Coach autonomy support predicts autonomous motivation and daily moderate-to-vigorous physical activity and sedentary time in youth sport participants

Fenton, Sally AM; Duda, Joan L.; Quested, Eleanor; Barrett, Timothy

DOI:
10.1016/j.psychsport.2014.04.005

Document Version
Peer reviewed version

Citation for published version (Harvard):
Fenton, SAM, Duda, JL, Quested, E & Barrett, T 2014, 'Coach autonomy support predicts autonomous motivation and daily moderate-to-vigorous physical activity and sedentary time in youth sport participants', *Psychology of Sport and Exercise*, vol. 15, no. 5, pp. 453-463. https://doi.org/10.1016/j.psychsport.2014.04.005

Coach autonomy support predicts autonomous motivation and daily moderate-to-vigorous physical activity and sedentary time in youth sport participants

ARTICLE *in* PSYCHOLOGY OF SPORT AND EXERCISE · SEPTEMBER 2014

Impact Factor: 1.9 · DOI: 10.1016/j.psychsport.2014.04.005

4 AUTHORS, INCLUDING:

Sally A.M. Fenton
University of Birmingham
9 PUBLICATIONS **12** CITATIONS
SEE PROFILE

Joan L. Duda
University of Birmingham
332 PUBLICATIONS **9,069** CITATIONS
SEE PROFILE

Eleanor Quested
Curtin University
42 PUBLICATIONS **293** CITATIONS
SEE PROFILE

Coach autonomy support predicts autonomous motivation and daily moderate-to-vigorous physical activity and sedentary time in youth sport participants

Corresponding Author: Joan L Duda, School of Sport, Exercise and Rehabilitation Sciences, University of Birmingham, Edgbaston, UK, B15 2TT. Email: j.l.duda@bham.ac.uk Tel: 0121 4142737. Fax: 0121 414 4121 (School of Sport and Exercise Sciences main office)

Sally A. M. Fenton[1], Joan L. Duda[1], Eleanor Quested[1], Timothy Barrett[2]

[1] School of Sport, Exercise and Rehabilitation Sciences, University of Birmingham, Edgbaston, B15 2TT, UK.

[2] School of Clinical and Experimental Medicine, University of Birmingham, Edgbaston, B15 2TT, UK.

DOI: 10.1016/j.psychsport.2014.04.005

Original article available at: http://www.sciencedirect.com/science/article/pii/S1469029214000521

Abstract

Objective: Guided by self-determination theory (Deci & Ryan, 1987), this study tested a trans-contextual model linking perceptions of the social environment created by the youth sport coach to levels of autonomous motivation and objectively measured daily moderate-to-vigorous physical activity (MVPA) and sedentary time (ST) in young football players. **Design:** The study employed a cross-sectional design, assessing physical activity using accelerometers. **Method:** 105 male youth sport footballers (*M age* = 12.79 ± 1.85 years) wore a GT3X accelerometer for 7 days. Measures of height and weight were recorded. Participants completed a multi-section questionnaire assessing perceptions of autonomy support and controlling coaching behaviours, and motivation toward their participation in sport and physically active games. **Results:** Path analysis supported a model in which players' perceptions of coach-provided autonomy support positively predicted autonomous motivation for sport engagement. In turn, autonomous motivation was positively associated with MVPA, and negatively related to ST (min/day). Controlling coach behaviours were positively linked to controlled motivation. However, controlled motivation for sport and physically active games was unrelated to daily MVPA and ST. Perceptions of coach-provided autonomy support had a significant positive indirect effect on daily MVPA, and a significant negative indirect effect on daily ST. **Conclusions:** Results suggest that autonomy supportive coach behaviours are related to daily physical activity patterns in young male footballers. Theory-based interventions that aim to encourage autonomy supportive coaching, and subsequently foster autonomous reasons for sport engagement, may enhance the potential of youth sport for increasing daily MVPA and reducing ST among children and adolescents active in this setting.

Key Words: Self-determination Theory; MVPA; sedentary time; youth sport; accelerometer; children; motivation

Coach-provided autonomy support predicts autonomous motivation and daily moderate-to-vigorous physical activity and sedentary time in youth sport participants

A wide body of research indicates engagement in PA above a moderate intensity (i.e., moderate-to-vigorous physical activity, MVPA) is related to positive health outcomes in children (Carson & Janssen, 2011; Ekelund et al., 2012; Janssen & Leblanc, 2010; Mark & Janssen, 2011; Martinez-Gomez, Eisenmann, Tucker, Heelan, & Welk, 2011; Ness et al., 2007; Prentice-Dunn & Prentice-Dunn, 2011). Specifically, higher levels of MVPA are associated with reduced risk of obesity during childhood (Ness et al., 2007), improved cardio-metabolic health (Ekelund et al., 2012) and a reduction in the presence of inflammatory markers associated with cardiovascular disease and type II diabetes in youth (Carson & Janssen, 2011). Such findings have led to the development of evidence-based guidelines which state children should engage in at least 60 minutes and up to several hours of MVPA per day (Janssen & Leblanc, 2011; Strong et al., 2005).

More recently, researchers have begun to investigate the negative effects of sedentary behaviour on health outcomes related to obesity and non-communicable diseases (Carson & Janssen, 2011; Chaput et al., 2012; Gaya et al., 2009; Henderson et al., 2012; Martinez-Gomez et al., 2012; Mitchell, Pate, Beets & Nader, 2013; Prentice-Dunn & Prentice-Dunn, 2011). Sedentary behaviour refers to any waking behaviour characterised by low energy expenditure (typically $\leq$ 1.5 metabolic equivalents) and little physical movement (e.g., behaviours undertaken in a sitting or reclining posture) (Sedentary Behaviour Research Network, 2012). Existing research focused on sedentary behaviour and health has largely examined associations between total sedentary time (ST) (i.e., the sum of the time spent in all sedentary behaviours), and/or time spent engaged in a specific sedentary behaviour (e.g., television viewing) and health outcomes (Tremblay et al., 2011). Results from studies investigating the relationships between total ST and health are somewhat equivocal. For

example, some studies have reported positive associations between ST and indicators of adiposity, cardiovascular risk and type 2 diabetes (Gaya et al., 2009; Henderson et al., 2012; Mitchell et al., 2013; Sardinha et al., 2008) where others have reported no associations (Carson & Janssen, 2011; Chaput et al., 2012; Colley et al., 2013; Ekelund, Brage, Griffin & Wareham, 2009). Conversely, engagement in specific sedentary behaviours are more consistently linked to negative health outcomes, with positive relationships reported between TV viewing and computer use with obesity associated health outcomes (Carson & Janssen, 2011; Martinez-Gomez et al., 2012; Tremblay et al., 2011). Nevertheless, a recent systematic review concluded that decreasing any type of sedentary time is associated with lower health risks in youth aged 5 to 17 years (Tremblay et al., 2011). As such, the most recent PA guidelines have included a recommendation for children to minimise time spent engaged in sedentary pursuits (Department of Health, 2011; US Department of Health and Human Services, 2013).

Despite the endorsement of evidence-based recommendations for MVPA and ST across the globe, youth are becoming increasingly sedentary (Nelson, Neumark-Stzainer, Hannan, Sirard, & Story, 2006), and only a small percentage of children are engaging in sufficient levels of MVPA to meet recommended guidelines (Craig & Mindell, 2008; Riddoch et al., 2007). Thus, there is a need to understand what motivates children to engage in MVPA, as well as the psycho-social factors that might contribute towards engagement in ST in order to promote health-conducive PA patterns in youth. Concerning the encouragement of MVPA in particular, past work has suggested that physically active children are more likely to become physically active adults (Telama et al., 2005). Thus, childhood seems to be a critical developmental period in which the formation of positive PA habits (i.e., higher levels of MVPA participation) may be relevant to the promotion of

lifelong PA engagement and reduced risk of overweight and associated diseases during adulthood.

Youth sport as a setting for physical activity promotion

Traditionally, efforts to increase MVPA and reduce ST among youth across the globe have targeted the school setting. Certainly, the school is uniquely placed as the only environment which almost all youth experience from early childhood to adolescence. However, recent survey data indicates between 34% and 68% of school-aged youth engage in youth sport in western countries (Australian Bureau of Statistics, 2009; National Council of Youth Sports, 2008; UK Statistics Authority, 2013). As such, youth sport also represents an important and globally relevant domain with regard to promoting engagement in MVPA and reducing ST in children and adolescents. Studies have demonstrated youth sport participants are more active than their non-sporting counterparts (Nelson et al., 2011). However, recent research indicates that whilst youth sport can offer children and adolescents the opportunity to engage in MVPA, MVPA accrued during youth sport time alone is not sufficient to meet recommended guidelines (Leek et al., 2011, Wickel & Eisenmann, 2007). Studies have also revealed youth sport participants to spend as much as 11 hours per day sedentary (Machado-Rodrigues et al., 2012, Van-Hoye et al., 2013). Thus, participation in youth sport may not necessarily mitigate the health risks of engaging in low levels of MVPA and high levels of ST. Moreover, past studies have reported that around one in four youth sport participants are overweight (Dowda, 2001), and 48% of obese youth report participation in sport (BeLue, Francis, Rollins & Colaco, 2009). It seems, therefore, that a consideration of factors that predict daily engagement in MVPA and ST among youth sport participants may have important implications for encouraging healthier PA-related behaviours (i.e., higher daily MVPA and less ST) during non-youth sport time, and subsequently, reducing the risk of poor health among children and adolescents active in the youth sport setting. However, despite the

potential utility of youth sport as a context for PA promotion, studies to date have largely neglected to examine the concomitants of MVPA engagement and ST among youth sport participants.

