ASSOCIATIONS BETWEEN AFFECT, BASIC PSYCHOLOGICAL NEEDS AND MOTIVATION IN PHYSICAL ACTIVITY CONTEXTS: SYSTEMATIC REVIEW AND META-ANALYSIS

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ABSTRACT: Our study analyzed the published literature on the associations between affect, exercise motivation and basic psychological needs in physical activity/exercise settings. A comprehensive search of studies published in peer-review articles (1990-2015) was conducted on electronic databases (e.g., PubMed). Ten studies analyzing the relation between affect, motivational regulations and/or basic psychological needs were included. Studies were rated for methodological quality. Data were synthesized using narrative and meta-analytic approaches. The studies showed that all basic psychological needs were positively associated with positive affects (all *p*'s < .05). For negative affects, a negative association appear with competence (p = .04) and a positive association with relatedness (p < .001). For autonomy no significant association was found. More autonomous forms of motivation seem to contribute to a better affective response, partially explained by the influence of intrinsic motivation. Satisfaction of basic psychological needs is associated with higher scores of positive affects.

KEYWORDS: Basic psychological needs, motivational regulations, affects, exercise.

ASOCIACIONES ENTRE EL AFECTO, LAS NECESIDADES PSICOLÓGICAS BÁSICAS Y LA MOTIVACIÓN EN CONTEXTOS DE ACTIVIDAD FÍSICA: REVISIÓN SISTEMÁTICA Y META-ANÁLISIS

RESUMEN: Nuestro estudio analizó la literatura publicada sobre las asociaciones entre el afecto, regulación motivacional y las necesidades psicológicas básicas en contextos de actividad / ejercicio físico. Se realizó una búsqueda exhaustiva de estudios publicados (1990-2015) en bases de datos electrónicas (e.g., PubMed). Los estudios que analizan la relación entre los afectos, regulación de motivación y /o necesidades psicológicas básicas se incluyeron. Los datos se sintetizaron usando técnicas narrativa y enfoques meta-analíticos. Los estudios mostraron que todas las necesidades psicológicas básicas se asociaron positivamente con afectos positivos (todos *p*'s < .05). Para efectos negativos, una asociación negativa aparece con la competencia (p = .04) y una asociación positiva con la relación (p < .001). Por autonomía se encontró ninguna asociación significativa. Más formas autónomas de motivación parecen contribuir a una mejor respuesta afectiva, en parte explicado por la influencia de la motivación intrínseca. Satisfacción de las necesidades psicológicas básicas se asocia con las puntuaciones más altas de afectos positivos.

PALABRAS CLAVE: Necesidades psicológicas básicas, regulaciones motivacionales, afectos, ejercicio físico.

ASSOCIAÇÕES ENTRE AFETOS, NECESSIDADES PSICOLÓGICAS BÁSICAS E MOTIVAÇÃO EM CONTEXTOS DE ATIVIDADE FÍSICA: UMA REVISÃO SISTEMÁTICA E META-ANÁLISE

RESUMO: Este estudo teve como objetivo analizar a literatura publicada sobre as associações entre afetos, motivação para o exercício e necessidades psicológicas em contextos de exercício/atividade física. Uma pesquisa exaustiva de estudos publicados em revistas com revisão por pares (1990-2015) foi feita em várias bases de dados (e.g., PubMed). Dez estudos que analisam as relações entre afetos, regulações motivacionais e/ou necessidades psicológicas básicas foram incluidos. Os estudos forma classificados de acordo com a sua qualidade metodológica. Os dados foram sintetizados usando técnicas narrativas e analíticas. Os estudos indicam que todas as necessidades psicológicas básicas estavam positivamente associadas com os afetos positivos (todos os *p*'s < .05). Para os afetos negativos, existe uma associação negativa com a competência (p = .04) e uma associação positiva com o relacionamento positivo (p < .001).

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Para a autonomia não se encontraram associações significativas. Formas mais autónomas de motivação paracem contribuir para uma melhor resposta afetiva, parcialmente explicada pela influência da motivação intrínsica. A satisfação das necessidades psicológicas básicas esteve associada a melhores pontuações nos afetos positivos.

