Social antecedents in physical activity: tracking the self-determination theory sequence in adolescents

Short title: SOCIAL ANTECEDENTS IN ADOLESCENCE PHYSICAL ACTIVITY

Key words: Physical Activity, significant others, Self Determination theory, adolescents, social agents.

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Abstract

Aims: The aim of the study was to test the Self Determination Theory (SDT) sequence to predict physical activity (PA) and intention to be active during adolescence: social factors (father, mother, friends, and physical education teacher) → basic psychological needs (BPN) → types of motivation were assessed→ PA and intention to be active.

Method: Participants were 1150 adolescents (M_{age} = 15.01 [1.55]) who completed questionnaires. Structural equation modeling supports the SDT sequence model.

Results: results revealed that intrinsic and extrinsic motivation positively predicted both PA and intention to be active while amotivation did so negatively. Moreover, social factors behaved differently with BPN, finding positive relationships between father, friends and PE teachers with competence, autonomy and relatedness, whereas mother's support does not influence the sequence.

Conclusion: The study shed light on the SDT theory to provide a better understanding of physical activity behaviors and intentions during adolescence.

Keywords: Physical activity, intention to be active, self-determination theory sequence, adolescents, social factors.

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Regular physical activity (PA) during adolescence implies health benefits at physical, psychological and social levels (e.g., Biddle, Sallis, & Cavill, 2000). Global data show that less than 20% of adolescents (13-16 years old) reach PA recommendations for health, i.e., 60 minutes of moderate to vigorous PA per day (Hallal et al., 2012). Furthermore, PA recommendations are not satisfied in adulthood, either, with a remarkable decrease in PA during the transition from high school to university years (Bray & Born, 2004). Therefore, understanding adolescents' future intentions to participate in an active lifestyle is essential, because it also reflects the relative motivating force to engage in PA in adulthood (Hein, Müür, & Koka, 2004). PA behavior is complex and numerous domains have been identified as potential determining factors. For example, motivation or perceived competence within the psychological domain, the influence of significant others within the social domain and gender within the personal domain have been identified as important PA influencing factors (e.g., Bauman et al. 2012). Therefore, a broader view of the determining factors is required to successfully promote PA (Li, Iannoti, Haynie, Perlus, & Simons-Morton, 2014).

Theoretical approach

The Self Determination Theory (Deci & Ryan, 1985) is a macro-level framework to explain human motivation to engage in different behaviors, and it has become increasingly more important in order to understand PA (e.g., Standage, Gillison, Ntoumanis, & Treasure, 2012). Additionally, Vallerand (1997, 2007) established a hierarchical model of motivations based on Self Determination Theory (SDT). The model describes the following sequence: social factors → psychological issues→ types of motivation → cognitive, affective and/or behavioral consequences. It considers that self-determined motivation causes important cognitive, affective and behavioral consequences, such as PA or intentions. The purpose of

this study is to elaborate the SDT sequence model designed to predict PA or the future component of PA behavior, namely, the intention to be physically active. To do so, the model should be represented at a global level where all social factors, psychological issues and the continuum of motivation are represented by all available possibilities, instead of at a situational or contextual level where the behavioral consequences are too specific to be generalized. Together with the SDT we have integrated SDT mini-theories to explain PA and intention to be active in depth: Cognitive Evaluation (CE) theory, Basic Psychological Needs (BPN) theory and Organismic Integration (OI) Theory, also extending the number of theories tested in previous studies (e.g., Gunnell, Crocker, Mack, Wilson, & Zumbo, 2014).

Social factors. During adolescence, the home, schools and the community are responsible for promoting regular PA participation (Zhang & Solmon, 2013). Therefore, parents at home, friends and peers in the community and at schools, as well as PE teachers at schools, are potentially relevant persons in terms of PA behavior as they are the social factors that are most commonly in contact with adolescents.

In the home, family involvement and support may seem essential to promote PA in adolescents (Zhang & Solmon, 2013). Nevertheless, results from previous research showed that this is not clear. Some studies reported an absence of relationship between parental involvement or support and PA (e.g., Ferreira et al., 2006), whilst other researchers found that parental support predicted PA in adolescents (e.g., Gustafson & Rhodes, 2006). In light of the discrepancies, the influence of parents has been analyzed through several different aspects, such as social support, role modeling, parental PA participation, family cohesion, parent-child communication or influence on internal motivation to PA (e.g., Li, et al., 2014; Trost, et al., 2003). Recently, in a meta-analysis, Yao and Rhodes (2015) concluded that parental support is the most sizeable correlate to adolescents' PA in relation to social influences from parents. In relation to parental support, there are few studies that consider both influences

separately; moreover mothers did not show any effect on psychological issues while fathers did in the prediction of PA behaviors (Abarca-Sos, Bois, Generelo, Zaragoza, & Julián, 2013). Fathers and mothers may influence adolescents differently, playing a key role in the transmission of different beliefs depending on their gender, as enunciated by Vallerand (1997) within the SDT context. The present article takes into account both influences separately.

Within the school and community context, research has shown that experiences with peers in adolescence could be complex and PA is related to several domains (Fitzgerald, Fitzgerald, & Aherne, 2012): the presence of peers or friends during PA, peer norms, quality of friendship, peer crowds, peer acceptance, peer victimization and peer support. Also, in the SDT context, Vallerand (2007) added that peers improve motivation to participate and persist in PA. The domain that showed the strongest relationship, denoting its importance in PA behaviors during adolescence, was peer support (Fitzgerald, et al., 2012).

In addition, almost all adolescents are enrolled in schools. These institutions are considered an ideal environment to promote PA, because they provide opportunities to intervene in the physical education (PE) context in the youth population (Sallis et al., 2012). PE teachers provide a learning environment to develop an active and healthy lifestyle (Biddle, et al., 2000), and they are social factors involved in developing self-determined motivation in their students (Ryan & Deci, 2000b). According to Vallerand's postulate number three (2007), PE teachers may be linked to an active lifestyle of their students as they influence PE in general, at a global level.

Hence, this research widens the study of the social factors in the SDT sequence, previously studied in isolation or combined exclusively from an autonomy support point (e.g., Almagro, Sáenz-López, & Moreno, 2010; Hagger, Chatzisarantis, Culverhouse, & Biddle, 2003; McDavid, Cox, & Amorose, 2012). Therefore, this study includes social factors

in the SDT sequence that have been recognized as the most influential: mother support, father support, peer support, and PE support to determine PA behaviors in adolescents.

