# The Bright and Dark side of motivation in exercise: promoting persistence and adherence

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# Dedication

“Remember the guy who gave up? Neither does nobody else”

*Unknown*

**To you mom.**

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It has been a long journey. Even though I started my PhD studies in 2017, I have been searching this goal since 2012. It is funny how my “academic life” has changed along these last years. First, I obtained my Bachelor’s degree in Sports management. During my Master degree I created a physical exercise intervention to reduce fall risk in octogenarian institutionalized. Now, this doctoral thesis focused on the promotion of physical activity using theoretical and behavioral frameworks. I have been blessed.

I will try to do my best on recognizing everyone who has given his contribute to this work:

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# List of publication

This doctoral thesis is comprised of the following papers (ordered by thesis sequence):

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- **Rodrigues, F.**, Hair, J., Neiva, H.P., Teixeira, D., Cid, L., & Monteiro, D. (2019). The Basic Psychological Need Satisfaction and Frustration Scale in Exercise (BPNSFS-E): validity, reliability, and gender invariance in Portuguese exercisers. *Perceptual and Motor Skills,* 126(5), 949-972. Doi: 10.1177/003152519863188

- **Rodrigues, F.**, Neiva, H.P., Marinho, D.A., Mendes, P., Teixeira, D., Cid, L., & Monteiro, D. (2019). Assessing satisfaction and frustration in Portuguese exercise instructors: scale validity, reliability and invariance between gender. *Cuadernos de Psicología del Deporte*, 19(1), 233-240.

- **Rodrigues, F.**, Pelletier, L.G., Neiva, H.P., Teixeira, D., Cid, L., & Monteiro, D. (2019). Initial validation of the Portuguese version of the Interpersonal Behavior Questionnaire (IBQ & IBQ-Self) in exercise: measurement invariance and latent mean differences. *Current Psychology*, 1-12. Doi: 10.1007/s1214401900374-y

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Of agreement on exercisers' psychological needs using polynomial regression analysis.

- **Rodrigues, F.**, Neiva, H.P., Travassos, B., Teixeira, D., Cid, L., & Monteiro, D. (under revision). The satisfaction and frustration of basic psychological needs on behavioral regulations: are we seeing the whole picture?

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# Resumo

Tornar o exercício físico num comportamento rotineiro é um processo complexo. Estudos anteriores evidenciam que a desistência da prática de exercício físico ocorre nas primeiras fases do comportamento e que os episódios de desistência são elevados entre novos praticantes. A falta de motivação é apontada por muitos como um dos principais motivos para o não envolvimento na prática regular de exercício físico. Almejando reverter as atuais taxas de inatividade física e comportamentos sedentários, torna-se necessário compreender e analisar o papel das determinantes motivacionais na persistência e na adesão à prática de exercício físico. Diferentes quadros conceptuais e motivacionais têm sido utilizados nos estudos que procuram analisar formas de aumentar as taxas de atividade física. No entanto, a literatura existente não considera as sequências teóricas completas e/ou não considera outros construtos cognitivos como por exemplo a intenção, na análise da persistência da prática de exercício físico. Este trabalho consistiu em analisar as determinantes motivacionais na persistência e adesão à prática de exercício físico. De forma alcançar este objetivo, realizamos uma revisão da literatura, traduzimos e validamos quatro escalas e medimos a sequência teórica e motivacional mais favorável e mais adversa na persistência e na adesão. Os resultados dos oito estudos científicos englobados nesta tese de doutoramento mostram que: i) a nossa revisão sistemática foi a primeira a considerar a sequência teórica e motivacional mais favorável e mais adversa na persistência e na adesão; ii) as regressões polinomiais com gráficos de superfície são um procedimento estatístico robusto, que considera duas variáveis independentes semelhantes, mas distintas, e a sua interação com uma variável dependente; iii) o divertimento é um preditor forte e deve ser tido em conta pelos técnicos profissionais aquando da promoção do exercício físico; iv) a experiência passada é um dos preditores mais fortes na adesão futura; v) abranger vários quadros teóricos num modelo complexo parece revelar em medir o impacto das determinantes de forma direta e indireta no comportamento; e, vi) investigações futuras devem considerar os comportamentos interpessoais como promotores do compromisso com o exercício. A perceção de comportamentos de suporte pelos praticantes de exercícios levam a maiores intenções de manter a participação no exercício no futuro. De forma oposta, a perceção de comportamentos de frustração é responsável por maiores taxas de abandono. Em suma, esta tese contribui para o avanço conceptual sobre como os comportamentos interpessoais se encontrar relacionados com a manutenção da prática de exercício apresenta diversas implicações práticas importantes para a indústria do fitness e para os investigadores sobre a criação de intervenções adequadas na promoção da prática do exercício.

