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How does need satisfaction mediate the relation between harmonious passion and positive affect in coaches and athletes? A dyadic longitudinal study in coach-athlete dyads

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Abstract

Previous research has linked harmonious passion to positive affect in both coaches and athletes. Additionally, need satisfaction is suggested to mediate this relationship. However, these studies often relied on cross-sectional designs or failed to account for the inherent dyadic relationship between coaches and athletes. Addressing these limitations, our study combines a longitudinal design with a dyadic perspective to provide a more comprehensive understanding of the processes underlying positive affect in coaches and athletes. Using the longitudinal actor-partner interdependence mediation model, we investigated actor and partner effects for coaches and athletes at both the between- and within-person level. Our findings reveal that, for both coaches and athletes, their own harmonious passion is positively associated with their own positive affect at both the between- and within-person level. Notably, for coaches, this relationship is partly mediated by their own need satisfaction. Moreover, we found preliminary evidence for partner effects through coaches' need satisfaction at both the between- and within-person level. In summary, the longitudinal design suggests that harmonious passion is important for both coaches and athletes, not only in terms of between-person differences but also in terms of changes within an individual over a season. Additionally, the dyadic perspective yields valuable insights into potential partner effects via coaches' need satisfaction.

Keywords

Actor-partner interdependence model, self-determination theory, psychological wellbeing

Introduction

Fostering positive affect in sports is crucial for athletes' and coaches' psychological and physical well-being.[1–3] Despite extensive sport psychological research on the factors contributing to positive affect, such as harmonious passion and need satisfaction, the focus has predominantly been on either athletes or coaches, overlooking the inherent dyadic nature of their relationship. Yet, previous research has underscored the importance of the coach-athlete relationship in fostering positive outcomes, including performance and general well-being.[4–6] As such, studying potential partner effects, where one person's characteristics have an influence on their partner's outcome,[7] between coaches and athletes could further help understand the processes promoting positive affect in sports. Recently, Fonteyn et al.[8] revealed the mediating role of need satisfaction in the relationship between harmonious passion and positive affect in coaches and athletes, but found limited evidence for partner effects from coaches to athletes and vice versa. Despite these recent advancements exploring potential partner effects between coaches and athletes, to date, most studies adopt cross-sectional designs which only

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capture a single point in time. As such, it is not possible to study changes over time, limiting the conclusions to between-person differences. In contrast, a longitudinal design would allow to not only compare individuals to one another, but also investigate how processes unfold over time within individuals.[9,10] Such a longitudinal approach could thus provide a deeper understanding of how harmonious passion, need satisfaction and positive affect interplay within coach-athlete dyads. To address this, the present study combines a dyadic perspective with a longitudinal design to study potential bidirectional influences between coaches and athletes that unfold over time. To tackle the data-analytical challenges of such a design, we combine two existing statistical models and propose the longitudinal actor-partner interdependence mediation model (L-APIMeM).

Harmonious passion

The dualistic model of passion (DMP)[11–14] defines passion as "a strong inclination toward a specific object, activity, concept or person that one loves (or at least strongly likes), highly values, invests time and energy in on a regular basis, and that is part of one's identity".[12] Depending on the internalization, the DMP distinguishes between two types of passion: harmonious and obsessive passion.[11–14] Harmonious passion arises from an autonomous internalization, where individuals willingly and freely accept an activity as an essential but not overwhelming part of themselves. This type of passion is in harmony with other aspects of a person's life, and individuals have control over their engagement. In contrast, obsessive passion stems from a controlled internalization, resulting in intra- and/or interpersonal pressure that can lead to compulsive engagement in the activity. This form of passion may generate conflicts with other personal values and goals.

Due to the distinct internalization processes, different cognitive, affective and behavioral outcomes are linked to harmonious and obsessive passion. The DMP posits that harmonious passion is conducive to more adaptive outcomes, whereas obsessive passion is expected to be less associated with adaptive outcomes or even yield maladaptive outcomes.[11–14] A meta-analysis by Curran et al.[11] which included 94 studies across diverse samples (e.g., athletes, teachers, medical populations, working individuals and students) demonstrated that harmonious passion is positively associated with positive emotional outcomes and other adaptive outcomes, such as performance. This finding aligns with more recent studies showing similar patterns.[14] In contrast, obsessive passion showed weaker or even absent associations with these adaptive outcomes.[11,14,15] When controlling for harmonious passion, it was often even linked to maladaptive outcomes instead, such as rumination and burnout.[11,14,15] This suggests that problems could especially arise when obsessive passion outweighs harmonious passion. The positive association between harmonious passion and positive affect has also been well documented for both athletes and coaches. However, for athletes and coaches, the results for obsessive passion are again less consistent, sometimes demonstrating weak, absent or negative associations with adaptive outcomes, particularly when controlling for harmonious passion.[2–4,8,14,16–19]

Basic psychological need satisfaction

Research based on the Self-Determination Theory (SDT) suggests that one mechanism which, in part, may help explain the relation between harmonious passion and positive affect is Basic Psychological Need Satisfaction. According to the SDT, individuals require three basic psychological needs for optimal functioning, namely the need for autonomy, relatedness and competence.[20–22] The need for autonomy refers to a sense of freedom and volition to make decisions and determine behavior. The need for relatedness refers to a desire to have fulfilling and reciprocal connections with others. Lastly, the need for competence refers to the need to have effective interactions with one's environment and to develop a feeling of mastery within it. People are believed to engage in activities to fulfil these needs, and their satisfaction predicts positive outcomes such as psychological well-being, autonomous motivation and performance, while thwarting of these needs yields more negative outcomes, such as dishonesty and depressive symptoms.[20–22] Like harmonious passion, psychological need satisfaction is frequently linked to indicators of psychological well-being, including positive affect.[20–23] A recent meta-analysis by Stanley et al.,[23] which included 16 studies for each need, revealed a significant positive association between need satisfaction and positive affect for all three needs. Across all studies on autonomy, competence and relatedness, the authors found that greater need satisfaction is associated with higher positive affect. This association holds true for both athletes and coaches, underscoring the importance of psychological needs in fostering positive affect.[8,18,19,21,22,24,25]

