



Citation:

Curran, T and Hill, AP and Ntoumanis, N and Hall, HK and Jowett, GE (2016) A Three-Wave Longitudinal Test of Self-Determination Theory's Mediation Model of Engagement and Disaffection in Youth Sport. *J Sport Exerc Psychol*, 38 (1). pp. 15-29. ISSN 1543-2904 DOI: <https://doi.org/10.1123/jsep.2015-0016>

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1 A three-wave longitudinal test of self-determination theory's mediation model of engagement and
2 disaffection in youth sport

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23 Accepted in the *Journal of Sport and Exercise Psychology*

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Abstract

Research adopting self-determination theory (SDT) supports a mediation model whereby coach motivational styles (autonomy support and interpersonal control) predict athletes' engagement and disaffection in youth sport via the satisfaction and frustration of psychological needs (autonomy, competence, and relatedness). Our study extends this research by examining SDT's mediation model longitudinally with three-waves of data. Two-hundred and fifty-two youth sports participants ($M_{age} = 12.98$; $SD = 1.84$; range = 11-17; female $n = 67$) completed measures of study variables at the start, middle, and end of a competitive soccer season. Cross-lagged path analyses revealed that associations between the two coach motivational styles and athletes' engagement were mediated by psychological need satisfaction. Furthermore, a positive reciprocal association between psychological need satisfaction and engagement emerged over time. This study therefore supports the temporal assumptions underpinning SDT's mediation model but, importantly, evidences a mutually reinforcing interplay between athletes' psychological needs and their engaged behavior.

Keywords: Autonomy support; Interpersonal control; Motivation; Physical activity; Coaching; Engagement

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1 Participation in youth sport is an important source of physical, psychological, and social
2 well-being for adolescents (Eime, Young, Harvey, Charity & Payne, 2013). Yet figures show that
3 youth sports participation is declining across Europe, the US, and Oceania (Australian Bureau of
4 Statistics, 2011; Commission of the European Communities, 2007; National Sporting Goods
5 Association, 2010). Sports coaches are likely to be influential in whether adolescents continue to
6 participate or dropout of youth sport (Barnett, Smoll & Smith, 1992). This is because coaches create
7 conditions that foster either positive or negative experiences for their athletes, depending on their
8 motivational style (Duda, 2013). Understanding coach behavior, and how it shapes experiences in
9 youth sport, is therefore essential in order to promote persistence to health-enhancing sport and
10 physical activity beyond adolescence.

11 **Behavioral engagement and behavioral disaffection**

12 Continued participation in youth sport is closely linked with levels of behavioral
13 engagement (Martin, 2008). As described by Skinner and colleagues (Skinner, Kindermann,
14 Connell & Wellborn, 2009), behavioral engagement refers to a set of behaviors that encapsulate
15 high levels of physical effort and perseverance, as well as mental efforts such as concentration and
16 attention. These behaviors and mental efforts contribute to the development of motor and cognitive
17 competencies (e.g., movement skills, information retention), and hence long-term task persistence is
18 an important outcome of behavioral engagement (Blair & Razza, 2007; Furrer, Skinner, Marchand,
19 & Kindermann, 2006; Guthrie, Schafer, & Huang, 2001). Yet this is not the only benefit.
20 Behavioral engagement also facilitates social competencies by forging natural connections with
21 peers, and offers opportunities to discover new areas of interest (Skinner, Furrer, Marchand &
22 Kinderman, 2008).

23 Behavioral engagement, though, is not ubiquitous to youth sport and many athletes instead
24 exhibit signs of behavioral disaffection. According to Skinner et al (2009), behavioral disaffection
25 is a distinct construct, negatively associated with behavioral engagement, which refers to a set of
26 enervated behaviors, including passivity, a lack of initiation, giving up, as well as indicators of

1 mental withdrawal, such as inattention and distraction. In contrast to behavioral engagement,
2 behavioral disaffection impedes the development of motor and cognitive competences and thus,
3 over time, gives rise to attrition (Blair & Razza, 2007; Furrer et al., 2006; Guthrie et al., 2001). It
4 also, unlike behavioral engagement, fosters a disruptive social milieu and blocks opportunities to
5 seek out new sources of motivation from the environment (Skinner et al., 2008). Accordingly, when
6 considering how to promote adolescents' persistence in youth sport, the adaptive effects of
7 behavioral engagement and the maladaptive effects of behavioral disaffection are readily apparent.

8 **A self-determination theory approach to behavioral engagement and disaffection in youth
9 sport**

10 Self-determination theory (SDT; Deci & Ryan, 1985), an organismic theory of human
11 motivation, has been used to understand engagement and disaffection in achievement domains such
12 as youth sport (Vallerand & Losier, 1999). From this perspective, levels of athlete engagement and
13 disaffection are influenced by two coach motivational styles. The first motivational style is
14 autonomy support. It refers to the degree to which coaches value athletes' opinions, offer desired
15 choice, acknowledge negative affect, and provide meaningful rationales (Mageau & Vallerand,
16 2003). The second motivational style is interpersonal control. It refers to the degree to which
17 coaches pressure athletes to meet demands, solve problems on athletes' behalf, and adopt their own
18 perspective, rather than the athletes' perspective (Bartholomew, Ntoumanis, & Thøgersen-
19 Ntoumani, 2009).

20 In this study we conceive autonomy support and interpersonal control as distinct, negatively
21 related, coach motivational styles with unique associations to athletes' engagement and disaffection.
22 We do so because these styles, although relatively stable at the contextual level, can sometimes
23 alternate situationally as coaches' exhibit a broad array of behaviors in response to dynamic social-
24 contexts (Bartholomew et al, 2009). The crucial difference between them, though, is that autonomy
25 support and interpersonal control confer very different information. Autonomy supportive
26 provisions, on the one hand, embed personal relevance of sports participation and hence cultivate

1 proactive outcomes such as engagement. On the other hand, controlling provisions socially impose
2 the relevance of sports participation and hence foster reactive outcomes such as disaffection. In
3 support of these ideas, perceived coach autonomy support and interpersonal control have been
4 found to predict higher athlete engagement and disaffection in sport (e.g., Curran, Hill, Hall, &
5 Jowett, 2014; Sarrazin, Vallerand, Guillet, Pelletier & Cury, 2002; Smith, Ntoumanis, & Duda,
6 2007).

7 A further tenet of SDT is that the effects of coach autonomy support and interpersonal
8 control, on athletes' engagement and disaffection, are accounted for by the respective satisfaction
9 and frustration of three psychological needs. These psychological needs represent inherent self-
10 actualization tendencies, which permit well-being and optimal functioning when satisfied but
11 contribute to ill-being and impoverished functioning when frustrated (Ryan & Deci, 2000). The
12 first, autonomy, is the need to experience behavior as originating from within the self (de Charms,
13 1968). The second, competence, is the need to feel that one can effectively negotiate their
14 interactions with the environment (White, 1959). The third, relatedness, is the need to create close
15 social bonds and attachments with significant others (Baumeister & Leary, 1995).

