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Optimising physical activity engagement during youth sport: A self-determination theory approach

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Running head: Autonomy support, autonomous motivation and youth sport PA engagement

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Abstract

Research suggests participation in youth sport does not guarantee physical activity (PA) guidelines are met. Studies indicate few children achieve recommended levels of moderate-to-vigorous physical activity (MVPA) during their youth sport involvement, and habitual levels of MVPA are below the recommended 60 minutes per day. Informed by self-determination theory, this study examined whether the coach created social environment and related player motivation predict variability in objectively measured MVPA within the youth sport setting. Seventy three male youth sport footballers (Mage = 11.66 ± 1.62) completed a multi-section questionnaire assessing their perceptions of the social environment created in youth sport (autonomy supportive and controlling), and motivation towards their football participation (autonomous and controlled). Intensity of PA during youth sport was measured using accelerometers (GT3X, Actigraph). Results supported a model in which perceptions of autonomy support significantly and positively predicted autonomous motivation towards football, which in turn significantly and positively predicted youth sport MVPA (% time). A significant indirect effect was observed for perceptions of autonomy support on youth sport %MVPA via autonomous motivation. **Conclusion:** Results have implications for optimising PA engagement during youth sport and increasing daily MVPA towards recommended and health enhancing levels on youth sport days.

Key words: *Youth sport, self-determination theory, autonomy support, MVPA, accelerometer*

Introduction

Evidenced based guidelines advise that children and adolescents should engage in at least 60 minutes of moderate-to-vigorous physical activity (MVPA) per day (Mark & Janssen, 2011; Strong et al., 2005). However, population based studies indicate few children and adolescents achieve these levels of participation (Collings et al., 2014; Troiano et al., 2008). Accordingly, considerable attention has been drawn towards identifying settings that afford youth the opportunity to regularly engage in MVPA towards health enhancing levels.

Youth sport has been advocated as a vehicle through which more physically active lifestyles can be realised and encouraged among children and adolescents (Centers for Disease Control and Prevention, 2000; Commission of the European Communities, 2007). Indeed, a number of studies have indicated youth sport participants engage in higher levels of self-reported MVPA than their non-sporting peers (Nelson et al., 2011). However, advances in the objective assessment of physical activity (PA) have since enabled studies to more critically determine levels of PA engagement associated with sport participation. Specifically, the application of accelerometers to youth sport research has revealed that participation in youth sport and engaging in a physically active lifestyle (i.e., meeting guidelines for MVPA) are not synonymous. Indeed, there is a growing body of evidence to indicate that few children achieve recommended levels of MVPA during their youth sport involvement, and also within their daily lives. For example, studies have revealed youth sport participants can accumulate as little as 17 minutes of MVPA during their youth sport participation, spending up to 70% of sport time sedentary or engaged in light PA (Fenton, Duda & Barrett, 2015a; Guagliano, Rosenkranz, & Kolt, 2013; Sacheck et al., 2011). Similarly, a recent study also demonstrated that only 19% of youth sport footballers accumulated ≥ 60 minutes of MVPA every day of the week (Fenton, Duda & Barrett, 2015b). This is comparable to levels of daily MVPA observed in a population-based study of Irish youth (Woods et al., 2010). Thus, whilst

involvement in youth sport may offer a number of children and adolescents the opportunity to engage in substantial amounts of MVPA, participation alone does not necessarily guarantee MVPA recommendations are met. As such, it appears there is scope to increase young people's engagement in MVPA during youth sport time in order to help them meet recommended and health enhancing levels of MVPA on 'sport days' (Leek et al., 2011; Pate & O'Neill, 2011).

In order to encourage higher levels of MVPA engagement during youth sport, it is important to identify potential determinants of PA participation within this setting. To date, studies have investigated how PA engagement during youth sport may vary as a function of both demographic and contextual factors [e.g., body mass index (BMI), gender, age, sport and session type (i.e., training sessions versus matches)] (Cohen, McDonald, McIver, Pate, & Trost, 2014; Fenton et al., 2015a; Leek et al., 2011; Sacheck et al., 2011). However, whilst numerous studies have identified important psychological correlates of PA engagement within PE and leisure time settings (e.g., perceptions of autonomy, self-efficacy and enjoyment) (Carroll & Loumidis, 2001; Perlman, 2013; Standage, Gillison, Ntoumanis, & Treasure, 2012), existing research has neglected to investigate social psychological factors that may contribute towards the variability in levels of objectively assessed MVPA engagement observed within the youth sport context (i.e., within the organised sport club setting).

Self-determination theory (SDT, Deci & Ryan, 1987; Deci & Ryan, 2000) is a theoretical framework that has been successfully applied in order to understand the psychological processes likely to impact upon PA engagement across many contexts, including youth sport (Fenton, Duda, Quested, & Barrett, 2014; Owen, Smith, Lubans, Ng, & Lonsdale, 2014; Teixeira, Carraca, Markland, Silva, & Ryan, 2012). SDT considers motivation not as a unitary concept concerned only with the intensity of motivation (i.e.,

whether high or low in motivation), but as a multifaceted construct, outlining the importance of understanding not only to what extent an individual is motivated to act, but also 'why' (Deci & Ryan, 2000). Specifically, SDT advocates that variability in the reasons 'why' an individual is motivated to act (i.e., the quality of motivation), holds implications for one's cognition, affect and behaviour (e.g., PA engagement).