**Palavras-chave:** Comportamentos interpessoais; necessidades básicas, motivação; persistência; adesão; modelo teórico; análises estatísticas avançadas.

# Abstract

Turning physical exercise into a habitual behavior is a complex process. Studies have shown that individuals tend to drop-out in the first stages and that the number of withdrawal episodes is highest amongst new participants. Individuals point out the lack of motivation as the one of the main reasons for not engaging in exercise participation. Therefore, understanding the motivational determinants behind exercise commitment seems paramount to reverse the current rates of physical inactivity and sedentary behaviors. Research has assessed several motivational frameworks attempting to deepen the literature on how to increase physical activity rates. However, studies analyzing the entire motivational sequences and/or considering the influence of other cognitive constructs such as intention on exercise commitment are scarce. Thus, the main purpose of the present work was to assess the determinants of the bright and dark side of motivation and their relationship with exercise persistence and adherence. To accomplish this, we reviewed the current literature, translated and validated four scales, and measured the impact of the bright and dark sides of motivational determinants on exercise adherence and persistence. The results of the eight studies included in this thesis showed that: i) our systematic review was the first one to consider the full casual sequence of motivational constructs according to Self-Determination Theory in the exercise context; ii) the four translated and validated scales have adjusted psychometric proprieties and can be reliably used in future research with Portuguese individuals in the exercise context; ii) polynomial regression analysis with response surface methodology is a strong statistical procedure on how two similar but distinct independent variables interact on one dependent variable; iii) enjoyment is a strong predictor of exercise persistence and should be therefore considered by exercise professionals when promoting physical exercise; iv) past exercise adherence is the strongest forecaster of future exercise adherence. Results showed that a regular two times weekly frequency is necessary to promote habitual behavior; v) encompassing several theory constructs into one comprehensive model seems thought-provoking in measuring how they impact directly and indirectly exercise outcomes, and; vi) future interventions should consider interpersonal behaviors as promoters for exercise commitment. Perceived supportive behaviors by exercisers lead to increased intentions to maintain exercise participation, whereas perceived thwarting behaviors are responsible for higher rates of drop-out. Overall, this research provides new insights on how interpersonal behaviors are responsible for exercise outcomes; offers important practical implications for the fitness industry and researchers on how to design adequate interventions aiming at promoting exercise adherence and points out the relevance of the social context and past behavior for exercise outcomes.