Self-determination Theory

Self-determination theory (SDT; (Deci & Ryan, 1987; Deci & Ryan, 2000) is a theoretical framework increasingly used to explain why some individuals are more likely to engage in PA than others (Chatzisarantis & Hagger, 2009; Edmunds, Ntoumanis, & Duda, 2008; Hagger et al., 2009; Standage, Gillison, Ntoumanis, & Treasure, 2012; Teixeira, Carraca, Markland, Silva, & Ryan, 2012; Vierling, Standage, & Treasure, 2007). A central tenet of SDT is that behaviour is directed by motivation regulations that vary in levels of self-determination. These motivation regulations are on a continuum ranging from those that are more autonomous to more controlled, with the former linked to more adaptive outcomes (Alvarez, Balaguer, Castillo, & Duda, 2009; Bartholomew, Ntoumanis, Ryan, & Thogersen-Ntoumani, 2011; Cox, Smith, & Williams, 2008; Deci & Ryan, 1987; Deci & Ryan, 2008; Owen, Astell-Burt, & Lonsdale, 2013; Pelletier, Fortier, Vallerand & Brière, 2001; Teixeira et al., 2012).

Intrinsic motivation (IM) is the quintessential form of autonomous motivation and represents the most self-determined (autonomous) regulation. When intrinsically motivated, individuals engage in an activity primarily for the inherent rewards such as interest, fun and satisfaction (Deci & Ryan, 2000). Four types of extrinsic motivation exist which vary in the extent to which they are self-determined; i.e., integrated, identified, introjected and external regulations. Integrated (i.e., the individual participates in sport because this behaviour is integrated with his/her sense of self and reflects the individual's true goals and values) and identified (i.e., the person identifies with the value of sport and chooses to take part as a means to achieve personal goals and outcomes) regulations are autonomous forms of

extrinsic motivation, as the source of behaviour regulation emanates from the self. However, it has been argued that the advanced nature of integrated regulation (i.e., established and fully internalised values and goals) means this behavioural regulation is often not prevalent until adulthood (Vallerand, 1997). As a result, studies among youth largely focus on examining the consequences of intrinsic and identified regulations, often combining the two to represent autonomous motivation. Introjected (i.e., participation in sport regulated by contingencies that have been partially internalized, for example to avoid feelings of shame or guilt, or to attain ego enhancement) and external (i.e., sport participation regulated by external demands, rewards or pressures) regulation are considered controlled forms of extrinsic motivation (Deci & Ryan, 2008). SDT also recognises amotivation, characterised by a lack of or absence of motivation (Ryan, 1995). Previous research has indicated more autonomous forms of motivation towards PA (e.g., daily, and/or within leisure time, exercise, physical education settings) to be positively associated with levels of PA engagement among both adults and children (Aelterman et al., 2012; Gillison, Standage, & Skevington, 2011; Owen et al., 2013; Standage et al., 2012; Taylor, Ntoumanis, Standage, & Spray, 2010; Vierling et al., 2007; Sebire, Jago, Fox, Edwards, & Thompson, 2013; Teixeira et al., 2012). Conversely, controlled motivation towards PA has been negatively linked to levels of PA engagement (Owen et al., 2013; Standage et al., 2012; Teixeira et al., 2012), although these associations are reported less consistently than observed for autonomous motivation (in a positive direction).

According to SDT, the social environment surrounding an individual is a central determinant of autonomous motivation to be physically active (Deci & Ryan, 2008; Pelletier, et al., 2001; Standage et al., 2012). In the PA contexts most frequently experienced by children (e.g., PE classes, youth sport), the social environment is largely coloured by the interpersonal styles of adults acting within these settings (i.e., the teacher/coach created social

environment). SDT advocates that more autonomous forms of motivation are promoted in social environments that support an individual's sense of autonomy, (i.e., contexts that promote choice, decision making, acknowledge the others' perspectives, provide a rationale for what individuals are requested to do). Conversely, when controlling atmospheres are most pronounced (i.e., contexts which limit choice, exert pressure, are coercive and in which negative conditional regard is displayed), more controlled/less autonomous motivation will result (Deci & Ryan, 1987; Deci & Ryan, 2000; Deci & Ryan, 2008). For example, within the youth sport context, an autonomy supportive coach may provide players with meaningful options in training, acknowledges athletes' preferences and explain the rationale behind the decisions they make during training sessions and matches (Mageau & Vallerand, 2003). A controlling coach may fail to listen to players' opinions and perspectives, display negative conditional regard (i.e., withdraw attention if performance expectations are not met), and employ the use of rewards to 'motivate' players to perform better (Bartholomew, Ntoumanis, & Thogersen-Ntoumani, 2010).

Self-determination theory and physical activity among youth

To date, studies exploring the relationships between perceptions of the social environment and PA engagement in youth have largely been conducted with a focus on the social environment created by teachers in the PE setting. These studies have principally investigated the associations between autonomy support, autonomous motivation and subsequent engagement in PA. Overall, findings have revealed perceptions of teacher-provided autonomy support in PE classes to be positively related to daily, leisure time and PE class PA engagement as a result of fostering more autonomous forms of motivation (Chatzisarantis & Hagger, 2009; Cox et al., 2008; Hagger et al., 2009; Standage et al., 2012; Vierling et al., 2007). In addition, based on bivariate associations, studies have demonstrated controlled motivation to be negatively linked to daily and leisure time PA.

Perhaps most importantly, results from studies conducted in this domain have highlighted the presence of a trans-contextual effect, demonstrating autonomous motivation fostered by the social environment in the PE setting, is related to PA engagement outside this setting (i.e., daily and leisure time PA). Such findings are in line with Vallerand's hierarchical model of motivation which suggests that motivation to engage in a behaviour (e.g., PE) can generalise across contexts (Vallerand, 1997). That is, where individuals are autonomously motivated towards PA participation in one setting, they may also be autonomously motivated towards PA outside of this context. Subsequently, higher levels of engagement both within and outside the setting in question may ensue.

With respect to existent studies examining the motivational processes through which the social environment created within youth PA settings may impact upon young people's PA engagement, a number of limitations should be acknowledged. First, an almost exclusive focus on the PE setting limits our understanding of the potential value of promoting autonomy support in other youth PA environments so that we might enhance children's levels of daily PA engagement. Given that youth are physically active across a variety of settings throughout the week and curricular time allocated to PE is declining in many Western countries (Dollman, Norton & Norton, 2005), examining the motivational processes operating within other youth PA environments and their implications for levels of PA engagement, is an important area of research. Second, studies to date have largely neglected to examine the impact a controlling interpersonal style may have upon levels of PA engagement among youth. As controlling social environments are linked to more controlled motivation, studies examining the implications of controlling behaviours among adults central to shaping youth PA environments are warranted. Finally, previous research in this area has tended to largely rely on self-report questionnaires and pedometers to assess PA engagement among children and adolescents. The questionable validity of self-report

measures of PA (particularly among youth) and the inability of pedometers to determine different dimensions of PA (e.g., intensity) limit our understanding of how social contextual factors operating in youth PA settings are related to engagement in specific PA behaviours (e.g., MVPA).

Accelerometers provide an accurate means of assessing frequency, intensity and duration of PA (Trost, 2007). In SDT-grounded research on adults, accelerometers have been utilised to investigate the relationships between motivation and MVPA (Sebire, Standage & Vansteenkiste, 2011; Standage, Sebire & Loney, 2008; Teixeira et al., 2012). However, among youth, very few studies exist that have employed accelerometers to investigate the associations between the psychosocial correlates of PA and daily, leisure time, and/or domain specific engagement in MVPA within the framework of SDT (Aelterman et al., 2012; Lonsdale et al., 2013; Owen et al., 2013; Perlman, 2013; Roemmich, Lambiase Ms, McCarthy, Feda, & Kozlowski, 2012; Sebire et al., 2013).

Self-determination theory and prediction of MVPA

Existing accelerometer-based studies which have examined the motivational processes postulated by SDT have typically investigated the bivariate associations between a single facet of the SDT model (i.e., the social context *or* motivation regulations) and MVPA (Aelterman et al., 2012; Owen et al., 2013; Roemmich et al., 2012). In general, results have been consonant with SDT tenets with respect to the prediction of engagement in MVPA. Only one study has examined these associations at the multivariate level, testing a sequential SDT based model which demonstrated a positive association between basic psychological need satisfaction (See Ryan and Deci, 2000 for an overview of basic needs theory) and intrinsic motivation towards PA, which in turn was positively linked to daily MVPA (Sebire et al., 2013). However, the role of social contextual factors as determinants of the targeted psychological antecedents and PA engagement was not examined. Owen et al., (2013)

conducted the only study to date which sought to examine the trans-contextual associations between motivation and MVPA. Findings revealed more autonomous motivation (and specifically intrinsic motivation) towards PE to be positively related to leisure time MVPA (Owen et al., 2013). In contrast, external regulation was negatively associated with leisure time MVPA, providing initial support for the contention that quality of motivation in one context, may be related to engagement in MVPA in another.