Central to SDT is the proposition that an individuals' choice to engage in a behaviour can vary in the degree to which it emanates from the self (i.e., is autonomous), or is driven by external factors or internalised contingencies such as shame or guilt (i.e., is controlled) (Deci & Ryan, 1985). Where behaviour is regulated by more autonomous motives (i.e. intrinsic motivation and identified regulation), an individual will engage in an activity for its own sake, for the inherent fun and interest in that activity (*intrinsic motivation,* e.g., because I enjoy it), or to accomplish valued and internalised goals and outcomes (*identified regulation, e.g.,* because it is important to me). In contrast, where participation in an activity occurs due to internal pressures, to enhance internal feelings of pride or self-esteem *(introjected regulation,* e.g., because I would feel guilty if I did not), or due to external factors (*external regulation,* e.g., because people push me to), less self-determined or controlled motivation is assumed to be operating (Deci & Ryan, 2000). SDT postulates that where behaviours are guided by more autonomous motivation, adaptive cognitive, affective and behavioural consequences will result (Deci & Ryan, 2008). Conversely, it is hypothesised that controlled motivation is associated with more maladaptive outcomes and behavioural disengagement (Deci & Ryan, 2008; Pelletier, Fortier, Vallerand, & Brière, 2001).

A fundamental tenet of SDT is that central to an individuals' motivation regulation is the social environment operating within a given context (Deci & Ryan, 1987). Social environments are largely created by the interpersonal behaviours of significant others (e.g., authority figures; coaches, parents, managers, teachers, general practitioners) acting within a

specific setting. Studies across multiple domains (including youth sport) reveal that perceptions of an autonomy supportive context (i.e., one which offers a choice, provides rationale and promotes understanding) are likely to facilitate more autonomous motivation (Alvarez, Balaguer, Castillo, & Duda, 2012; Edmunds, Ntoumanis, & Duda, 2008; Rouse, Ntoumanis, Duda, Jolly, & Williams, 2011). Conversely, perceptions of a controlling environment (i.e., a coercive environment in which pressure is exerted upon individuals and choice is limited), are likely to undermine autonomous motivation and are associated with more controlled forms of motivation (Balaguer et al., 2012; Bartholomew, Ntoumanis, & Thogersen-Ntoumani, 2010; Pelletier et al., 2001). As such, a motivational sequence is proposed by SDT in which the social environment can serve to facilitate or forestall ones degree of self-determined motivation, which in turn, will result in varied cognitive, affective and behavioural consequences, depending on the degree to which behaviour is self-determined (Deci & Ryan, 1987; Deci & Ryan, 2000).

The social environment and youth PA engagement

Adults acting within youth PA settings (e.g., Physical Education (PE) teachers, coaches) are principle contributors towards the creation of the social environment (Deci & Ryan, 1987; Deci and Ryan, 2000). Past work examining the associations between the social environment, motivation and PA engagement among youth have largely been informed by a trans-contextual model of motivation, examining the implications of the social environment within the Physical Education and youth sport settings for levels of PA engagement outside of these contexts (Chatzisarantis & Hagger, 2009; Gonzalez-Cutre, Sicilia, Beas-Jimenez, & Hagger, 2013; Hagger et al., 2009; Standage et al., 2012). Results from these studies have provided support for the motivational processes theorised by SDT to underlie adaptive behavioural outcomes. That is, perceptions of autonomy supportive PE and youth sport environments are reported to be positively associated with PA related autonomous

motivation, which in turn, is linked to higher levels of daily or leisure time PA engagement. However, extant studies examining the SDT-referenced motivational processes underpinning levels of PA engagement are largely hampered by their reliance on self-report instruments, or pedometers, which do not enable calculation of time spent in different PA intensities (e.g., Chatzisarantis & Hagger, 2009; Cox, Smith & Williams, 2008; Standage et al., 2012). Indeed, it is only recently that researchers have begun to employ accelerometers in order to examine the contribution of the social environment and ensuing motivation to MVPA engagement among youth (e.g., Fenton et al., 2014). Still, these studies employing accelerometry also point to the social environment as a prominent factor influencing habitual levels of PA engagement among youth.

Building upon extant SDT-informed work employing objective measures of daily and leisure time PA, several studies have also examined the relationship between autonomous motivation and levels of accelerometer assessed MVPA during PE lessons (i.e., *within-context* MVPA). These investigations have highlighted autonomous motivation to be a salient predictor of MVPA engagement during PE (Aelterman et al., 2012; Lonsdale et al., 2013; Owen, Astell-Burt, & Lonsdale, 2013; Perlman, 2013). However, present research has neglected to examine the role of the social environment as a precursor to autonomous motivation cultivated within the PE setting, and resulting *within-context* MVPA engagement. In addition, current studies have also not extended their investigations beyond the PE environment. As such, research is required to investigate the motivational processes hypothesised by SDT (i.e., the social environment → motivation → PA engagement) with regards to *within-context* MVPA participation. Moreover, this line of enquiry should move beyond an exclusive focus on the PE context, and encompass other settings which are assumed to provide young people with the opportunity to engage in health enhancing PA (e.g., youth sport).