16 Like autonomy support and interpersonal control, psychological need satisfaction and
17 frustration are orthogonal constructs. That is, low autonomy, competence, and relatedness are not
18 directly mirrored by high heteronomy, incompetence, and rejection (or vice-versa; Bartholomew et
19 al., 2009). When satisfied, the needs provide the basis for the proactivity and enthusiasm indicative
20 of engagement (e.g., Curran, Hill, Hall, & Jowett, 2015; Curran, Hill, & Niemiec, 2013; Joesaar,
21 Hein, & Hagger, 2011). However, when frustrated, the needs provide the basis for the reactivity and
22 passiveness indicative of disaffection (e.g., Curran et al., 2014; Bartholomew et al., 2011b;
23 Belanger et al., 2012). Accordingly, within SDT, the psychological needs are a unifying principle,
24 linking coach motivational styles to athlete behaviors (Vansteenkiste & Ryan, 2013).

25 **SDT's mediation model**

SDT's mediation model, then, proposes two indirect pathways to engagement and disaffection. The first indirect pathway is based on the provision of autonomy support and operates through psychological need satisfaction. When adolescents perceive their social-contexts to be replete with; (a) opportunities to voice and act on ideas (autonomy), (b) trust in abilities to be self-directed (competence), and (c) interest in others' perspectives (relatedness), psychological need satisfaction is promoted and so too is engagement (Skinner et al., 2009). The second indirect pathway is based on the provision of interpersonal control and operates through psychological need frustration. When adolescents perceive their social-contexts to include; (a) a restriction of voice and choice (heteronomy), (b) a discerning tone (incompetence), and (c) a detached demeanor (rejection), the psychological needs are frustrated and disaffection is likely to result (Deci & Ryan, 2000).

A number of studies in sport have supported SDT's mediation model. Most of this work has centered on the indirect path including autonomy support and psychological need satisfaction. Reinboth et al. (2004), for instance, observed that vitality and life satisfaction were positively predicted by coach autonomy support via psychological need satisfaction in youth sports participants (see also Adie et al., 2008). Similar findings have been obtained in samples of adult athletes, youth sport participants, and dancers reporting aggregate levels of coach autonomy support (e.g., Bartholomew et al., 2001a, study 3; Quested, Ntoumanis, et al., 2013; Quested & Duda, 2011), as well as in children reporting a relative score of teacher autonomy support (versus control) in high school (Jang, Reeve, Ryan, & Kim, 2009).

More recently, researchers have moved to examine perceptions of coach interpersonal control and psychological need frustration. Findings are similarly supportive of SDT's mediation model, and allude to the impoverishing consequences of coach interpersonal control. Here, Batholomew and colleagues (2011a, study 1) found that coach interpersonal control positively predicted depression and burnout in female adult athletes via higher psychological need frustration. This study also modelled autonomy support and found that unique variance in the satisfaction and

1 frustration of psychological needs was explained by both the motivational styles (see also Gunnell,
2 Crocker, Wilson, Mack, & Zumbo, 2013). As such, an inclusion of cross-over pathways in SDT's
3 mediation model (e.g., autonomy support to psychological need frustration) appears to be important
4 alongside the parallel pathways that respectively link coach autonomy support and interpersonal
5 control to athletes' engagement and disaffection.

6 The indirect parallel and indirect cross-over pathways within SDT's mediation model are
7 shown in Figure 1. Building on extant research, this model assumes both unique (parallel) and
8 collective (parallel plus cross-over) effects of the motivational styles on engagement and
9 disaffection via the psychological needs. As we have seen, separate pathways have empirical
10 support but research is now begging to accrue that tests both unique and collective pathways within
11 SDT's mediation model concurrently. Most germane to this study, Curran and colleagues (2014)
12 recently tested the parallel and cross-over pathways shown in Figure 1 for youth sports participants'
13 behavioral engagement and behavioral disaffection. These authors found that coach autonomy
14 support (interpersonal control) positively predicted psychological need satisfaction (frustration) and
15 negatively predicted psychological need frustration (satisfaction). Psychological need satisfaction
16 (frustration), in turn, positively predicted engagement (disaffection) and negatively predicted
17 disaffection (engagement). This model has additional support in physical education (Haerens,
18 Aelterman, Vansteenkiste, Soenens, & Petegem, 2015), adolescent sport (Bartholomew et al.,
19 2011b), and youth sport (Balaguer et al., 2012) settings.

20 A shortcoming of extant research on SDT's mediation model, though, is that much of it
21 relies on cross-sectional data. Mediation models using cross-sectional data cannot examine the
22 temporal ordering of variables and are hence a poor indicator of directional causality. Furthermore,
23 cross-sectional models must assume that mediated associations are stable over time (Gollob &
24 Reichardt, 1987) – an assumption at odds with dynamic social-contexts such as youth sport. These
25 limitations are particularly noteworthy because recent longitudinal studies in the high school
26 classroom indicate that certain paths in SDT's mediation model exhibit reciprocity and are unstable

1 over time (i.e., psychological need satisfaction to engagement; Jang, Kim, & Reeve, 2012; Reeve &
 2 Lee, 2014). The interpretation, therefore, is that SDT's mediation model may reveal a more
 3 complex set of relationships not captured with cross-sectional data.

4 In sport, a few attempts have been made to test the relations within SDT's mediation model
 5 over time. In these studies, support has been found for mediated associations of coach behavior on
 6 adolescent well- and ill-being via the psychological needs at both within-person (intra-individual
 7 change) and between-person (inter-individual change) levels (Adie et al., 2012; Balaguer et al.,
 8 2012; Quested & Duda, 2011). Yet these studies do not capture engagement or disaffection per se
 9 and include autoregressive paths with only two waves of data. The latter limitation is important
 10 because autoregressive paths permit tests of the extent to which one variable is related to future
 11 values of another variable, controlling for its earlier values (Gollob & Reichardt, 1987). Hence, in
 12 mediation models, a first wave of data collection is needed to establish a baseline, a second wave is
 13 needed to observe the effect of a predictor on future levels of a mediator, and a third wave is
 14 required to observe the effect of a mediator on future levels of a criterion (see Maxwell & Cole,
 15 2007). The present study was therefore conducted to mirror extant longitudinal data in an education
 16 context by extending longitudinal data on this topic in sport. To do so, we test SDT's mediation
 17 model, with three waves of data, across a competitive youth soccer season.