PALAVRAS CHAVE: Necessidades psicológicas básicas; regulações motivacionais, afetos, exercício.

There is a large body of literature that clearly identifies the benefits of physical activity and exercise in psychological and physical well-being, health outcomes and prevention of several chronic diseases (ACSM, 2014). Research however indicates that there is still a large number of adults that do not engage in physical exercise at the necessary level defined by the major public health institutions (e.g., Garber et al., 2011).

One theoretical framework that has been useful in understanding behaviors associated with physical activity and exercise is Self-determination Theory (SDT: Deci & Ryan, 1985, 2002). SDT is a macro-theory of human motivation, emotion, and personality that has been under development for 40 years. According to this theory, motives underpinning behaviors reside along a continuum of autonomous (i.e., intrinsic, integrated and identified regulations) and controlled motivational regulations (extrinsic and introjected regulations) that affect a person's behaviors, including the ones related to carrying out and maintaining physical exercise programs (Isen & Reeve, 2005; Klain et al., 2016; Vansteenkiste, Niemiec, & Soenens, 2010; Wilson, Mack, Blanchard, & Gray, 2009). In accordance with previous considerations, SDT suggests that the type of motivation experienced is influenced by how well a person's basic psychological needs (BPN) for competence (e.g. succeeding at challenging tasks and attaining desired outcomes), autonomy (e.g. experiencing choice and being the promoter of one's actions), and relatedness (e.g. reliance and mutual respect with others) are met in a particular context (Deci et al., 2001). Satisfaction of BPNs is assumed to lead to more autonomous forms of regulation, which in turn, will lead to stronger intentions to be physical active, facilitate the adoption of a particular behavior and promote more positive health outcomes (Rouse, Ntoumanis, Duda, Jolly, & Williams, 2011; Supervía, Bordás, Orozco, & Jarie, 2018; Vansteenkiste, et al., 2010). Contrastingly, the undermining of the needs (i.e., needs thwarting) can lead to patterns of regulations, behaviors and affects that may hinder the development of the well-being expected (Bartholomew, Ntoumanis, Ryan, & Thøgersen-Ntoumani, 2011).

The relation between affect related-concepts and physical activity/exercise behavior has been studied extensively in recent years, illustrated by a Special Issue on Affective Responses to Exercise published in *Psychology of Sport and Exercise* in 2013. Ekkekakis, Hargreaves, and Parfitt (2013a) demonstrate the recent growing in key-word searching related to the topic of the present systematic review (nearly 3 times more specific key-term entries (i.e., mood, affect and emotion) in two major scientific databases in the period 2002-2012). Additionally, the importance of the affective valence (i.e., pleasure vs. displeasure) has been supported recently by the inclusion in the 2011 update of the ACSM position stand (Garber et al., 2011). It is suggested that it could be used by professionals to modulate or refine the prescribed exercise intensity, allowing a better way to control and regulate exercise intensity and facilitate exercise adherence (Ekkekakis, Hargreaves, & Parfitt, 2013b; Garber et al., 2011; Latinjak, 2012; Williams et al., 2008).

Despite strong support in recent years of a significant relation between exercise and affects, the influence of SDT variables in this matter remains unclear (Hagger & Chatzisarantis, 2008). The satisfaction of BPN acts as a facilitator of the internalization of the behavior, making it more autonomous in nature (Vansteenkiste et al., 2010). This is associated with better cognitive and affective behavior and seems to be facilitating the maintenance of that particular behavior (Carraça, 2017; Deci & Ryan, 1991; Rouse et al., 2011). Additionally, affect could steam from bodily sensations (e.g., feeling energy, pain) or follow certain patterns of cognitive appraisals (e.g. perceptions of achievement or competence) (Ekkekakis, Lind, & Vazou, 2010). Some research supports a positive association between positive affect and perceived competence in exercise settings, but for the relation with autonomy and relatedness, there are mixed findings (Teixeira et al., 2012). One of the reasons for this is that competence satisfaction has been the most measured variable of BPN and those differences in measures and exercise settings may be blurring some study results.