Self-determination theory and sedentary time

The recent advancement towards using accelerometry has gone someway toward testing the theoretical tenets of SDT with respect to the prediction of MVPA. However, only one study to date has pulled from SDT in the investigation of the psychosocial correlates of ST. In this intervention study, Lonsdale et al., (2013) sought to determine if the creation of autonomy supportive PE environments would result in changes in students' motivation towards PE and time spent sedentary during a 20 minute PE session. Results revealed where the PE teacher provided opportunity for free choice of activities during PE, motivation towards PE remained unchanged, but ST during the PE lesson was reduced (Lonsdale et al., 2013). Whilst this study offers a novel contribution to the literature, further SDT-based research is warranted which further explores the psychosocial correlates of ST and the motivational processes underlying engagement in ST behaviours. In particular, given the high levels of daily ST reported among youth (Pate, Mitchell, Byun & Dowda, 2011), studies examining the motivational processes underlying engagement in daily ST are paramount from a public health perspective.

As previously highlighted, initial support has been provided for the presence of a trans-contextual association between motivation in one context and engagement in MVPA in another (Owen et al., 2013). However, less is known concerning whether contextual motivation to engage in PA in one setting, would be related to time spent engaged in

sedentary behaviours outside this context. Consonant with Vallerand's hierarchical model of motivation (Vallerand, 1997), a lower quality of motivation towards PA, may mean that children chose to spend their time engaged in activities of a more sedentary nature across multiple contexts. Whilst there may be other important mediators in this relationship, exploring the trans-contextual association between quality of motivation towards PA fostered in one context and engagement in ST across other contexts, is an important first step in determining the relevance of youth PA environments as trans-contextual settings for reducing ST among children and adolescents.

When arguing the relevance of determining trans-contextual associations between domain specific motivation for PA and daily ST, it is important to consider the PA and sedentary behaviour paradigm as discussed across the literature (Biddle, Marshall, Gorely, & Cameron, 2009; Katzmarzyk, 2010; Maher, Olds, Mire & Katzmarzyk, 2014). Indeed, in contrast to evidence demonstrating MVPA and ST are two distinct behaviours (Biddle et al., 2009), there is evidence to suggest that MVPA and ST are related behaviours with similar correlates (Epstein, Roemmich, Paluch & Raynor, 2005; King et al., 2010). Based on the latter assertion, it is likely that where motivation in one context is positively related to MVPA in another, the opposite association may be observed for ST (i.e., an increase in MVPA may be correspond to a decline in ST, Epstein, Roemmich, Paluch & Raynor, 2005; Loucaides, Jago & Theophanous, 2011). Thus, determining associations between PA motivation and both MVPA and ST may also contribute to an important body of research seeking to determine the extent to which these two behaviours are related among youth.

The present study

The current study sought to build upon existing research by extending previous findings from the PE context to an important setting for PA promotion in youth outside the school (i.e., youth sport). We addressed this by testing a sequential SDT-based model

examining the trans-contextual associations between the social environment created by coaches in the youth sport setting (i.e., its autonomy supportive and controlling features), sport and PA related autonomous and controlled motivation and accelerometer-assessed daily MVPA and ST. The inclusion of ST in our hypothesised model served a secondary and more exploratory aim; i.e., we wanted to secure preliminary data regarding the potential value of the youth sport context as an avenue through which levels of ST may be reduced among youth sport participants. The indirect effects of perceptions of coach-provided autonomy support and controlling coach behaviour on autonomous and controlled motivation were also examined in order to explore the psychosocial mechanisms linking the social environment created in youth sport football to daily engagement in MVPA and ST. Due to its popularity across the world, our focus in the present study was on grassroots football participants (*note*: football is also internationally referred to as soccer). Globally it is estimated over 22 million youth participate in grassroots football (Kunz, 2007) and in some westernised countries, footballers comprise between 40% and 68% of all youth sport participants (Australian Bureau of Statistics, 2009; UK Statistics Authority, 2013; Womens Sports Foundation, 2008).

Method

Participants and procedures

Males aged 10-16 years (N = 156, $M\ age$ = 12.78 ± 1.91) were recruited from 24 football clubs. To be eligible for the study, participants were required to be playing grassroots football regularly (i.e., ≥ one training session and/ or match per week) for a community club team outside school. Following initial contact with coaches at football clubs, trained researchers visited clubs to distribute consent forms and information sheets to interested participants and parents. Researchers returned one week later to administer a multi-section questionnaire assessing perceptions of coach behaviour and players' motivation regulations. Following this, measures of height and weight were recorded and accelerometers (GT3X

Actigraph, Pensacola, FL) were distributed. Study procedures and assessments were approved by the local National Health Service Ethics Committee. Informed parental consent and participant assent were obtained before participation in the study. All data were collected six to seven months into the competitive football season (i.e., between February and March), allowing time for the social environment within the youth sport setting to have been established.

Measures

Perceptions of the coach created social environment. Perceptions of coach-provided autonomy support and controlling coach behaviours were assessed via previously validated scales (Adie, Duda, & Ntoumanis, 2012; Bartholomew et al., 2010; Williams, Grow, Freedman, Ryan, & Deci, 1996). Following the stem "So far this season....," five items (e.g., my coach gives players choices and options) and six items (e.g., my coach threatens to punish players to keep them in line during training) were used to measure players' perceptions of coach-provided autonomy support and controlling coach behaviours, respectively. Players were asked to rate their agreement with the items on a 5-point Likert-scale ranging from 1 (strongly disagree) to 5 (strongly agree). Both scales had acceptable internal consistency (autonomy support, α = .67; controlling behaviours, α = .74).

Motivation regulations. Behaviour regulations for participation in sport and active games were assessed using an adapted version of the Behavioural Regulation in Sport Questionnaire (BRSQ, Lonsdale, Hodge, & Rose, 2008). Following the stem "I participate in sport and active games because....," three items measured intrinsic motivation (e.g., because it is fun)[1], and four items tapped identified (e.g., because I value the benefits), introjected (e.g., because I would feel guilty if I quit) and external (e.g., Because if I don't other people will

[1] The original BRSQ measure uses four items to tap intrinsic motivation. In the present study, the item "because it feels pleasurable" was removed as this term was not thought to reflect

not be pleased with me) motivation. Items were responded to on a 7-point Likert scale ranging from 1 (not true at all) to 7 (very true). The BRSQ subscales demonstrated acceptable internal consistency in this study (intrinsic motivation, α = .75, identified regulation, α = .74, introjected regulation, α = .80 and external regulation , α = .84), and have been validated in research involving a large sample of youth sport football participants of similar age to those targeted in this study (Viladrich et al., 2013). Consonant with SDT and the approach used in other SDT-based studies in sport and other physical activity settings (Aelterman et al., 2012; Chan & Hagger, 2012), autonomous motivation (intrinsic motivation + identified regulation) and controlled motivation (introjected regulation + external regulation) variables were computed and used as primary variables in subsequent analysis.

Anthropometry. Height was measured with a stadiometer (SECA, Leicester height measure) to the nearest 0.1cm. Weight was measured with electronic scales (WW, precision scale) to the nearest 0.1 kg. Body mass index (BMI) was calculated using the equation, weight (kg) ÷ height (m^2), and participants were classified as normal-weight, overweight or obese according to UK BMI reference charts (Cole, Freeman, & Preece, 1995). BMI standard deviation scores (BMI-SDS) adjusted for age-and-sex were computed (Cole, Freeman, & Preece, 1998).

Physical activity. Daily MVPA and ST were measured using the Actigraph GT3X accelerometer. The Actigraph accelerometer has been shown to be a valid and reliable measure of PA among youth (Trost, 2007). The GT3X detects movements over pre-specified time periods called epochs. Movements within each epoch are converted to 'activity counts' which are interpreted to determine time spent at different activity intensities. Accelerometers were initialised in 15 second epochs in the present study (Riddoch et al., 2007). A trained researcher distributed the accelerometers and provided participants and parents with verbal and written instructions on how accelerometers should be worn. For assessment of PA among

youth, a seven-day measurement protocol is recommended to obtain a reliability coefficient of 0.8 or above (Trost, Pate, Freedson, Sallis, & Taylor, 2000). As such, participants were asked to wear the accelerometer for seven days following their training session (i.e., five week days and two weekend days) during all waking hours, and instructed to remove the accelerometer when bathing and/or engaged in water sports (e.g., swimming). Participants were asked to record time periods when the accelerometer was removed (indicating reasons why), and daily participation in sports and PA (e.g., cycling) in activity logs to aid with data cleaning.