18 **The present study**

19 On the basis of recent research, longitudinal tests of SDT's mediation model are needed to
 20 examine the temporality and reciprocity of effects from the psychological needs to engagement and
 21 disaffection in youth sport¹. This model appears in Figure 2 and contains temporal, reciprocal,
 22 autoregressive, and additional direct effects. For temporal effects, two solid boldface paths depict
 23 the hypotheses that season start autonomy support (control) would predict increases in mid-season
 24 psychological need satisfaction (frustration) that, in turn, would predict increases in season-end

¹ Since analyses show that young athletes' perceptions of coach motivational style are reasonably stable over time, with 12-month correlations of .60 (Jõesaar, Hein, & Hagger, 2012), it seemed reasonable to measure autonomy support and interpersonal control at the initial time point only.

1 engagement (disaffection). As in previous research (e.g., Bartholomew et al., 2011b; Gunnell et al.,
 2 2013; Haerens et al., 2015), we also modelled the cross-over temporal effects in SDT's mediation
 3 model (solid cross-over boldface lines). Here, however, we offer no specific hypotheses owing to
 4 the orthogonality of constructs and mixed findings in the literature.

5 We also model reciprocal effects as theory (Deci & Ryan, 2000) and research (Jang et al.,
 6 2012; Reeve & Lee, 2014) alludes to the reciprocal interplay of the psychological needs and
 7 engaged behavior. Here, two dashed upwardly sloping cross-lagged paths depict the hypotheses that
 8 season start and mid-season engagement (disaffection) predict increases in mid-season and season
 9 end psychological need satisfaction (frustration). Moreover, autoregressive effects are also
 10 included, and are depicted as eight horizontal lines to represent the effects of each variable on itself
 11 at a later time point. These paths are statistical controls, and allow the temporal and reciprocal
 12 effects in the model to reflect that of change. Finally, to further understand the temporal dynamics
 13 of SDT's mediation model, we also model a number of additional direct effects in Figure 2. These
 14 are depicted as downward sloping diagonal paths, which provide an estimate of the variance
 15 explained in the outcome variables (viz. engagement and disaffection), by the motivational styles
 16 (viz. autonomy support and control), over and above the psychological needs. In so doing, the
 17 additional direct effects test for potential exogenous pathways of influence, which would otherwise
 18 be assumed as null (Selig & Preacher, 2009).

19 Method

20 Participants and procedure

21 The participants were youth soccer players representing recreational clubs in the North of
 22 England (M age = 12.98; range = 11-17). A multi-section questionnaire was given to the
 23 participants in a training session setting at three time points; season start (September; n = 316,
 24 female n = 80), mid-season (January; n = 219, female n = 58) and season-end (May; n = 197,
 25 female n = 49)². No significant differences were observed on the study variables for those who were

² Attrition occurred for several reasons. First, 2 clubs were unable to recruit the required number of players to their teams and therefore were forced to cease competition soon after the season began. Second, 2 clubs declined to

1 lost to the final sample versus those who responded at all three time points³. Participants who
 2 completed only one questionnaire were removed. The data from participants who completed the
 3 questionnaire at least twice (season start and mid-season, season start and season end or all three
 4 time points; $n = 252$, $SD = 1.84$; female $n = 67$) were used in all subsequent analyses. These
 5 participants had been with their present coach for an average of 3.60 ($SD = 2.60$) years with whom
 6 they spent an average of 4.90 ($SD = 4.40$) hours each week. Ethical approval was obtained from the
 7 relevant university ethics committee prior to participant recruitment.

8 Instruments

9 Instruments that assessed perceptions of the coach motivational style were administered at
 10 the season start only. The other instruments were administered at all three time points. The stem for
 11 each questionnaire was adapted to focus participants on their experiences in soccer and all items
 12 were responded to on a scale which ranged from 1 (*not true at all*) to 7 (*very true*).

13 **Engagement and disaffection.** Engaged and disaffected behaviors were measured using the
 14 behavioral sub-scales of the Engagement Versus Disaffection with Learning Scale (EVDLS;
 15 Skinner, Kindermann & Furrer, 2009), adapted to soccer training, as this is the primary learning
 16 domain for young soccer players (Curran et al., 2014). The behavioral engagement (e.g., “I try hard
 17 to do well in training”) and behavioral disaffection (e.g., “In training, I do just enough to get by”)
 18 each contain 5 items. The adapted EVDLS has been found to be valid and internally reliable in
 19 youth sports participants (Curran et al., 2014).

20 **Psychological need satisfaction.** Psychological need satisfaction was measured using the
 21 Basic Need Satisfaction in Sport Scale (BNSSS; Ng, Lonsdale & Hodge, 2011). This instrument
 22 contains autonomy (10 items; e.g. “In soccer, I can take part in the decision-making process”),

participate in subsequent data collections after the the first questionnaire because they couldn't allocate sufficient time before/after training for questionnaire response. Finally, a particularly severe winter, and subsequent sacrifice of training time, resulted in a failure to schedule time 2 and 3 data collection with 3 clubs.

³ Multivariate analysis of variance revealed that the mean scores on the study variables were not significantly different between attrited and non-attrited participants [$F(6,248) = 1.59$, $p = .15$]. Furthermore, the Box's M test similarly showed that the covariance matrices of attrited versus non-attrited participants did not differ [$F(21,18640.77) = 1.54$, $p = .06$].

1 relatedness (5 items; e.g. "In soccer, I feel close to other people") and competence (5 items; e.g. "I
2 have the ability to perform well in soccer") satisfaction sub-scales. The three sub-scales were
3 averaged to form a psychological need satisfaction composite in this study. We created this
4 composite because SDT; (a) does not specify a link between the specific psychological need
5 satisfied (or frustrated) and the type of behavior that ensues, and (b) assumes that the psychological
6 needs are inter-dependent (see Deci & Ryan, 2000 for a detailed overview of this issue). The
7 BNSSS has been found to possess adequate psychometric properties in sport (Ng et al., 2011).

8 **Psychological need frustration.** Psychological need frustration was measured using the
9 Psychological Need Thwarting Scale (PNTS; Bartholomew et al., 2011a). This instrument contains
10 autonomy (4 items; e.g. "I feel pushed to behave in certain ways in soccer"), relatedness (4 items;
11 e.g. "I feel others in football can be dismissive of me") and competence (4 items; e.g. "There are
12 situations in soccer where I am made to feel inadequate") frustration sub-scales. On the same basis
13 as psychological need satisfaction, the three sub-scales were averaged to form a psychological need
14 frustration composite in this study. The PNTS has been found to possess adequate psychometric
15 properties in sport (Bartholomew et al., 2011a).

16 **Autonomy support.** An adapted sport version (Gillet, Vallerand, Paty, Gobance & Berjot,
17 2010) of the 12-item Perceived Autonomy Support Scale for Exercise Settings (PASSES; Hagger,
18 Chatzisarantis, Hein, Pihu, Soos & Karsai, 2007) was employed to measure perceived coach
19 autonomy support (e.g. "I feel that my coach provides me with choices, options and opportunities
20 about whether to play soccer"). This adapted version of the PASSES has been found to possess
21 adequate psychometric properties in sport (Gillet et al., 2010).