Psychological issues. Social factors may influence PA behavior by the way in which individuals interpret those factors in terms of facilitating their basic psychological needs (Vallerand, 2007). The basic psychological needs (BPN) mini-theory is comprised of the competence, autonomy, and relatedness of an individual. Ryan and Deci (2000a) have conceptualized BPN as nutriments for individuals' development, growth, integrity and physiological or psychological health. Competence is the need to interact effectively with and to master one's behavior, feeling confident and effective in action and seeking optimal challenges for their capacities (Ryan & Deci, 2000a). Autonomy is the need to be the origin or source of one's own behavior and performance, based on interest and integrated values (Ryan & Deci, 2000a). Finally, relatedness refers to the need to feel a sense of connectedness to others in one's social surroundings, connecting with peers, forming part and being accepted (Ryan & Deci, 2000a). Following Vallerands' sequence (1997, 2007), social factors affect the accomplishment level of an individual's basic psychological needs and consequently, competence, autonomy, and relatedness are related differently to the continuum of motivation, which is the precursor of cognitive, affective and behavioral consequences such as PA behaviors and intentions. (e.g., Jackson-Kersey & Spray, 2016; Standage, Duda, & Ntoumanis, 2005).

Following the SDT sequence, it is the CE theory that focuses on the effects of interpersonal social-contextual events and structures (e.g., rewards, communications, feedback) on motivated behaviors. Social factors may improve motivation related to behavior, because they permit satisfying the basic need for competence, autonomy and relatedness (Ryan & Deci, 2000a). Moreover, combined with postulate number three

described by Vallerand (1997) it is indicated that social factors may influence adolescents' PA motivation by either supporting or thwarting the BPNs.

Motivation. The SDT sequence and the organismic integration mini-theory (OI), establish motivation as a continuum, characterizing it by different levels of self-determination: intrinsic motivation, extrinsic motivation and amotivation (Deci & Ryan, 1985). Intrinsic motivation reflects the highest self-determination degree, engaging in a behavior or activity to experience satisfaction, pleasure and for its own sake. Extrinsic motivation refers to doing an activity or behavior because it leads to a different and separable result (Ryan & Deci, 2000a). Finally, amotivation is defined as the state of acting passively or lacking the intention to behave in any way (Deci & Ryan, 1985). Previous research in PA has observed that the SDT sequence has some inconsistencies (see review of Teixeira, Carraça, Markland, Silva, & Ryan, 2012). Firstly, authors have found a positive association between intrinsic motivation and PA behavior as behavioral consequences, supporting the SDT sequence between motivation and behavioral consequences such as the behavior of engaging in PA(Postulate five; Vallerand, 1997, 2007). Regarding external motivation, 43% of the studies showed negative relationships with PA, whereas 57% did not show any association. These differences could be explained because adolescents' involvement in a particular behavior like PA is due, to a greater extent, to internal rewards rather than external benefits. Finally, amotivation was negatively related to PA in 36% of the studies whilst the rest did not show any association (Owen, Smith, Lbans, Ng, & Lonsdale, 2014). Thus, according to Vallerand (postulate one; 1997, 2007), it is essential to analyze the effect of the continuum of motivation in order to understand behavioral consequences such as adolescents' participation in PA and their intention to participate.

Although many studies have analyzed motivation at a situational and contextual level, fewer studies have evaluated it at a global level (Vallerand, 2007). Global motivation has

been defined as a general motivational orientation to interact with the environment in an autonomous, controlled, or amotivated way (Vallerand, 1997, 2007). In this study, social factors, psychological issues, motivation and consequences, PA and the intention to be physically active, were tested at a global level, extending previous research on the SDT sequence.

The current study

One of the strengths of the present study is the possibility to empirically test the SDT sequence theoretical approach applied to PA behavior during adolescence. Additionally, another strength is that the influences of social factors are broader in this research, thus mothers and fathers are considered together and separately as an antecedent to the SDT sequence (McDavid et al., 2012), as well as friends and PE teachers. Accordingly, the main purpose of this research was to test the SDT sequence by developing a model whereby the social factors of significant others influence BPNs, BPNs influence motivation and motivation influences PA and intention to be physically active (the future component of healthy behavior). It was hypothesized that: a) Mothers, fathers, friends and PE teachers will positively affect competence, autonomy and relatedness; b) Satisfying BPN will have a positive effect on intrinsic motivation and a negative effect on extrinsic motivation and amotivation; c) High levels of intrinsic motivation have a positive effect on PA and the intention to be physically active, whereas extrinsic motivation and amotivation will be negatively related to these behavioral consequences.

Method

Participants

Participants included 1150 Spanish adolescents from 5 public and private secondary schools located in an urban area (town population with over 2,000 adolescents). The response rate was 95.47%. We have eliminated 52 cases by applying the exclusion criteria: incomplete

and missing data. Consequently, the final sample was comprised of 1098 participants (M_{age} = 15.01, *SD* = 1.55): 576 girls (M_{age} = 15.04, *SD* = 1.57) and 522 boys (M_{age} = 14.97, *SD* = 1.53). Schools were selected based on accessibility and willingness to cooperate criteria.

Measures

Physical activity. The Assessment of Physical Activity Levels Questionnaire (APALQ: Telama, Yang, Laakso, & Viikari, 1997) was used to measure physical activity. It consists of 5 items rated on a 4-point Likert scale ranging from 1 to 4 that refer to physical activity. The score of the questionnaire is calculated using the sum of the values of each question with a maximum score of 20 points. Examples of the items used are: "Outside school, do you take part in organized sport?" or "Outside school, how many hours per week do you usually take part in physical activity or sport to the extent that you get out of breath or sweat?" The Spanish version (Zaragoza et al., 2012) has shown correlations ranging from .31 to .70 ($p < .05$) between PA and Actigraph accelerometers, depending on gender and accelerometer values (moderate to vigorous PA and steps), denoting adequate validity, as well as test – retest reliability, recording an intra-class correlation coefficient of .76, in the Spanish sample. Recently, the APALQ version of Zaragoza et. al, (2012) has proven to be the most valid and accurate self-reporting questionnaire in Spanish adolescents (see review of Martínez-Lemos, Ayán Pérez, Sánchez Lastra, Cancela Carral & Valcarce Sánchez, 2016).