The present study: within-context MVPA engagement during youth sport

Fenton et al., (2014) were the first to provide evidence to support the sequential associations hypothesised by SDT with respect to the social environment created in youth sport and objectively assessed MVPA participation. Specifically, the authors reported perceptions of coach provided autonomy support positively predicted autonomous motivation, which in turn, was positively linked to daily MVPA. However, whilst findings from this study underlined the value of fostering autonomous motivation for promoting higher habitual engagement in MVPA, the potential contribution of the coach created social environment (and ensuing motivation regulations) to levels of MVPA engagement *during* youth sport time were not explored. Thus, the primary aim of the present study was to investigate the sequential associations between perceptions of the social environment created by the coach (autonomy supportive and controlling), motivation for sport participation (autonomous and controlled) levels of MVPA engagement exhibited within the youth sport setting [i.e., within-context (youth sport) MVPA)] (Figure 1). A second exploratory aim of the present study was to examine the bivariate relationships between the social environment and individual motivation regulations (i.e., intrinsic motivation and identified, introjected and external regulations) with engagement in both moderate PA (MPA) and vigorous PA (VPA) when considered separately. Indeed, the importance of studying the correlates of VPA separate to MPA has been emphasised as a result of research revealing VPA to be more strongly associated with health outcomes than MPA among youth (Steele, van Sluijs, Cassidy, Griffin & Ekelund, 2009). Due to its global popularity and the resulting potential for widespread application of findings (Kunz, 2007), youth sport football was the targeted sport examined in the current research.

****Figure 1 inserted here****

Method

Participants and recruitment

Participants were a subsample of male youth sport football players (N = 149) aged 9 to 15 years, recruited within a larger multi-method trial (the Promoting Adolescent Physical Activity Project (PAPA) Project [EC FP7 – Health, project reference - 223600]; www.projectpapa.org) (Duda et al., 2013). In the present study, youth sport football was defined as participation in football as part of an organised sports club outside the school setting (i.e., during leisure time). Players recruited to the PAPA project were participating in football at the grassroots level (i.e., recreational participation, training sessions and/or match play ≥ once per week), and were not playing for professional clubs or in regional, national or international teams. Objective PA data (i.e., PA assessed via accelerometer) were collected from a subsample of participants recruited to the larger project. The full protocol for the PAPA Project and the core objective PA measurement protocol are detailed elsewhere (Duda et al., 2013; Van Hoye et al., 2013). The following sections outline the protocol followed in England where supplementary measures were included (i.e., PA diaries enabling identification of time spent engaged in youth sport football during the week).

Lead coaches at grassroots football clubs were contacted by a member of the research team [via phone call and/or email, (clubs, N = 58)]. A total of 38 male teams, representing 18 clubs agreed to participate in the study. Interested coaches were provided with information about the study protocol and this information was passed on to parents and players. Players were then recruited based on their willingness to take part (N = 4 per team). Only male footballers were recruited as a smaller number of female teams showed interest in participating (N = 1). Informed participant assent and parental consent was obtained before recruitment to the study. The study was approved by the local National Health Service ethics committee (application: 10/H1207/39).

Protocol

A researcher visited two training sessions of participating teams one week apart to carry out anthropometric measurements (i.e., body mass index [height and weight]), distribute accelerometers and administer questionnaires. During the first visit, participants were fitted with an accelerometer and measures of height and weight were recorded (approximately 10 minutes per participant). PA diaries were also distributed to aid with data cleaning and interpretation to enable participants to record participation in youth sport football sessions during the study week. During the second visit, participants were asked to complete a questionnaire assessing perceptions of the coach created social environment and PA diaries and accelerometers were collected (approximately 40 minutes for each participant to complete the full PAPA questionnaire pack; Duda et al., 2013). All data were collected at least 6 weeks into the football season in order to allow time for the coach created social environment to have been established (Duda et al., 2013; Tessier et al., 2013).

Measures

Anthropometrics. Height (SECA, Leicester height measure) and weight (Tanita, SC3310) were measured with participants' bare foot and wearing light clothing. Measures were conducted in duplicate to the nearest 0.1cm and 0.1kg, respectively. BMI was calculated [(BMI = weight (kg)/height (m^2)] and converted to BMI standard-deviation-scores (BMI-SDS) for use in subsequent analysis (Cole, Freeman, & Preece, 1998).

Perceptions of the coach created social environment. Perceptions of coach-provided autonomy support and controlling coach behaviours were assessed via the Empowering and Disempowering Motivational Climate Questionnaire (Appleton, Ntoumanis, Quested, Vildarich & Duda, 2015). The validity, factor structure and internal reliability of this measure have been supported via analyses across three separate samples (total N = 2273) of youth sport participants (Appleton et al., 2015). Following the stem "So far this season....,"

twelve items were used to assess perceptions of the social environment as autonomy supportive (5 items, e.g., my coach gives players choices and options) and controlling (7 items, e.g., my coach threatens to punish players to keep them in line during training). Players were asked to rate their agreement with questionnaire items on a 5-point Likert-scale ranging from 1 (strongly disagree) to 5 (strongly agree).