22 **Interpersonal control.** The Controlling Coach Behaviors Scale (CCBS; Bartholomew,
23 Ntoumanis, & Thogersen-Ntoumani, 2010) was employed to measure perceived coach interpersonal
24 control. This instrument contains controlling use of rewards (4 items; e.g. "My coach only uses
25 rewards or praise to make me train harder"), negative conditional regard (4 items; e.g. "My coach
26 pays me less attention if I have displeased him/her"), intimidation (4 items; e.g. "My coach

1 threatens to punish me to keep me in line in training”), and excessive personal control (3 items; e.g.
 2 “My coach tries to control what I do during my free time”) sub-scales. As in previous research
 3 (Taylor, Turner, Gleeson, & Hough, 2015), the four sub-scales of the CCBS were averaged to form
 4 a coach interpersonal control variable. This scale has been found to possess adequate psychometric
 5 properties in sport (Bartholomew et al., 2010).

6 **Data analysis.** We employed cross-lagged path analysis of observed variables with
 7 autoregressive and cross-lagged paths to test the hypothesized model using AMOS version 18.0
 8 (Arbuckle, 2009). In line with Maxwell and Cole (2007), all possible autoregressive paths were
 9 included alongside the temporal, cross-lagged, and additional direct effects of interest. Furthermore,
 10 we modelled covariances between the disturbance terms to reflect the possibility that third variables
 11 account for shared variance in the mediators and criterions (Anderson & Williams 1992). To
 12 evaluate model fit, we relied on a combination of incremental (IFI and CFI) and absolute (RMSEA)
 13 indexes. Fit was deemed acceptable in this study if IFI and CFI > .90 and RMSEA < .10 (Marsh,
 14 Hau & Wen, 2004).

15 **Results**

16 **Preliminary analyses**

17 At each time point, for those that responded, missing values were replaced with the mean of
 18 the non-missing items in the respective sub-scale for each individual case (Graham, Cumsille &
 19 Elek-Fisk, 2003). This approach was justified on account of the low number of missing items at
 20 each of the three time points and evidence of randomness (Little’s MCAR χ^2 for data across all time
 21 points = 154.61, $df = 152$, $p = .43$) in the distribution of the missing data (Tabachnick & Fidell,
 22 2007). Across the time points, where questionnaire non-response accounted for missing data, Full
 23 Information Maximum Likelihood (FIML) method for model estimation was used (Enders &
 24 Bandalos, 2001). Means, standard deviations, Cronbach’s alpha coefficients, and bivariate

1 correlations for each variable at each time point can be found in Table 1⁴. All scales demonstrated
 2 acceptable internal reliability. The bivariate correlations were in the directions predicted by SDT.

3 **Hypothesized model and temporal effects**

4 The results of the cross-lagged path analysis for the hypothesized model appear in Figure 3.
 5 The findings suggest that the model fit the data adequately $\chi^2 = 105.51$, df = (33), $p < .01$; IFI = .94;
 6 CFI = .94; RMSEA = .09, 90% CI [.07-.11]. With autoregressive paths as statistical controls, three
 7 significant temporal effects emerged. First, season start autonomy support predicted increases in
 8 mid-season psychological need satisfaction. Second, season start coach interpersonal control
 9 predicted decreases in mid-season psychological need satisfaction. Finally, mid-season
 10 psychological need satisfaction predicted increases in season-end engagement. The remaining
 11 temporal effects in our model were non-significant (see Table 2).

12 **Reciprocal effects**

13 Of the four tested reciprocal effects, one was significant (see Figure 3). With autoregressive
 14 paths as statistical controls, mid-season psychological need satisfaction predicted increases in
 15 season end engagement, and mid-season engagement predicted increases in end of season
 16 psychological need satisfaction. The remaining reciprocal effects in our model were non-significant
 17 in the presence of their autoregressive paths (see Table 2).

18 **Additional direct effects**

19 A number of additional direct effects emerged in our analyses (see Figure 3). Specifically,
 20 coach autonomy support at season start negatively predicted athletes' mid-season disaffection.
 21 Likewise, coach interpersonal control at season start negatively predicted athletes' mid-season
 22 engagement. Finally, and unexpectedly, athletes' season start psychological need satisfaction
 23 positively predicted their mid-season disaffection. All other additional direct effects in the model
 24 were non-significant (see Table 2).

⁴ Not shown in Table 1 are the distributional properties of the 14 study variables. Skewness values averaged $M = | .76 |$ (highest value = -1.11), and kurtosis values averaged $M = | .72 |$ (highest value = 2.10). These statistics indicate that the data are approximately normal in terms of their underlying distribution of values.

1 Mediation

2 To assess the statistical significance of the indirect pathways in our model (mediation),
3 specific indirect effects were calculated as the product of the coefficients (i.e., ab) and their 95%
4 confidence intervals were estimated using Mackinnon, Fritz, Williams and Lockwood's (2007)
5 PRODCLIN program. Provided a zero effect is not observed between the upper and lower bound of
6 the 95% confidence interval, the indirect effect is deemed significant at the $p < .05$ level. The
7 analysis produced a number of statistically significant indirect effects. Supporting our mediation
8 model, the positive indirect effect of season start coach autonomy support on athletes' season end
9 engagement via their mid-season psychological need satisfaction was significant ($ab = .04$, 95% CI
10 [.01, .08]). Similarly, the negative indirect effect of season start coach interpersonal control on
11 adolescents' season end engagement via their mid-season psychological need satisfaction was also
12 significant ($ab = -.03$, 95% CI [-.07, -.01]).

13 In addition, the negative indirect effect of coach autonomy support on athletes' season end
14 disaffection via their mid-season disaffection was significant ($ab = -.06$, 95% CI [-.13, -.00]).
15 Likewise, the positive indirect effect of coach autonomy support on athletes' season end
16 psychological need satisfaction via their mid-season psychological need satisfaction was also
17 significant ($ab = .07$, 95% CI [.02, .13]). The negative indirect effect of season start coach
18 interpersonal control on athletes' season end psychological need satisfaction via their mid-season
19 engagement was significant ($ab = -.02$, 95% CI [-.05, -.00]), as was the negative indirect effect of
20 coach interpersonal control on athletes' season end engagement via their mid-season engagement
21 ($ab = -.05$, 95% CI [-.11, -.01]). Finally, the negative indirect effect of coach interpersonal control
22 on athletes season end psychological need satisfaction via their mid-season psychological need
23 satisfaction was significant ($ab = -.06$, 95% CI [-.11, -.02]). No other significant indirect effects
24 emerged.