Intention to be physically active. The Intention to be Physically Active scale developed by Hein et al. (2004) was used to assess the intention to be physically active in adolescents. It consists of 5 items rated on a Likert scale ranging from *completely disagree* = 1 to *completely agree* = 5. Examples of the items used are: "After graduation I would like to be physically active" or "Outside PE lessons, I like to do sport". The Spanish version (MIFA: Moreno-Murcia, Moreno, & Cervello, 2007) has an internal consistency of .94 (In our study alpha was .70 and omega .82).

Motivation. The Sport Motivation Scale (SMS; Brière, Vallerand, Blais, & Pelletier, 1995) was used to assess motivation towards PA and sport. The scale is comprised of 28 items (7 subscales) with a 7-point Likert scale going from, *does not correspond at all* = 1 to *correspond exactly* = 7. The 7 subscales are comprised of three dimensions of the motivation continuum integrated into the SDT (Deci & Ryan, 1985): Intrinsic motivation through the intrinsic motivation to know subscale (e.g., "For the pleasure it gives me to know more about the sport that I practice"), intrinsic motivation to accomplish subscale (e.g., "For the pleasure I feel while improving some of my weak points") and intrinsic motivation to experience stimulation subscale (e.g., "For the pleasure I feel in living exciting experiences"); extrinsic motivation through the identified regulation subscale (e.g., "Because, in my opinion, it is one of the best ways of meeting people"), introjected regulation subscale (e.g., "Because it is absolutely necessary to do sports if one wants to be in shape.") and external regulation subscale (e.g., "Because it allows me to be well-regarded by people that I know."); and the last dimension integrated by the sole amotivation subscale (e.g., "I don't know anymore; I get the impression that I am incapable of succeeding in this sport."). The Spanish SMS version (Núñez, Martín-Albo, Navarro, & González, 2006) presented internal consistencies of alpha ranging from .71 to .92. Our study presented an internal consistency of $\alpha = .86$ ($\omega = .78$) for the dimension of intrinsic motivation, $\alpha = .92$ ($\omega = .85$) for the dimension of extrinsic motivation and $\alpha = .73$ ($\omega = .65$) for the dimension of amotivation.

Basic psychological needs. The multidimensional questionnaire, Psychological Need Satisfaction in Exercise Scale (PNSE: Wilson, Rogers, Rodgers, & Wild, 2006) was used to measure psychological need satisfaction. It consists of 6 items for each of the three needs: competence (e.g., "Capable of doing challenging physical activity"), autonomy (e.g. "Free to make my own physical activity decisions") and relatedness (e.g., "Sense of camaraderie with companions") rated on a 5-point Likert scale ranging from *totally disagree* = 1 to *totally*

agree = 5. The Spanish version (Moreno-Murcia, Marzo, Martínez-Galindo, & Conte, 2011) showed internal consistency of α = .80 in competence, α = .69 in autonomy and α = .73 in relatedness. In our study, the values of internal consistency were α = .89 (ω = .94), α = .75 (ω = .86) and α = .85 (ω = .91), respectively.

Mother and Father support. Both Mother and Father support were measured separately using the parental questionnaire developed by Trost, et al. (2003), which assesses the weekly frequency of mothers' and fathers' PA behaviors related to their children's PA (e.g., "Encouraged their child to do physical activities or play sports"). It consists of 5 items rated on a Likert scale ranging from *totally disagree* = 1 to *totally agree* = 5. Father's support showed internal consistency of α = .69 (ω = .72) and Mother's support showed internal consistency of α = .71 (ω = .81).

Friends' support. The Sport Friendship Quality Scale (SFQS: Weiss & Smith, 1999) was used to assess sport friendship quality. The three dimensions (12 items), referring to a group of friends, assessed were: self-esteem enhancement and supportiveness (e.g., "My friend has confidence in me during sports"), loyalty and intimacy (e.g., "My friends look out for me") and companionship and pleasant play (e.g., "I like to play with my friends"). The item response format was also rated on a 5-point Likert scale, ranging from *not at all true* = 1 to *really true* = 5. Our study presented adequate internal consistency (α = .81, ω = .93).

Physical education teacher support. The Perceived Autonomy Support Scale for Exercise Settings (PASSES: Hagger et al., 2007) was used to assess PE teacher perceived autonomy support in exercise. It is comprised of 12 items rated on a 7-point Likert scale, ranging from *strongly disagree* = 1 to *strongly agree* = 7. Examples of the items used are: "My PE teacher cares about the active sports and/or vigorous exercise I do in my free time", or "My PE teacher displays confidence in my ability to do active sports and/or vigorous exercise in my free time". The Spanish version used (Moreno-Murcia, Parra, & González-

Cutre, 2008) showed appropriate construct validity (α = .91). In our study, internal consistency was α = .90 (ω = .87).

Procedure

Firstly, the project was submitted to the University Research Ethics Committee and it was approved. Afterwards, and once the study had been presented and approved by the Regional Government Education Department and High Schools had shown voluntary interest in participating, PE teachers, parents and students were informed about the voluntary and confidential nature of the study. Moreover, students signed an informed assent in order to participate in the study. Parental consent was obtained passively: after an informative letter was sent to parents, if they did not refuse to allow their children to participate, the questionnaire was administered. The questionnaires took approximately 40 minutes to complete and were given out during regular PE lessons by researchers and trained assistants.

Statistical Analysis

Structural equation modeling was used to analyze the data by means of Mplus, Version 7.11. Parcels were made up to cut down the sampling error by reducing the specific variances of each item. Items were randomly assigned to parcels and then averaged, as strongly recommended in the parceling procedure described by Little, Rhemtulla, Gibson and Schoemann (2013).

The model proposed was tested in agreement with the two-step procedure recommended by Anderson and Gerbing, (1998). Firstly, construct validity of the latent variables was tested via Confirmatory Factor Analysis (CFA) and the resulting model was named measurement model. Secondly, once the factor structure was supported, the proposed theoretical model, the structural model, was tested. Then, the structural model was run in a multi-group analysis by gender and measurement invariance for structural and path-

coefficients across gender was tested, following the recommendations of Wang and Wang (2012).