Data processing

Data from the GT3X were downloaded and analysed using Actilife software (Actigraph, Pensacola, Florida). Questionnaire and PA data were cleaned and checked for missing and spurious values respectively. Periods of accelerometer non-wear were determined by strings of consecutive zeros lasting > 30 minutes, allowing for 1 minute of counts < 100 (Cain, Sallis, Conway, Van Dyck, & Calhoon, 2013). Participants were excluded from further analysis where they failed to record valid PA data [$N = 41$, ≥ 4 days, with ≥ 8 valid hours of activity per day, including one weekend day), and/or provided incomplete responses to questionnaire items ($N = 10$). The final sample consisted of 105 males (compliance = 66.88%), representing youth sport football players from all 24 of the football clubs initially recruited. Of these, 45.7 %, 38.1%, 8.6% and 7.6% recorded 7, 6, 5 and 4 days of valid PA data respectively. Mean scores for questionnaire variables were calculated from responses to the targeted scales, and average daily levels of MVPA and ST were determined (minutes/day). MVPA and ST were defined as ≥ 2296 and <100 and cpm respectively based on the cut points derived by Evenson and colleagues (Evenson, Catellier, Gill, Ondrak, & McMurray, 2006). One-way analysis of variance indicated the final sample

did not differ from those excluded for physical characteristics (age, height, weight and BMI-SDS), or because of missing questionnaire data (all $p = < .05$).

Statistical analysis

Descriptive statistics (M ± SD) were calculated for all measured variables using SPSS. Pearsons correlations were calculated to examine bivariate relationships between variables in the hypothesised model (Figure 1), and to identify confounding factors that may impact upon these relationships (i.e., BMI-SDS, age and valid-wear time). Where confounding relationships were identified, the hypothesised model was adjusted accordingly to control for these relationships (i.e., direct paths were stipulated between confounding factors and PA variables where necessary; see Figure 2).

Path analysis with maximum likelihood estimation was employed in conjunction with the bootstrapping procedure to test the hypothesised model (Figure 1) (Arbuckle & Wothke, 1999). Bootstrapping is a nonparametric resampling procedure that does not impose the assumption of normality of the sampling distribution (Preacher & Hayes, 2008). Previous research has shown this approach to be superior to alternative tests with respect to Type 1 error rates and power (Preacher & Hayes, 2008), Bootstrap-generated 95% bias corrected confidence intervals were constructed for 2000 samples on the hypothesised model (Preacher & Hayes, 2008; Shrout & Bolger, 2002). Model fit was evaluated using the chi-square statistic (χ^2), comparative fit index (CFI), root square mean error of approximation (RMSEA), and standardised root mean square residual (SRMR) (Hu & Bentler, 1999). Both the CFI and RMSEA were appropriate to assess model fit in the present study as they are less sensitive to sample size than other goodness-of-fit indices (Fan, Thompson, & Wang, 1999). A non-significant χ^2 ($p = < .05$) and values of > .90 (CFI) ≤ .06 (RMSEA) and ≤ .08 (SRMR) were used as cut off criteria to indicate good fit of the data to the hypothesised model. In the case of a CFI value > .95, the model is considered to have excellent fit (Hu & Bentler, 1999).

Where significant associations between motivation regulations and MVPA and ST were observed, the phantom model approach for testing specific effects was used to examine the indirect effects of coach-provided autonomy support and/or controlling coach behaviour on MVPA and ST (via motivation regulations) (Macho & Ledermann, 2011). This method involves creating a separate latent variable model (i.e., the phantom model) that represents the specific effect to be tested as a total effect (Figure 2). Bootstrap bias corrected 95% confidence intervals were used to determine significance. Where the confidence interval does not cross zero, a significant indirect effect is assumed. Results are reported in their unstandardised form as the phantom approach does not allow estimation of standardised effects.

Results

Descriptive statistics

Descriptive statistics are shown in Table 1. The sample largely consisted of normal-weight participants (73.3%, $N = 77$), with 18.1% and 8.6% classified as overweight (BMI $\geq$ 85th percentile, $N = 19$) and obese (BMI $\geq$ 95th percentile, $N = 9$), respectively (Cole et al., 1995). Mean scores for the targeted social psychological variables indicate high levels of autonomous motivation and perceptions of autonomy support across the sample. Perceptions of controlling coach behaviour and controlled motivation were comparatively lower than perceptions of coach-provided autonomy support and autonomous motivation. On average, participants engaged in MVPA for over 1 hour per day and spent between 8-9 hours per day engaged in sedentary behaviours.

Pearson correlations

Table 2 reports the bivariate associations between all measured psychological variables[2] and PA behaviours. Results indicate that perceived autonomy support was significantly and positively correlated with autonomous motivation, and was unrelated to controlled motivation. Perceived controlling coach behaviour was significantly and positively correlated with controlled motivation, and significantly negatively correlated with autonomous motivation. Autonomous motivation was also significantly positively associated with daily MVPA and negatively related to daily ST. No relationships were observed between controlled motivation and MVPA or ST.

BMI-SDS was not associated with MVPA (p = .46) or ST (p = .88) Further, age was not related to MVPA (p = .09). However, both age and valid-wear time were significantly positively correlated with ST (r = .51, p = < .01 and r = .52, p = < .01 respectively), and valid wear time was also significantly positively associated with MVPA (r = .23, p = < .05). The hypothesised model was therefore adjusted to control for these relationships in the subsequent path analysis (i.e., direct paths were stipulated between valid wear time and MVPA and ST, and between age and ST; see Figure 2).

Path analysis

The hypothesised model demonstrated an excellent fit to the data (Figure 2; χ^2 (14) = 18.64, p = .18, CFI = .98, RMSEA = .06, SRMR = .07). Perceptions of coach-provided autonomy support positively predicted autonomous motivation, which in turn, positively predicted daily MVPA and negatively predicted ST. Perceptions of controlling coach behaviour positively predicted controlled motivation. Controlled motivation was unrelated to MVPA and ST. Perceptions of autonomy support and controlling coach behaviour were not associated with controlled motivation and autonomous motivation, respectively. The 95% bootstrap-generated bias-corrected confidence intervals revealed perceptions of coach-

[2] The factoral validity for each of the psychological scales was supported by confirmatory factor analysis. Please contact the first author for further details

provided autonomy support had a significant positive indirect effect on MVPA (unstandardised β = 4.90 [95% CI = .11 to 9.75]), and a significant negative indirect effect on ST (unstandardised β = -9.90 [95% CI = -20.35 to -.27]), via autonomous motivation.

Squared multiple correlations indicated perceptions of coach-provided autonomy support accounted for 18.1% of the variance in autonomous motivation. Perceptions of coach-provided autonomy support and autonomous motivation together explained 4.9% of the variance in PA behaviours (MVPA = 3.3% ST = 1.6%). Significant path coefficients can be interpreted to indicate that every standard deviation unit increase in autonomous motivation (i.e., 0.65) is associated with an increase in daily MVPA by 4.82 minutes per day, and a reduction in daily ST of 9.87 minutes per day. Over a week, this equates to an extra 34 minutes of MVPA, and over 1 hour (69 minutes) less ST.

Discussion

Grounded in self-determination theory (Deci & Ryan, 1987; Deci & Ryan, 2000), this is the first study to test the relationships between perceptions of the autonomy supportive and controlling features of the coaching environment, player motivation regulations to participate, and accelerometer assessed daily MVPA as well as ST. Results are in line with the theoretical tenets of SDT, and demonstrated perceptions of coach-provided autonomy support to positively correspond to autonomous motivation towards sport and active games. In turn, autonomous motivation was positively associated with daily MVPA and negatively predicted daily ST in youth sport footballers. Perceptions of controlling coach behaviour were significantly and positively associated with controlled motivation. However, controlled motivation towards sport and active games was unrelated to both daily MVPA and ST.

The present study builds upon existing research by extending findings from the PE context to an important setting for PA promotion outside the school environment, namely youth sport. It is the first to demonstrate that the social environment created in the youth

sport setting is linked to daily levels of MVPA and ST. Given growing evidence for a positive relationship between MVPA and markers of obesity and cardio-metabolic risk, and a negative association between ST and these same health indicators (Gaya et al., 2009; Henderson et al., 2012; Mitchell et al., 2013; Sardinha et al., 2008), findings have important health implications for the millions of children active within youth sport settings.

Present results indicated that for every increase in autonomous motivation by one standard deviation (i.e., 0.65), MVPA would increase by almost 5 minutes per day (approximately 35 minutes per week). These findings are consonant with the work of Sebire et al., (2013) who reported an increase in intrinsic motivation (the quintessential form of autonomous motivation) by the same amount (i.e., SD = 0.65) would have equated to an increase in MVPA of 4.45 minutes per day. Reflecting a new contribution to the literature, findings also revealed autonomous motivation to be negatively related to daily ST. In particular, for every SD increase in autonomous motivation, ST would decrease by approximately 10 minutes per day (over an hour per week). The clinical significance of the present findings can be illustrated when we consider past work investigating the associations between MVPA, ST and health. Research has demonstrated an additional 10 minutes of MVPA is reported to be associated with a 6-7% reduction in biomarkers of insulin sensitivity. Conversely, an additional 10 minutes of ST per day is associated with up to a 2-4% increase in these same biomarkers (Henderson et al., 2012). Moreover, data from the International Children's Accelerometry Database (ICAD) demonstrated an additional 10 minutes of MVPA per day is associated with a 0.5cm decrease in waist circumference (Ekelund et al., 2012). A recent study reported that for every 1cm increase in waist circumference, the odds of having levels of Alanine aminotransferase (a marker of the metabolic syndrome) above those associated with increases in insulin sensitivity and central adiposity, increased by 1.06 (Trilk et al., 2013). Thus, present results suggest that fostering autonomous motivation

towards sport and active games may contribute towards increasing daily MVPA and reducing ST towards levels which may lead to clinical health benefits. However, longitudinal studies and, in particular, intervention studies are necessary to determine whether increasing autonomy supportive coaching behaviours corresponds to increased levels of MVPA and reduced ST among youth sport participants.