**Keywords:** Interpersonal behaviors; basic needs; motivation; exercise commitment

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# List of Abbreviations

| | |
|---|---|
| AMO | Amotivation |
| AUTO | Autonomous Motivation |
| AVE | Average Variation Extracted |
| BPN | Basic Psychologial Needs |
| BPNSFS | Basic Psychologial Need Satisfaction and Frustration Scale |
| BREQ-3 | Behavioral Regulation Exercise Questionnaire – version 3 |
| CI | Confidence Interval |
| CFI | *Comparative Fit Index* |
| CONT | Controlled Motivation |
| CR | Composite Reliability |
| DF | Degrees of freedom |
| e.g. | *exempli gratia* |
| EXT | External Regulation |
| HMIEM | Hierarquical Model of Intrinsic and Extrinsic Motivation |
| IDEN | Identified Regulation |
| INTRO | Introjected Regulation |
| INTRI | Intrinsic Motivation |
| i.e | *id est* |
| M | Mean |
| ML | Maximum Likelihood |
| N | Sample size |
| p | Level of significance |
| PACES | Physical Activity Enjoyment Scale |
| r | correlations |
| $r^2$ | Squared correlation |
| RMSEA | Root Mean Square Error of Approximation |
| SDT | Self-determination Theory |
| SEM | Structural Equation Modeling |
| SRMR | Standardized Root Mean Square Residual |
| TLI | Tucker-Lewis Index |
| TPB | Theory of Planned Behavior |
| $\chi^2$ | qui-square test |
| $\chi^2/df$ | Normalized qui-square test |
| $\Delta\chi^2$ | Differences in qui-square |

| | |
|---|---|
| Δdf | Differences in degrees of freedom |
| ΔCFI | Differences in CFI |
| ΔSRMR | Differences in SRMR |
| ΔRMSEA | Differences in RMSEA |

# Chapter 1

# Introduction

Exercise participation is of upmost importance since it represents a healthy way to reduce chronic diseases and mortality (WHO, 2017). However, according to recent studies (Eurobarometer, 2018), more than 68% of the Portuguese population is physically inactive and individuals reported the lack of time and motivation as being the main reasons for having sedentary behaviors, 43%, and 23%, respectively. In fact, motivation seems to be the most important variable explaining not only decrease in exercise drop-out but also increase in exercise participation (Teixeira et al., 2012). Thus, how someone regulates his motivation towards a specific behavior is influenced by contextual, social, and personal factors. Therefore, its examination is fundamental to create effective interventions to promote exercise persistence.

In order to understand motivational determinants on exercise persistence, several theories have been applied theoretically and empirically in this context. Thus, Self-Determination Theory (SDT; Ryan & Deci, 2017) stands out by considering motivational cues as agents for affective, cognitive and behavioral outcomes. This macro theory of human motivation is concerned on understanding the natural tendencies to behave efficiently with the environment and has shown to be effective in analyzing exercise related-outcomes (Ntoumanis et al., 2017). To simplify the casual sequence of SDT constructs, Vallerand (1997) developed the Hierarchical Model of Intrinsic and Extrinsic Motivation (HMIEM), referring that the social context (e.g., teachers, coaches, exercise physiologists) is in charge for the satisfaction or frustration of three Basic Psychological Needs (BPN). These BPN (autonomy, competence, and relatedness) are the most important factors accountable for the quality of motivation, thus leading to differentiated behavioral, emotional and cognitive outcomes. However, most of the past studies in exercise context have only tested parts of the HMIEM (Edmunds, Duda, & Ntoumanis, 2006, 2007, 2008), corroborating partly with the theoretical view. Studies considering the whole sequence are scarce but they likewise support its validity in an empirical manner (Monteiro, Pelletier, Moutão, Cid, 2018; Pulido et al., 2014).

Recently, researchers have suggested the integration of several theories into one comprehensive model, showing that SDT principles could be responsible for the Theory of Planned Behaviors' Intention, increasing the prediction of actual behavior or future behavior (Hagger & Chatzisarantis, 2015; Hagger, 2018). As it is seen, all theoretical models

present some strengths and they give us key tools to analyze human behavior, even in the exercise context. Past literature helps researchers on integrating their prediction into one comprehensive and simple model, explaining exercise related-outcomes.

The current thesis presents the path taken to test the HMIEM, considering the integration of the Theory of Planned Behavior (TPB; Ajzen, 1991) constructs, relying on understanding which determinants impacts more exercise persistence. Most studies examined parts of the proposed model, and only few have analyzed the impact of the social environment on psychological mediators. In addition, regarding exercise context, few studies have used validated scales measuring the motivational constructs under analysis based on SDT, and in Portuguese there are inexistent translated and validated scales.