Structural equation modeling analyses were assessed with maximum-likelihood-estimation (ML) and robust maximum-likelihood-estimation (MLR). The results were identical showing a multivariate normal distribution of the data (Hox, Maas, & Brinkhuis, 2010), thus ML has been used. Goodness-of-fit was tested with the common fit index. Thus, a fit model is considered adequate when the Comparative Fit Index (CFI) and Tucker-Lewis Index (TLI) have values of >.90, the Root Mean Square Error of Approximation (RMSEA) is <.06 and Standardized Root Mean Square Residual (SRMR) <.08 (Iacobucci, 2010). In addition, χ^2 was reported as the only inferential statistics in the model. The internal consistency of the instruments used was assessed via alpha and omega. Omega proved to be less risky in terms of overestimating or underestimating reliability (Dunn, Baguley, & Brunsden, 2013), as well as a more sensitive index of internal consistency, in relation to alpha and also when compared with others (Revelle & Zinbarg, 2009).

Results

After the parceling procedure was conducted, the model to be tested was composed of 12 latent variables and 31 parcels. The loading of the first indicator was fixed to one for each parcel. The remaining factor loadings were freely estimated. In order to enable replication of the present study, the covariance matrix is presented in Table 1. A confirmatory factor analysis was conducted to assess construct validity of the measures assessed in this study. The model provided an adequate fit to the data χ^2 (df = 368) = 1123.45, RMSEA = .044, TLI = .94, CFI = .95, SRMR = .039 (see Table 2). Thus, the variables have proven adequate construct validity. Correlations between latent variables are presented in Table 3. PA is related to all other variables of the study as well as intentions to be physically active. Social factors (mothers, fathers, friends, and PE teachers support) are related positively.

Competence, autonomy and relatedness are related among them as predicted the Basic Psychological Needs theory. Finally, within the continuum of motivation, intrinsic is related to extrinsic motivation positively and to amotivation negatively. Conversely, extrinsic motivation showed no relation with amotivation.

Structural equation modeling

The hypothesized model presented an adequate fit to the data $\chi^2 = 1282.782$, $df = 394$; CFI = .941, TLI = .931, RMSEA = .046, 90% CI [.044, .049], SRMR = .047. Furthermore, in an attempt to obtain a more parsimonious model, we ensured that the values of the non-significant parameters of the structural model were different to zero. They must also be representative and be present in the model. More specifically, we developed nested models by imposing the value of the non-significant parameter fixed to zero, one by one. Each resulting model was compared with the structural model by means of the chi-square difference test. None of the values resulted different to zero. After eliminating all the paths, the definitive model was not different to zero, showing an adequate fit $\chi^2 = 1283.802$, $df = 399$; CFI = .942, TLI = .932, RMSEA = .046, 90% CI [.043, .049], SRMR = .047. In addition, the chi-square test showed that both models, the final model and the structural model, are equivalent $\Delta\chi^2$ ($df = 5$) = 1.44, $p = .92$. Figure 1 shows the final model.

Gender analysis. Firstly, the structural model was run for males $\chi^2 = 533.234$, $df = 279$; CFI = .959, TLI = .948, RMSEA = .043, 90% CI [.037, .048], SRMR = .043 and females separately $\chi^2 = 621.750$, $df = 279$; CFI = .952, TLI = .939, RMSEA = .047, 90% CI [.042, .052], SRMR = .044, showing both models an adequate fit to the data. Therefore, a baseline model was developed in order to be able to evaluate if male or female participants conceptualized the constructs in the same way (configural invariance) and consequently compared to a nested model with constrains in all factor loadings to be the same across gender groups (metric invariance). The resulting difference between the constrained and the

unconstrained models of measurement invariance was not significant ($\Delta\chi^2$ [df = 35] = 33.34, p = .55). It denotes that observed item differences indicate gender differences in the construct measured.

Furthermore, the structural model was run in a multi-group analysis by gender and measurement invariance for path-coefficients across gender was tested. The resulting difference between the constrained and the unconstrained models of the first step in the invariance routine was not significant ($\Delta\chi^2$ [df = 27] = 22.13, p = .73). It denotes the lack of gender differences in the structural model designed.

Discussion

This study has examined the influence of social factors (mothers, fathers, friends and PE teachers) on the SDT sequence in which BPNs influence self-determined motivation, which, in turn, influences PA and intention to be physically active in adolescents. The results provide a better understanding of how social antecedents, analyzed at a global level, influence SDT variables in the PA context, providing experimental support to the hypothesized relations in the sequence: social factors → psychological issues (BPN) → types of motivation → behavioral consequences (PA) (Vallerand, 1997, 2007).

The first hypothesis in agreement with the SDT sequence (Vallerand, 1997, 2007) is related to the positive effect of social factors (mothers, fathers, friends, and PE teachers) on BPNs. The hypothesis is partially supported because several of the hypothesized relations were not found. Regarding the different social factors, it is noteworthy that no mother effect was found in any of the BPNs whilst father support positively predicts competence and relatedness. This lack of relationship between mother support and psychological issues, even though father association is significant, has been found in previous studies (e.g., Abarca-Sos, et al., 2013). This fact could be explained by the complexity to understand the different ways of supporting adolescents. While fathers often explicitly express their support by encouraging

their children or by their own behavior, mothers may often provide more support in logistics (Davison, Cutting, & Birch, 2003). However, in a study developed under the SDT framework, McDavid, et al. (2012) found a positive influence of mothers' and fathers' autonomy support on self-determined motivation, in contrast to our findings. Moreover, Bois, Sarrazin, Brustad, Trouilloud and Cury (2005) found that mothers have a stronger influence on PA, but, however, with younger children. Therefore, the results and previous literature suggest that as age increases the influence of parents on PA, specifically the mother's, tends to disappear. In line with this premise, McDavid et al. (2012) enunciated that adolescents may differentiate the strength of support given by their mothers and fathers as our results showed.

In the SDT context, the influence of parents on PA has focused mainly on autonomy support (e.g., McDavid, et al., 2012), as well as on the trans-contextual model (Hagger, et al., 2003). However, the SDT postulates that various forms of social support, not only autonomy support, should have a positive relationship with healthy behaviors (Deci & Ryan, 1985). The present study showed that friend support was a strong predictor of BPN satisfaction, because no relations have been found for the mother's support and regarding the father only positive influences to competence and relatedness. The positive link in the PA domain between peers' influence and behavior is considered classical, given the large number of studies that have reported this result (e.g., Beets, et al., 2006; Fitzgerald, et al., 2012) considering the SDT sequence. Therefore, the results and previous studies suggest that the period of adolescence is more sensitive to the support of friends than to the support of other social factors.