Akin with previous studies (Cox et al., 2008; Hagger et al., 2009; Owen et al., 2013; Standage et al., 2012), present results demonstrated domain specific autonomous motivation fostered within a specific youth PA context (i.e., youth sport) was related to engagement in PA outside this setting (i.e., daily MVPA). Thus, findings suggest the presence of a trans-contextual effect, indicating that motivation towards sport and active games cultivated in the youth sport setting, was related to engagement in MVPA and the time spent in sedentary pursuits across multiple contexts. Past work has indicated MVPA accrued during youth sport is not sufficient to meet recommended guidelines (Leek et al., 2011). As such, children and adolescents need to engage in additional MVPA outside the youth sport environment to achieve recommended levels. The presently observed trans-contextual associations may therefore have implications for increasing daily MVPA towards levels identified as being beneficial for health among sport participants. Our findings suggest that if the coach-created climate is more autonomy supportive, and young football players are more autonomously motivated, then they are more likely to exhibit higher levels of daily MVPA. These results are in line with Vallerand's hierarchical model of motivation which suggests motivation regulation for engagement in a particular behaviour (e.g., PA) can generalise across life domains (e.g., sport, the home, school) (Vallerand, 1997). Whilst we did not measure participants' motivation towards PA across other contexts in this study, other research has demonstrated motivation towards PA (and subsequent PA engagement) to transfer across contexts. For example, Standage et al., (2012) reported autonomous motivation towards PE to

be positively related to autonomous motivation towards exercise related PA, which in turn, was positively associated with 4 day pedometer step count (i.e., total PA). Current and past findings therefore indicate that autonomous motivation fostered by the social environment created within different youth PA settings (e.g., PE and youth sport) is likely an important determinant of PA engagement outside the immediate PA context. Future studies should seek to determine whether motivation towards sport and physically active games predicts autonomous motivation towards PA across other contexts.

We also observed autonomous motivation towards sport and physically active games to exhibit a negative trans-contextual association with ST. The present findings serve an important first step in determining how quality of motivation in one setting, may relate to engagement in ST outside of this setting. As such, results highlight the potential of youth sport as a domain through which levels of ST may be reduced among youth. That is, results suggest that enhancing autonomous motivation towards sport and active games may offer an avenue through which ST can be attenuated among youth sport participants. However, important to note is that autonomous motivation accounted for 1.6% of the variance in ST. Thus, it is likely that other psychosocial variables are influencing young footballers' time spent in sedentary activities.

The finding that autonomous motivation was related to both MVPA and ST (positively and negatively, respectively) also warrants further discussion. Specifically, results may indicate that these two behaviours are somewhat related among the current sample of youth sport footballers, and that higher levels of MVPA may correspond to lower levels of ST in this group of children and adolescents. Indeed, research among youth has indicated that where engagement in MVPA is increased, time spent sedentary is reduced (Epstein et al., 2005; Loucaides et al., 2011). Whilst this opposes studies suggesting that these two behaviours are independent (Biddle et al., 2009), the correlation between MVPA and ST

observed in the present research is higher than that reported in population based studies of youth (Biddle et al., 2004; Ekelund et al., 2012). In addition, our findings indicated youth sport participants spent approximately 72% of their day engaged in MVPA or ST. Thus, it may be that when not engaged in sport and active games, youth sport participants are likely to be engaged in ST. However, important to note is that the present correlation between MVPA and ST ($r = -0.46$) indicates there is a substantial portion of the variance in ST that cannot be explained by engagement in MVPA.

This study makes a further novel contribution to the literature, demonstrating the presence of a significant indirect effect of perceptions of coach-provided autonomy support on daily MVPA and ST via autonomous motivation. Results therefore support the basic tenets of SDT, underlining the central role of autonomous motivation for encouraging adaptive behavioural outcomes (i.e., PA engagement). Previous studies conducted in the PE setting report contradictory findings to present results, revealing no significant indirect effect of teacher-provided autonomy support on PA engagement via motivation regulations for PE or leisure time (Standage et al., 2012; Vierling et al., 2007). Contrasting findings may result from inconsistencies in terms of the variable used to represent differences in motivation regulations. The present study focused specifically on autonomous motivation representing intrinsic and identified regulations, whereas past research which examined indirect effects have employed a relative autonomy/self-determination index (Hagger et al., 2009; Standage et al., 2012). Thus, differing findings might indicate perceptions of autonomy support are related to PA engagement via a positive association with autonomous motivation, rather than a negative association with controlled motivation. Such detailed information is lost when a self-determination index is employed.

The current study is also the first to investigate the motivational processes through which perceptions of a controlling interpersonal style may be related to objectively assessed

MVPA and ST among youth. Past research conducted in youth sport and PE settings has largely focused on investigating the role of perceptions of autonomy support as an antecedent of motivation and related outcomes, neglecting to examine the possible deleterious consequences of controlling behaviours (Bartholomew et al., 2011). Our findings revealed perceptions of controlling coach behaviour to be positively related to controlled motivation, but unrelated to autonomous motivation. Controlled motivation, in turn, was unrelated to daily MVPA and ST. Results are in line with previous studies demonstrating perceptions of controlling behaviours to be more strongly related to motivation regulations which fall lower on the self-determination continuum (i.e., introjected or external motivation) (Deci & Ryan, 1987; Deci, Eghrari, Patrick, & Leone, 1994; Pelletier et al., 2001). Indeed, SDT posits that perceptions of a controlling interpersonal style are related to less overall internalisation and more controlled motivation (Ryan & Deci, 2000). However, in contrast to present findings, a recent study demonstrated controlled motivation towards leisure time PA to be negatively related to leisure time MVPA (Owen et al., 2013). Differing findings may be due to the fact analysis was only conducted at the bivariate level in the previous study. Future studies should aim to further investigate the potentially maladaptive consequences of controlling interpersonal styles and controlled motivation in the context of PA engagement among youth within and across PA-related settings. Further, in explicating the lack of significant relationships between controlled motivation and daily MVPA and ST in the present study, the cross-sectional design employed should be kept in mind. Longitudinal studies have demonstrated controlled motivation to be related to dropout among sport participants (García Calvo, Cervelló, Jiménez, Iglesias, & Moreno Murcia, 2010). Thus, in the long term, controlled motivation may result in lower levels of MVPA (and perhaps increased ST) as a result of discontinued sport engagement (Kjonniksen, Anderssen, & Wold, 2009; Nelson et al., 2011).

Whilst present results highlight the value of the youth sport setting as a context for PA promotion, youth sport is only one setting in which children and adolescents have the opportunity to be physically active during a typical week. Consequently, the psychosocial factors operating in this environment are likely one of many influences on daily/weekly levels of PA engagement and ST pursuits. In line with this, the theoretical model tested in the present study accounted for only 3.3 % of the variance in daily MVPA, variance similar to that reported by Sebire et al., 2013, who demonstrated intrinsic motivation to account for 4% of the variance in daily MVPA among youth (Sebire et al., 2013). Such findings point towards the importance of considering the broader context of youth PA, i.e., the many social, psychological and physical-environmental factors (e.g., teachers, parents, peers, the built environment) operating within various settings in which children have the opportunity to be physically active (e.g., sport, PE, the school yard, the home, recreational environments). Research exploring the salience of such factors across a variety of youth PA settings will help to identify malleable targets for interventions aimed at increasing PA engagement in youth. As such, a more comprehensive approach to PA promotion among youth is likely to be most effective towards increasing daily MVPA and reducing ST towards levels identified as being beneficial for health.

A notable strength of the current study is the use of accelerometers to measure PA. Accelerometers provide a more accurate, objective assessment of PA over and above that of self-report measures (Trost, 2007), and allow researchers to quantify intensity and frequency of PA. Moreover, the analytical approach adopted enabled a model to be tested that adjusted for significant associations between accelerometer wear time, age and MVPA and ST. Previous studies that have not controlled for these relationships may have overestimated the variance accounted for in PA behaviours by motivation (e.g., Standage et al., 2012). Thus,

present results may reflect a more accurate representation of the potential influence of quality of motivation on engagement in PA relative to existing research.

Certain considerations should be made when interpreting current findings. Youth sport football was the sport examined due to the potential for widespread application of findings to large numbers of youth sport participants across the globe. However, caution should be taken before generalising current findings to other sports. In addition, a lack of access to and interest from female football teams regarding participation in the study resulted in an exclusively male sample. Nevertheless, the basic tenets of SDT are not assumed to differ as a function of gender, and previous research investigating the relationships between perceptions of autonomy support, motivation regulations and PA measured by pedometers, reported model fit was invariant across samples of male and female youth (Standage et al., 2012). Future research should seek to replicate the present research via the inclusion of both males and females from a variety of different sports. Further, the cross-sectional design of this study limits inferences concerning the direction of causality. For example, it is possible that a coach's interpersonal behaviour may be influenced by a player's motivation. Therefore, it is important to replicate the present study employing a longitudinal design to explore the targeted relationships over time. Finally, whilst this study makes an important contribution to the literature regarding the role of motivation towards sport for reducing ST in leisure time, findings do not allow speculations to be generated regarding how perceptions of the social environment created in youth sport might be linked to time spent engaged in specific sedentary pursuits (e.g., TV viewing, video games, and computer use). Future studies would do well to employ a mixed methodology, combining self-report measured of sedentary behaviour and accelerometer assessed ST in order to further understand the implications of youth sport participation for children's engagement in sedentary behaviours (Sebire, Jago, Gorely, Hoyos Cillero, & Biddle, 2011).

