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ORIGINAL PAPER

How does frustration make you feel? A motivational analysis in exercise context

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Abstract
Not all exercisers experience the same psychological benefits. The understanding of motivational processes and their relation with emotional consequences of exercise should be considered in the context of the exercisers motivation. This was a cross-sectional study of 153 gym users ($M = 36.21$ years, $SD = 8.44$; 44.9% men, 55.1% women; M years exercise = 8). Weekly attendance averaged 4.3 ($SD = 2.6$) sessions per week; reported exertion intensity was 5.6 ($SD = 2.1$) (scale: 0–11). The basic psychological needs (BPNs) posited by self-determination theory, motivational regulation, and emotional response to physical activity, were measured. Possible mediators of BPN-emotion relationships were analyzed. BPN satisfaction was associated with a positive emotional response to exercise which was partially mediated by the effect of autonomous regulation on positive activation and psychological well-being. Mediation models indicated that the negative effects of BPN frustration were counteracted by autonomous regulation. Exercise professionals should be able to create psychologically supportive contexts and identify behaviors associated with need frustration so as to enhance emotional responses to exercise.

Keywords Physical exercise · Motivational regulation · Basic psychological needs satisfaction · Basic psychological needs frustration · Emotional response

Introduction

The fitness industry is growing rapidly. A recent report shows that over 140 million people are engaged in some sort fitness activity in a health club or fitness center, and this type of exercise represents one of the most common forms of sport-related activity in the world (IRSHA 2014). Despite this trend there are constraints limiting the extent to which people obtain the expected psychological benefits from exercise. Motivation may be one of the factors influencing the emotional outcomes of exercise (Thogersen-Ntoumani and Fox 2007).

One theoretical framework that has been widely used to better understand the participant's motivation to exercise is the self-determination theory (SDT: Deci and Ryan 1985). This theory distinguishes two types of motivation influencing one's behavior: the intrinsic motivation, related with performing an activity because of some type of inherent satisfaction, and extrinsic motivation, associated with doing a task or activity for instrumental reasons, to obtain some outcome separable of the activity itself, or to avoid some sort of disapproval (Ryan and Deci 2000; Sebire et al. 2009). Extrinsically motivated behaviors are distributed across four regulations, the external regulation (i.e., controlled by specific external contingencies), introjected regulation (i.e., doing a task due to avoid internal pressure or to obtain social approval), identified regulation (i.e., recognition and acceptance of the value of a behavior) and integrated regulation (i.e., identification and integration of behaviors with others aspects of the self) (Deci and Ryan 2000). These different regulation mechanisms represent varying degrees of internalization, the process by which individuals attempt to transform habits and requests into personal values and

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self-regulation mechanisms (Deci and Ryan 2000). This may be applied in the study of exercise behavior, as exercisers usually present different motivations and may be in a given period of time in different degrees of this internalization continuum. SDT postulates that different types of extrinsic motivation may vary between controlled (i.e., external and introjected regulation) and autonomous (i.e., identified and integrated regulations) motivations, representing the results of the interaction with a particular environment, where a person has been less or more able in the internalization and integration of the regulatory style of a particular activity (Deci and Ryan 2000; Vallerand 1997). Therefore, intrinsic motivation and well-internalized extrinsic motivation (i.e., autonomous motivation) on one hand, and external and introjected regulation (i.e., controlled motivation) on the other, determine the level of self-determined behavior for a particular task or activity and may help to understand how to improve the quality of the motivation of the individuals.

SDT also assumes that the type of motivation a person experiences in a particular context depends on how well his or her basic psychological needs (BPNs) are met. Deci et al. (2001) stated that the satisfaction of these needs, namely the need for competence (i.e., the ability to succeed at challenging tasks and attain desired outcomes), the need for autonomy (i.e., being able to choose one's behavior and being in control of one's activities), and the need for relatedness (i.e., having relationships based on trust and mutual respect) leads to more autonomous behavioral regulation and promotes the internalization of behavior. SDT also postulates that frustration of BPNs influences behavior. Satisfaction of BPNs contributes to well-being whereas frustration of BPNs is associated with ill-being manifestations (Vansteenkiste and Ryan 2013). Research has demonstrated that inability to fulfill any of the BPNs leads to psychological compensation mechanisms which can have a severely negative impact on health and well-being. Low need satisfaction hampers growth, but frustration of needs is particularly harmful and should be considered a qualitatively different process (Bartholomew et al. 2011; Mallison-Howard and Hill 2011).