Finally, grounded in the SDT (Deci & Ryan, 1985; Ryan & Deci, 2000a) and Vallerand's sequence (1997, 2007), we have examined whether support given by PE teachers, may influence BPNs. Results showed that PE teachers emerged as the only adults that have

shown positive and significant inroad into improving psychological issues (competence, autonomy and relatedness) during adolescence. Taking a major step forward, Standage, Sebire and Loney (2008) showed indirect effects of PE teacher support on intrinsic motivation in PA and variables related to adolescents' health. Thus, intrinsic motivation was also positively predicted by PE teacher support when mothers and fathers were measured at the same level (McDavid, et al., 2012). In sum, PE teachers play an important role reinforcing PA behaviors in adolescents (Hagger, et al., 2003; McDavid, et al., 2012).

An important contribution to literature was the role played by the social factors analyzed as antecedents of psychological issues in PA behaviors in adolescence (Hager, et al., 2009). Consequently, the tested model supported that social factors should be evaluated as determining factors of psychological issues (Gustafson & Rhodes, 2006; Vallerand, 1997, 2007). Understanding the influence of support from parents analyzed separately as well as from friends and PE teachers on motivation and health outcomes such as PA and intention to be physically active should be the subject of further investigation. This would provide valuable insight with a view to developing successful intervention programs to increase PA (Zhang & Solmon, 2013).

The second hypothesis, related to the precept that competence, autonomy and relatedness have an important influence on motivation (Deci & Ryan, 1985) is partially supported because some of the relationships were not found as indicated by the SDT sequence (Vallerand, 1997, 2007). Firstly, intrinsic motivation is positively predicted by perceived competence and relatedness whilst autonomy is not significantly associated. Different studies have empirically demonstrated these positive relationships, using BPNs in the sequence, where social factors predict intrinsic motivation (e.g., Almagro, et al., 2010; Standage, et al., 2003; Standage, et al., 2005). However, autonomy was not found to be predictive, similarly to the results found in the PE context (Ntoumanis, 2001). This variability

of results implies mixed findings about the importance of autonomy in literature related to SDT. Furthermore, in the PA context, Standage, et al. (2012) found that autonomy and competence predict the relative autonomous index, whilst relatedness did not show any significant association. Therefore, the relationships between BPNs and intrinsic motivation should be re-analyzed following the SDT sequence and developing a model with the three BPNs in isolation in order to clarify the strength of the relationships.

Secondly, competence, autonomy and relatedness were positively associated with extrinsic motivation. Based on the theoretical tenets of the SDT, the positive links were not supported (Deci & Ryan, 1985; Vallerand, 2007) whereas empirical research encountered these positive relationships between BPNs and extrinsic motivation. For instance, the results of Standage, et al. (2005) showed that BPNs positively predict introjected regulation as well as intrinsic motivation. Lim and Wang (2009) showed that perceived autonomy positively predicts identified regulation. Finally, Fenton, Duda and Barrett (2016) found no significant associations between controlled motivation, created by introjected and external regulations and moderate to vigorous PA, whereas, regarding correlational analysis, identified regulation was significantly related to PA whilst intrinsic motivation did not show any correlation with moderate to vigorous PA. Therefore, there are numerous studies in the PA and sport context where BPNs are positively related to extrinsic regulations. The extrinsic motivation variable was created in the analyzed model with identified, introjected and external regulations. Nevertheless, identified regulation is characterized by finding importance in an activity and introjected regulation is associated with satisfying internal contingencies (Ryan & Deci, 2000b). Thus, BPNs are positively associated with extrinsic motivation.

Thirdly, amotivation is predicted by two of the BPNs, positively by autonomy and negatively by competence, whilst no relationships were found with relatedness. Fewer studies have analyzed amotivation compared with other regulations in the same model (Teixeira, et

al., 2012), but in a recent meta-analysis, PA was negative when associated with this variable (Owen, et al., 2014). Thus, amotivation is relevant to be included in motivational models. Competence has emerged as the strongest negative predictor of amotivation. This result has been seen in other studies (e.g., Standage, et al., 2003; Ntoumanis, 2001) supporting the SDT premise that competence plays an essential role in positive and negative motivations towards PA and PE. Relatedness did not predict amotivation when it was hypothesized that there should have been a negative relationship (Deci & Ryan, 2000a; Vallerand, 2007). Nevertheless, other studies have not shown any associations (Standage, et al., 2003), because, when competence is included in the model, this is the prevalent influence for amotivation due to the lack of ability dimension. In terms of the third BPN, autonomy, its relationship in our study may, on the one hand, suggest that it has no impact on intrinsic motivation when analyzed jointly with perceived competence and relatedness, but, on the other hand, it has a positive association with amotivation. These relationships were not supported by SDT (Deci & Ryan, 1985; Ryan & Deci, 2000a) or by Vallerand's (1997, 2007) sequence, but these results may be influenced by the instrument items. The autonomy subscale of the PNSE questionnaire focused on adolescents' choice and freedom to carry out PA. However, their own decision to choose the exercises, to engage in PA or sport may not reflect the satisfaction of practicing PA in this group. Moreover, a person can feel autonomous to join a team or group but, in this context, leaders or significant others, such as the coach or teammates, could have a degree of control over decisions taken. Therefore, autonomy is a complex perception and a broad measurement must be addressed to understand their relationships with motivation.

Finally, the results suggested that satisfying all three needs would be a significant predictor of motivation. This is an important finding because it emphasizes the need to

further our understanding of the combined role of autonomy, competence and relatedness in motivational processes, studying the different motivation types, including amotivation.

The third hypothesis, namely that intrinsic motivation has a positive effect on PA and intention to be physically active whilst extrinsic motivation and amotivation are negatively related, is partially supported, because extrinsic motivation showed positive and significant associations with both behavioral consequences. In our study, we have included the hypothesized variables in Vallerand's sequence (1997, 2007), whilst other studies have not integrated BPNs (e.g., Fenton, et al., 2016; Hein, et al., 2004; McDavid, et al., 2012) and motivational types separately (e.g., Almagro, et al., 2010). Furthermore, some researchers included other emotional or cognitive consequences in the model (e.g., Standage, et al., 2012). The differences in the tested models have implied a variability of results, despite all of them being related to the SDT sequence. Therefore, more research is needed to analyze the SDT sequence, integrating all the variables in order to facilitate the comparison of the results related to the variance of PA and intention to be physically active.