Motivation regulations. An adapted version of the Behavioral Regulation in Sport Questionnaire (BRSQ) was employed to measure participants' autonomous and controlled motivation towards engagement in football (Lonsdale, Hodge, & Rose, 2008; Viladrich et al., 2013). The internal consistency, test re-test reliability and factorial validity of the BRSQ has been supported in previous research conducted among sport participants (Lonsdale et al., 2008). Recently, the BRSQ was validated among a sample of youth sport footballers aged 9 to 15 years old from 5 European countries (Viladrich et al., 2013). Following the stem: "I play football for this team…", sixteen items were used to tap intrinsic motivation (4 items, e.g., because it is fun) identified regulation (4 items, e.g.., because I value the benefits), introjected regulation, (4 items, e.g., because I would feel guilty if I quit) and external regulation (4 items, e.g., because if I don't other people will not be pleased with me). Players were asked to rate their agreement with questionnaire items on a 5-point Likert-scale ranging from 1 (strongly disagree) to 5 (strongly agree). Intrinsic motivation and identified regulation were combined, and introjected and external regulation joined to form the composite variables of autonomous and controlled motivation, respectively.

Youth sport physical activity. The GT3X accelerometer (Actigraph; Pensacola, FL) was used to measure PA in youth sport footballers. Actigraph accelerometers have been validated against criterion measures of PA in youth (de Vries et al., 2009). The GT3X uses a tri-axial accelerometer to detect movements in three planes, recorded over pre-specified time periods called epochs. Movements within each epoch are summed and converted to 'activity

counts' that are interpreted to determine time spent in different intensities of activity. Accelerometers were initialised to measure PA in 15 second epochs. Participants were asked to wear the accelerometer for seven days during all waking hours, removing only for water-based activities (e.g., swimming, bathing). Verbal instructions were given by a trained researcher on how the accelerometer should be worn and a demonstration given. Participants were asked to record non-wear time (i.e., removal of accelerometers) and participation in youth sport football in PA diaries.

Data reduction

Physical activity data were downloaded from the GT3X to a computer and analysed using the Actilife software (Actilife version 6.2; Actigraph). Participants were excluded from subsequent analysis where they did not record valid youth sport PA data during the study week [N = 59 (no accelerometer data = 33, no PA diary = 26]), or failed to complete questionnaires assessing psychological variables (N = 17). Therefore, the final sample included 73 males aged 9 to 14 years (compliance = 48.99%), representing participants from 33 teams across all 18 clubs recruited.

Calculation of youth sport PA

Time spent in youth sport football was identified from PA diaries and visual comparisons were made with graphed data to check for accuracy in self-reported timings. To further ensure youth sport session timings were accurately identified, data from accelerometers and PA diaries were checked against the dates and times of training sessions and matches, as reported by each team coaches. In addition, data comparisons were drawn between players within teams who were scheduled to participate in training sessions or matches at the same time during the study week. Minutes of MPA ($\geq$ 2296 counts per minute) and VPA ($\geq$ 4012 counts per minute) accumulated during youth sport football were calculated and summed to determine youth sport session time engaged in MVPA

(min/session) (Evenson, Catellier, Gill, Ondrak, & McMurray, 2006, Trost, Loprinzi, Moore, & Pfeiffer, 2011). In order to adjust for the differing length of youth sport sessions, percentage of youth sport session time engaged in MPA, VPA and MVPA were calculated (e.g., youth sport %MVPA = (MVPA min/session ÷ youth sport session length) x 100) and used as dependent variables in subsequent analysis. Adopting this approach reduced the number of parameters identified in path models, allowing testing of more parsimonious models. Specifically, it was not necessary to youth sport session length (and the associated error term) as variables within the hypothesised model.

Statistical Analysis

Descriptive statistics were computed for all measured variables. Residuals for all measured variables were checked for non-normality. Non-normally distributed variables included age, perceptions of autonomy support and autonomous motivation (also intrinsic and identified regulation separately). Log transformations reduced skewness in the case of age, but did not improve skewness for the psychological variables. Consequently, non-transformed variables of autonomy support and autonomous motivation were retained for use in path analysis, and models analysed in conjunction with bootstrapping. Bootstrapping is a nonparametric resampling procedure that does not impose the assumption of normality of the sampling distribution. For consistency, age was therefore also retained for analyses in its non-normalised form.