Given the diversity of interactions in health clubs it is likely that the social context will fulfill and frustrate need satisfaction at different times. BPNs frustration has been recently studied in sport contexts regarding perfectionism concerns and striving (Mallinson-Howard and Hill 2011), athlete attachment and well/ill-being (Felton and Jowett 2014) and goal striving and personal motivation (Healy et al. 2014). These studies argued that the same context can support both satisfaction and frustration of BPNs at different points in time, and with differing effects on well-being outcomes. Moreover, need satisfaction may act as a buffer against the psychological dysfunction and counteract the effects of frustration by leading to the development of internal resources which contribute to an individual's ability to cope with adversity (Bartholomew et al. 2011; Vansteenkiste and Ryan 2013). In this particularly setting, accordingly with SDT and aforementioned sport context studies, both BPNs satisfaction and frustration are expected to co-occur. A health club usually presents several fitness professionals and exercisers interactions, classes, activities and diverse individual goals, which may influence BPNs status. The perfectionism strive from a fitness instructor regarding eating or training habits of a client, the exercise execution mocking from other exercisers, the deliberant exclusion of a new exerciser in a preexisting exercise group, among other situations, may pose a risk for BPN frustration.

In exercise contexts, satisfaction of psychological needs and autonomous forms of motivation have been associated with positive physical and psychological outcomes, and stronger intentions to be active (Edmunds et al. 2007; McDonough and Crocker 2007; Rouse et al. 2011; Vansteenkiste et al. 2010). The separate roles of BPNs and motivational regulation in exercise outcomes have been exhaustively studied by measuring direct associations between variables (see for example the work of Ng et al. 2012); however it has been suggested that the links between BPNs and autonomous regulation and health outcomes are often indirect and may be subject to multiple influences (e.g., Ryan et al. 2008; Teixeira et al. 2012). Using research methods that permit analysis of these indirect effects may prove useful in exercise settings, as a means of developing an understanding of how best to promote more autonomous regulation of exercise and exercise habits, which lead to satisfaction of BPNs and the attendant psychological benefits. This will also be particularly important for the case for BPN's frustration, as it is hypothesized that different BPNs frustration may lead to distinct detrimental effects, and indirect effect paths are understudied in this setting (Bartholomew et al. 2011; Vansteenkiste and Ryan 2013).

Recent years have seen renewed interest in research on emotional responses to exercise (Ekkekakis et al. 2013). This new wave of research has led to discussion of the role that emotional response to exercise settings plays in regulating exercise intensity (Garber et al. 2011) and determining the pleasure or displeasure people feel when exercising (Rose and Parfitt 2010) with a view to improving understanding of the factors which contribute to adherence to a regular exercise regime (Duncan et al. 2010; Ekkekakis et al. 2008), amongst other research topics. Despite strong support in recent years for the existence of an interaction between exercise and affect, the influence of SDT variables on this interaction remains unclear. Some research has indicated that BPN satisfaction is associated with positive emotional responses in sport/exercise contexts (e.g., higher positive affect and vitality, reductions in depressive symptoms and physical exhaustion) (Bartholomew et al. 2011; McDonough and Crocker 2007; Teixeira et al. 2012). This