Regarding the relation between affect and motivational regulations, research suggests that more autonomous motivations promote a better emotional response, and controlled motivations the inverse response (i.e., worst emotional response). However, there is some evidence pointing that these relations are not so direct and clear. For example, introjected regulation has been shown to contribute to the enhancing of positive affects in previous studies (Ng et al., 2012). This manifestation may be due to ego involvement in the task or doing the activity in order to obtain some sort of reward or to avoid a negative third person judgment (Edmunds, Ntoumanis, & Duda, 2006; Ng et al., 2012; Silva et al., 2010). Introjected regulation has been suggested to be the first step of the adaptive process of the internalization of a particular behavior, and that external influences may in early stages account to the acquisition of the experience needed to become competent and familiar with the activity (Gillison, Osborn, Standage, & Skevington, 2009). This suggests that introjected regulation can be an adaptive form of motivation for some minor period and may account for a temporal enhancing of positive affects (Pelletier, Fortier, Vallerand, & Briere, 2001). This may be a frequent case in the exercisers motives, as there are often pressured to exercise by peers, physicians and social agents, in order to correspond to a certain health/physical outcome. Additionally, it is proposed by Ryan, Patrick, Deci, and Williams (2008) that some indirect paths may exist that may be explaining the influence of BPN independently and in support to motivational regulations,

highlighting the importance of the understanding of these variables in the emotional response and ultimately in behavioral modification.

The answers to these issues may prove to be helpful to health and exercise professionals as a way to better understand the associations of these variables in physical activity and exercise settings. This may also prove to be useful in the promotion of individual needs and to better regulate exercisers motivations, contributing to a better emotional response that may, in turn, act as a facilitator to exercise maintenance. Bearing this in mind, this raises the question of how, in an adult population, the satisfaction of psychological basic needs and more autonomous motivations are associated with a better affective state in physical activity contexts.

The aim of this systematic review is to analyze published literature on the associations between affect, psychological needs and exercise motivation in physical activity and exercise settings, within SDT framework.

METHOD

This systematic review and meta-analysis is reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) statement (Liberati et al., 2009).

Eligibility Criteria

We included experimental (e.g., Randomized Controlled Trials (RCTs)) and non-experimental (e.g., Cohorts and Cross-Sectional) studies published in English language in peer-review journals, targeting adults (> 18 yrs and < 60 yrs) participating in any form of physical activity or exercise. To be eligible, studies should also report on the associations between positive and /or negative affect, or emotions, or mood and at least one of the following outcomes: regulation of autonomous/controlled motivation or one of the basic psychological needs (autonomy, competence and relatedness). We have considered the definitions for Physical Activity and Physical Exercise by Caspersen, Powell, and Christenson (1985), therefore restrictions were made to the context of exercise practice, excluding studies that were conducted in sports competition environment. In the cases in which this was not clearly stated, we chose to include these studies mainly because participants were recruited from workplaces or universities, possibly excluding their participation in professional sports.

Information Sources and Search Strategy

A comprehensive search of articles published in English language in peer-reviewed journals was made on the databases PubMed, PsycINFO and SportDiscus for articles published between 1990 and May 2015. The search was conducted using the combined key-words *self-determination theory*, *affect**, *emotion**, *mood*, *physical exercise* and *physical activity.* Additionally, systematic reviews and references of retrieved studies were screened for possible eligibility.

Quality Assessment of Selected Studies

We assessed the quality assessment with the Cho and Bero (1994) short scale (short version) instrument, where score 1 is the maximum quality score. Methodological quality was independently rated by two authors. Disagreements were resolved by a third author. Inter-rater agreement, assessed by means of Cohen's *k,* was moderate*,* with k = .410 (Altman, 1991).