Youth sport PA data represented a mixture of both football training sessions and matches (training sessions, N = 34, matches, N = 39). Age, BMI and youth sport context (i.e., training sessions versus match play) have been shown to demonstrate associations with PA during youth sport (Fenton et al., 2014; Guagliano et al., 2013; Leek et al., 2011; Sacheck et al., 2011). Preliminary analyses were therefore conducted to identify whether these individual (age and BMI) and contextual (youth sport context) level factors were associated with youth sport PA engagement. Pearson correlations were conducted to investigate the relationships between % youth sport time engaged in MPA, VPA and MVPA with age and BMI-SDS. One

way univariate Analyses of Variance (ANOVAs) were also performed to determine whether youth sport MPA, VPA and MVPA (% session time) varied as a function of youth sport context. Effect sizes are reported to illustrate the magnitude of the differences observed (η^2; .01 to <.06 = small, .06 to <.14 = medium, ≥.14 = large). Where associations were present, variables were adjusted for in subsequent analyses.

Following preliminary analyses, partial correlations (adjusting for age, BMI and youth sport context where appropriate) were carried out to examine the relationships between perceptions of the targeted dimensions of the social environment, motivation regulations and youth sport PA variables. With regards to the primary study aim, (i.e., investigating the associations between the social environment, autonomous and controlled motivation, and youth sport %MPA, %VPA and %MVPA), associations between the targeted variables were then further examined in a subsequent path analysis.

Path analysis with maximum likelihood estimation was employed to test the theorised relationships between the social environment, autonomous and controlled motivation, and youth sport %MVPA using AMOS version 21 (Figure 1). Model fit was analysed using chi squared (χ^2), comparative fit index (CFI), the root square mean error of approximation (RMSEA) and the standardised root square mean 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 ≤ .06 (RMSEA) and ≤.08 (SRMR) indicate a well-specified model. For the CFI, thresholds of > .90 and > .95 indicate acceptable and excellent fit of the data to the hypothesised model respectively (Hu & Bentler, 1999). To examine indirect effects, the phantom model approach was used in conjunction with bootstrapping (Macho & Ledermann, 2011). Bootstrap-generated 95% bias corrected confidence intervals were constructed for 5000 samples on the hypothesised model (Preacher

& Hayes, 2008). Advantages of the bootstrapping approach include its reported superiority to alternative tests with respect to Type 1 error rates and power, and increased stability of parameter estimates under conditions of non-normality (Preacher & Hayes, 2008). The application of the phantom model approach enables only the calculation of unstandardized path coefficients. The size of the effects can therefore be interpreted using the original scales of the variables in the hypothesised model.

Results

Descriptive statistics for physical characteristics are reported in Table 1. One way univariate ANOVAs indicated participants included in the final sample (N = 73) did not differ from those excluded in terms of age (F (1,147) = .22, p = .64, η^2 = .00), height (F (1,144) = .03, p =.86, η^2 = .00), weight (F (1,144) = .97, p =.33, η^2 = .01), BMI (F (1,144) = 3.16, p =.08, η^2 = .02), and daily MVPA (F (1,121) = 2.65, p =.11, η^2 = .02), and VPA (F (1,121) = .62, p =.43, η^2 = .01). BMI-SDS was significantly higher in excluded compared to included participants (F (1,144) = 6.17, p = .01, η^2 = .04, and daily MPA (min/day) was significantly higher in included relative to excluded participants (F (1,121) = 5.61, p = .02, η^2 = .04). However, the proportion of normal-weight to overweight/obese participants was not significantly different between the included and excluded groups (BMI $\geq 85^{th}$ percentile; included, N = 12, excluded, N = 18, χ^2 (1) = 1.51, p = .22).

****Table 1 inserted here****

Youth sport PA and covariates

Youth sport session length ranged from 60 to 150 minutes (M = 106.71 ± 15.86). Participants engaged in MPA, VPA and MVPA for 22.53% ± 6.22, 25.48% ± 11.94 and 48.25% ± 13.90 of youth sport session time, respectively. Preliminary analysis revealed BMI-SDS was not significantly associated with youth sport %MPA (r = .15, p = .20), %VPA (r = .07, p = .56) or %MVPA, (r = .13, p = .28). Youth sport %MPA was also not significantly

related to age (r = .09, p = .48). However, youth sport %VPA and %MVPA were significantly positively associated with age (%VPA, r = .60 p <.01, %MVPA, r = .56, p <.01). In addition, participants who reported engaging in match play spent a significantly higher percentage of time engaged in MPA, VPA and MVPA than those who reported engaging in training sessions (%MPA, F (1, 71) = 6.98, p = .01, η^2 = .09; %VPA, F (1, 71) = 4.05, p <.05, η^2 = .05; %MVPA F (1, 71) = 7.80, p <.01, η^2 = .10 [*training sessions*; %MPA, M = 20.46 ± 6.02, %VPA, M = 23.33 ± 10.14, *match play;* %MPA, M = 27.08 ± 7.34, %VPA, M = 31.33 ± 15.89]). Based on preliminary analyses, age and youth sport context (i.e., training sessions vs. match play) were considered as predictor variables and controlled for in partial correlations and path models (see Figure 2 legend).