relationship has been predicted by proponents of SDT who argued that well-being is dependent on satisfaction of the BPNs defined in SDT. There is also some evidence that the affective response may be influenced by the type of motivational regulation involved in exercise behavior (McDonough and Crocker 2007; Puente and Anshel 2010). So, for this matter, two levels of analysis emerges: (1) associations between affect and adherence, where more positive affect promote better exercise adherence or exercise persistence (Duncan et al. 2010; Ekkekakis et al. 2008); and (2) BPN satisfaction and motivational regulations (autonomous motivations) as promoters of well-being and associated with the development of a better emotional response (McDonough and Crocker 2007; Teixeira et al. 2012). These interactions are still poorly explored, particularly in the proposed context of the present study. A systematic review and meta-analysis analyzed the relation of affect, BPN and motivational regulations (Teixeira et al. 2018). Only ten studies were included in the work, suggesting that these relations have not been sufficiently explored in recent years. In the results, autonomous motivations and BPN satisfaction were associated with higher scores of positive affects in several exercise settings, and no control for needs frustration were made. Therefore, this study aimed to analyze the mediation effects of the quality of motivation on the relation between need satisfaction, need frustration and emotional response to exercise. The lack of evidence in health clubs contexts regarding need satisfaction/frustration and their influence in both positive and negative emotional responses to exercise enhances the pertinence of this study. Additionally, the study of indirect paths may provide an in-depth analysis of the influence of SDT constructs in emotional outcomes, which represent important variables available to the exercise professionals in order to promote supportive contexts that allow BPN satisfaction, more autonomous regulated motivations and better emotional experiences and in consequence, better exercise persistence.

Method

Participants and procedures

A convenience sample of one hundred and fifty-three exercisers from several Portuguese health clubs', engaged in the most usual classes and activities characteristic of this context, participated in this cross-sectional study (M = 36.21 years; *SD* = 10.44). Weekly attendance averaged 4.3 (*SD* = 2.6) sessions per week, with a reported exertion intensity of 5.6 (*SD* = 2.1) (scale: 0–11). The sample comprised 44.9% men and 55.1% women, averaging 8 years' experience of regular exercise (range from 0 to 65).

Participants were recruited from local health clubs through authorized mailing lists and gave informed consent. Ethical approval was obtained from the ethics board of the Faculty of Human Kinetics, University of Lisbon.

Measures

A package of instruments was prepared for the assessment of: (a) SDT variables (i.e., need satisfaction, need frustration, and motivational regulation), (b) emotional response to exercise (i.e., positive and negative activation, psychological well-being, psychological distress, and fatigue) and (c) general sociodemographic variables.

A Portuguese version of the Psychological Need Satisfaction in Exercise Scale (PNSE; Palmeira et al. 2012) was used. Cronbach's α for the original version was reported to be between 0.79 and 0.89 (Wilson et al. 2006). The PNSE is an 18-item scale used to measure satisfaction of the need for autonomy (e.g., 'I feel free to exercise in my own way'), competence (e.g., 'I feel that I can complete exercises that are personally challenging'), and relatedness (e.g., 'I feel attached to my exercise companions because they accept me for who I am'); responses are given on a six-point Likert scale. A composite score calculated by averaging scores for satisfaction of the three basic needs was used for the mediation analysis as in previous similar research (e.g., Hagger et al. 2006).

A Portuguese version of the Behavioral Regulation in Exercise Questionnaire-3 was used (BREQ3-P; Cid et al. 2015). This instrument is a 24-item self-report measure adapted from the BREQ2 (original version: Markland and Tobin 2004; Portuguese version: Palmeira et al. 2007) to include an integrated regulation scale (Wilson et al. 2006). The BREQ3 consists of 6 four-item subscales assessing different form of motivational regulation: intrinsic (e.g., 'I enjoy my exercise sessions'), integrated (e.g., 'Getting exercise is a fundamental part of who I am'), identified (e.g., 'It's important to me to exercise regularly'), introjected (e.g., 'I feel guilty when I don't exercise'), and external (e.g., 'I feel under pressure from my family/friends to exercise'), including lack of motivation (e.g., 'I don't see why I should have to exercise'). Each item was scored on a five-point scale ranging from 0: 'not true for me' to 4: 'very true for me'. Reliability studies provided evidence for the validity of the BREQ3 as a measure of motivational regulation of exercise habits (Markland and Tobin 2004). Cronbach's α for all subscales was > 0.63 for the BREQ3-P. In this study we use a composite index of autonomous regulation calculated as the average of score for identified regulation, integrated regulation, and intrinsic regulation. Recommendations to use composite scores followed reports of suppression effects associated with these variables, and correlation and mediation analyses leading to different conclusions owing

to buffering effects (Silva et al. 2010). All regulations of the bivariate correlation analysis in tables were maintained in order to facilitate the interpretation of results. Scores for controlled forms of motivational regulation (external and introjected regulation) were treated as separate variables as the constructs are considered dissimilar and might have different influences on behavior and well-being (Silva et al. 2010, 2011).