Data Coding and Extraction

Data were extracted by one author using a pre-specified form and was double-checked by the other two authors. The following characteristics were extracted: 1) Bibliographic information (authors, year of publication, country and reference); 2) Study design (e.g., RCT, cross-sectional); 3) Sample characteristics (sample size, gender); 4) Measures (objective and self-reported measures); 5) Outcomes (quality of exercise, affect, self-determined motivation, psychological basic needs, exercise adherence, other) and 6) Statistical data and/or significance and direction of the association between at least two outcomes of interest.

Data Synthesis

Characteristics and findings of included studies were qualitatively synthesized and tabulated. Whenever appropriated, outcomes were quantitatively combined in meta-analysis using Comprehensive Meta-analysis v2.2. (Borenstein, Hedges, Higgins, & Rothstein, 2005). This was the case for the associations between Psychological Needs (autonomy, competence, and relatedness) and Affect (positive/negative). For the associations between Motivation and Affect, only the summary results reported in each study are presented due to lack of information, differences in methods and instruments used, absence/incompatibility of key variables and statistically insufficient data presented. Meta-analyses were conducted using the recommended random-effect model. Effect sizes were the correlation (r), interpreted according to Pearson correlation coeficient (values of .10, .30 and .50 correspond, respectively, to weak, moderate and strong magnitude of the effects). To calculate effect sizes for the selected outcomes, we extracted the sample size and value of the bivariate correlation presented in the original articles. Authors of included studies were contacted whenever necessary to provide additional statistical information needed for the meta-analysis that was missing in published reports. If this information remained unavailable, the mean and standard deviation of each variable were extracted. Z-values and corresponding p-values were the indicators of the significance of the association. We also inspected the standard residuals for outliers (> 1.96).

Heterogeneity in the effects was inspected using: 1) Cochran's Q statistic (Cochran, 1954), for which a significant effect (< .05) demonstrates that there is heterogeneity between studies, and the I^2 statistic (Julian, Simon, Jonathan & Douglas, 2003) that ranges from 0 to 100% (values of 25%, 50%, and 75% reflect low, moderate and high heterogeneity.

Publication bias was examined through visual inspection of funnel plots and with the Duval and Tweedie's 'trim and fill' method (Duval & Tweedie, 2000), which allows the estimation of an adjusted effect size taking into account possible missing studies.