In conclusion, extending findings focused largely within the PE context, our results suggest that more autonomy supportive environments within youth sport appear conducive to higher levels of autonomous motivation towards sport and active games, and are associated with more positive PA-related behaviours (i.e., higher engagement in MVPA and less ST per day) in this sample of young male footballers. Thus, encouraging autonomy supportive behaviours among youth sport coaches may hold implications for increasing daily MVPA towards recommended guidelines and reducing daily ST in youth. Overall, this study points to the promise of the youth sport setting as a context for PA promotion (and sedentary time reduction) among children and adolescents.

Acknowledgements

The authors would like to acknowledge Tom Allen and Nicholas Jones for their contribution to the data collection involved in this investigation and all of the players who agreed to participate in this study.

Table 1. Descriptive statistics

	Mean ± SD (N = 105)	Range (min – max)
Psychological Variables		
Autonomy support	3.98 ± 0.55	2.40 – 5.00
Controlling coach behaviour	2.19 ± 0.64	1.00 – 4.18
Autonomous motivation	6.24 ± 0.69	4.00 – 7.00
Controlled motivation	2.93 ± 1.55	1.00 – 6.83
Intrinsic motivation	6.55 ± 0.56	4.75 – 7.00
Identified regulation	5.75 ± 0.97	2.75 – 7.00
Introjected regulation	2.85 ± 1.50	1.00 – 6.65
External regulation	2.33 ± 1.45	1.00 – 6.75
Physical Characteristics		
Age (years)	12.77 ± 1.85	10 – 16
Height (m)	1.60 ± 0.13	1.31 – 1.90
Weight (kg)	51.81 ± 14.13	26.0 – 92.30
BMI (kg/m^2)	20.01 ± 3.26	13.16 – 30.17
BMI-SDS	.55 ± 1.05	-2.93 – 2.79
Physical Activity		
MVPA (min/day)	70.29 ± 24.58	20.54 – 143.11
ST (min/day)	486.66 ± 66.21	320.45 – 616.13
Valid-wear days	6.22 ± 0.90	4.00 – 7.00
Valid-wear time (hours/day)	12.83 ± 0.88	10.75 – 14.91

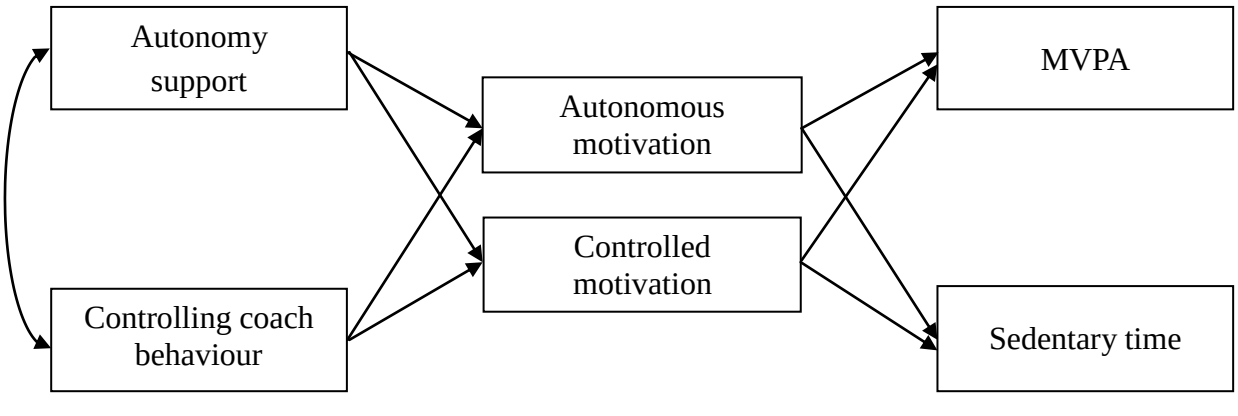
Table 2. Pearson correlations between psychological and PA variables

	1	2	3	4	5
1. Autonomy support					
2. Controlling coach behaviour	-.32**				
3. Autonomous motivation	.58**	-.23*			
4. Controlled motivation	-.12	.42**	-.07		
5. MVPA	.14	-.11	.22*	.13	
6. ST	-.01	.04	-.09	-.07	-.46**

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

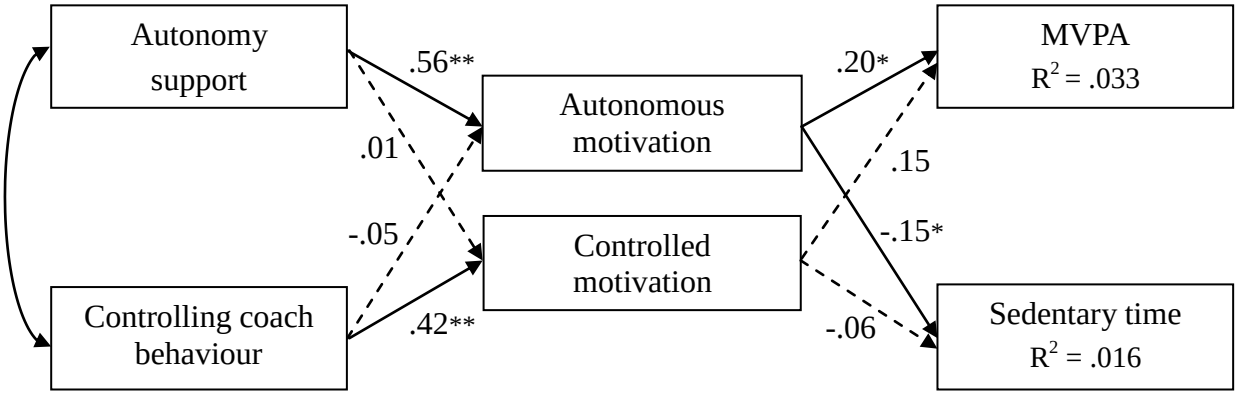
.

Figure 1. The self-determination theory process model



Note: Arrows indicate all paths tested

Figure 2. Data fit to the hypothesised model



Note*:* ** p = <.01, * p = <.05. Dashed lines indicate a non-significant relationship (p >.05).

Age and valid wear time were also included as endogenous variables in the model. Previously identified confounding relationships were controlled for by stipulating direct paths between *a)* valid wear time and MVPA, *b)* valid wear time and ST *c)* age and ST, *d)* age and valid wear time. These relationships are excluded from the figure to allow ease of interpretation

References

Adie, J. W., Duda, J. L., & Ntoumanis, N. (2012). Perceived coach-autonomy support, basic need satisfaction and the well- and ill-being of elite youth soccer players: A longitudinal investigation. *Psychology of Sport and Exercise, 13*(1), 51-59.

Aelterman, N., Vansteenkiste, M., Van Keer, H., Van den Berghe, L., De Meyer, J., & aerens, L. (2012). Students' objectively measured physical activity levels and engagement as a function of between-class and between-student differences in motivation toward physical education. *Journal of Sport and Exercise Psychology, 34*(4), 457-480.

Alderete, T., Gyllenhammer, L. E., Byrd-Williams, C. E., Spruijt-Metz, D., Goran, M. I., & Davis, J. N. (2012). Increasing Physical Activity Decreases Hepatic Fat and Metabolic Risk Factors. *Journal of Exercise Physiology Online, 15*(2), 40-54.

Alvarez, M. S., Balaguer, I., Castillo, I., & Duda, J. L. (2009). Coach autonomy support and quality of sport engagement in young soccer players. *Spanish Journal of Psychology, 12*(1), 138-148.

Arbuckle, J. L., & Wothke, W. (1999). *Amos 4.0 user's guide* Marketing Department, SPSS Incorporated.

Australian Bureau of Statistics. (2009). *Children's Participation in Cultural and Leisure Activities*. Retrieved from: http://www.abs.gov.au/ausstats/abs@.nsf/Products/4901.0~Apr+2009~Main+Features~Organised+sport

Bartholomew, K. J., Ntoumanis, N., Ryan, R. M., & Thogersen-Ntoumani, C. (2011). Psychological need thwarting in the sport context: assessing the darker side of athletic experience. *Journal of Sport and Exercise Psychology, 33*(1), 75-102.

Bartholomew, K. J., Ntoumanis, N., & Thogersen-Ntoumani, C. (2010). The controlling interpersonal style in a coaching context: development and initial validation of a psychometric scale. *Journal of Sport and Exercise Psychology, 32*(2), 193-216.

BeLue, R., Francis, L. A., Rollins, B., & Colaco, B. (2009). One Size Does Not Fit All: Identifying Risk Profiles for Overweight in Adolescent Population Subsets. *Journal of Adolescent Health, 45*(5), 517-524.

Biddle, S. J., Gorely, T., Marshall, S. J., Murdey, I., & Cameron, N. (2004). Physical activity and sedentary behaviours in youth: issues and controversies. *The Journal of the Royal Society for the Promotion of Health, 124*(1), 29-33.