Considering the good psychometric properties of the Portuguese version of PNSE and the absence of a validated instrument to access needs frustration, we used 12 items of the Basic Psychological Need Satisfaction and Frustration Scale—Portuguese version (BNPSFS-p; Cordeiro et al. 2016) that tapped the needs frustration. The 12 items received slight syntax adjustments to the exercise context (e.g., "Most of the things I do feel like I 'have to'" to "Most of the things I do in my exercise session I feel I 'have to'"). These contextual adjustments were made independently by four exercise psychology specialists and syntax issues discussed to an agreement. Exploratory and Confirmatory Factor Analysis of the 12 items with contextual adjustments provided good indicators consistency across domains [χ^2 (51) = 434.767; RMSEA = 0.07; SRMR = 0.05; NNFI = 0.92; CFI = 0.94]. Further psychometric validation of this instrument is currently underway.

The used set of items comprised a stem, 'In my workout session…' which is completed with statements relating to competence (e.g., 'I have serious doubts about being able to do well in my workout sessions'), autonomy, (e.g., 'I feel that the activities in my workout sessions are a obligations'), and relatedness (e.g., 'I have the impression that exercise trainers do not like me') with which the respondent indicates agreement using a seven-point Likert scale (e.g., 1: totally disagree, through 4: neither agree nor disagree, to 7: totally agree). A composite variable (the average of score for frustration of competence, autonomy and relatedness) was created for use in the multiple mediation analysis.

Two instruments were used to measure emotional response to exercise. The first one was the Portuguese version of the Subjective Exercise Experiences Scale (SEES; Palmeira 2006) which is specific for emotional assessment in the exercise domain, for which Cronbach's α for the subscales is between 0.79 and 0.88. This scale is based on the original Subjective Exercise Experiences Scale (SEES; Mcauley and Courneya 1994) and is a brief 12-item scale consisting of three 4-item subscales assessing positive well-being (PWB) (e.g., great, strong), psychological distress (PD) (e.g., crummy, awful) and fatigue (e.g., tired, fatigued). The second instrument used was the Portuguese version of the Positive And Negative Affects Scale (PANAS; Galinha and Ribeiro 2005) based on the original version (PANAS; Watson et al. 1988), who reflects a broader context of the emotional state. The Cronbach's α for the PANAS ranges from 0.85 to 0.90. The original scale has been extensively used in exercise settings (Ekkekakis 2013) and has been shown to have acceptable internal consistencies and test–retest reliability (Crawford and Henry 2004; Watson et al. 1988). The instrument uses a five-point scale to assess respondents' experience of positive and negative affect during an activity, ten items assess experience of positive affect (e.g., inspiration, alertness), and ten items assess experience of negative affect (e.g., distress, fright). Sometime after the introduction of the PANAS it was suggested that the names of the subscales should be changed to positive activation (PA) and negative activation (NA), to indicate more clearly that the dimensions refer to something other than pleasure and displeasure and are defined only by their high-arousal poles (Ekekkakis 2013; Gray and Watson 2007). In this study we use these revised subscale names.

Data analysis

Data were screened for analysis assumptions and descriptive statistics. Independent *t* tests and bivariate correlations were conducted using IBM SPSS Statistics, version 21.0. We also evaluated the indirect effects of BPN satisfaction and NF on emotional response to exercise through multiple mediators (motivational regulation variables). The most commonly used method for this type of analysis is structural equation modeling (SEM) with latent variables, but our sample was not large enough to allow the requisite parameters to be estimated using this technique, so we opted to use the causal steps procedure (Baron and Kenny 1986) and bootstrapping methods, which have been recommended by several authors for testing indirect effects under these circumstances (Bollen and Stine 1990; Mackinnon et al. 2004). The bootstrapping procedure is considered more efficient than the normal theory approach as it provides a more accurate estimate of type I error probability and is more powerful in smaller samples (Mackinnon et al. 2004).