The first relationship found in the model is consistent with corollary 5.1 described by Vallerand (1997, 2007), which indicates that consequences are positively decreasing from intrinsic motivation to amotivation because intrinsic motivation is positively associated with PA (Ryan & Deci, 2000a). This positive relationship has been shown in numerous studies (e.g., Owen, et al., 2014; Teixeira, et al., 2012). This strong association can probably be explained because the adolescents who scored a higher score in PA and intention to be physically active selected the activity freely and, therefore, the main causes of their involvement were internal as well as the fact that they found inherent satisfaction when they engaged in the behavior (Moreno-Murcia, et al., 2014).

However, extrinsic motivation also positively predicts PA and intention to be physically active, in contrast to SDT (Deci & Ryan, 1985; Ryan & Deci, 2000a), corollary

5.1, the formulated hypothesis and other studies (Li, et al., 2014). However, integrated and identified regulations are comprised of intrinsic characteristics. Several studies have also found positive relationships between identified motivation and PA (e.g., Standage, et al., 2008). This fact could be explained because PA is carried out in adolescents in different contexts: mandatory physical education, organized PA or sports and leisure time PA. These contexts are substantially different and the motivations to adolescents' involvement in each one could differ. For instance, there are studies in competitive sports in which external regulation (demonstrating to others how good in sports I can be) and introjected regulation (feeling good when I practice my sport) have achieved higher scores related to PA (e.g., Almagro, Conde, Moreno, & Sáenz-López, 2009), whereas in the PE context, identified regulation (I am involved in PE because I learn useful contents for my life) achieved higher scores than intrinsic motivation (e.g., Standage, et al., 2005). Therefore, PA could be predicted by intrinsic motivation and also by extrinsic motivation, because not only is the quality of motivation (e.g., intrinsic motivation) important, but also the amount of motivation, adding extrinsic motivations to PA participation. Related to the intention to be physically active, adolescents who scored higher may have considered that PA participation in the future implies benefits and that they will be involved in PA and sport, not only for enjoyment or to have good experiences, but also to develop other aspects of life.

The third relationship is in agreement with the SDT and the aforementioned corollary, because PA and intention to be physically active were significantly and negatively predicted by amotivation. This association was described in several previous studies with both variables (e.g., Miquelon, Chamberland, & Castoguay, 2016). In a recent meta-analysis that analyzed PA in isolation, amotivation showed a significant negative association with PA ($\rho = -.11$ to $-.21$), resulting in a steady relationship. Regarding intention to be physically active, previous studies have displayed contradictory results. Lim and Wang (2009) analyzed all the

variables integrated in the motivation continuum, showing a positive and significant relationship between amotivation and intention, whilst Standage, et al. (2003) found the opposite to be true. Therefore, this study and previous literature is consistent with the positive relationship between intrinsic motivation and PA (Teixeira, et al., 2012), whereas extrinsic motivation and amotivation relationships with health behaviors need to be analyzed more in depth.

Despite this study contributing novel information about social influences on SDT sequence related to PA and intention to be physically active, there are limitations that should be mentioned. Firstly, the results of the invariance analysis revealed that the model fit was invariant across gender, similarly to other studies in the SDT context (e.g., Standage, et al., 2012) and the tenet of SDT about invariance by gender (Deci & Ryan, 2000a). Although the study has followed the correct steps in the structural equation model to verify if there were gender differences, PA levels in adolescents have shown significant differences in numerous studies, with strong results in different countries and contexts (e.g. Hallal et al., 2012). Moreover, other studies developed under the SDT framework have shown different paths by gender, for instance, between BPN satisfaction and extrinsic motivation, which was positive and significant for females and non-significant for males (Standage, et al., 2005). Therefore, future studies should seek to focus on the SDT sequence relationships analyzed by gender in order to understand whether motivational processes related to PA agree with the SDT invariance postulate. Secondly, data were collected using a convenience sample, not a representative sample of Spanish adolescents. For future investigations, samples should be representative, including rural and urban areas, adolescents from different socio-economic strata or, for instance, members of PA intervention programs. Thirdly, due to the cross-sectional nature of the survey, causality attributions were not feasible and results must be analyzed with caution. Therefore, testing the analyzed model with longitudinal data and

developing, implementing and assessing interventions, based on social factors, are needed to provide evidence concerning the causal relationships between variables. Fourthly, PA assessment using questionnaires, despite the instrument having shown appropriate validation data, may overestimate or underestimate PA levels (Armstrong & Welsman, 2006). Adolescent PA is intermittent and varies depending on the different types of days. This implies that objective measures, such as accelerometers, should be used to collect more accurate data (Ekelund, et al., 2001). Finally, the decision to include some regulations and not others in the extrinsic motivation dimension could complicate the comparisons between studies and even modify the relationships. In agreement with the theoretical framework, we have used an extrinsic motivation variable comprised of external, introjected and identification regulations (Deci & Ryan, 1985; Ryan & Deci, 2000a). However, several studies have included the identification regulation as intrinsic motivation (e.g., Gunnell, et al., 2014), because the definitions contain self-determination characteristics.

Conclusions

This study has examined the SDT sequence extending the findings on PA behavior in adolescents. The results have shown the importance of social factors, mainly father support, friend support and PE autonomy support in the BPN mediators, whilst mother support has no significant influence, positively predicting intrinsic and extrinsic motivation and negatively associated with amotivation. Finally, PA and intention to be physically active were positively predicted by intrinsic and extrinsic motivation and negatively predicted by amotivation. These results highlight the usefulness of the SDT sequence to predict PA and the intention to be physically active, because we health professionals could focus our intervention programs on the skills and tools of significant others to support BPNs that indirectly enhance PA and intention to be physically active, through motivation.

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Table 1.

Descriptive statistics, variances (on the diagonal) and covariances matrix between parcels.