In addition to their association with positive affect, several cross-sectional studies have also linked harmonious passion and psychological need satisfaction to one another,[8,11,12,19,26–28] suggesting a potential mediating role of need satisfaction in the relation between harmonious passion and positive affect. Specifically, passionate activities, such as sports, hold the potential to fulfil basic psychological needs. Particularly in individuals with harmonious passion, engagement in sports aligns with other life activities, goals and values, and has the potential to fulfil their psychological needs which in turn could lead to increased positive affect.[12,26] Previous research consistently supports the positive association between harmonious passion and need satisfaction in sports.[8,11,19,27,28] In contrast, findings

for obsessive passion and need satisfaction are inconsistent with studies reporting positive correlations, others negative, and yet others finding no significant correlation.[8,11,19,27,29] Additionally, as most research is correlational, the direction of the relationship between harmonious passion and need satisfaction is still unclear. While both Fonteyn et al.[8] and Verner-Filion et al.[26] consider harmonious passion as antecedent of need satisfaction, the reverse model has also received empirical support.[30–32] This bidirectional evidence highlights the complexity of this relationship and suggests causal interpretations should be made with caution.

Despite the interconnectedness between harmonious passion, need satisfaction and positive affect, studies integrating these variables into a single model are scarce. Previously, Verner-Filion et al.[26] investigated whether need satisfaction acts as a mediator in the relationship between harmonious passion and life satisfaction in athletes. In two cross-sectional studies involving 172 soccer players and 598 hockey players, they found evidence supporting their mediation model. While this research provides initial evidence for the mediating role of need satisfaction in the relation between harmonious passion and positive emotional outcomes, such as life satisfaction, its cross-sectional nature and exclusive focus on athletes limit the conclusions to between-person effects in athletes only.

Dyadic perspective

Given the predominant focus on either coaches or athletes individually, scholars have advocated for a more comprehensive approach that considers athletes and coaches simultaneously.[33] A dyadic design in which antecedents and consequences are measured in both coaches and athletes would allow to study partner effects from coaches to athletes and vice versa, on top of the actor effects in coaches and athletes.[7,33] Actor effects are intrapersonal effects of one's predictor on one's own outcome, and partner effects represent the interpersonal transfer effects of one's predictor on the partner's outcome. Estimating both actor and partner effects for coaches and athletes simultaneously, is possible with the actor-partner interdependence model (APIM)[7] (for an accessible introduction and comprehensive overview of the APIM, see Fitzpatrick et al.[34]).

Recent studies have applied the APIM to unravel the complex dynamics of the coach-athlete relationship. For instance, Fonteyn and Loeys[19] used the APIM to study the impact of the COVID-19 pandemic on the association between passion and both need-based experiences and affective outcomes. Their study involved 87 coach-athlete dyads active in different individual sports and at different competition levels. They demonstrated that one's own harmonious passion was positively associated with one's own positive affect and need satisfaction in both coaches and athletes. The authors found no evidence for partner effects except in the subset of dyads impacted by the COVID-19 pandemic where one's harmonious passion was positively associated with the partner's need satisfaction. Therefore, Fonteyn and Loeys[19] argue that harmonious passion may particularly contribute to a partner's need satisfaction in uncertain or challenging times. More recently, Fonteyn et al.[8] used an extension of the APIM to explore the mediating role of need-based experiences in the relation between passion and affective outcomes in cross-sectional data of 198 coach-athlete dyads. Their findings revealed that one's own passion was related to one's own need-based experiences, which in turn was related to one's own affect. However, limited evidence was found for partner effects between coaches and athletes.

Longitudinal design

Despite these recent advancements exploring partner effects between coaches and athletes, to date, most studies adopt a cross-sectional design. Therefore, researchers have made a general call for more longitudinal studies in sport psychological research.[14,19,35] In a longitudinal dyadic design, a sample of dyads is repeatedly examined on multiple time points, which allows not only to compare dyads to one another but also to investigate how processes unfold over time within dyads.[9] More specifically, a longitudinal design allows to investigate both the effect of between-person differences (for example, do athletes who are more harmoniously passionate also score higher on positive affect?), which can be examined in cross-sectional studies, and within-person changes (for example, does an athlete who is more passionate at a specific time point compared to their average also experience more positive affect then?).[10,35]

A handful of studies have previously explored the impact of need satisfaction and/or harmonious passion on athlete well-being. For example, Felton and Jowett[35] conducted a longitudinal study on the impact of need satisfaction in the coach-athlete and parent-athlete relationship on indicators of athlete well-being. 110 athletes completed questionnaires on three time-points over a period of 6 months. Their findings indicated that, at the between-person level, need satisfaction predicted well-being in athletes, both in relation to coaches and parents. However, at the within-person level, only need satisfaction in the athlete-parent relational context was associated with vitality. Similarly, Verner-Filion and Vallerand[18] investigated the influence of passion and need satisfaction on positive affect in a longitudinal study with 91 youth soccer players. The results revealed that between-person differences in harmonious passion and within-person changes in need satisfaction are positively associated with positive affect. However, despite using a longitudinal design, Verner-Filion and Vallerand[18] did not consider the between-person effects of need satisfaction and within-person effects of passion. Additionally, both studies lacked a dyadic perspective, focusing solely on athlete outcomes.

The present study

To date, there is a lack of longitudinal research that simultaneously considers both athletes' and coaches' perspective. Combining a dyadic perspective with a longitudinal design, we aim to enhance our understanding of the relationship between harmonious passion, need satisfaction and positive affect in coach-athlete dyads. Given the importance of positive affect for coaches' and athletes' physical and psychological well-being, our investigation specifically targets the mediating role of need satisfaction in linking harmonious passion to positive affect. Combining previous dyadic statistical models, we investigate whether harmonious passion is directly associated with positive affect and/or indirectly via need satisfaction. First, within this model, we investigate the intrapersonal actor effects at the between-person level for coaches and athletes. Second, our dyadic perspective enables us to study partner effects between coaches and athletes. Lastly, going beyond the limitations of cross-sectional studies, our longitudinal design allows to separate time-constant between-effects (addressing the question *who* has higher positive affect compared to whom) from time-specific within-effects (addressing the question *when* someone has higher positive affect) both for actor and partner effects**.** This dyadic longitudinal setting gives rise to a plenitude of potential mediating effects. A detailed description of all direct and indirect effects arising from the longitudinal actor-partner interdependence mediation model is provided in the method section. To the best of our knowledge, no studies have yet investigated mediation in longitudinal dyadic data in general.