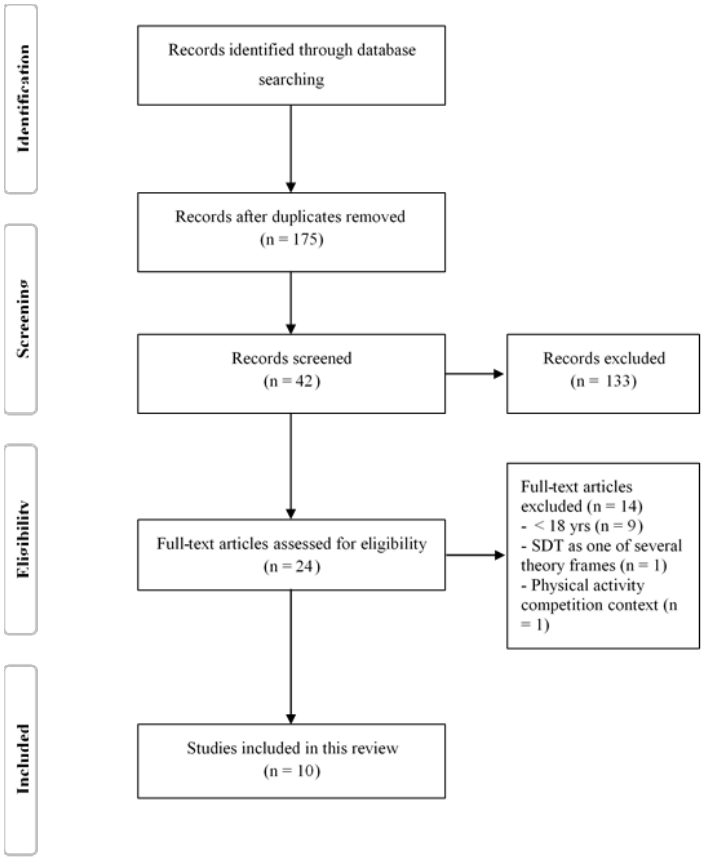

Figure 1. Process of selection and eligibility of search articles

RESULTS

Study Selection

Three hundred and twenty-two records were identified in the databases (Figure 1). One hundred and forty-seven were found to be duplicates, so they were excluded. First, titles and abstracts were screened, resulting in 24 articles eligible for full-text reading. Full-text articles were reviewed by two independent researchers. Of these, 14 articles were excluded because of target population or context. Therefore, ten studies were included in this review.

Quality of Studies

Table 1 shows the quality of the studies reviewed. The mean quality assessment score was .58 (on a scale from 0 to 1), mainly because only two studies were trials, and this scale penalizes studies with other designs such as cross-sectional. The experimental study by Guérin and Fortier (2012) presented the higher methodological quality score (0.82) and the cross-sectional study made by Lutz, Lochbaum and Turnbow (2003) the lower score (0.49). Items with poorer classification were related with reporting of participants' attrition to the study and adequate sample size (e.g., a priori power calculation).

Study Characteristics

Studies were conducted in United States (*n* = 4), United Kingdom (*n* = 3) and Canada (*n* = 3). Most studies targeted undergraduate students at university settings (*n* = 5), in other studies participants were selected from their workplace (*n* = 3) or usual exercise facilities (*n* = 2). Most studies were conducted with participants enrolled in a fitness modality class and/or leisure-time activities (*n* = 8). In this systematic review 1853 female (60.83%) and 1193 (39.17%) male participants were included. From the ten studies analyzed, one was experimental (Guérin & Fortier, 2012) and one was a cohort study design (Kwan, Hooper, Magnan, & Bryan, 2011). The remaining eight were cross-sectional studies.

RESULTS

Autonomous motivation and affect

Seven out of ten studies included in this review, reported on the relation between autonomous motivations and affect in exercise settings (Edmunds et al, 2010; Frederick Morrison, & Manning, 1996; Kwan et al., 2011; Lutz et al., 2003; McDonough & Crocker,

2007; Puente & Anshel, 2010; Thogersen-Ntoumani & Fox, 2007) (Table 1).