Biddle, S., Marshall, S., Gorely, T., & Cameron, N. (2009). Temporal and Environmental Patterns of Sedentary and Active Behaviors during Adolescents Leisure Time. *International Journal of Behavioral Medicine, 16*(3), 278-286.

Biddle, S. J. H., Pearson, N., Ross, G. M., & Braithwaite, R. (2010). Tracking of sedentary behaviours of young people: A systematic review. *Preventive Medicine, 51*(5), 345-351.

Cain, K., Sallis, J. F., Conway, T. L., Van Dyck, D., & Calhoon, L. (2013). Using Accelerometers in Youth Physical Activity Studies: A Review of Methods. *Journal of Physical Activity and Health, 10*(3), 437-450.

Carson, V., & Janssen, I. (2011). Volume, patterns, and types of sedentary behavior and cardio-metabolic health in children and adolescents: a cross-sectional study. *BMC Public Health, 11*(274).

Chan, D. K., & Hagger, M. S. (2012). Self-determined forms of motivation predict sport injury prevention and rehabilitation intentions. *Journal of Science and Medicine in Sport, 15*(5), 398-406.

Chaput, J. P., Lambert, M., Mathieu, M. E., Tremblay, M. S., O' Loughlin, J., & Tremblay, A. (2012). Physical activity vs. sedentary time: independent associations with adiposity in children. *Pediatric Obesity, 7*(3), 251-258.

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 & Health, 24*(1), 29-48.

Cole, T. J., Freeman, J. V., & Preece, M. A. (1995). Body mass index reference curves for the UK, 1990. *Archives of Disease in Childhood, 73*, 25-29.

Cole, T. J., Freeman, J. V., & Preece, M. A. (1998). British 1990 growth reference centiles for weight, height, body mass index and head circumference fitted by maximum penalized likelihood. *Statistics in Medicine, 17*(4), 407-429.

Colley, R. C., Garriguet, D., Janssen, I., Wong, S. L., Saunders, T. J., Carson, V. et al. (2013). The association between accelerometer-measured patterns of sedentary time and health risk in children and youth: results from the Canadian Health Measures Survey. *BMC Public Health, 13*, 200.

Cox, A. E., Smith, A. L., & Williams, L. (2008). Change in physical education motivation and physical activity behavior during middle school. *Journal of Adolescent Health, 43*(5), 506-513.

Craig, R., & Mindell, J. (2008). *Health Survey for England 2006: Volume 2, Obesity and other risk factors in children.* The Information Centre.

Deci, E. L., & Ryan, R. M. (1987). The support of autonomy and the control of behavior. *Journal of Personality and Social Psychology, 53*(6), 1024-1037.

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*(4), 227-268.

Deci, E. L., & Ryan, R. M. (2008). Facilitating Optimal Motivation and Psychological Well-Being Across Life's Domains. *Canadian Psychology, 49*(1), 14-23.

Deci, E. L., Eghrari, H., Patrick, B. C., & Leone, D. R. (1994). Facilitating Internalization: The Self-Determination Theory Perspective. *Journal of Personality, 62*(1), 119-142.

Department of Health. (2011). UK physical activity guidelines. *Department of Health*. Retrieved from http://www.dh.gov.uk

Dollman, J., Norton, K., & Norton, L. (2005). Evidence for secular trends in childrens physical activity behaviour. *British Journal of Sports Medicine, 39*(12), 892-897

Dowda, M. (2001). Environmental influences, physical activity, and weight status in 8- to 16-year-olds. *Archives of Pediatrics & Adolescent Medicine, 155*(6), 711-717.

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*(2), 375-388.

Ekelund, U., Brage, S., Griffin, S. J., & Wareham, N. J. (2009). Objectively measured moderate- and vigorous-intensity physical activity but not sedentary time predicts insulin resistance in high-risk individuals. *Diabetes Care, 32*(6), 1081-1086.

Ekelund, U., Luan, J., Sherar, L. B., Esliger, D. W., Griew, P., & Cooper, A. (2012). Moderate to vigorous physical activity and sedentary time and cardiometabolic risk factors in children and adolescents. *Journal of the American Medical Association, 307*(7), 704-712.

Epstein, L. H., Roemmich, J. N., Paluch, R. A., & Raynor, H. A. (2005). Physical activity as a substitute for sedentary behavior in youth. *Ann.Behav.Med, 29*(3), 200-209.

Evenson, K. R., Catellier, D. J., Gill, K., Ondrak, K. S., & McMurray, R. G. (2006). Calibration of two objective measures of physical activity for children. *Journal of Sports Sciences, 24*(14), 1557-1565.

Fairclough, S., & Stratton, G. (2005). 'Physical education makes you fit and healthy'. Physical education's contribution to young people's physical activity levels. *Health Education Research., 20*(1), 14-23.

Fan, X., Thompson, B., & Wang, L. (1999). Effect of sample size, estimation methods, and model specification on structural equation modeling fit indexes. *Structural Equation Modeling: A Multidisciplinary Journal, 6*(1), 56-83.

García Calvo, T., Cervelló, E., Jiménez, R., Iglesias, D., & Moreno Murcia, J. A. (2010). Using self-determination theory to explain sport persistence and dropout in adolescent athletes. *Spanish Journal of Psychology, 13*(2), 677-684.

Gaya, A. R., Alves, A., Aires, L., Martins, C. L., Ribeiro, J. C., & Mota, J. (2009). Association between time spent in sedentary, moderate to vigorous physical activity, body mass index, cardiorespiratory fitness and blood pressure. *Annals of Human Biology, 36*(4), 379-387.

Gillison, F. B., Standage, M., & Skevington, S. M. (2011). Motivation and body-related factors as discriminators of change in adolescents' exercise behavior profiles. *Journal of Adolescent Health, 48*(1), 44-51.

Hagger, M., Chatzisarantis, N. L., Hein, V., Soos, I., Karsai, I., Lintunen, T. et al. (2009). Teacher, peer and parent autonomy support in physical education and leisure-time physical activity: A transcontextual model of motiation in four nations. *Psychology and Health, 24*(6), 689-711.

Henderson, M., Gray-Donald, K., Mathhieu, M., Barnett, T. A., Hanley, J. A., O'Loughlin, J. et al. (2012). How Are Physical Activity, Fitness, and Sedentary Behavior Associated With Insulin Sensitivity in Children? *Diabetes Care, 35*(6), 1272-1278.

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

Janssen, I., & Leblanc, A. G. (2010). Systematic review of the health benefits of physical activity and fitness in school-aged children and youth. *International Journal of Behavior Nutrition and Physical Activity., 7*, 40.

Katzmarzyk, P. T. (2010). Physical Activity, Sedentary Behavior, and Health: Paradigm Paralysis or Paradigm Shift? *Diabetes, 59*(11), 2717-2725.

King, A. C., Parkinson, K. N., Adamson, A. J., Murray, L., Besson, H., Reilly, J. J. et al. (2010). Correlates of objectively measured physical activity and sedentary behaviour in English children. *The European Journal of Public Health*.

Kjonniksen, L., Anderssen, N., & Wold, B. (2009). Organized youth sport as a predictor of physical activity in adulthood. *Scandinavian Journal of Medicine & Science in Sports, 19*(5), 646-654.

Kunz, M. (2007). *265 million playing football*. In *FIFA Magazine, July issue* Retrieved from http://www.fifa.com/mm/document/fifafacts/bcoffsurv/emaga_9384_10704.pdf

Leek, D., Carlson, J. A., Cain, K. L., Henrichon, S., Rosenberg, D., Patrick, K. et al. (2011). Physical activity during youth sports practices. *Archives of Pediatriacs and Adolescent Medicine, 165*(4), 294-299.

Lonsdale, C., Hodge, K., & Rose, E. A. (2008). The behavioral regulation in sport questionnaire (BRSQ): instrument development and initial validity evidence. *Journal of Sport and Exercise Psychology., 30*(3), 323-355.

Lonsdale, C., Rosenkranz, R. R., Sanders, T., Peralta, L. R., Bennie, A., Jackson, B. et al. (2013). A cluster randomized controlled trial of strategies to increase adolescents' physical activity and motivation in physical education: Results of the Motivating

Active Learning in Physical Education (MALP) trial. *Preventive Medicine, 57*(5), 696-702.

Loucaides C.A, Jago, R., & Theophanous, M. (2011). Physical activity and sedentary behaviours in Greek-Cypriot children and adolescents: a cross-sectional study. *8*, 90.

Machado-Rodrigues, Am. M., Coelho e Silva, M. J., Mota, J., Santos, R. M., Cummin, S. P., & Malina, R. M. (2012). Physical Activity and Energy Expenditure in Adolescent Male Sport Participants and Nonparticipants Aged 13 to 16 Years. *Journal of Physical Activity and Health, 9*(5), 626-633.

Macho, S., & Ledermann, T. (2011). Estimating, testing, and comparing specific effects in structural equation models: The phantom model approach. *Psychological Methods, 16*(1), 34-43.

Mageau, G. A., & Vallerand, R. J. (2003). The coach athlete relationship: a motivational model. *Journal of Sports Sciences, 21*(11), 883-904.

Maher, C., Olds, T., Mire, E., & Katzmarzyk, P. T. (2014). Reconsidering the sedentary behaviour paradigm. *PLoS ONE, 15*(9), e86403.