Given the complexity of the proposed model, the present study focuses specifically on harmonious passion, which has consistently been linked to adaptive outcomes such as need satisfaction and positive affect in coaches and athletes. In line with Fonteyn et al.[8] and Verner-Filion et al.,[26] we focus on the model where harmonious passion is considered an antecedent to need satisfaction. While obsessive passion is an important construct, research findings on athletes and coaches have been inconsistent.[2–4,8,14,16–19] Similarly, while psychological need frustration and negative affect are crucial to understanding well-being in sports,[8,20,36] this study focuses on the adaptive constructs of need satisfaction and positive affect to clarify their relationship with harmonious passion. Given the complexity of examining all these constructs simultaneously and the novelty of the current model, the present study provides an initial, focused exploration on harmonious passion, need satisfaction and positive affect.

Methods

Transparency and openness

This three-wave longitudinal study was conducted in accordance with the ethical guidelines of the General and Specific Ethical Protocol of the Faculty of Psychology and Educational Sciences, Ghent University and has received approval from the ethical committee of this faculty. While Fonteyn and Loeys[19] describe the cross-sectional data from the first time point, this paper performs a longitudinal analysis of the study data including all three time points. The study was designed to have 80% power to detect moderate actor and partner effects (partial correlations equal to .3) at the first time point at the 5% significance level.[8,37] More specifically, the APIMPowerR app by Ackerman and Kenny[38] showed about 85 dyads were needed. No formal power calculations for the longitudinal part were performed, as those analyses were rather deemed exploratory in nature. Analysis code and data are available via the Open Science Framework (OSF; https://osf.io/6sm37/).

Participants

The study ran from November 2021 until May 2022. During this period coach-athlete dyads completed three online surveys every 1.5 to 2 months. This timeframe was chosen to ensure that all surveys were completed within the same competitive season in Belgium. It is important to note that the study took place during a period when COVID-19 pandemic restrictions were gradually being eased. The athletes and coaches participated or coached in different individual sports, such as swimming, athletics, dance, snowboard and golf. In total, 87 coach-athlete dyads completed the online survey at the first wave (T1), 56 dyads completed the survey at wave two (T2) and 46 dyads completed the last survey (T3). Demographic information was collected only at T1, with Table 1 providing a breakdown of sample demographics at each time point. Dyads for which the athlete or coach did not complete the first survey and/or did not sign the informed consent were excluded from the study (17 in total). At T1, athletes were aged between 16 and 72 years ($M_{T1} = 28.63$, $SD_{T1} = 12.95$) and coaches between 21 and 78 years ($M_{T1} = 40.86$, $SD_{T1} = 14.65$). The sample comprised more female than male athletes, and more male than female coaches. Athletes participated at various competition levels, with the majority participating at the recreational/amateur level (32%), followed by competitive (30%) and high-competitive levels (26%), and the minority participating at the low-competitive level (11%). On average, athletes reported almost 11 years of experience in their sport at T1 ($SD_{T1} = 8.67$). Coaches reported on average almost 14 years of coaching experience at T1 ($SD_{T1} = 11.03$), with 89% holding a coaching degree. Athletes who completed the T1 survey reported an average of 5.13 h of weekly training with their coach ($SD_{T1} = 3.94$), of which 1.59 h alone with their coach ($SD_{T1} = 2.61$). Further, they reported an average coach-athlete relationship length of 4.42 years ($SD_{T1} = 3.88$). Although some dropout occurred over the three waves, and the distribution of the baseline characteristics slightly changed over the three time points, none of the differences were deemed practically relevant. A comparison of T1 characteristics between completers and non-

Table 1. Demographic information for the coach-athlete dyads at each time point.

Background variables	T1 (N = 87)	T2 (N = 56)	T3 (N = 46)
Athletes			
Age (years)			
Mean (SD)	28.63 (12.95)	27.29 (13.35)	28.28 (14.63)
Range	16–72	16–72	16–72
Sex (N)			
Male	33 (38%)	22 (39%)	16 (35%)
Female	54 (62%)	34 (61%)	30 (65%)
Competition level (N)			
Recreational/amateur	28 (32%)	17 (30%)	14 (30%)
Low-competitive	10 (11%)	4 (7%)	3 (7%)
Competitive	26 (30%)	20 (36%)	19 (41%)
High-competitive	23 (26%)	15 (27%)	10 (22%)
Experience (years)			
Mean (SD)	10.99 (8.67)	9.43 (5.45)	9.70 (5.43)
Range	0–45	0–23	1–23
Coaches			
Age (years)			
Mean (SD)	40.86 (14.65)	40.30 (14.36)	40.67 (15.19)
Range	21–78	21–78	21–78
Sex (N)			
Male	59 (68%)	37 (66%)	31 (67%)
Female	28 (32%)	19 (34%)	15 (33%)
Coaching Degree (N)			
Yes	77 (89%)	53 (95%)	44 (96%)
No	10 (11%)	3 (5%)	2 (4%)
Experience in coaching (years)			
Mean (SD)	13.95 (11.03)	15.00 (11.45)	14.74 (11.72)
Range	0.5–42	0.5–42	1–42
Hours of coaching per week (hours)			
Mean (SD)	14.13 (12.85)	13.04 (11.60)	12.70 (11.59)
Range	2–60	3–50	4–50
Coach-Athlete Relationship			
Years of collaboration (years)			
Mean (SD)	4.42 (3.88)	4.58 (4.21)	4.59 (4.04)
Range	0.03–20	0.03–20	0.21–20
Total contact with coach (hours)			
Mean (SD)	5.13 (3.94)	5.35 (3.95)	5.40 (4.00)
Range	0–17.5	0–17.5	0–17.5
One-to-one contact with coach (hours)			
Mean (SD)	1.59 (2.61)	1.37 (2.22)	1.60 (2.46)
Range	0–15	0–12	0–12

completers also revealed no significant differences after correction for multiple testing (all $p > .01$). In addition, we do not anticipate that the drop-out is related to the unobserved passion or positive affect (which would imply missingness not at random), and hence we make the missing completely at random assumption here.[39]

Procedure

Participants were recruited via the involved researchers and master students through online advertisement on social media and posters that were distributed on relevant locations (e.g., sport clubs). Coaches and athletes could only participate when both dyad members agreed to participate, and each individual could only enroll once. Upon agreement, the coach and athlete received more information on the study, an online informed consent and a web-link to a password protected online survey (LimeSurvey). At every time point, the survey took about 30 min to complete. While the variables discussed here required less time, additional variables were questioned too as discussed in Fonteyn et al..[8] If participants did not complete the survey within a week, they received a reminder e-mail. Up to five reminder e-mails were sent.

