonomous motivation predicts three-year weight loss in women. *Medicine and Science in Sports and Exercise, 43*, 728-737. doi:10.1249/MSS.0b013e3181f3818f

Silva, M. N., Markland, D., Minderico, C. S., Vieira, P. N., Castro, M. M., Coutinho, S. R., . . . Teixeira, P. J. (2008). A randomized controlled trial to evaluate self-determination theory for exercise adherence and weight control: Rationale and intervention description. *BMC Public Health, 8*(234). Retrieved from http://www.biomedcentral.com/content/pdf/1471-2458-8-234.pdf

Silva, M. N., Markland, D., Vieira, P. N., Coutinho, S. R., Carraça, E. V., Palmeira, A. L., . . . Teixeira, P. J. (2010). Helping overweight women become more active: Need support and motivational regulations for different forms of physical activity. *Psychology of Sport and Exercise, 11*, 591-601. doi:10.1016/j.psychsport.2010.06.011

Silva, M. N., Vieira, P. N., Coutinho, S. R., Minderico, C. S., Matos, M. G., Sardinha, L. B., & Teixeira, P. J. (2010). Using self-determination theory to promote physical activity and weight control: A randomized controlled trial in women. *Journal of Behavioral Medicine, 33*, 110-122. doi:10.1007/s10865-009-9239-y

Simoneau, H., & Bergeron, J. (2003). Factors affecting motivation during the first six weeks of treatment. *Addictive Behaviors, 28*, 1219-1241. doi:10.1016/S0306-4603(02)00257-5

Skinner, E. A., & Belmont, M. J. (1993). Motivation in the classroom: Reciprocal effects of teacher behavior and student engagement across the school year. *Journal of Educational Psychology, 85*, 571-581. doi:10.1037//0022-0663.85.4.571

Soenens, B., & Vansteenkiste, M. (2005). Antecedents and outcomes of self-determination in 3 life domains: The role of parents' and teachers' autonomy support. *Journal of Youth and Adolescence, 34*, 589-604. doi:10.1007/s10964-005-8948-y

Soenens, B., Vansteenkiste, M., Vandereycken, W., Luyten, P., Sierens, E., & Goossens, L. (2008). Perceived parental psychological control and eating-disordered symptoms: Maladaptive perfectionism as a possible intervening variable. *The Journal of Nervous and Mental Disease, 196*, 144-152. doi:10.1097/NMD.0b013e318162aabf

Standage, M., Duda, J. L., & Ntoumanis, N. (2003). A model of contextual motivation in physical education: Using constructs from Self-Determination and Achievement Goal Theories to predict physical activity intentions. *Journal of Educational Psychology, 95*, 97-110. doi:10.1037/0022-0663.95.1.97

Standage, M., Duda, J. L., & Ntoumanis, N. (2005). A test of self-determination theory in school physical education. *British Journal of Educational Psychology, 75*, 411-433. doi:10.1348/000709904X22359

Stotland, S., & Zuroff, D. C. (1990). A new measure of weight locus of control: The Dieting Beliefs Scale. *Journal of Personality Assessment, 54*, 191-203. doi:10.1207/s15327752jpa5401&2_19

Street, R. L., Jr., Makoul, G., Arora, N. K., & Epstein, R. M. (2009). How does communication heal? Pathways linking clinician-patient communication to health outcomes. *Patient Education and Counseling, 74*, 295-301. doi:10.1016/j.pec.2008.11.015

Sullivan, P. W., Morrato, E. H., Ghushchyan, V., Wyatt, H. R., & Hill, J. O. (2005). Obesity, inactivity, and the prevalence of diabetes and diabetes-related cardiovascular comorbidities in the U.S., 2000–2002. *Diabetes Care, 28*, 1599-1603. doi:10.2337/diacare.28.7.1599

Tabachnick, B. G., & Fidell, L. S. (2007). *Using multivariate statistics* (5th ed.). Boston, MA: Pearson Education, Inc.

Taylor, I. M., & Lonsdale, C. (2010). Cultural differences in the relationships among autonomy support, psychological need satisfaction, subjective vitality, and effort in British and Chinese physical education. *Journal of Sport & Exercise Psychology, 32*, 655-673.

Taylor, I. M., Ntoumanis, N., & Standage, M. (2008). A self-determination theory approach to understanding the antecedents of teachers' motivational strategies in physical

education. *Journal of Sport & Exercise Psychology, 30*, 75-94.