Latent construct	Parcels	*M*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
PA	1 Parcel-a	2.97	.55																														
	2 Parcel-b	2.37	.25	.45																													
Intentions to be PA	3 Parcel-a	4.45	.20	.16	.47																												
	4 Parcel-b	4.18	.38	.34	.39	1.07																											
Intrinsic motivation	5 Parcel-a	5.25	.37	.30	.41	.61	1.77																										
	6 Parcel-b	5.41	.43	.36	.46	.68	1.39	2.22																									
	7 Parcel-c	5.47	.37	.34	.40	.70	1.48	1.42	2.00																								
	8 Parcel-a	3.84	.22	.24	.28	.38	.74	.80	.80	2.16																							
Extrinsic motivation	9 Parcel-b	4.57	.28	.26	.41	.47	.80	.92	.76	1.19	2.09																						
	10 Parcel-c	4.70	.31	.27	.33	.42	1.04	1.06	1.10	1.12	1.06	1.76																					
Amotivation	11 Parcel-a	2.31	-.31	-.17	-.21	-.31	-.45	-.45	-.41	.11	-.05	-.15	2.13																				
	12 Parcel-b	2.40	-.26	-.16	-.17	-.28	-.38	-.31	-.30	.28	.08	-.01	1.29	2.44																			
Competence	13 Parcel-a	3.96	.22	.20	.24	.38	.61	.64	.63	.47	.46	.48	-.35	-.26	.77																		
	14 Parcel-b	4.04	.22	.19	.25	.36	.62	.61	.63	.39	.39	.45	-.38	-.30	.59	.78																	
	15 Parcel-c	3.91	.26	.23	.25	.41	.63	.64	.66	.47	.41	.48	-.43	-.34	.61	.65	.93																
Autonomy	16 Parcel-a	3.86	.10	.04	.12	.16	.32	.35	.28	.35	.43	.35	-.13	-.11	.31	.33	.30	.88															
	17 Parcel-b	3.51	.08	.04	.12	.15	.28	.31	.26	.36	.42	.32	-.03	.01	.22	.25	.24	.42	.81														
	18 Parcel-c	3.40	.01	-.07	.05	.03	.13	.17	.12	.19	.25	.14	-.00	.02	.13	.16	.16	.44	.45	.96													
Relatedness	19 Parcel-a	3.90	.13	.15	.17	.24	.49	.55	.52	.39	.39	.57	-.14	-.11	.27	.28	.27	.22	.23	.09	.79												
	20 Parcel-b	3.87	.16	.19	.19	.28	.53	.61	.58	.37	.34	.59	-.14	-.07	.27	.27	.29	.17	.22	.05	.53	.90											
	21 Parcel-c	4.00	.15	.16	.16	.25	.45	.53	.47	.28	.30	.53	-.23	-.20	.25	.28	.29	.16	.16	.08	.47	.54	.76										
Father support	22 Parcel-a	4.80	.24	.23	.22	.26	.47	.45	.50	.36	.45	.53	-.23	-.15	.29	.28	.30	.15	.13	.02	.25	.27	.24	2.19									
	23 Parcel-b	4.88	.39	.40	.31	.51	.56	.72	.61	.50	.59	.62	-.33	-.25	.35	.35	.38	.15	.08	-	.35	.40	.35	1.24	2.92								
Mother support	24 Parcel-a	4.46	.14	.04	.11	.18	.26	.27	.25	.23	.30	.34	-.06	.02	.14	.12	.13	.08	.12	.06	.15	.17	.14	.80	.62	1.90							
	25 Parcel-b	4.80	.28	.25	.23	.40	.52	.62	.60	.36	.53	.53	-.33	-.18	.32	.30	.29	.08	.08	-	.33	.35	.28	.81	1.40	1.07	2.36						
Friends support	26 Parcel-a	4.17	.07	.09	.09	.15	.30	.30	.32	.15	.19	.26	-.13	-.07	.21	.20	.22	.12	.10	.05	.22	.21	.21	.20	.23	.17	.25	.46					
	27 Parcel-b	3.67	.03	.04	.06	.08	.18	.19	.15	.18	.19	.17	-.04	-.02	.12	.12	.14	.11	.12	.10	.15	.13	.13	.10	.11	.10	.11	.16	.57				
	28 Parcel-c	4.60	.05	.04	.07	.10	.18	.18	.19	.05	.08	.14	-.11	-.10	.09	.12	.13	.06	.05	.02	.12	.14	.14	.08	.13	.04	.11	.17	.16	.25			
PE teacher support	29 Parcel-a	4.89	.17	.18	.20	.22	.38	.43	.37	.25	.38	.46	-.10	-.10	.25	.24	.22	.17	.16	.04	.26	.30	.26	.51	.56	.39	.51	.21	.10	.10	1.73		
	30 Parcel-b	4.60	.11	.17	.14	.22	.40	.44	.44	.32	.40	.51	-.04	.00	.25	.22	.26	.14	.19	.08	.30	.32	.29	.40	.47	.34	.49	.19	.09	.09	1.26	1.98	
	31 Parcel-c	4.43	.08	.09	.16	.15	.32	.39	.40	.26	.32	.45	-.05	.03	.18	.17	.19	.11	.17	.09	.32	.36	.30	.36	.37	.39	.45	.20	.08	.09	1.18	1.58	2.24

Note. PA = physical activity, PE = physical education.

Table 2.

Reliability of parcels, standardized and unstandardized coefficients for measurement model