We used the Preacher and Hayes (2008) SPSS Macros for multiple mediation procedures. The models allow the control of the indirect effect of individual mediators while controlling for all the others. Additionally, need satisfaction and frustration were introduced as covariates in order to control for the effects between each other. Bias-corrected bootstrapped point estimates for the indirect effects of the independent variable on the dependent can be calculated, together with standard errors and 95% confidence intervals. This procedure estimates the direct effect of the independent variable (i.e., need satisfaction or need frustration) on the dependent variable (i.e., emotional response) and the indirect effect through multiple mediators (i.e., motivational regulation variables). We used bootstrapping with 5000 samples and statistical inferences were made on the basis of bias-corrected and accelerated intervals.

Results

Analysis revealed gender differences in the age distribution of our sample [t(129) = 2.27, p = .025; men were older] and in PA [t(136) = 2.23, p = .027; men had higher scores]. Bivariate and partial correlation analysis (controlling for gender) resulted in similar correlation scores so only the results of the bivariate correlation are presented here. Cronbach's α values for the various scales were mostly good ($0.7 \leq \alpha \leq 0.9$); in two cases they were excellent (≥ 0.9) and two acceptable ($0.6 \leq \alpha \leq 0.7$ (Morgan and Griego 1998) (Table 1).

In general, the bivariate analysis showed that BPN satisfaction was positively associated with all types of autonomous regulation and with a positive emotional response and was negatively associated with BPN frustration. BPN frustration was positively associated with introjected regulation, negative activation, psychological distress, and fatigue, and was negatively associated with autonomous regulation and a positive emotional response (Table 2).

Figure 1 depicts the direct and indirect effects of motivational regulation on the relationship between satisfaction or frustration of BPNs and the emotional response to exercise.

BPN satisfaction in total effect analysis showed positive associations with PA [t(138) = 4.40, p < .001] and PWB [t(138) = 5.46, p < .001]. The multiple mediation models show that BPN satisfaction was a significant predictor of PA (27.17%), and PWB (25.21%). These associations are the result of the direct and indirect effect of investigated variables; autonomous regulation was the only mediator which contributed significantly to the positive association between

Table 1 Mean, standard deviation, independent *t* test and Cronbach alpha for variables in study

	α	df	Men		Women		t	p	90% CI
			M	SD	M	SD			
Age	–	129	38.57	10.50	34.45	10.12	2.27	.025	1.11–7.13
BPN satisfaction	0.90	136	27.74	4.80	26.54	5.27	1.38	.171	−0.24 to 2.63
BPN frustration	0.83	136	6.56	2.44	6.90	2.65	−0.76	.446	−1.06 to 0.39
External regulation	0.60	136	0.53	1.25	0.64	1.42	−0.49	.626	−0.49 to 0.27
Introjected regulation	0.74	136	6.15	3.85	7.05	3.74	−1.40	.164	−1.98 to 0.17
Identified regulation	0.61	136	12.34	2.83	13.11	2.61	−1.65	.100	−1.53 to 0.01
Integrated regulation	0.89	136	12.03	4.30	11.80	4.00	0.32	.746	−0.94 to 1.40
Intrinsic regulation	0.87	136	12.79	3.42	13.34	3.10	−0.99	.323	−1.47 to 3.39
Positive activation	0.92	136	37.63	7.00	34.67	8.30	2.23	.027	0.76–5.15
Negative activation	0.87	136	15.00	6.51	16.22	6.14	−1.16	.247	−3.04 to 0.53
Psychological well-being	0.87	136	22.11	3.99	21.45	5.46	0.80	.424	−0.71 to 2.04
Psychological distress	0.87	136	4.53	1.13	4.74	2.27	−0.65	.519	−0.73 to 0.32
Fatigue	0.83	136	14.81	5.77	14.05	5.39	0.79	.430	−0.82 to 2.33

BPN basic psychological need, *α* Cronbach' alpha

Table 2 Correlation analysis between basic psychological needs, need frustration, motivational regulations and emotional response to exercise