25

Discussion

1 This study longitudinally tested SDT's mediation model of athletes' engagement and
2 disaffection in youth sport. As expected, the effects of season-start coach autonomy support and
3 interpersonal control to athletes' season-end engagement were mediated by athletes' mid-season
4 psychological need satisfaction. No significant temporal effects, however, were observed in the case
5 of psychological need frustration and disaffection. In addition, our analyses qualified SDT's
6 mediation model by evidencing the presence of reciprocal effects between psychological need
7 satisfaction and engagement. Akin to other longitudinal studies (Jang et al., 2012; Reeve & Lee,
8 2014), the causal and reciprocal effects in our model were small in magnitude but predicted
9 meaningful proportions of variance over and above the autoregressive paths. Next, we describe the
10 conceptual and practical implications of these findings for SDT and youth sport.

11 **Temporal effects**

12 This is the first study to examine SDT's mediation model with three waves of data in a sport
13 context. As such, it provides an important extension to extant cross-sectional (e.g., Adie et al., 2008;
14 Curran et al., 2014; Reinboth et al., 2004) and longitudinal (e.g., Adie et al., 2012; Balaguer et al.,
15 2012; Quested & Duda, 2011) research by supporting the temporal assumptions underpinning
16 SDT's mediational sequence. Here, season start coach autonomy support positively predicted mid-
17 season psychological need satisfaction that, in turn, positively predicted season end engagement.
18 Coach autonomy support is therefore an enriching motivational style – contributing to gains in
19 athletes' psychological need satisfaction and engagement over the course of a season. By contrast,
20 season start coach interpersonal control negatively predicted mid-season psychological need
21 satisfaction that, in turn, negatively predicted season end engagement. Coach interpersonal control,
22 then, is an impoverishing motivational style – contributing to season long reductions in athletes'
23 psychological need satisfaction and engagement.

24 Though non-significant, temporal paths from the coach motivational styles to adolescents'
25 psychological need frustration are worthy of mention. These null findings suggest that autonomy
26 supportive and controlling behaviors do not predict variability in athletes' psychological need

1 frustration over time. While this might be expected for autonomy support, it is an unexpected
2 finding in the case of coach interpersonal control, which has been shown to positively predict
3 change in psychological need frustration (Balaguer et al., 2012). There are a number of possible
4 explanations for this finding. Athletes whose psychological needs are frustrated may, in the short-
5 term, invest extra effort to demonstrate worth as compensatory source of competence and/or
6 relatedness (see Koestner & Losier, 2002). Alternatively, the effects of coach interpersonal control
7 on psychological need frustration may have been masked by suppression in the model due to the
8 high inter-correlation of these constructs at season start ($r = -.51$, see Table 1; Cohen, Cohen, West,
9 & Aiken 2003). In whichever case, these null findings require careful consideration in future
10 research.

11 **Reciprocal and additional effects**

12 As hypothesized, psychological need satisfaction and engagement shared a reciprocal
13 association. Mid-season change in psychological need satisfaction predicted change in season end
14 engagement. Yet change in mid-season engagement also predicted change in season-end
15 psychological need satisfaction, even after controlling for change in mid-season psychological need
16 satisfaction. This finding is in line with data from education domains (Jang et al., 2012; Reeve &
17 Lee, 2014), and suggests that athletes behaviorally engage in order to fulfil their psychological
18 needs, which in turn promotes more behavioral engagement. Such a reciprocal interplay is at the
19 core of SDT's organismic meta-theory, and our analysis certainly supports an amplifying cycle of
20 proactivity in youth sport (viz. higher psychological need satisfaction to higher engagement to
21 higher psychological need satisfaction and so on), which appears to be triggered by autonomy
22 support, but inhibited by interpersonal control.

23 Alongside the reciprocal effects, some noteworthy additional indirect effects emerged. The
24 negative indirect effect of season start coach autonomy support to season end disaffection via mid-
25 season disaffection was significant, as was the negative indirect effect of coach control to season
26 end engagement and psychological need satisfaction via mid-season engagement. The coach

1 motivational styles therefore appear to have direct associations with athlete engagement and
2 disaffection, over and above the psychological needs, which endure over time. Moreover, season
3 start interpersonal control negatively predicted season end psychological need satisfaction via lower
4 mid-season engagement. Hence controlling behaviors appear to restrict opportunities for athletes to
5 both receive and seek out psychological need satisfaction, because they directly predict lower levels
6 of engaged behavior.

7 Finally, there was an unexpected additional indirect effect in our analysis. Season start
8 psychological need satisfaction positively predicted mid-season behavioral disaffection that, in turn,
9 positively predicted season end behavioral disaffection. This finding, again, may be indicative of
10 suppression as psychological need satisfaction is highly inter-correlated with the other predictor
11 variables in the model (see Table 1). When this is the case, a predictor (psychological need
12 satisfaction) can have a large absolute negative correlation with a criterion (disaffection) but have a
13 reversed beta weight provided one or more of the other predictors in the model are assigned credit
14 for that predictor's shared explanatory ability (Cohen et al., 2003). Further research, though, is
15 needed to confirm that this relation is indeed an artefact of suppression.

16 **Practical implications**

17 This study found that coach autonomy support triggers higher athlete psychological need
18 satisfaction and engagement, whereas coach interpersonal control has the opposite pattern of
19 association. The conclusion, therefore, is that coaches should promote autonomy support and reduce
20 interpersonal control. To this goal, a number of practical strategies can be adopted, which have been
21 detailed elsewhere (see Reeve, 2006, Ntoumanis & Mallet, 2014). Another important finding in this
22 study is that psychological need satisfaction and behavioral engagement share a reciprocal
23 association. The practical implication here is that athletes are inclined to behave in manner
24 conducive to the fulfilment of their own psychological needs. To expedite this process, athletes
25 might be encouraged to not only behaviorally engage, but to also cognitively engage in sport by
26 deliberately planning, self-monitoring, and self-evaluating for experiences of autonomy and

1 competence. They may also be encouraged to seek out social support, or spend time with teammates
2 to whom they have a close interpersonal connection, to generate opportunities for relatedness. In
3 short, to be effective facilitators of engagement and long-term persistence, our data shows that
4 coaches must structure environments that provide athletes with many opportunities to engage
5 themselves.

6 **Limitations**

7 The conceptual and practical implications notwithstanding, this study has limitations. We
8 did not measure coach motivational styles at every time point. Multiple measurements of coach
9 motivational style would strengthen future research – especially because they permit tests of the
10 possibility that, over time, athlete behaviors may impact the motivational styles of their coaches
11 (Reeve, 2009). Moreover, we employed composite variables to measure interpersonal control,
12 psychological need satisfaction, and psychological need frustration in this study. Such an approach
13 may mask the presence of a number of associations between specific aspects of interpersonal
14 control (e.g., conditional regard) and specific psychological needs (e.g., incompetence). Subsequent
15 research should seek to disaggregate these variables for a more nuanced analysis.