Teixeira, P. J., Carraça, E. V., Markland, D., Silva, M. N., & Ryan, R. M. (2012). Exercise, physical activity, and self-determination theory: A systematic review. *International Journal of Behavioral Nutrition and Physical Activity, 9:78*. doi:10.1186/1479-5868-9-78

Teixeira, P. J., Going, S. B., Houtkooper, L. B., Cussler, E. C., Metcalfe, L. L., Blew, R. M., . . . Lohman, T. G. (2006). Exercise motivation, eating, and body image variables as predictors of weight control. *Medicine and Science in Sports and Exercise, 38*, 179-188. doi:10.1249/01.mss.0000180906.10445.8d

Teixeira, P. J., Silva, M. N., Mata, J., Palmeira, A. L., & Markland, D. (2012). Motivation, self-determination, and long-term weight control. *International Journal of Behavioral Nutrition and Physical Activity, 9:22*. doi:10.1186/1479-5868-9-22

Tengs, T. O., Adams, M. E., Pliskin, J. S., Safran, D. G., Siegel, J. E., Weinstein, M. C., & Graham, J. D. (1995). Five-hundred life-saving interventions and their cost-effectiveness. *Risk Analysis, 15*, 369-390. doi:10.1111/j.1539-6924.1995.tb00330.x

Tessier, D., Sarrazin, P., & Ntoumanis, N. (2008). The effects of an experimental programme to support students' autonomy on the overt behaviours of physical education teachers. *European Journal of Psychology of Education, 23*, 239-253. doi:10.1007/BF03172998

The Scottish Government. (2010). *Preventing overweight and obesity in Scotland: A route map towards healthy weight*. Retrieved from http://www.scotland.gov.uk/Resource/Doc/302783/0094795.pdf

Thøgersen-Ntoumani, C., & Ntoumanis, N. (2006). The role of self-determined motivation in the understanding of exercise-related behaviours, cognitions and physical self-evaluations. *Journal of Sports Sciences, 24*, 393-404. doi:10.1080/02640410500131670

Thøgersen-Ntoumani, C., Ntoumanis, N., & Nikitaras, N. (2010). Unhealthy weight control

behaviours in adolescent girls: A process model based on self-determination theory. *Psychology and Health, 25*, 535-550. doi:10.1080/08870440902783628

Vallerand, R. J. (1997). Toward a hierarchical model of intrinsic and extrinsic motivation. *Advances in Experimental Social Psychology, 29*, 271-360. doi:10.1016/S0065-2601(08)60019-2

van den Berg, M. H., Schoones, J. W., & Vliet Vlieland, T. P. M. (2007). Internet-based physical activity interventions: A systematic review of the literature. *Journal of Medical Internet Research, 9*(3). Retrieved from http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2047289/

Vansteenkiste, M., Simons, J., Soenens, B., & Lens, W. (2004). How to become a persevering exerciser? Providing a clear, future intrinsic goal in an autonomy-supportive way. *Journal of Sport & Exercise Psychology, 26*, 232-249.

Viswesvaran, C., & Ones, D. S. (1995). Theory testing: Combining psychometric meta-analysis and structural equations modeling. *Personnel Psychology, 48*, 865-885. doi:10.1111/j.1744-6570.1995.tb01784.x

Vlachopoulos, S. P., & Michailidou, S. (2006). Development and initial validation of a measure of autonomy, competence, and relatedness in exercise: The Basic Psychological Needs in Exercise Scale. *Measurement in Physical Education and Exercise Science, 10*, 179-201. doi:10.1207/s15327841mpee1003_4

Wang, Y. C., McPherson, K., Marsh, T., Gortmaker, S. L., & Brown, M. (2011). Health and economic burden of the projected obesity trends in the USA and the UK. *The Lancet, 378*, 815-825. doi:10.1016/S0140-6736(11)60814-3

Wild, T. C., & Enzle, M. E. (2002). Social contagion of motivational orientations. In E. L. Deci & R. M. Ryan (Eds.), *Handbook of Self-determination Research* (pp. 141-157). Rochester, NY: The University of Rochester Press.

Williams, G. C. (2002). Improving patients' health through supporting the autonomy of

patients and providers. In E. L. Deci & R. M. Ryan (Eds.), *Handbook of Self-determination Research* (pp. 233-254). Rochester, NY: The University of Rochester Press.

Williams, G. C., Cox, E. M., Hedberg, V. A., & Deci, E. L. (2000). Extrinsic life goals and health-risk behaviors in adolescents. *Journal of Applied Social Psychology, 30*, 1756-1771. doi:10.1111/j.1559-1816.2000.tb02466.x

Williams, G. C., & Deci, E. L. (2001). Activating patients for smoking cessation through physician autonomy support. *Medical Care, 39*, 813-823. doi:10.1097/00005650-200108000-00007

Williams, G. C., Gagne, M., Mushlin, A. I., & Deci, E. L. (2005). Motivation for behavior change in patients with chest pain. *Health Education, 105*, 304-321. doi:10.1108/09654280510602516

Williams, G. C., Grow, V. M., Freedman, Z. R., Ryan, R. M., & Deci, E. L. (1996). Motivational predictors of weight loss and weight-loss maintenance. *Journal of Personality and Social Psychology, 70*, 115-126. doi:10.1037/0022-3514.70.1.115