Table 2. Means, standard deviations (SD), McDonald's Omega (ω) and intraclass correlation coefficients (ICC) for the study variables.

	T1			T2			T3			
Variable	Mean	SD	ω	Mean	SD	ω	Mean	SD	ω	ICC
Harmonious Passion										
Coach	5.50	0.72	0.68	5.38	0.76	0.69	5.36	0.70	0.68	0.63
Athlete	5.28	0.81	0.62	5.38	0.75	0.65	5.26	0.81	0.71	0.53
Need Satisfaction										
Coach	5.87	0.69	0.73	5.92	0.68	0.80	5.84	0.74	0.81	0.47
Athlete	5.93	0.67	0.78	5.91	0.85	0.89	5.89	0.78	0.80	0.57
Positive Affect										
Coach	20.83	2.59	0.82	20.39	3.68	0.92	20.85	2.87	0.81	0.35
Athlete	19.26	3.17	0.84	19.55	2.69	0.73	19.59	3.64	0.83	0.57

Measures

Harmonious passion for sport and coaching. At each time point, harmonious passion for sport and coaching in athletes and coaches was measured using the harmonious passion subscale of the Passion Scale comprising six items (e.g., "Doing sport is in harmony with other things that are part of me.").[13] The items were answered on a seven-point Likert scale ranging from 1, "I do not agree at all", to 7, "I strongly agree". The backtranslation procedure was used to translate the original instrument into Dutch.[8] Initially, a Dutch-speaking researcher familiar with sport psychology translated the original items to Dutch. Next, an independent person with a master's degree in languages conducted the back translations. Finally, a third person fluent in both Dutch and English, and familiar with the sports context reviewed and compared the original and back-translated items. Any discrepancies were addressed through discussions. Previous studies using the adapted version of the Passion Scale for athletes and coaches have shown appropriate levels of validity and reliability.[13,19] A composite score was calculated by taking the mean of the six items.[13] The internal consistencies of the harmonious passion subscale were acceptable with McDonald's omega[40,41] ranging between 0.62 and 0.71 for coaches and athletes over the three waves (Table 2).

Basic psychological need satisfaction within the coach-athlete relationship. Coaches and athletes basic psychological need satisfaction was assessed using a Dutch sport-specific version of the Basic Psychological Need satisfaction and Frustration Scale.[36,42] This adapted scale has previously been validated and used in coaches and athletes.[42] This sport-specific questionnaire was phrased to target the coach-athlete relationship specifically. Participants answered six items tapping into need satisfaction, including autonomy (e.g., "My coach gave me a sense of freedom of choice in the things I did." or "I felt free to coach my athlete the way I wanted."), competence (e.g., "The coach gave me confidence that I could complete the exercise/competition successfully." or "I felt successful in coaching my athlete.") and relatedness (e.g., "While practicing sport, I felt connected with my coach/athlete."). The items were measured on a seven-point Likert scale ranging from 1, "Totally not agree", to 7, "Totally agree". In line with Delrue et al.[42] and Fonteyn et al.,[8] the mean of the six items was calculated to obtain a composite score for need satisfaction for coaches and athletes. The composite score of the six items was used as the subscales include only two items for each need. The internal consistencies of this scale were acceptable with McDonald's omega values of at least 0.73 (Table 2).

Positive affect. Athletes and coaches reported the positive affect experienced during coaching or participating in their sport by completing the positive affect subscale of the Positive and Negative Affect Schedules (PANAS).[43] Previously, the PANAS has been translated and validated in Dutch.[44] For this study a selection of five items was made, selected based on applicability and relevance to the sport context, including the terms enthusiastic, excited, strong, active and proud, items not included were, for example, attentive and alert.[8,44] These items were qualitatively selected to assess the key emotional experiences that are commonly experienced during sport participation or coaching. Participants were asked to evaluate the items while thinking of participating or coaching in the sport. The items were measured on a five-point Likert scale ranging from 1, "Very slightly or not at all", to 5, "Extremely". A sum-score was calculated for athletes and coaches. The internal consistencies for coaches were at least 0.81 and at least 0.73 for athletes (Table 2).

Analytic approach

Previously, Fonteyn et al.[33] showed how the Actor-Partner Interdependence Model (APIM) can be used to estimate actor and partner effects in cross-sectional data collected in coach-athletes dyads. Extending upon this, we propose the longitudinal actor-partner interdependence mediation model (L-APIMeM) to assess mediation in longitudinal dyadic data. This model combines for the very first time

the longitudinal extension of the actor-partner interdependence model (L-APIM),[10] which extends the APIM to longitudinal data, with the actor-partner interdependence mediation model (APIMeM),[45] which extends the APIM to explore mediation in cross-sectional dyadic data. As suggested by Gistelinck and Loeys[10] mediation analysis in our setting is possible by combining the two approaches, but to the best of our knowledge, longitudinal dyadic data have not yet been analyzed in such a way.