16 Another limitation is that we employed a cross-lagged path model to test our hypotheses.
17 These models permit tests of temporal precedence and potential reciprocal effects, which are
18 important considerations for SDT. Nonetheless, a legitimate criticism of the cross-lagged path
19 model is that it assumes all athletes are changing in a systematic way. This means that any within-
20 person variability existing around the average rate of between-person change is overlooked (Selig &
21 Preacher, 2009). It is therefore important that future research supplements our analysis with random
22 slope models, which can model trajectories of within-person change.

23 Finally, the current study did not assess perceptions of structure and involvement from
24 coaches. Structure refers to the help, support, rules, and limits that socializers provide to foster
25 subordinates' competence (Mageau & Vallerand, 2003). Involvement refers to the interest, warmth
26 and concern that socializers show their subordinates to foster relatedness (Skinner, Wellborn, &

1 Connell, 1990). Recent studies have shown that structure and autonomy support interact to predict
2 higher psychological need satisfaction and engagement in high school children (Jang, Reeve &
3 Deci, 2010; Sierens, Vansteenkiste, Goossens, Soenens & Dochy, 2009) and youth sports
4 participants (Curran et al., 2013),. Therefore, it is important for future research stemming from our
5 work to include autonomy support, structure, and involvement in SDT's mediation model.

6 Conclusion

7 This study provides a number of important conclusions. Foremost, the motivational styles
8 that coaches adopt have significant implications for youth sports participation. In line with SDT,
9 coach autonomy support at the beginning of a season fosters increases in athletes' season end
10 behavioral engagement, because it increases athletes' perceptions of mid-season psychological
11 need satisfaction. By contrast, coach interpersonal control at season start yields reductions in
12 athletes' season end behavioral engagement, because it reduces athletes' perceptions of mid-season
13 psychological need satisfaction. Many countries are experiencing steep declines in youth sports
14 participation, especially in adolescence. These temporal effects offer insight for practitioners and
15 indicate that increased long-term engagement in youth sport is more likely when coaches exhibit
16 autonomy support (as opposed to interpersonal control).

17 Alongside the practical implications, reciprocal relationships also emerged in our analysis
18 which have significant implications for SDT. Here, the positive reciprocal effect of psychological
19 need satisfaction and behavioral engagement indicates that athletes, over time, receive (from
20 coaches) and seek out (in the form of their engagement) opportunities for autonomy, competence,
21 and relatedness. From this non-linear perspective, recursive and amplifying feedback loops connect
22 the psychological needs and behavioral engagement as they dynamically interact over time.
23 Therefore, although our study supports the temporal assumptions of SDT's mediation model, the
24 data nevertheless qualify it by evidencing a reciprocal interplay between the psychological needs
25 and engaged behaviors – an interplay demanding close consideration in subsequent (cross-sectional)
26 research.

1

2 Acknowledgements

3 This research was supported by the European Commission under the Framework 7 Program
4 (Health; 2236000) as part of the PAPA Project (www.projectpapa.org). We gratefully acknowledge
5 the critical and constructive reviews provided by 3 anonymous reviewers, which helped us to
6 significantly improve earlier versions of this manuscript.

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Table 1. Scale Reliabilities, Descriptive Statistics, and Inter-Correlations.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1.Coach autonomy support T1	.95													
2.Coach interpersonal control T1	-.51**	---												
3.Psychological need satisfaction T1	.45**	-.33**	---											
4.Psychological need frustration T1	-.55**	.51**	-.39**	---										
5.Behavioral engagement T1	.40**	-.26**	.55**	-.32**	.83									
6.Behavioral disaffection T1	-.41**	.51**	-.20*	.56**	-.42**	.81								
7.Psychological need satisfaction T2	.40**	-.25**	.62**	-.27**	.30**	-.07	---							
8.Psychological need frustration T2	-.31**	.34**	-.24*	.51**	-.29**	.33**	-.27**	---						
9.Behavioral engagement T2	.40**	-.23**	.42**	-.29**	.44**	-.23*	.49**	-.15	.78					
10.Behavioral disaffection T2	-.20**	.27**	-.02	.28**	-.22*	.50**	-.13	.38**	-.20**	.72				
11.Psychological need satisfaction T3	.26**	-.21*	.38**	-.20**	.21**	-.11	.54**	-.13	.39**	-.07	---			
12.Psychological need frustration T3	-.35**	.28**	-.34**	.46**	-.34**	.19*	-.38**	.44**	-.22*	.18*	-.33**	---		
13.Behavioral engagement T3	.33**	-.13	.32**	-.22**	.30**	-.09	.42**	-.15	.53**	-.16*	.60**	-.21*	.76	
14.Behavioral disaffection T3	-.23*	.19*	-.21*	.35**	-.35**	.36**	.03	.18*	-.24*	.35**	-.11	.25*	-.22*	.77
<i>M</i>	5.40	2.50	5.40	2.75	5.67	2.73	5.47	2.64	5.70	2.80	5.47	2.71	5.75	2.80
<i>SD</i>	1.14	1.13	.91	1.14	1.05	1.31	.89	1.22	.97	1.21	.89	1.30	.93	1.24

Note. Scale reliabilities (Cronbach's α) are shown on the diagonal. T = Time. The Cronbach α values for the individual measures that were used to form the coach control, psychological need satisfaction and psychological need frustration composites were: conditional regard ($\alpha = .80$), intimidation ($\alpha = .84$), negative use of rewards ($\alpha = .79$), excessive personal control ($\alpha = .87$), autonomy satisfaction (T1 $\alpha = .85$; T2 $\alpha = .86$; T3 $\alpha = .84$), competence satisfaction (T1 $\alpha = .85$; T2 $\alpha = .82$; T3 $\alpha = .88$), relatedness satisfaction (T1 $\alpha = .82$; T2 $\alpha = .79$; T3 $\alpha = .84$), autonomy frustration (T1 $\alpha = .79$; T2 $\alpha = .82$; T3 $\alpha = .87$), competence frustration (T1 $\alpha = .81$; T2 $\alpha = .86$; T3 $\alpha = .90$) and relatedness frustration (T1 $\alpha = .82$; T2 $\alpha = .87$; T3 $\alpha = .88$). * $p < .05$, ** $p < .01$.