Williams, G. C., Levesque, C., Zeldman, A., Wright, S., & Deci, E. L. (2003). Health care practitioners' motivation for tobacco-dependence counseling. *Health Education Research, 18*, 538-553. doi:10.1093/her/cyf042

Williams, G. C., Lynch, M. F., McGregor, H. A., Ryan, R. M., Sharp, D., & Deci, E. L. (2006). Validation of the "Important Other" Climate Questionnaire: Assessing autonomy support for health-related change. *Families, Systems, & Health, 24*, 179-194. doi:10.1037/1091-7527.24.2.179

Williams, G. C., McGregor, H. A., Sharp, D., Levesque, C. S., Kouides, R. W., Ryan, R. M., & Deci, E. L. (2006). Testing a self-determination theory intervention for motivating tobacco cessation: Supporting autonomy and competence in a clinical trial. *Health Psychology, 25*, 91-101. doi:10.1037/0278-6133.25.1.91

Williams, G. C., McGregor, H. A., Zeldman, A., Freedman, Z. R., & Deci, E. L. (2004). Testing a self-determination theory process model for promoting glycemic control through diabetes self-management. *Health Psychology, 23*, 58-66. doi:10.1037/0278-6133.23.1.58

Williams, G. C., Minicucci, D. S., Kouides, R. W., Levesque, C. S., Chirkov, V. I., Ryan, R. M., & Deci, E. L. (2002). Self-determination, smoking, diet and health. *Health Education Research, 17*, 512-521. doi:10.1093/her/17.5.512

Williams, G. C., Niemiec, C. P., Patrick, H., Ryan, R. M., & Deci, E. L. (2009). The importance of supporting autonomy and perceived competence in facilitating long-term tobacco abstinence. *Annals of Behavioral Medicine, 37*, 315-324. doi:10.1007/s12160-009-9090-y

Williams, G. C., Patrick, H., Niemiec, C. P., Ryan, R. M., Deci, E. L., & McGregor Lavigne, H. (2011). The Smoker's Health Project: A self-determination theory intervention to facilitate maintenance of tobacco abstinence. *Contemporary Clinical Trials, 32*, 535-543. doi:10.1016/j.cct.2011.03.002

Williams, G. C., Patrick, H., Niemiec, C. P., Williams, L. K., Divine, G., Lafata, J. E., . . . Pladevall, M. (2009). Reducing the health risks of diabetes: How self-determination theory may help improve medication adherence and quality of life. *The Diabetes Educator, 35*, 484-492. doi:10.1177/0145721709333856

Williams, G. C., Rodin, G. C., Ryan, R. M., Grolnick, W. S., & Deci, E. L. (1998). Autonomous regulation and long-term medication adherence in adult outpatients. *Health Psychology, 17*, 269-276. doi:10.1037/0278-6133.17.3.269

Wilson, P. M., & Rodgers, W. M. (2002). The relationship between exercise motives and physical self-esteem in female exercise participants: An application of self-determination theory. *Journal of Applied Biobehavioral Research, 7*, 30-43. doi:10.1111/j.1751-9861.2002.tb00074.x

Wilson, P. M., Rodgers, W. M., Loitz, C. C., & Scime, G. (2006). "It's who I am... Really!" The importance of integrated regulation in exercise contexts. *Journal of Applied Biobehavioral Research, 11*, 79-104. doi:10.1111/j.1751-9861.2006.tb00021.x

Wilson, P. M., Rogers, W. T., Rodgers, W. M., & Wild, T. C. (2006). The Psychological Need Satisfaction in Exercise Scale. *Journal of Sport & Exercise Psychology, 28*, 231-251.

Wing, R. R., & Hill, J. O. (2001). Successful weight loss maintenance. *Annual Review of Nutrition, 21*, 323-341. doi:10.1146/annurev.nutr.21.1.323

Wing, R. R., & Jeffery, R. W. (1999). Benefits of recruiting participants with friends and increasing social support for weight loss and maintenance. *Journal of Consulting and Clinical Psychology, 67*, 132-138. doi:10.1037/0022-006X.67.1.132

World Health Organization. (2010). *World health statistics 2010*. Retrieved from http://www.who.int/whosis/whostat/EN_WHS10_Full.pdf

World Health Organization. (2011). *World health statistics 2011*. Retrieved from http://www.who.int/gho/publications/world_health_statistics/EN_WHS2011_Full.pdf

Yusuf, S., Hawken, S., Ôunpuu, S., Dans, T., Avezum, A., Lanas, F., . . . Lisheng, L. (2004). Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries (the INTERHEART study): Case-control study. *The Lancet, 364*, 937-952. doi:10.1016/S0140-6736(04)17018-9

Zigmond, A. S., & Snaith, R. P. (1983). The hospital anxiety and depression scale. *Acta Psychiatrica Scandinavica, 67*, 361-370. doi:10.1111/j.1600-0447.1983.tb09716.x