	1	2	3	4	5	6	7	8	9	10	11
1—BPN satisfaction											
2—BPN frustration	−0.38***										
3—External regulation	−0.07	0.14									
4—Introjected regulation	0.08	0.20*	0.08								
5—Identified regulation	0.30***	−0.08	−0.21*	0.50***							
6—Integrated regulation	0.42***	−0.25**	−0.20*	0.37***	0.60***						
7—Intrinsic regulation	0.50***	−0.35***	−0.20*	0.32***	0.63***	0.82***					
8—Positive Activation	0.45***	−0.41***	−0.12	0.06	0.31***	0.36***	0.46***				
9—Negative activation	−0.11	0.30***	−0.09	0.35***	0.10	−0.12	−0.06	−0.27***			
10—Psychological well-being	0.49***	−0.30***	−0.19*	0.16	0.40***	0.46***	0.56***	0.68***	−0.06		
11—Psychological distress	−0.08	0.32***	0.17*	0.14	−0.08	−0.04	−0.08	−0.15	0.32***	−0.24**	
12—Fatigue	0.12	0.20*	0.12	0.13	0.07	0.07	−0.02	0.03	0.19*	0.12	0.18*

*p < .05; **p < .01; ***p < .001

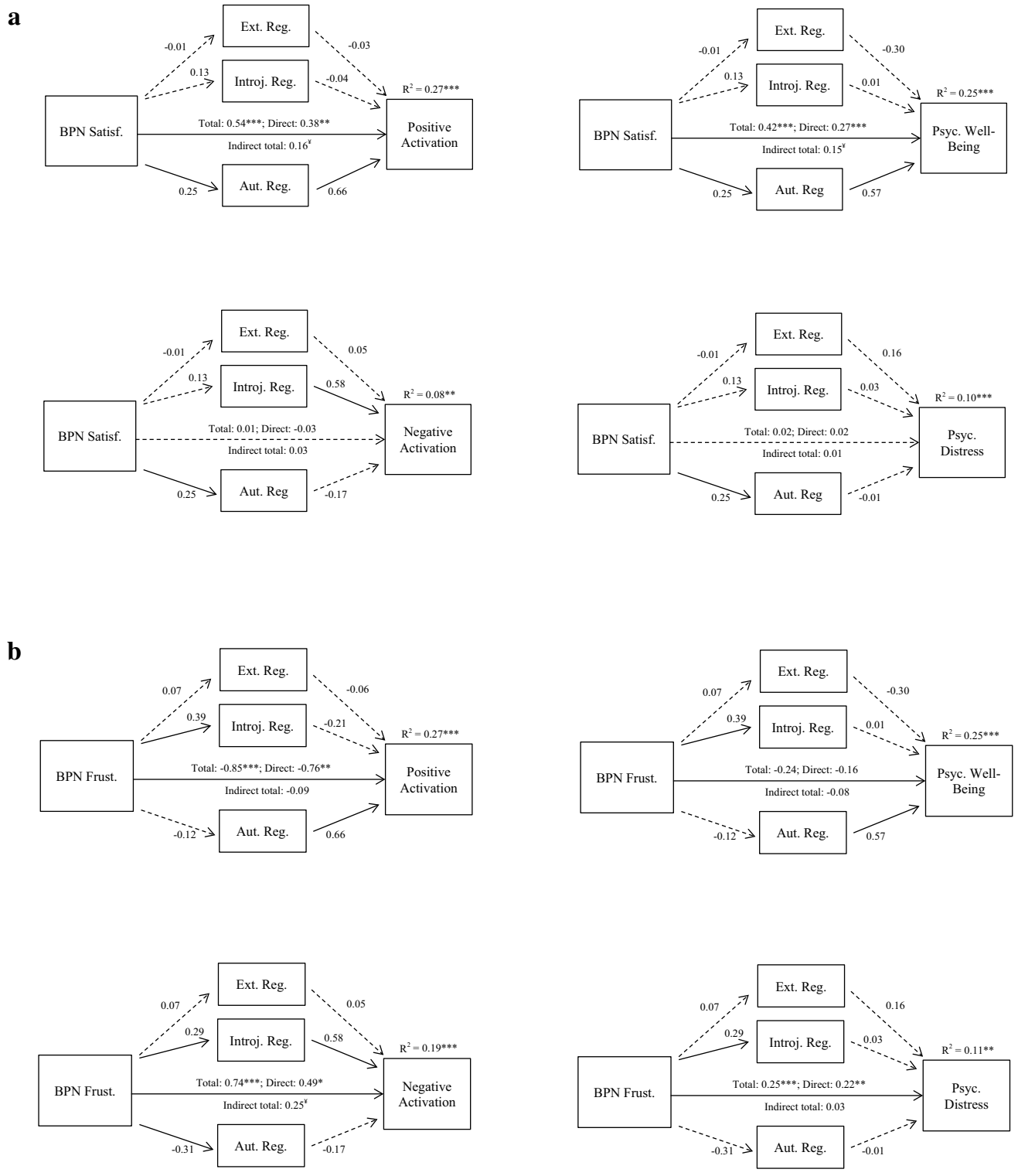

Fig. 1 **a** Direct and indirect effect analysis of motivational regulation in the relationship between basic psychological needs and emotional response to exercise. **b** Direct and indirect effect analysis of motivational regulation in the relationship between need frustration and emotional response to exercise. *p < .05; **p < .01; ***p < .001; ¥ the 95% CI of the Bias and corrected and accelerated estimate indicate a significant indirect effect: solid arrow, significant effect; dotted arrow, non-significant effect

BPN satisfaction and emotional response. BPN satisfaction was not associated with NA or PD .

BPN frustration was positively associated with NA [t(138) = 0.74, p = .001], PD [t(138) = 0.55, p < .001], and fatigue [t(138) = 2.54, p = .001], and negatively associated with PA [t(138) = − 3.48, p < .001]. These multiple mediator models also predicted PA (27.17%), PWB (25.21%), NA (8.81%), and PD (10.61%). Data highlights the importance of direct effects in the studied relationships. For the positive emotional response, autonomous regulations seem to partially counteract the negative association of BPN frustration in PA and PWB. As for the negative emotional response, introjected regulation (only for NA) appears to be reinforcing the negative emotional response.

Discussion

The goal of the study was to analyze motivational regulation variables as potential mediators of the relationship between need satisfaction or need frustration and emotional response to exercise.

Our results were in line with SDT, showing that satisfaction of BPNs was associated with a positive emotional response in exercisers, mainly due to the direct associations between BPN satisfaction and PA and PWB. It has consistently been reported that BPN satisfaction promotes PWB (Deci and Ryan 2008; Ng et al. 2012), and the data from our sample of health club members provide further confirmation of this relationship. The mediation analysis also indicated that BPN satisfaction was positively associated with autonomous forms of motivational regulation. Models including autonomous regulation as a mediator indicated that variable had a significant indirect effect on PA; in other words autonomous regulation