Table 1

Description of included studies

Reference	Quality assessment Score	Design	Sample Size/gender/age mean	Measures	Outcomes	Results
Edmunds, Duda & Ntoumanis (2010)	0.54	Cross-sectional	N=260; females; M = 32.24 years	Psychological need satisfaction (PNSE); Motivational Behavior Regulation in Exercise (BREQ), Exercise Motivation Scale (EMS); Positive and Negative Affect (PANAS);	Quality of group exercise experience	Relatedness emerged as significant positive predictor on motivational regulations; intrinsic motivation emerged as a significant predictor for positive affect. Psychological need satisfaction and autonomous motivation predicted exercise-related outcomes for white and black participants but not for asian participants.
Frederick, Morrison & Manning (1996)	0.51	Cross-sectional	N=118; 38 males and 80 females; M = 22 years	Exercise Enjoyment Questionnaire (EEQ); Motivation for Physical Activity Measure (MPAM)	Relation of affect with motivation for exercise, for adherence, perceived competence and satisfaction	Intrinsic motivation was a predictor of affect and perceived competence and satisfaction; extrinsic motivation predicted adherence in men.
Guérin & Fortier (2012)	0.82	Experimental	N=41; females; M = 40.98 years	Positive and Negative Affect (PANAS); The Situational Motivation Scale (SIMS)	Motivation and intensity and relation with positive affect	Significant interaction effect between RPE and introjection but not between RPE and identified regulation or intrinsic motivation. At low levels of introjection, the influence of RPE on the change in positive affect was considerable, with higher RPE ratings being associated with greater increases in positive affect.
Kwan, Hooper, Magnan & Bryan (2011)	0.74	Cohort	N=104; 60 females and 44 males; M = 18.23 years	Behavioral Regulations for Exercise Questionnaire-2 (BREQ-2); Feeling Scale (FS)	Causality orientations, self-determined regulations and exercise related positive affect	Exercise-related affect was more positive for those with higher levels of the autonomy orientation and lower levels of the impersonal orientation. Exercise-related affect partially mediated the relationship between autonomy and impersonal orientations and self-determined regulations for exercise.
Lutz, Lochbaum & Turnbow (2003)	0.49	Cross-sectional	Study 1: N=141; 71 male; 70 female; age not reported Study 2: N=99; female; age not reported	Exercise Motivation Scale (EMS); Positive and Negative Affect (PANAS); Activation Deactivation Adjective Checklist (AD ACL)	Motivation and relation with affect response in exercise	Autonomy significantly predicts post-exercise positive affect; pre-exercise affect was a significant predictor of post-exercise positive affect.
McDonough & Crocker (2007)	0.54	Cross-sectional	N=558; males; M = 45.09 years	Integrated Regulation scale (INTEG); Behavioral Regulation in Exercise Questionnaire (BREQ); Exercise need satisfaction (PNSE); Positive and Negative Affect (PANAS)	Motivation and relationship between psychological need fulfillment and affective and behavioral outcomes	Psychological needs predict self-determined motivation and affective and behavioral outcomes; self-determined motivation only partially mediated the effects on positive and negative affect.
Puente & Anshel (2010)	0.54	Cross-sectional	N=238; 103 males and 135 females; M = 20.4 years	Exercise Self-Regulation Questionnaire (SRQ-E); Perceived Competence Scale (PCS); Basic Psychological Needs Scale (BPNS); Positive and Negative Affect (PANAS); Physical Activity Enjoyment Scale (PACES)	Mediation of autonomy and competence on the relationship between exercisers perceptions of instructor interaction style; affective and behavioral outcomes from SDT regulation	Higher levels of self-determined regulation to exercise favorably influences enjoyment, positive affect and exercise frequency while reducing negative affect; exercise adherence is more likely under the condition of self-determined regulation and consequent positive affect and enjoyment.
Sebire, Standage & Vansteenkiste (2009)	0.54	Cross-sectional	N=410; 118 males and 292 females; M = 41.39 years	Behavioral Regulation in Exercise Questionnaire (BREQ); Psychological Need Exercise Scale (PNSE);	Association between intrinsic exercise goals and cognitive, affective and behavioral outcomes	Intrinsic goals relative with extrinsic goals were positively associated with reported exercise engagement, physical self-worth, and psychological well-being and negatively associated with feelings of anxiety; intrinsic goal content

						contribute to more adaptive affective and behavioral functioning in exercise.
Thogersen-Ntoumani & Fox (2007)	0.54	Cross-sectional	N=769; 158 males and 607 female; M = 43.02 years	Behavioral Regulation in Exercise Questionnaire (BREQ).	Autonomous exercise motivation and well-being indicators	Autonomous motivation predicted most of the well-being indicators; introjected regulation significantly predicted most well-being indicators, including life satisfaction, self-esteem, physical self-worth, and physical satisfaction in a negative direction.
Wilson, Mack, Blanchard & Grey (2009)	0.56	Cross-sectional	Study 1: N=143; 25 male and 118 female; M = 30.92 years Study 2: N=174; 83 male and 91 female; M = 22.5 years	Psychological Need Satisfaction scale (PNSE); Subjective Exercise Experience Scales (SEES); Positive and Negative Affect (PANAS);	Psychological need fulfillment and affective response	Satisfaction of Psychological needs enhanced positive and reduce negative affect in exercise; basic psychological needs seems to be a plausible framework for understanding different subjective experiences in exercise.