Mark, A. E., & Janssen, I. (2011). Influence of movement intensity and physical activity on adiposity in youth. *Journal of Physical Activity and Health, 8*(2), 164-173.

Martinez-Gomez, D., Eisenmann, J. C., Healy, G. N., Gomez-Martinez, S., Diaz, L. E., Dunstan, D. W. et al. (2012). Sedentary behaviors and emerging cardiometabolic biomarkers in adolescents. *Journal of Pediatrics, 160*(1), 104-110.

Martinez-Gomez, D., Eisenmann, J. C., Tucker, J., Heelan, K. A., & Welk, G. J. (2011). Associations between moderate-to-vigorous physical activity and central body fat in 3-8-year-old children. *International Journal of Pediatric Obesity, 6*(2-2), e611-e614.

Mitchell, J. A., Pate, R. R., Beets, M. W., & Nader, P. R. (2013, print). Time spent in sedentary behavior and changes in childhood BMI: a longitudinal study from ages 9 to 15 years. *Int J Obes, 37*(1), 54-60.

National Council of Youth Sports. (2008). *Report on Trends and Participation in Organized Youth Sports*. Retrieved from: http://www.ncys.org/publications/2008-sports-participation-study.php

Nelson, M. C., Neumark-Stzainer, D., Hannan, P. J., Sirard, J. R., & Story, M. (2006). Longitudinal and Secular Trends in Physical Activity and Sedentary Behavior During Adolescence. *Pediatrics, 118*(6), e1627-e1634.

Nelson, T. F., Stovitz, S. D., Thomas, M., LaVoi, N. M., Bauer, K. W., & Neumark-Sztainer, D. (2011). Do youth sports prevent pediatric obesity? A systematic review and commentary. *Current Sports Medicine Reports., 10*(6), 360-370.

Ness, A., Leary, S., Mattocks, C., Blair, S. N., Reilly, J. J., Wells, J. et al. (2007). Objectively measured physical activity and fat mass in a large cohort of children. *PLoSMed, 4*(3), e97.

Owen, K. B., Astell-Burt, T., & Lonsdale, C. (2013). The Relationship Between Self-Determined Motivation and Physical Activity in Adolescent Boys. *Journal of Adolescent Health, 53*(3), 420-422.

Pate, R. R., Mitchell, J. A., Byun, W., & Dowda, M. (2011). Sedentary behaviour in youth. *British Journal of Sports Medicine, 45*(11), 906-913.

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* (4), 279-306.

Perlman, D. J. (2013). The influence of the social context on students in- class physical activity. *Journal of Teaching in Physical Education, 32*(1), 46-60.

Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behavior Research Methods, 40*(3), 879-891.

Prentice-Dunn, H., & Prentice-Dunn, S. (2011). Physical activity, sedentary behavior, and childhood obesity: A review of cross-sectional studies. *Psychology, Health & Medicine, 17*(3), 255-273.

Riddoch, C. J., Mattocks, C., Deere, K., Saunders, J., Kirkby, J., Tilling, K. et al. (2007). Objective measurement of levels and patterns of physical activity. *Archives of Disease in Childhood, 92*(11), 963-969.

Roemmich, J. N., Lambiase Ms, M. J., McCarthy, T. F., Feda, D. M., & Kozlowski, K. F. (2012). Autonomy supportive environments and mastery as basic factors to motivate physical activity in children: a controlled laboratory study. *International Journal of Behavioral Nutrition and Physical Activity*, *9*(16).

Ryan, R. M. (1995). Psychological needs and the facilitation of integrative processes. *Journal of Personality, 63*(3), 397-427.

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist, 55*(1), 68-78.

Sardinha, L. B., Andersen, L. B., Anderssen, S. A., Quiterio, A. L., Ornelas, R., Froberg, K. et al. (2008). Objectively measured time spent sedentary is associated with insulin resistance independent of overall and central body fat in 9- to 10-year-old Portuguese children. *Diabetes Care, 31*(3), 569-575.

Sebire, S. J., Jago, R., Gorely, T., Hoyos Cillero, I., & Biddle, S. J. H. (2011). "If there wasn't the technology then I would probably be out everyday": A qualitative study of children's strategies to reduce their screen viewing. *Preventive Medicine, 53*(4GÇô5), 303-308.

Sebire, S. J., Jago, R., Fox, K. R., Edwards, M. J., & Thompson, J. L. (2013) Testing a self-determination theory model of children's physical activity motivation: a cross-sectional study. *International Journal of Behavioral Nutrition and Physical Activity,* 10(1), 111.

Sebire, S. J., Standage, M., & Vansteenkiste, M. (2011). Predicting objectively assessed physical activity from the content and regulation of exercise goals: evidence for a mediational model. *Journal of Sport and Exercie Psychology, 33*(2), 175-197.

Sedentary Behaviour Research Network. (2012). Letter to the Editor: Standardized use of the terms 'sedentary' and 'sedentary behaviours'. *Applied Physiology, Nutrition, and Metabolism, 37*(3), 540-542.

Shrout, P. E., & Bolger, N. (2002). Mediation in experimental and nonexperimental studies: New procedures and recommendations. *Psychological Methods, 7*(4), 422-445.

Standage, M., Gillison, F. B., Ntoumanis, N., & Treasure, D. C. (2012). Predicting students' physical activity and health-related well-being: a prospective cross-domain investigation of motivation across school physical education and exercise settings. *Journal of Sport and Exercise Psychology, 34*(1), 37-60.

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 and Exercise Psychology, 30*(4), 337-352.

Strong, W. B., Malina, R. M., Blimkie, C. J. R., Daniels, S. R., Dishman, R. K., Gutin, B. et al. (2005). Evidence Based Physical Activity for School-age Youth. *The Journal of Pediatrics, 146*(6), 732-737. doi:10.1016/j.jpeds.2005.01.055

Taylor, I. M., Ntoumanis, N., Standage, M., & Spray, C. M. (2010). Motivational predictors of physical education students' effort, exercise intentions, and leisure-time physical

activity: a multilevel linear growth analysis. *Journal of Sport and Exercise Psychology, 32*(1), 99-120.

Teixeira, P., Carraca, E., Markland, D., Silva, M., & Ryan, R. (2012). Exercise, physical activity, and self-determination theory: A systematic review. *International Journal of Behavioral Nutrition and Physical Activity, 9*(1), 78.

Telama, R., Yang, X., Viikari, J., Valimaki, I., Wanne, O., & Raitakari, O. (2005). Physical activity from childhood to adulthood: a 21-year tracking study. *American Journal of Preventive Medicine, 28*(3), 267-273.

Tremblay, M. S., LeBlanc, A. G., Kho, M. E., Saunders, T. J., Larouche, R., Colley, R. C. et al. (2011). Systematic review of sedentary behaviour and health indicators in school-aged children and youth. *International Journal of Behavior Nutrition and Physical Activity, 8*, 98.

Trilk, J. L., Ortaglia, A., Blair, S. N., Bottai, M., Church, T. S., & Pate, R. R. (2013). Cardiorespiratory Fitness, Waist Circumference, and Alanine Aminotransferase in Youth. *Medicine & Science in Sports & Exercise, 45*(4).

Trost, S. G. (2007). State of the Art Reviews: Measurement of Physical Activity in Children and Adolescents. *American Journal of Lifestyle Medicine, 1*(4), 299-314.

Trost, S. G., Pate, R. R., Freedson, P. S., Sallis, J. F., & Taylor, W. C. (2000). Using objective physical activity measures with youth: how many days of monitoring are needed? *Medicine and Science in Sports and Exercise., 32*(2), 426-431.

UK Statistics Authority. (2013). *Taking Part - Statistical Release* Department for Culture, Media and Sport. Retrieved from: www.gov.uk/government/uploads/system/uploads/attachment_data/file/191967/Taking_Part_2011Q4_12Q3_Supplementary_Child_Report.pdf

US Department of Health and Human Services. (2013). Physical activity guidelines for Americans. Retrieved from http://www.health.gov/PAguidelines/guidelines/chapter3.aspx.

Vallerand, R. J. (1997). Toward a hierarchical model of intrinsic and extrinsic motivation. In M.P. Zanna (Ed.), *Advances in experimental social psychology* (pp. 271-360). New York: Academic Press.

Van Hoye, A. l., Fenton, S., Krommidas, C., Heuzé, J.-P., Quested, E., Papaioannou, A. et al. (2013). Physical activity and sedentary behaviours among grassroots football players: A comparison across three European countries. *International Journal of Sport and Exercise Psychology, 11*(4), 341-350

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*(5), 795-817.

Viladrich, C., Appleton, P. R., Quested, E., Duda, J. L., Alcaraz, S., Heuzé, J.-P. et al. (2013). Measurement invariance of the Behavioural Regulation in Sport Questionnaire when completed by young athletes across five European countries. *International Journal of Sport and Exercise Psychology, 11*(4), 384-394

Wickel, E. E., & Eisenmann, J. C. (2007). Contribution of youth sport to total daily physical activity among 6- to 12-yr-old boys. *Medicine and Science in Sports and Exercise, 39*(9), 1493-1500.

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*(1), 115-126.

Womens Sports Foundation. (2008). *Go Out and Play: Youth Sports in America*. Retrieved from: http://www.womenssportsfoundation.org/home/research/articles-and-reports/mental-and-physical-health/go-out-and-play