Similar as in the standard mediation setting, two models are fitted, one for the mediator (i.e., the effect of harmonious passion on need satisfaction) and one for the outcome (i.e., the effect of need satisfaction and harmonious passion on positive affect). Mediation analysis decomposes the total effect of a predictor (harmonious passion) on an outcome (positive affect) into a direct and an indirect effect via the mediator (need satisfaction). An indirect actor effect can occur in two ways: (1) one's own antecedent that affects one's own mediator, which in turn affects one's own outcome (i.e., a sequence of actor effects), or (2) one's own antecedent that affects one's partner mediator, which in turn affects one's own outcome (i.e., a sequence of partner effects). Similarly, an indirect partner effect can occur as a sequence of a partner and actor effect, or vice versa. We refer to these as simple indirect effects. Furthermore, since we consider longitudinal data, this decomposition can be done both at the within- and between-person level. Figure 1 shows a graphical representation of all parameters at the within- and between-person level in the full L-APIMeM. An overview of all direct and (simple) indirect effects in this setting are presented in Supplementary Table S1. We refer the interested reader to the Supplementary Material to see the model formulas and the assumptions about the covariance structure (Supplementary Material A).

All analyses were performed with R Statistical Software, version 4.2.3. Two separate L-APIM models, one for the mediator and one for the outcome variable, were fitted using structural equation modeling with the R-package lavaan, version 0.6–15.[46] Missing data was handled using full information maximum likelihood. Normality assumption was assessed upon graphical inspection. The bootstrap estimates of the model coefficients, based on 1000 bootstrap samples, were used to estimate the indirect effects. Percentile-based 95% confidence intervals (CIs) were used to determine whether direct, indirect and total effects were statistically significant at the 5% significance level. However, it is important to acknowledge that CIs, like p-values, have similar limitations when it comes to interpreting statistical significance.[47]

Results

Descriptive statistics

The means and standard deviations for the study variables are reported in Table 2. At each time point, the average harmonious passion, need satisfaction and positive affect reported by athletes and coaches was above the midpoint of the scale. On average, coaches reported higher positive affect than athletes at each time point. The data does not show a consistent pattern of change over time for any construct, although there was variability. The Intra Class Correlation (ICC) reveals that about half of the variability in the three constructs could be explained by the between-person level, i.e., differences between individuals, and the other half by the within-person level, i.e., changes within individuals across the three time points, for both coaches and athletes (Table 2).

The longitudinal actor-partner interdependence mediation model

Figure 2 presents the estimates of the coefficients of the actor and partner effects between harmonious passion, need satisfaction and positive affect of coaches and athletes at the between- and within-person level (See Supplementary Table S2 for the estimates, 95% CIs and standard errors). Table 3 adds to Figure 2 by presenting the estimates and 95% CIs of the total effects, total indirect effects, simple indirect effects and direct effects at the between- and within-person level. At each level, there are four effects between the predictor and outcome that can be mediated. These effects are labelled by referring to the dyad member's role of the outcome (coach or athlete) and the role dyad member of the predictor (actor or partner effect). For example, coach actor effects are effects from harmonious passion of the coach on positive affect of the coach and coach partner effects are effects from harmonious passion of the athlete on positive affect of the coach. Each of the four effects (athlete actor, athlete partner, coach actor and coach partner) has two different simple indirect effects. The total indirect effect is the sum of the two corresponding simple indirect effect, and the total effect is the sum of the total indirect and the direct effect. Supplementary Table S1 provides an overview of how the path coefficients in Figure 2 are combined to calculate the effects reported in Table 3. The estimated covariance parameters of the models are presented in Supplementary Table S3.

Between-person level

At the between-person level, both the total coach and athlete actor effects are significant (Table 3). The total coach actor effect reveals that coaches who report higher levels of harmonious passion report, on average, higher levels of positive affect. When further disentangling this total effect, we find that coaches' harmonious passion is directly positively associated with coaches' positive affect and with coaches' need satisfaction, which in turn is positively associated with coaches' positive affect (Table 3). The direct effect constitutes 71%