accounted for part of the associations between BPN satisfaction and PA and PWB. The idea that autonomous regulation would be associated with positive behavioral and psychological outcomes was based on SDT and previous research (see review by Teixeira et al. 2012). Correlation analysis provided evidence to support this and suggested that intrinsic motivation was the form of autonomous motivational regulation most strongly associated with PA (r = 0.46, p < .001) and PWB (r = 0.56, p < .001).

The multiple mediation analysis suggested that controlled forms of motivational regulation did not contribute to the association between BPN frustration and negative emotional response to exercise. However the results of the correlation analysis and the trends revealed by the mediation analysis (i.e., near-significant values and direction of associations in mediations) were consistent with previous research indicating that controlled motivational regulation is positively associated with negative emotional responses and negatively associated with positive emotional responses (McDonough and Crocker 2007; Ng et al. 2012). We found very low levels of external regulation in our sample, which probably accounts for the results of the analyses involving this form of regulation. Our participants' long history of regular exercise (M = 7.99 years) may reflect internalization of motivation as postulated by SDT, and may thus facilitate persistence to an exercise regime (Deci et al. 2001). Curiously, introjected regulation was positively associated with the three autonomous forms of motivational regulation rather than with external regulation, suggesting that in this population (exercisers in gym contexts) introjected regulation is more closely related to autonomous forms of motivational regulation than to external regulation. Another study suggested that this form of regulation could be bivalent, where in some individuals/contexts, a more positive or negative valence may be expressed (Assor et al. 2009). Inspection of the BREQ3 items used to assess introjected regulation, in particular the 'I get restless if I don't exercise regularly' item, suggests that they are open to interpretation; 'get restless' might reflect the importance of exercising regularly, or because the exerciser misses it, reflecting the positive valence of this form of regulation, and perhaps explaining why it was correlated with autonomous regulation. The degree of autonomy associated with introjected regulation may be context-dependent in the sense that controlling environments reinforce the controlled dimension and autonomy-supportive contexts foster the autonomous dimension (e.g., a controlling teaching style in a group class; a need-supportive personal trainer) (Pelletier et al. 2002). Pairwise correlations between the three BPNs and the motivational regulation variables (not presented in Results) revealed that need satisfaction was positively associated with all autonomous forms of motivational regulation (with the exception of relatedness-identified reg., all p < .01), supporting this idea.