In 5 of these studies subjects were enrolled in some sort of physical activity program. The instruments were applied in several ways (e.g., at the moment/before/after training; regarding last three months' physical experiences; last activity made in the week). Overall, results showed a significant relation of more autonomous motivations associated with better emotional response in physical activity/exercise contexts trough better scores of PA and, with less extent, NA. This effect seems to be greater when participants are more intrinsically motivated (Edmunds, Duda, & Ntoumanis, 2010; Frederick et al., 1996; Puente & Anshel, 2010). There was variability in the type of studies (e.g., cross-sectional, cohort, experimental), sample (e.g., some samples had only women or men, other both; mean of age ranged 18.23 to 45.09 years) instruments (e.g., PNSE vs. BPNS) and exercise settings (e.g., purposively created vs. usual) that should be considered.

Associations between basic psychological needs and affect

Combined point estimates for the associations between each of the basic psychological needs (autonomy, competence, and relatedness) and positive affect were significant and ranged from r = .20 (95% CI 0.02-0.56) to r = .52 (95% CI 0.41-0.62). The study by Wilson et al. (2009) showed the strongest association between positive affect and all three psychological needs (ranging from r = .52 to r = .63). Only the study by Edmunds et al. (2010) showed negative associations between relatedness and positive affect in all three sub-samples (Caucasian, Black and Asian), ranging from r = -.21 to r = -.34. There was evidence of high heterogeneity between studies in all analyses (I^2 = 79% to I^2 = 98%).

Overall effect sizes for the associations between psychological needs and negative affect ranged from r = -.27 (95% CI -0.34-.20) to r = .41(95% CI 0.37-0.45), and was not significant for Autonomy-Negative Affect (z = 0.08, p = .93). Only the association between Competence and Negative Affect was in the expected direction. The study conducted by Edmunds et al. (2010) presented strong positive associations (in the opposite direction as hypothesized) between all basic psychological needs and negative affect for all three sub-samples, with the exception of the relation autonomy-NA in the Asian sub-sample (r = -.82). Again the study by Wilson et al. (2009) presented the strongest correlations ranging from r = -.22 to r = -.40. For Autonomy-Negative Affect and Relatedness-Negative affect there was evidence of high heterogeneity between studies (I^2 = 99%).

Visual inspection of the funnel plots revealed asymmetry for Competence-Positive affect. After adjustment with the trim-and-fill procedure the magnitude of the effect sizes decreased from r = .52 to r = .49 (95% CI 0.44-0.53; number of trimmed studies = 1). There was no indication of asymmetry for any of the other outcomes.

Table 2

Meta-analytic analysis of basic psychological needs and affects

Variables	k	Sample size	Correlation (95% CI)	*Z*	*P*	*Q*	I^2
Competence and PA	3	970	0.52 (0.41 - 0.62)	7.70	< .001	9.29	79%
Autonomy and PA	6	1230	0.25 (0.02 - 0.46)	2.12	0.03	104.95	95%
Relatedness and PA	5	1230	0.20 (0.14 - 0.25)	7.07	0.00	231	98%
Competence and NA	3	970	-0.27 (-0.34 to - 0.20)	-7.51	0.04	2.36	15%
Autonomy and NA	6	1230	0.03 (-0.56 to 0.62)	0.08	0.93	1028	99%
Relatedness and NA	5	1230	0.41 (0.37 - 0.45)	16.74	< .001	552.74	99%

Note. PA = Positive Affect; NA = Negative Affect.

DISCUSSION

The objective of this study was to analyze published literature on the relation between Self-determination Theory (SDT) variables and positive and negative affect (PA and NA) in physical exercise settings. Ten studies were included in this review. Concerning motivational regulations, results from primary studies point to the importance of more autonomous motivations in affective states. This is expressed through the associations of autonomous motivations with higher scores of PA and, to a lesser extent, lower scores of NA. This response appears to be greater when participants were more intrinsically motivated, being in agreement with SDT predictions (Deci & Ryan, 2002).

However, integrated and identified regulations were not analyzed in the primary studies reviewed. As defined by SDT, motives reside along a continuum, and the possible influence of these regulations should be taken in account when interpreting results.