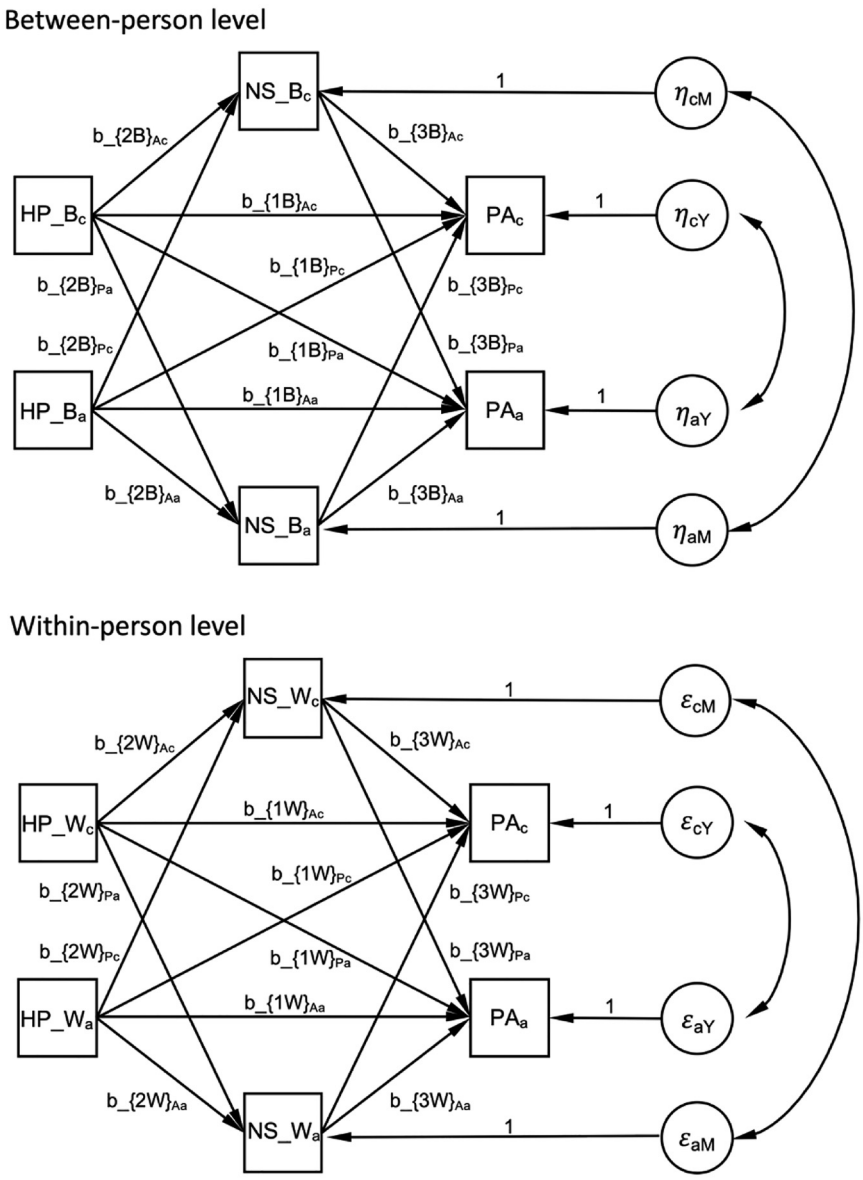

Figure 1. Schematic representation of the longitudinal actor-partner interdependence mediation model with corresponding actor and partner effects between harmonious passion, need satisfaction and positive affect of coaches and athletes at the between- (top) and within-person (bottom) level. HP represents the predictor, harmonious passion, NS the mediator, need satisfaction, and PA the outcome variable, positive affect. HP and NS are split up in a time-constant or between-person (B) and a time-varying or within-person effect (W). The index 'c' refers to the coach dyad member and 'a' to the athlete dyad member. The effect of HP on PA is represented by b_{1}, the effect from HP on NS by the coefficient b_{2} and the effect from NS on PA by b_{3}. Further, it is indicated whether the effect is situated at the between- (B) or within-person (W) level. Actor and partner effects are indexed 'A' and 'P' respectively. Lastly, residuals (at the within-person level) and random intercepts (at the between-person level) are included in these models to capture random variation. Both the effects of the residuals and random intercepts are fixed at 1.

and the total indirect effect 29% of the total coach actor effect. Similarly, the total athlete actor effect reveals that athletes who report higher levels of harmonious passion report on average higher levels of positive affect (Table 3). However, only the direct effect is significant and accounts for 97.5% of the total effect. In addition to the significant total actor effects, it is interesting to note that although the total coach partner effect (i.e., the effect of the athletes' passion on the coaches' positive affect) is not significant, the coach partner indirect effect via coaches' need satisfaction is significant. Figure 2 shows that athletes who score high on harmonious passion are associated with coaches who score high on need satisfaction which in turn is positively associated with coaches' positive affect.

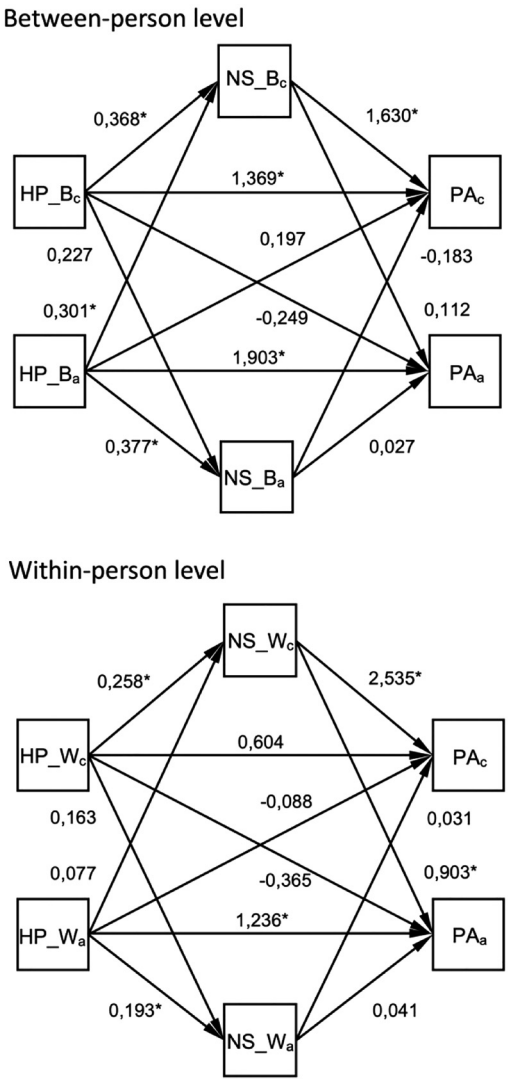

Figure 2. The estimated actor and partner effects between harmonious passion, need satisfaction and positive affect of coaches and athletes at the between- (top) and within- (bottom) person level. *p < .05.

Within-person level

At the within-person level, both the total coach and athlete actor effects are significant (Table 3). The total coach actor effect reveals that when a coach reports higher levels of harmonious passion, that coach also experiences higher levels of positive affect at that moment. When disentangling the coach actor effect into a direct and indirect effect, we find that only the indirect effect via coaches' need satisfaction is significant. The effects indicate that when a coach reports higher levels of harmonious passion, this is associated with higher need satisfaction within this coach, which in turn is associated with higher positive affect at that moment (Table 3). This indirect effect accounts for about 50% of the total coach actor effect. The total athlete actor effect reveals that when an athlete reports higher levels of harmonious passion, that athlete also experiences higher levels of positive affect at that moment. When disentangling the athlete actor effect into a direct and indirect effect, only the direct effect is significant and accounts for 92% of the total athlete actor effect, and hence unlike the coach there is no transmission through the athletes' need satisfaction at that moment. Finally, while the total athlete partner effect is not significant, the athlete partner indirect effect via coaches' need satisfaction is significant (Table 3). This effect reveals that at moments that a coach reports higher levels of harmonious passion, this is associated with higher need satisfaction in this coach, which in turn is associated with higher positive affect in the athlete at that moment.

Discussion

The aim of this study was to get a better understanding of the relation between harmonious passion and positive affect, and how need satisfaction mediates this relation in coach-athlete dyads. The importance of investigating positive affect and the underlying mechanisms in the context of sports lies in its impact on the psychological and physical well-being of coaches and athletes.[4–6] While previous studies used cross-sectional data and/or focused on a single perspective only, our dyadic longitudinal approach enabled us to study bidirectional influences between coaches and athletes over time. To unravel the complex mechanisms at play we introduced the L-APIMeM. Given the complexity of this model, the present study provides an initial, focused exploration. Our findings revealed a significant effect of harmonious passion on positive affect at both the within- and between-person level for athletes and coaches. However, the underlying mechanism differs. For coaches, this effect is partly mediated by their own need satisfaction at both levels, whereas for athletes, no such mediation occurs. In line with Fonteyn et al.,[8] little evidence was found for partner effects with only two significant partner effects both via coaches' need satisfaction. At the between-person level, athletes with higher harmonious passion tend to have coaches with greater need satisfaction, and in turn also higher positive affect. At the within-person level, on days that coaches experience higher harmonious passion, their increased need satisfaction leads to greater positive affect in athletes.