Partial correlations

Table 2 reports the means, standard deviations and Cronbach's α for perceptions of the social environment and motivation regulations. Observed means reflected high values for perceptions of autonomy support and autonomous motivation (composite, and intrinsic motivation and identified regulations), and moderate levels of perceptions of controlling coach behaviours and controlled motivation (composite, and introjected and external regulations) for the present sample. In line with the theoretical tenets of SDT, partial correlations demonstrated a significant positive relationship between perceptions of coach provided autonomy support and autonomous motivation. Similarly, perceptions of controlling coach behaviour were significantly positively linked to controlled motivation. In addition, perceptions of autonomy support were positively associated with both youth sport %MVPA and %VPA, and perceptions of controlling behaviour were significantly and negatively linked to youth sport %MVPA (Table 2). Analysis also indicated a significant positive association to exist between autonomous motivation and youth sport %MVPA, whilst the relationships

between autonomous motivation and youth sport %MPA and %VPA were positive but not significant. Controlled motivation was unrelated to all targeted youth sport PA variables.

For individual motivation regulations, intrinsic motivation was significantly positively correlated with youth sport %MPA and identified regulation was significantly and positively associated with youth sport %MVPA. In addition, the relationship between identified regulation and youth sport %VPA approached significance (p <.07). Introjected regulation and external regulation were not associated with youth sport %MPA, %VPA or %MVPA.

****Table 2 inserted here****

Path analysis

Path analysis sought to further explore the significant associations revealed in partial correlations (i.e., the SDT-referenced motivational processes with respect to the social environment, autonomous and controlled motivation and the prediction of %MVPA engagement during youth sport). Results from path analyses are reported in Figure 2. The hypothesised model demonstrated an excellent fit to the data (χ^2 (12) = 12.93, p = .37, CFI = .99, RMSEA = .03, SRMR = .07). Perceptions of coach provided autonomy support positively predicted autonomous motivation (R^2 = 0.17), and perceptions of controlling coach behaviour positively predicted controlled motivation (R^2 = 0.09). In turn, autonomous motivation positively predicted youth sport %MVPA, whereas controlled motivation was unrelated to youth sport %MVPA (Figure 2). The variance in youth sport %MVPA explained by the model was 48.8%. Together, autonomous motivation and perceptions of autonomy support accounted for 9.1% of the variance in youth sport %MVPA (autonomous motivation, R^2 = .05, autonomy support, R^2 = .04). Age and youth sport context accounted for 32.4% and 6.5% of the variance in youth sport %MVPA, respectively.

Perceptions of coach-provided autonomy support had a significant positive indirect effect on youth sport %MVPA (Figure 2, indirect estimate, b = 2.53 [95% CI = 0.45 to 6.07]) via

players' autonomous motivation. No significant indirect effect was observed for perceptions of controlling coach behaviour.

****Figure 2 inserted here****

Discussion

The present study is the first to investigate psychosocial factors influencing children's and adolescents' levels of engagement in health enhancing PA (i.e., MVPA) whilst participating in youth sport. Informed by self-determination theory (Deci & Ryan, 1987), we examined whether perceptions of coach-provided autonomy support and controlling coach behaviour were associated with player's motivation regulation towards their sport engagement, and in turn, participation in accelerometer assessed MVPA during youth sport football. Results demonstrated perceptions of coach-provided autonomy support were positively associated with percent time spent engaged in MVPA during youth sport football as a result of fostering higher levels of autonomous motivation. That is, where coaches adopt an interpersonal style which provides players with a sense of choice, supports self-initiative, acknowledges their perspectives, and provide a rationale to foster consideration of personal relevance, youth are more likely to engage in sport for the inherent fun and enjoyment derived from the activity, and in turn, spend a higher proportion of their youth sport time engaged in MVPA.

Whilst it is not able to discern the psychological processes by which autonomous motivation is linked to higher levels of MVPA engagement in the present study, past research consistently reveals autonomous motivation to positively associate with enjoyment, effort and persistence among youth across a variety of PA contexts (e.g., PE, youth sport, leisure time) (Alvarez et al., 2012; Pelletier et al., 2001; Wallhead et al., 2014; Zhang, 2009). In turn, evidence suggests enhanced enjoyment and effort are linked to higher levels of PA engagement during leisure time and PE among youth (Bergh et al., 2012; Brown, Hume,

Pearson & Salmon, 2013; Cox et al., 2008; Wallhead et al., 2014). For example, Cox et al., (2008) reported autonomous motivation to be positively related to students' enjoyment of PE, which in turn was related to self-reported MVPA engagement during leisure time. Therefore, it seems reasonable to suggest that the experience of heightened enjoyment and increased effort may play a pivotal role in the association between autonomous motivation and levels of within-context MVPA. Future studies should seek to examine the affective and behavioural consequences of perceptions of autonomy support and related autonomous motivation in the context of youth sport MVPA engagement.