Latent	Questionnaire	*Parcel*	*Items*	α	λ	*SE*	95% *CI*
PA	APALQ[1]	Parcel-a	1,2	-	.75	.02	.70, .79
		Parcel-b	3,4,5	-	.70	.02	.65, .74
Intentions to be PA	MIFA[2]	Parcel-a	1,2	.59	.70	.02	.66, .74
		Parcel-b	3,4,5	.63	.80	.02	.64, .74
Intrinsic motivation	SMS[3]	Parcel-a	2,4,23,27	.84	.87	.01	.85,.89
		Parcel-b	1,13,18,25	.75	.80	.01	.77,.82
		Parcel-c	8,12,15,20	.85	.89	.01	.87,.91
Extrinsic motivation	SMS[3]	Parcel-a	6,10,16, 22	.74	.70	.02	.65,.73
		Parcel-b	9,14,21,26	.73	.69	.02	.65,.73
		Parcel-c	7,11,17,24	.71	.85	.01	.81,.88
Amotivation	SMS[3]	Parcel-a	5,19	.53	.70	.02	.74, .85
		Parcel-b	3,28	.61	.71	.02	.65, .76
Competence	PNSE[4]	Parcel-a	1,4	.66	.86	.01	.84, .88
		Parcel-b	7,9	.74	.89	.01	.87, .90
		Parcel-c	11,14	.77	.85	.01	.83, .87
Autonomy	PNSE[4]	Parcel-a	2,5	.57	.73	.02	.68, .78
		Parcel-b	8,12	.52	.73	.02	.69, .78
		Parcel-c	15,17	.46	.65	.02	.60, .69
Relatedness	PNSE[4]	Parcel-a	3,6	.57	.78	.02	.75, .81
		Parcel-b	10,13	.67	.81	.01	.78, 84
		Parcel-c	16,18	.74	.79	.02	.76, 82
Father support	Parental support[5]	Parcel-a	1,2	.59	.62	.03	.56, .67
		Parcel-b	3,4,5	.51	.80	.02	.75, .85
Mother support	Parental support[5]	Parcel-a	1,2	.49	.57	.03	.51, .62
		Parcel-b	3,4,5	.64	.89	.03	.83, .96
Friends support	SFQS[6]	Parcel-a	1,2,3,4	.75	.73	.02	.67, .77
		Parcel-b	9,10,11,12	.73	.52	.03	.44, 56
		Parcel-c	13,14,15,16	.74	.69	.02	.64, 74
PE teacher support	PASSES[7]	Parcel-a	1,2,3,4	.75	.75	.01	.72, .78
		Parcel-b	5,6,7,8	.74	.91	.01	.89, .94
		Parcel-c	9,10,11,12	.82	.82	.01	.79, .84

Note: [1] APALQ Spanish version of Zaragoza, Generelo, Aznar, Abarca-Sos, Julián, and Mota (2012). It is a questionnaire with a test-retest reliability showed of .71; [2] MIFA version of Moreno-Murcia, Moreno, and Cervello (2007); [3] SMS version of Núñez, Martin-Albo, Navarro, and Gonzalez (2006); [4] PNSE version of Moreno-Murcia, Marzo, Martínez-Galindo, and Conte (2011); [5] Parental support version of Trost, Sallis, Pate, Freedson, Taylor, and Dowda (2003). Items were modified in order to specify mother or father support instead of parental support. One questionnaire for each parental support was administered resulting in questionnaires of: father support and mother support. [6] SFQS version of Weiss and Smith (1999); [7] PASSES Spanish version by Moreno-Murcia, Parra, and González-Cutre (2008).

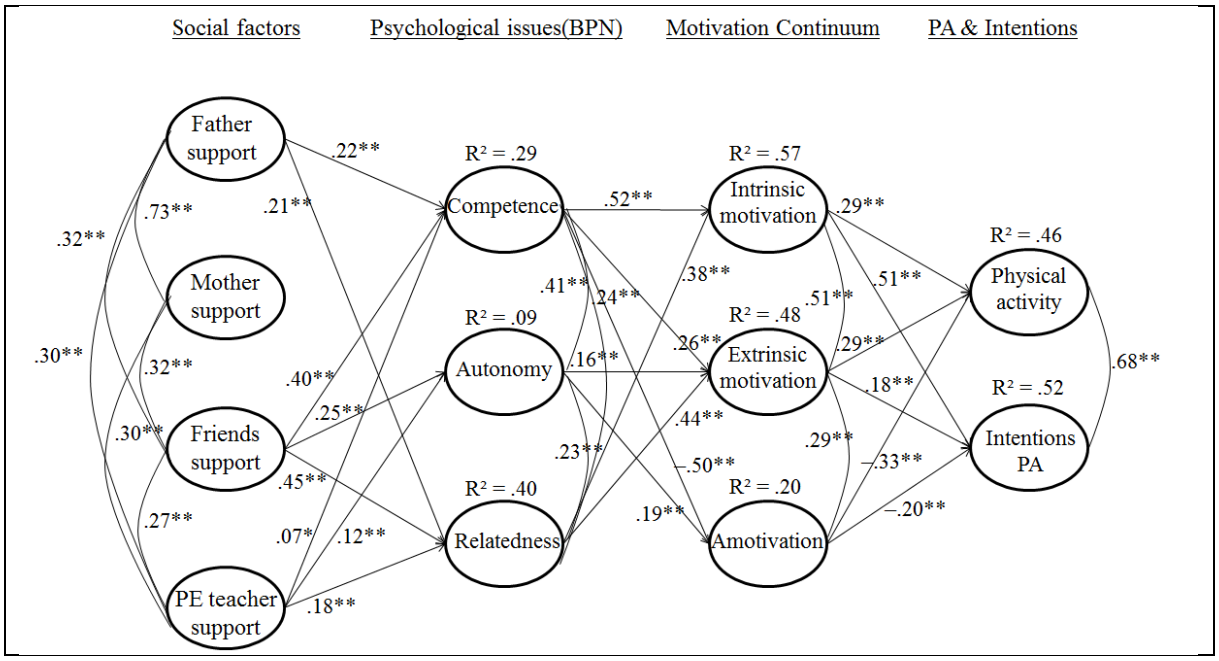
Table 3.

Correlation matrix between latent variables.

	1	2	3	4	5	6	7	8	9	10	11	12
1 PA	-	.83*	.59*	.51*	-.39*	.55*	.13*	.43*	.56*	.37*	.30*	.22*
2 Intentions to be PA		-	.69*	.54*	-.33*	.61*	.27*	.47*	.44*	.35*	.38*	.23*
3 Intrinsic motivation			-	.74*	-.29*	.67*	.33*	.60*	.38*	.34*	.47*	.28*
4 Extrinsic motivation				-	-.02	.54*	.45*	.61*	.42*	.34*	.37*	.32*
5 Amotivation					-	-.40*	-.07	-.19*	-.19*	-.16*	-.21*	-.03
6 Competence						-	.48*	.49*	.35*	.27*	.48*	.24*
7 Autonomy							-	.35*	.10*	.08*	.29*	.18*
8 Relatedness								-	.38*	.32*	.57*	.35*
9 Father support									-	.71*	.31*	.30*
10 Mother support										-	.30*	.30*
11 Friends support											-	.27*
12 PE teacher support												-

Note. PA = physical activity, PE = physical education. * $p < .05$.

Figure 1. Standardized parameters of the definitive model and correlations among residuals of indicators. Non-significant paths are omitted for presentation clarity. **$p < .01$. * $p < .05$.



Note: BNP = Basic Psychological Needs, PA = Physical activity, and PE = Physical education.