These results provide valuable insights into the factors contributing to positive affect in sports. First, they underscore the crucial role of one's own harmonious passion for one's own positive affect. Although harmonious passion tends to remain moderately stable once it is developed,[13,48,49] further understanding how harmonious passion evolves over time and identifying factors that might influence its development could help increase positive affect in sports. Secondly, our findings suggest that coaches'

Table 3. Estimate, 95% confidence interval and proportion of the total effect for all effects. levels. *p < .05.

			95% CI		
Level	Effect	Estimate	Lower	Upper	Proportion of the Total Effect (%)
Between-person level	**Coach actor effect HP_c - PA_c**				
	Total effect	1927*	1205	2606	
	Total IE	0558*	0190	1041	29,0
	IE via NS_c	0599*	0269	1034	
	IE via NS_a	−0041	−0280	0145	
	Direct effect	1369*	0648	2119	71,0
	Athlete actor effect HP_a - PA_a				
	Total effect	1953*	1036	2880	
	Total IE	0049	−0427	0560	2,5
	IE via NS_a	0013	−0410	0424	
	IE via NS_c	0036	−0341	0466	
	Direct effect	1903*	0999	3007	97,5
	Coach partner effect HP_a - PA_c				
	Total effect	0618	−0031	1263	
	Total IE	0421*	0006	0878	
	IE via NS_a	−0068	−0399	0217	
	IE via NS_c	0489*	0204	0882	
	Direct effect	0197	−0439	0799	
	Athlete partner effect HP_c - PA_a				
	Total effect	−0205	−0923	0559	
	Total IE	0044	−0441	0559	
	IE via NS_c	0039	−0448	0540	
	IE via NS_a	0005	−0285	0270	
	Direct effect	−0249	−1181	0824	
Within-person level	**Coach actor effect HP_c - PA_c**				
	Total effect	1265*	0220	2465	
	Total IE	0660*	0044	1637	52,2
	IE via NS_c	0656*	0040	1614	
	IE via NS_a	0005	−0202	0225	
	Direct effect	0604	−0268	1421	47,8
	Athlete actor effect HP_a - PA_a				
	Total effect	1313*	0476	2123	
	Total IE	0078	−0208	0398	5,9
	IE via NS_a	0010	−0226	0213	
	IE via NS_c	0067	−0092	0308	
	Direct effect	1236*	0435	2020	94,1
	Coach partner effect HP_a - PA_c				
	Total effect	0116	−0749	1204	
	Total IE	0204	−0312	0907	
	IE via NS_a	0006	−0234	0247	
	IE via NS_c	0197	−0264	0902	
	Direct effect	−0088	−0821	0751	
	Athlete partner effect HP_c - PA_a				
	Total effect	−0120	−0919	0735	
	Total IE	0244	−0065	0795	
	IE via NS_c	0234*	0001	0668	
	IE via NS_a	0011	−0215	0220	
	Direct effect	−0365	−1061	0394	

CI = confidence interval, IE = indirect effect. HP = harmonious passion, NS = need satisfaction, PA = positive affect. The subscript a or c refers to athlete or coach. The proportion of the total effect is only computed for the total indirect and direct effect when the total effect was significant.

need satisfaction may be important not only for their own but also for their athletes' positive affect. While this finding suggests that interventions aimed at enhancing coaches' need satisfaction at the within-person level could be beneficial for both coaches and athletes, further research is needed to confirm these effects.

Our findings align with previous cross-sectional research by Fonteyn et al.[8] which demonstrated the mediating role of need satisfaction in the relation between harmonious passion and positive affect, but found little evidence for partner effects in a sample of 198 coach-athlete dyads. However, since previous research demonstrated that effects can vary across different levels of analysis, it is crucial to compare effects at the between- and within person level to enhance theoretical understanding and separate the variability at these two distinct levels.[9,50] For example, although between-person effects may be susceptible to unmeasured individual-level variables, within-person effects are robust against such potential confounders.[9,50]

Compared to previous longitudinal studies with an individual perspective, our findings support only a subset of the effects. While Felton and Jowett[35] identified a positive association between athlete need satisfaction and both vitality and performance self-concept at the between-person level, we did not observe this association for positive affect. Similarly, although Verner-Filion and Vallerand[18] demonstrated that within-person changes in need satisfaction and between-person differences in harmonious passion are positively associated with positive affect in athletes, we only confirmed the latter. Several factors may explain these differences. First, unlike previous longitudinal studies, we controlled for harmonious passion when testing the effect of need satisfaction on positive affect. Second, we opted for a questionnaire specifically targeting the coach-athlete relationship during sport participation or coaching. In contrast, Felton and Jowett[35] used a general non-sport version of the Need Satisfaction Scale and Verner-Filion and Vallerand[18] examined general need satisfaction experienced in the sport without targeting the coach-athlete relationship. As such, prior findings may reflect more general processes that don't extend to the coach-athlete relationship within a sport specifically. Additionally, differences in timeframe and sample could also contribute to the differences in results. Specifically, Verner-Filion and Vallerand[18] included five questionnaires over the span of three competitive seasons, while Felton and Jowett[35] had a larger sample, a lower drop-out rate and a younger age range. Lastly, both the study by Felton and Jowett[35] and Verner-Filion and Vallerand[18] focused exclusively on athletes. Despite little evidence for partner effects, we did find some interpersonal findings relating to coaches' need satisfaction.