Previous studies conducted within school PA settings have demonstrated similar results to those reported presently. Specifically, cross-sectional studies have revealed autonomous motivation towards PE and recess (school breaks) to be positively linked to within-context MVPA engagement (Aelterman et al., 2012; Owen et al., 2013). In addition, a recent intervention study among secondary school students' reported increased perceptions of teacher-provided autonomy support resulted in higher levels of autonomous motivation and increased participation in MVPA during PE classes. However, whilst school PA settings such as PE may offer avenues through which to encourage daily participation in MVPA, curricular time allocated to PE is often limited to 1-2 hours per week. Moreover, the extent to which school breaks can encourage daily participation in MVPA towards health enhancing levels largely depends on the number and duration of break periods offered throughout the day. The present research therefore adds a further valuable and novel contribution to the literature, elucidating the motivational processes pertinent to PA engagement in an important youth PA setting outside the school environment. Specifically, this is the first study to demonstrate support for the sequential associations postulated by SDT (i.e., the role of the social environment as an antecedent of autonomous motivation and in turn, objectively assessed within-context MVPA participation) within the youth sport setting.

Examination of the beta coefficients and standard deviations observed in path analysis can illustrate the significance of the present findings. Results suggest that increasing participants' autonomous motivation from a score of 2 to 4 (i.e., from "disagree" to "agree", as measured by the BRSQ), would be associated with participants spending approximately 5% more youth sport time engaged in MVPA. For every 100 minutes of youth sport (M = 106.71 ± 15.86), this would contribute a further 5 minutes (8%) towards daily recommended guidelines for MVPA. As such, findings have implications for optimising youth sport involvement, encouraging higher levels of participation in PA above a moderate intensity during sport time. Specifically, where coaches adopt more autonomy supportive coaching styles, participants will likely accrue more minutes of MVPA during their sport participation, which in turn, may contribute towards more youth engaging in recommended and health enhancing levels of MVPA on youth sport days. This is particularly important when we consider data demonstrating high day-to-day variability in levels of MVPA engagement among youth sport footballers, with around 80% of participants failing to meet MVPA recommendations on every day of the week (Fenton et al., 2015b). Further, the promotion of higher daily levels of MVPA on sport days will also contribute to improving the health profile of children and adolescents active in the youth sport context. Indeed, higher daily levels of MVPA have been shown to be associated with lower levels of adiposity and higher cardiorespiratory fitness among youth sport footballers (Fenton et al., 2015b). However, whilst present results underline the social environment as relevant to optimising young people's participation in youth sport with respect to levels of MVPA, it is also important to consider the broader scope of possibilities through which the social environment may enhance youth sport engagement. Indeed, where the social environment manifested is autonomy supportive and fosters autonomous motivation, additional benefits such as

enhanced well-being and sustained engagement in youth sport will likely ensue (Alvarez et al., 2012; Balaguer et al., 2012; Pelletier et al., 2001).

A second exploratory aim of the present study was to examine the contribution of individual motivation regulations to MVPA, MPA and VPA experienced in youth sport. Results revealed intrinsic motivation to be positively associated with youth sport MPA participation, where identified regulation was positively related to engagement in MVPA within this setting. Interestingly, analyses also revealed the association between identified regulation and youth sport VPA to approach significance. Findings may therefore suggest that where a children's engagement in youth sport is guided by fun and enjoyment (i.e., intrinsic motivation), they may be more likely to engage in moderate intensity PA during youth sport. Alternatively, where a child's reasons for engagement stem from personally valuing the benefits of participation (i.e., they identify with the importance of their sport involvement), elevated levels of engagement in higher intensity PA may result. As such, where the desired outcome is promotion of both MPA and VPA (i.e., combined MVPA), fostering both intrinsic and identified regulation (i.e., autonomous motivation) will likely be effective. Results therefore align with the key finding from this study and point towards the importance of fostering overall autonomous motivation towards sport participation in order to encourage higher engagement in health enhancing PA during youth sport.

Interesting to note is that correlation analysis revealed a direct negative association between perceptions of controlling coach behaviour and percent of the youth sport session time engaged in MVPA in the present sample. SDT would postulate that this relationship would likely be a consequence of the association between perceptions of a controlling climate and more controlled motivation (Deci & Ryan, 1987). However, whilst controlling coach behaviours were positively linked to controlled motivation, controlled motivation was unrelated to %MVPA during youth sport in the current study. As such, other motivational

processes or affective states associated with perceptions of controlling interpersonal behaviours may play a more prominent role in the negative association between controlling coach behaviour and youth sport MVPA. For example, a recent study reported controlling coach behaviours positively predicted thwarting of the three basic needs for competence, autonomy and relatedness, which in turn, corresponded to increases in player burnout (Balaguer et al., 2012; Ryan & Deci, 2000). As such, future studies should seek to examine the occurrence of maladaptive motivational processes through which perceptions of a controlling PA environment (e.g., youth sport, PE) may hold deleterious consequences for young people's levels of within-context MVPA engagement. Still, a paucity of studies investigating the associations between controlled motivation and PA engagement among youth mean the consequences of less self-determined motivation are not well understood. Additional research is therefore necessary before conclusions can be drawn concerning the impact controlled motivation may have for levels of PA participation both within and outside organised PA contexts among youth.