Negative emotional responses to exercise seem to be associated with BPN frustration. In all models this effect was mainly due to the direct association between BPN frustration and negative emotional response; in all cases the direct associations were significant and stronger than the indirect associations. In models predicting PA and PWB the indirect path mediated by autonomous regulation was the main negative indirect influence on the associations between dependent and independent variables. Despite this negative indirect effect, the data clearly indicated that autonomous forms of motivational regulation seem to protected PA and PWB against the negative effects of BPN frustration. The correlation analysis supported this influence through integrated and intrinsic regulations negative associations with BPN frustration. This has been previously suggested in several contexts and is one of the assumptions underlying basic psychological needs theory (BPNT) (Bartholomew et al. 2011; Vansteenkiste and Ryan 2013). The results also suggest that in this context there is co-occurrence of BPN satisfaction and frustration,

as predicted by Bartholomew et al. (2011); this has clear and distinct implications for understanding how exercise context affects the emotional response to exercise which should be taken in account by exercise professionals.

These results extend our understanding of relationships involving satisfaction or frustration of BPNs in the specific context of gym exercise. It has been suggested that low scores on measures of psychological need satisfaction are not an adequate index of need frustration as defined in SDT (Bartholomew et al. 2011). These results tend to support that need satisfaction and frustration may have simultaneous positive and negative effects on well-being variables. For instance, in health clubs an individual may feel less competent because he or she cannot achieve a desired goal or level of performance in a class and this may represent low need satisfaction rather than need frustration; alternatively a thwarted need for competence may arise because the instructor demands more effort, criticizes or sets difficult goals (Ntoumanis et al. 2017). This may imply that an optimal need-related profile is associated with a high level of need satisfaction and extremely low level of need frustration.

It is important for exercise professionals to know how to promote need-supportive contexts, and to be aware of controlling behaviors that may lead to low need satisfaction or actively frustrate the exerciser's needs. This double-sided action poses a challenge to exercise professionals who should adjust their practice to promote satisfaction of BPNs, facilitate the development of more autonomous forms of motivation, and enhance emotional responses in exercise.

Although this study has several strengths it also has limitations which should be acknowledged. The small sample and the cross-sectional design should be considered when interpreting the results. Experimental studies, particularly with larger samples provide additional interpretations in mediation analysis, facilitating the understanding of causal pathways and interactions. A further limitation is related to the measurement of BPN frustration. This study is the first to have measured need frustration in this context with an instrument specifically designed to tap the relevant constructs. Although exploratory factor analysis of the instrument provided evidence of its reliability, there is currently no further evidence on its psychometric properties. This should be addressed in future studies. Also, study results may suggest that a profile analysis methodology may be helpful to better understand the optimal need satisfaction and frustration profile in exercisers, pinpointing these variables relation regarding well-being. Lastly, no analysis was made considering the types of classes' exercisers were engaged. Different activities were provided in the health club sample used in this study (e.g., exercise room, personal training, group classes, water activities), representing several different interactions. For example, it is plausible to assume that the need for competence is differently fulfilled/frustrated accordingly with the activity engaged, thus highlighting a fractioned activity analysis. However, up to 85% of our sample was engaged in two or more gym activities, therefore limiting our ability to differentiate intra activity needs satisfaction/frustration.

In general, the multiple mediation models indicated that BPN satisfaction is associated with a more positive emotional response to exercise; this result is partially accounted for by the effect of autonomous forms of regulation on PA and PWB. As for BPN frustration, mediation models indicate associations that have a negative influence on emotional response. Autonomous forms of regulation appeared to have a small protective effect in PA and PWB models against the negative effects of BPN frustration.

Compliance with ethical standards

Conflict of interest Diogo Teixeira, Marlene Silva and António Palmeira declare that they have no conflict of interest.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent Informed consent was obtained from all individual participants included in the study.

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