Table 2. Path Coefficients for the Cross-Lagged Path Model

Path	Season start → Mid-season				Mid-season → Season end			
	b	SE	[95% CI]	β	b	SE	[95% CI]	β
Autonomy support →								
Psychological need satisfaction	.13*	.06	[.01, .25]	.17	--	--	--	--
Psychological need frustration	.01	.08	[-.15, .17]	.01	--	--	--	--
Engagement	.12	.07	[-.01, .26]	.15	--	--	--	--
Disaffection	-.18*	.09	[-.36, -.00]	-.18	--	--	--	--
Interpersonal control →								
Psychological need satisfaction	-.11*	.05	[-.21, -.01]	-.14	--	--	--	--
Psychological need frustration	.13	.08	[-.03, .29]	.12	--	--	--	--
Engagement	-.13*	.06	[-.27, -.03]	-.15	--	--	--	--
Disaffection	.01	.08	[-.15, .17]	.01	--	--	--	--
Psychological need satisfaction →								
Psychological need satisfaction	.49**	.07	[.35, .63]	.52	.43**	.08	[.27, .59]	.42
Engagement	.17	.09	[-.01, .34]	.16	.25**	.05	[.15, .35]	.23
Disaffection	.24*	.11	[.04, .40]	.18*	.20	.11	[-.02, .40]	.14
Psychological need frustration →								
Psychological need frustration	.51**	.08	[.35, .67]	.49	.48**	.07	[.34, .62]	.44
Engagement	-.02	.06	[-.15, .09]	-.03	-.01	.05	[-.11, .09]	-.02
Disaffection	-.02	.08	[-.17, .15]	-.01	.12	.08	[-.04, .23]	.12
Engagement →								
Engagement	.17*	.07	[.05, .33]	.19	.35**	.07	[.21, .49]	.37
Psychological need satisfaction	-.07	.05	[-.17, .02]	-.09	.20**	.07	[.06, .34]	.22
Psychological need frustration	-.09	.08	[-.25, .07]	-.08	-.16	.09	[-.34, .02]	-.12
Disaffection →								
Disaffection	.39**	.07	[.25, .53]	.42	.34**	.08	[.18, .50]	.32
Psychological need satisfaction	.06	.04	[-.02, .14]	.07	.05	.04	[-.03, .13]	.07
Psychological need frustration	-.08	.07	[-.22, .06]	.01	.01	.08	[-.15, .17]	.01

Note. β = standardized path coefficient; SE = standard error; p = two-tailed probability value; R^2 = variance explained over and above autoregressive pathways; b = unstandardized path coefficient; CI = confidence interval. * $p < .05$, ** $p < .01$

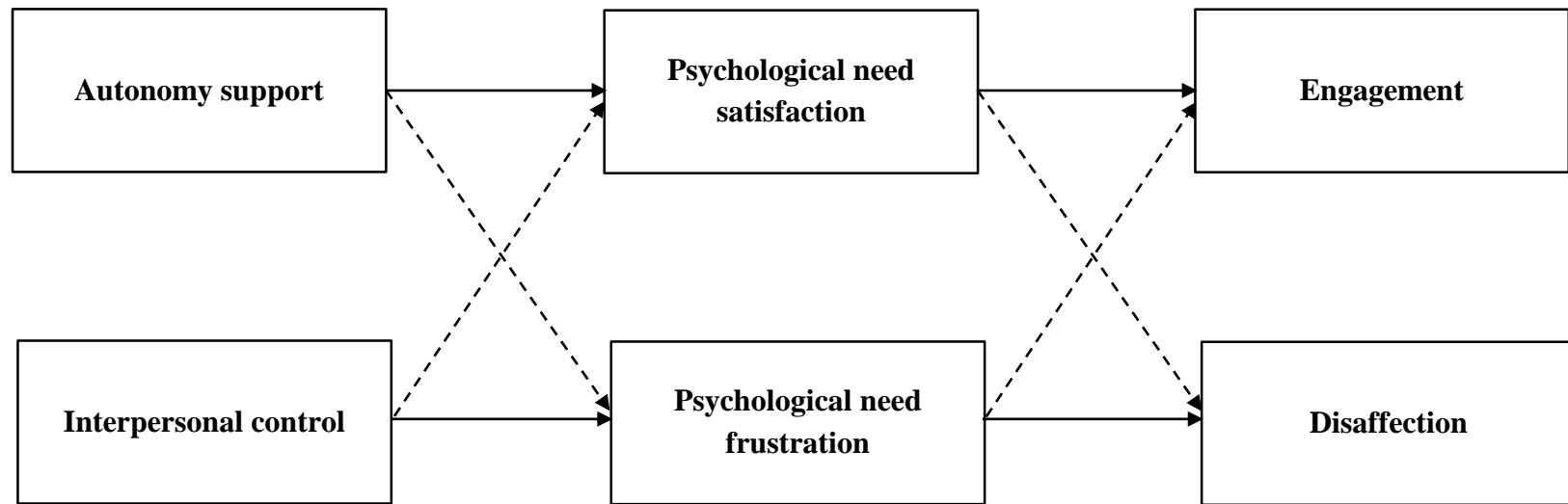


Figure 1 Self-determination theory's mediation model of engagement and disaffection. *Note.* Solid arrows depict positive associations, and dashed arrows depict negative associations.