While the current study advances our understanding of the association between passion, need satisfaction and positive affect in coach-athlete dyads, several limitations warrant consideration. First, while our model places harmonious passion as antecedent to need satisfaction, the reverse relationship has also received empirical support.[30–32] Despite being longitudinal in nature, the current study design does not justify causal conclusions. Nevertheless, the within-person effects reported here are robust against time-varying confounders.[51] Future quasi-experimental longitudinal dyadic designs could explore the possible reverse relationship. Second, our model focused exclusively on harmonious passion, need satisfaction and positive affect. Future research could also include obsessive passion, need frustration and/or negative affect to explore the opposite model or account for opposing constructs simultaneously. For example, prior research showed that studying both types of passion together provides a comprehensive understanding of their joint effects.[8,14,15] Furthermore, while coaches and athletes can contribute to need satisfaction, they may also play a role in need frustration which can negatively impact both affect and passion.[8,20,36] Lastly, on top of positive affect, all these processes may also influence negative affective experiences.[8]

Importantly, the timing of the study during the COVID 19 pandemic may also have played a role in both the absence of strong partner effects and the lack of association between athletes' need satisfaction and their own positive affect. The study ran from November 2021 until May 2022. Although the majority of the study was conducted outside of a lockdown period, the potential impact of COVID-19 pandemic measures was not considered. At the start of the study, restrictions could still have manifested as reduced contact between coach and athlete or modifications in training settings, such as outdoor sessions. This might have reduced the partner effects between coaches and athletes. Moreover, since previous studies indicated that the COVID-19 pandemic influenced the emotional well-being of both athletes and coaches,[52–54] this could also have reduced the effects for positive affect.

Another limitation involves the exclusion of demographic variables from the model. While no differences were deemed relevant between participants who dropped out and those who remained in the study, these variables could still influence our variables of interest. For instance, factors such as gender, age, level of competition and cultural background could shape interactions between coaches and athletes, potentially affecting harmonious passion, need satisfaction and affect. Additionally, situational factors such as recent performance or game results, training schedules, or even psychological stressors outside the sport context could further impact these variables. Given the potential impact of these factors, the observed relationships should be interpreted with caution. To better isolate the effects, future research should consider controlling for these variables.

Additionally, the internal consistency of the scales, particularly the harmonious passion scale, were lower than those reported in previous research.[13,55] While the Dutch versions of the need satisfaction and positive affect scales had been previously validated in different samples, the harmonious passion scale required translation. As such, potential issues related to translation may have affected its reliability. Future studies should consider

refining the Dutch version of the harmonious passion scale. We also verified how passionate the participants in our study were about sport/coaching. Vallerand et al.[13] proposed that for someone to be considered as having a passion for an activity, they must have a score of at least four on the item "This activity is a passion for me". In our sample less than 10 athletes and coaches are considered non-passionate at wave 1 according to this criterion, but there were no coach-athlete dyads who were simultaneously non-passionate. However, the alternative criterion proposed by Vallerand[12] of having a mean score of 4 on the passion criteria, was not assessed in this study. Using passion criteria as an eligibility criterion is recommendable in future research.

Furthermore, since there was severe drop out from wave 1 (N = 87) to wave 3 (N = 46), the sample size may have been too small to detect small to moderate partner effects. Initially, the study was designed to detect these effects in the overall sample at wave 1 with a power of 80%. However, a post-hoc sensitivity analysis assuming such partner effects at both the between and within level while mimicking the observed missing data structure and the observed variability, revealed a power below 50% at both levels of analysis. While no systematic demographic differences were found between participants who remained and those who dropped out, the COVID-19 pandemic could have had an impact here. As restrictions eased over the study period, participants may have prioritized their training and competitions, reducing their motivation or availability to continue participation in the study. Future studies could explore additional retention strategies as well as replicate this study in the absence of a pandemic.

Finally, while our longitudinal, dyadic design is a strength, the three time points across 4.5–6 months may have been too limited to detect meaningful within-person changes in passion. This timeframe was chosen because it spans one competitive season, allowing us to investigate changes within a single season specifically. However, athletes and coaches in the present study reported on average several years of experience. Previous research on the longitudinal trajectories of passion suggests that the development of passion in the initial phase is dynamic, while at these later stages passion develops more slowly.[13,48,49] Similar to Verner-Filion and Vallerand,[18] future research could space the time points more, include more time points or focus more on the initial phase when passion for an activity develops or when the coach-athlete collaboration initiates.

Conclusion

By adopting a dyadic longitudinal approach and introducing the L-APIMeM model, we got a better understanding of the interplay between harmonious passion, need satisfaction and positive affect in coach-athlete dyads. First, in terms of intrapersonal actor effects, our findings not only highlight the valuable role of harmonious passion for positive affect in coaches and athletes at the between-person level, but also at the within-level. Our findings suggest that momentary changes in harmonious passion are associated with changes in positive affect. Additionally, for coaches, this actor effect was partly mediated by their own need satisfaction, whereas for athletes, only the direct effect was significant. Second, while partner effects were smaller than anticipated, our findings suggest potential partner effects through coaches' need satisfaction both at the between- and within-person level. This suggests that coaches' need satisfaction may play a crucial role in the relationship between harmonious passion and positive affect, for both themselves and their athlete. Given the study's limitations, including the high dropout rates, the potential impact of the COVID-19 pandemic and sample heterogeneity, caution is warranted when interpreting these results. While the findings contribute to existing literature on positive affect in sports, further research in larger samples with coach-athlete dyads that are both truly passionate about coaching/sports is needed to validate these effects.

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Credit author contribution statement

Ayala Denul: Methodology, Formal Analysis, Investigation, Writing – Original Draft, Writing – Review & Editing. **Leen Haerens**: Writing – Review & Editing, Supervision. **Tom Loeys**: Conceptualization, Methodology, Writing – Review & Editing, Supervision

Data availability statement

Data and code are available via the Open Science Framework (OSF; https://osf.io/6sm37/).

Declaration of conflicting interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethics statement

This project was conducted in accordance with the ethical guidelines of the General and Specific Ethical Protocol of the Faculty of Psychology and Educational Sciences, Ghent University and has received approval from the ethical committee of this faculty. Participants gave consent via an online informed consent form before completing the online survey. Coaches and athletes could only participate when both dyad members agreed to participate and signed the informed consent.

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Supplemental material

Supplemental material for this article is available online.

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