Current findings indicated autonomy support and autonomous motivation explained 4% and 5.1% of the variance in youth sport MVPA respectively. These results parallel those reported in a recent study, in which personal autonomous motivation towards PE was reported to account for 4% of the variance in MVPA during PE classes (Aelterman et al., 2012). Thus, whilst past and present findings point towards the social environment and ensuing autonomous motivation as pertinent correlates of within-context PA engagement, results also underscore the importance of acknowledging other influences upon PA participation within youth PA settings. Indeed, Aelterman et al., (2012) revealed gender and course topic (activity type) to be significant predictors of in-class MVPA. Similarly, our finding revealed both youth sport context and age as prominent factors associated with PA engagement during youth sport. Certainly, the associations observed between youth sport

context and MPA, and particularly, between age and VPA may account for the lack of associations observed between motivational regulations and these two PA intensities when considered separately. One possible explanation for the latter findings could be the move towards more competitive and high intensity play as children progress into adolescent teams, and the inherent age related increase in strength and power likely to result in more physical capacity to engage in higher intensity PA (Roemmich & Rogol, 1995). Other factors likely to contribute towards the prediction of within-context youth sport MVPA may be sport type and pre-session planning by the coach (e.g., instruction time). Nevertheless, whilst there is certainly a need to recognise the role of individual and contextual level variables in the context of youth PA promotion, significant positive associations between perceptions of autonomy support, autonomous motivation and combined MVPA engagement during youth sport emerged in the present study after accounting for two prominent person factors related to variability in youth sport MVPA engagement (i.e., age and gender). Encouraging youth sport coaches to adopt autonomy supportive coaching styles may therefore go some way towards ensuring all children benefit more equally from their involvement in youth sport, in terms of their participation in health enhancing MVPA.

Strengths of the current study include utilising accelerometers to measure PA which allows quantification of both frequency and intensity of PA engagement. In addition, the analytical approach adopted adjusted for individual and contextual level variables which are likely to influence levels of PA engagement during youth sport. Indeed, past studies adopting a theoretical perspective examining variability in both daily and within-context PA engagement have neglected to control for such factors (Owen et al., 2013; Standage et al., 2012).

Limitations to the present study include low adherence to the accelerometer protocol. As a result, the final analyses in the current study included N = 73 of the initial N = 149

participants recruited. Due to the reduced sample size, we were not able to account for measurement error within multivariate analyses (i.e., via structural equation modelling). As such, diminished reliabilities may mean the magnitude of the associations reported at the multivariate level may be smaller than would have been observed in the case where structural equation modelling was employed. In addition, whilst it would have been interesting to test additional path models (e.g., examining the contribution of individual motivation regulations to youth sport PA, and testing model invariance across youth sport context) this was not possible.

When considering the analytical decisions employed, it is important to acknowledge a number of participants (N = 22) provided within-subject data points for youth sport physical activity (i.e., provided youth sport physical activity data for both training sessions and match play). For these subjects, training session data was selected to represent their levels of youth sport MVPA engagement. This approach was taken in order to ensure consistency with regards to the treatment of data where participants provided both training session and match play data, whilst also ensuring an even split with regards to the representation of both youth sport contexts. Importantly, this allowed the context-related variability of youth sport football participation to be reflected in the current data set and subsequent analyses.

In line with the limitations associated with data reduction, whilst the present study was able to retain participants representing 33 of the original 38 teams recruited, those included were found to differ significantly from those excluded only in terms of BMI-SDS and daily MPA (min/day). Specifically, included participants engaged in more MPA per day and had a lower BMI-SDS. Consequently, results may be bias towards those participants recruited who engaged in the highest levels of daily MPA and with a lower BMI-SDS. However, effect sizes reported in ANOVAs for MPA and BMI-SDS were small to moderate ($\eta^2 = .04$), and the proportion of normal-weight to overweight/obese participants was not

significantly different between included and excluded participants. Bias with regards to adiposity status in particular may therefore be somewhat attenuated.

The cross-sectional nature of this study should also be acknowledged. Longitudinal and experimental studies are needed before inferences can be made regarding direction of the relationships between the social environment, motivation regulation and MVPA engagement during youth sport. In addition, all participants recruited were male grassroots footballers from England. Thus, present findings may not extend into other sport types, females or cultures. However, the processes by which the social environment is thought to impact upon positive behavioural outcomes are shown to be invariant across genders and countries (Quested et al., 2013; Standage et al., 2012). This constitutes another interesting direction for future research. Finally, we were unable to attend all youth sport sessions to note down session start and stop times. However, rigorous checks were carried out on the data to ensure accuracy in self-reported timings (i.e., comparisons with 1) graphed data, 2) coach reported youth sport timings and 3) between player accelerometer and diary data within teams).

Overall the results of the present study indicate that where more autonomy supportive environments are created within youth sport settings, children are likely to experience higher levels of autonomous motivation and in turn, engage in higher levels of MVPA whilst participating in sport. Findings have implications for optimising engagement in MVPA during youth sport, contributing towards more youth meeting recommended and health enhancing levels of MVPA on youth sport days. However, additional research is warranted to explore these associations among larger and more heterogeneous samples. In addition, longitudinal and experimental studies are required to determine whether theoretically-grounded interventions that encourage autonomy supportive behaviours in adults' central to shaping youth PA environments, hold potential value for increasing within-context MVPA engagement among youth.

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