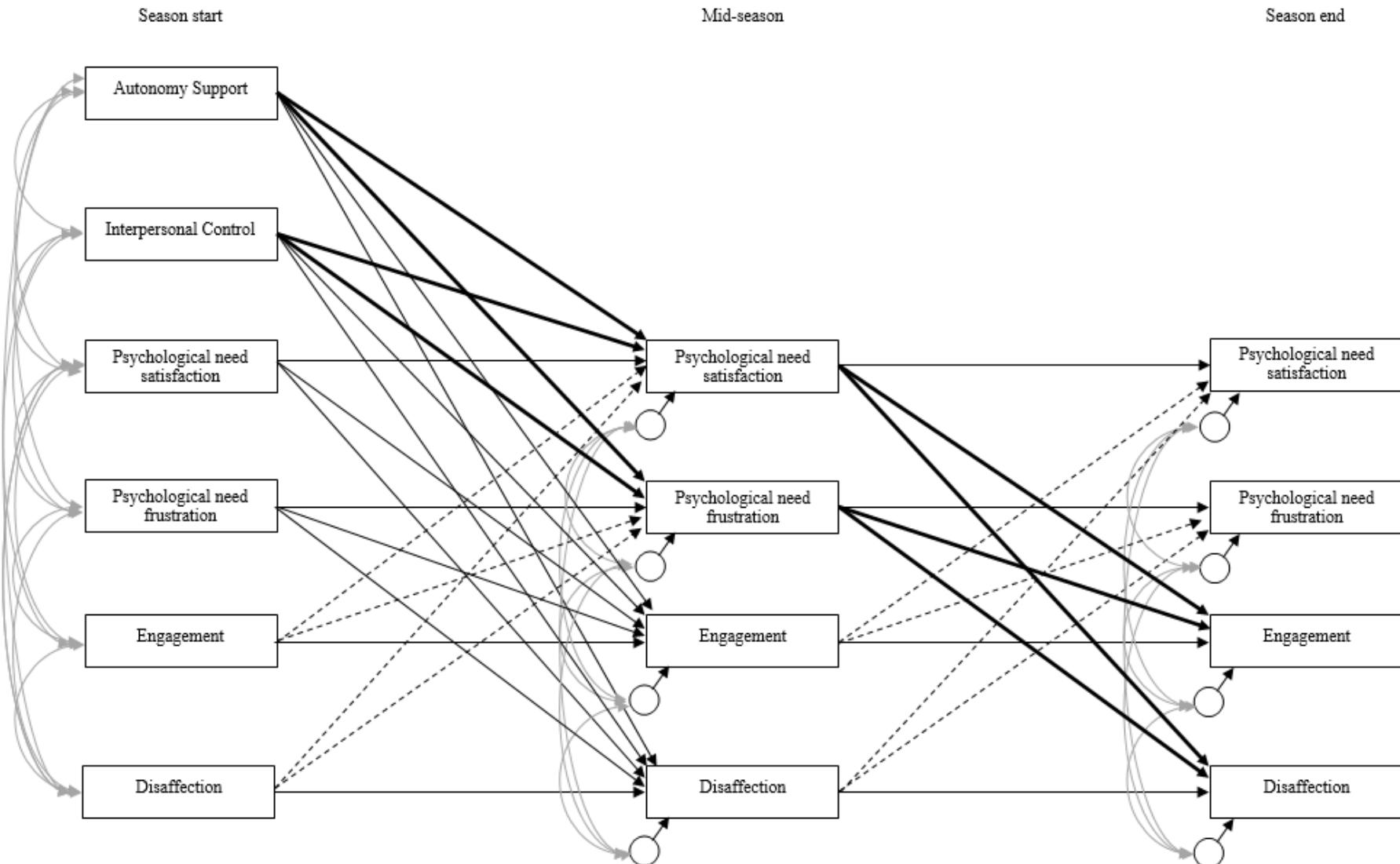


Figure 2 The hypothesized cross-lagged path model. *Note.* The eight downwardly sloped boldfaced solid lines test for temporal effects. The four upwardly sloped non-boldfaced dashed lines test for reciprocal effects. The eight downwardly sloped non-boldface solid lines test for additional direct effects. The eight non-boldface solid horizontal paths are the autoregressive controls.

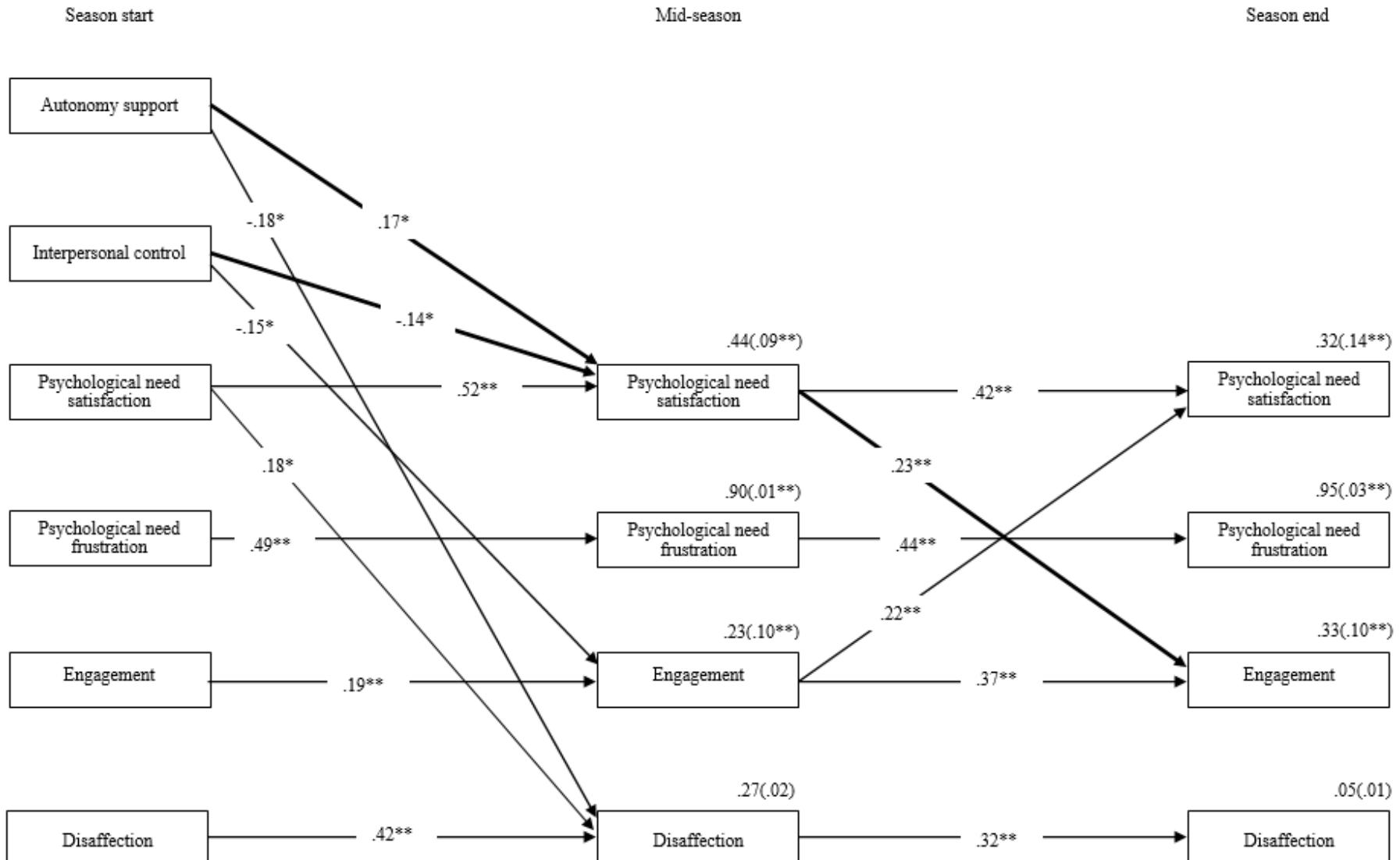


Figure 3 Standardized parameter estimates and R^2 values for the hypothesized model. In the interest of clarity, only significant parameter estimates are presented. ΔR^2 values in parentheses denote the unique variance explained in the criterion variables over and above the autoregressive paths (i.e., R^2 full model – R^2 restricted model, autoregressive paths only). The significance of ΔR^2 was estimated using F tests. Model fit: $\chi^2 = 105.51$ (33); IFI = .94; CFI = .94; RMSEA = .09, 90% CI [.07-.11]. * $p < .05$, ** $p < .01$.