Research based on SDT indicates that the satisfaction of BPN may improve participants affective state in exercise settings (Ng et al., 2012; Ryan & Deci, 2000; Vansteenkiste et al., 2010). This tendency has been supported by recent studies that, however, present some variations in the interpretation of each need influence (see for example the works of Dyrlund & Wininger, 2006; Gunnell, Crocker, Wilson, Mack, & Zumbo, 2013; Teixeira et al., 2012). In this systematic review we found that PA shows a positive association with all BPN, and that NA shows a negative association with competence. For autonomy and relatedness, and contrary to expected, a positive association was found (relatedness $p < .001$ and for autonomy $p = .93$). These results are in line with SDT predictions (except for relatedness, but nonetheless in line with studies in this context) (Vansteenkiste et al., 2010). Yet, there were high levels of heterogeneity between studies that do not allow a precise evaluation of the association between BPNs and affect. SDT conceptualizes that the internalization of behaviors is warranted by the satisfaction of BPN and, consequently, the more autonomous regulations would mediate associations between need satisfaction and behavioral and emotional outcomes. As seen in table 1 and 2, some affective changes seem to occur due to BPN influence, but often, other variables like intrinsic motivation (Edmunds, et al. 2010, Frederick et al., 1996) intrinsic goals (Sebire et al., 2009) and changes in motivational regulations (Guérin & Fortier, 2012; McDonough & Crocker, 2007; Puente & Anshel, 2010) may be masking the magnitude of the BPN effect. Besides that, better emotional responses in exercise settings may in turn influence perceptions of the extent to which BPN are met, indirectly influencing the motivational regulations (Schneider & Kwan, 2013). We recommend, as previously envisioned by SDT authors, and more recently suggested by Teixeira et al. (2012), that more in-depth analysis should be made, like path analysis and structural equation modeling, in order to improve the understanding of BPN in these dynamic cycles of affective response to exercise. Additionally, another factor to consider when interpreting these results is that needs thwarting have not be measured or accounted. The absence of this measure may give a panoramic view of the BPN but hide possible maladaptive behavior or ill-being (Deci & Ryan, 2000).

An interesting finding was that none of the retrieved studies included the searched terms “mood” and “emotion”, commonly used in this field of study for affect-related concepts. This contrast with previous indications, were these key-terms were used in specialized search engines, showing a trend in this area study. Additionally, it is possible to detect the use of different instruments to measure affect (e.g., PANAS, FS, SEES), despite their different approaches to measure emotional responses in exercise settings. For this matter, the differences in conceptual understanding and measuring of affect seems to justify the inclusion of these terms and, possibly, may justify in the future the inclusion of the key-word “feeling”, to tap the most usually used terminology.

Results from this systematic review and meta-analysis show the importance of motivational regulations and BPN in affect response in exercise settings. For exercise professionals, the development of skills and strategies that develop BPN satisfaction and more autonomous forms of motivation may be effective strategies to enhance exercise experience and contribute to continued adherence to exercise programs.

In spite of its strengths, some study limitations should be considered. Firstly, there was high variability between studies (i.e., different context, sample sizes, etc.). Secondly, the lack of adequate statistical data reported in the studies that assessed motivational regulations did not allow the use of meta-analysis techniques to test the pooled strength of its associations with affect. We contacted some of the authors to obtain additional statistical estimates, but, for different reasons (e.g. authors data losses, emails not answered), we had no access to this information. Thirdly, many of the studies included in this review were of cross-sectional design. More longitudinal (observational and intervention) studies are needed to test the key hypothesis about the relations between SDT variables and affect. The small number of studies included in this review limits the conclusions that can be drawn from both qualitative and quantitative data syntheses. This possibly points to the necessity of more studies that analyze SDT constructs in physical activity and exercise settings and their associations with emotional responses.

In conclusion, more autonomous forms of motivation predict better affective response in exercise settings, and it is partially explained by the influence of intrinsic motivation. Our analysis seems to support SDT assumptions that the satisfaction of basic psychological needs is associated with higher positive affects and lower scores on negative affects contributing to a better emotional response in exercise.

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