Our main purpose is to assess motivational determinants, considering the bright and dark sides of motivation on exercise persistence and adherence. In order to achieve this goal, we intend to review past literature bearing in mind motivational constructs (i.e., interpersonal behaviors, basic psychological needs, behavioral regulations), emotional outcomes (i.e., enjoyment), and intention to engage in physical exercise. The research begins with a systematic review outlining the existent literature according to the proposed model (Chapter 2). We aim to analyze studies bearing in mind supportive and thwarting interpersonal behaviors, basic psychological need satisfaction and frustration, all six behavioral regulations, and both emotional and behavioral outcomes in an exercise context.

In Chapters 3 and 4 we aimed to translate and validate The Basic Psychological Need Satisfaction and Frustration Scale (BPNSFS; Chen et al., 2015) in exercisers and exercise physiologists. Following this, the Interpersonal Behavior Questionnaire (IBQ and IBQ-Self; Rocchi, Pelletier, Desmarais, Beaudry, 2016) a scale measuring supportive and thwarting interpersonal behaviors perceived by exercisers and exercise physiologists will be translated and validated (Chapter 5). The validation of these scales consists of an important advancement since the majority of literature has used adapted scales from another context, without prior validation, leading to potential bias results.

In Chapter 6, polynomial regression analysis with surface response methodology will be performed to examine the agreement and differentiation of perceived interpersonal behaviors from exercisers and exercise physiologists and how this influences exercisers' basic needs satisfaction and frustration. This type of analysis differentiates itself from others since it considers the independent impact as well as the interaction of two distinct but similar variables (in this case self-perceived and perception from others behaviors) on one dependent variable (for this study exercisers' basic psychological needs). These results

are essential for Chapter 7, where the same statistical procedures will be used to analyze the interaction between basic need satisfaction and frustration on all six behavioral regulations, according to SDT determinants (Ryan & Deci, 2017) and some empirical studies (Rocchi & Pelletier, 2017).

Results from study 5 and 6 are paramount since it gives us the necessary insight to understand how interpersonal behaviors interact on BPN, and how BPN predict different behavioral regulations. Looking at their results, we will have the necessary tools to build the full motivational sequence of SDT for further studies in this research. The full sequence of the HMIEM (based on SDT) on enjoyment, predicting intentions, and leading to exercise persistence will be displayed in Chapter 8. In this study, we will consider all aspects of the previous studies, bearing in mind the bright and dark side of motivation as proposed by SDT.

Last, we intend to exhibit a new way to study habitual behavior, considering the HMIEM and past behavior on intentions towards exercise adherence, and how they are significant predictors of exercise adherence, in Chapter 9. This research presents an overall prspective of the present thesis since it gives new insights on how exercise adherence can be developed according to recent findings.

In Chapter 10 we will discuss all research conducted and encompass the utility of each aspect of the present thesis. In turn, general conclusions are presented in Chapter 11, coming to an end of what are the main implications of what was done during the eight studies. Last, in Chapter 12, we intend to announce some ideas/agenda for future research, and what they could represent for the literature.

In sum, we intend to assess which motivational determinants impact more exercise persistence and adherence. In order to achieve this goal, we will have to: 1) understand the casual sequence of motivational and cognitive constructs on exercise participation; 2) translate and validate scales assessing interpersonal behaviors and basic psychological need satisfaction and frustration into Portuguese and in the exercise context; 3) determine the effect of interaction between supportive and thwarting behaviors on basic needs; 4) continue this interaction analysis, assessing satisfaction and frustration of needs on autonomous and controlled motivational regulations; 5) consider all previous research and test a hierarchical model of motivation on a six month exercise persistence perspective, and; 6) test a differentiated approach on habitual behavior, testing multi-theoretical model of motivational and cognitive determinants, considering past behavior on predicting future exercise adherence.

We speculate that our proposed research sequence will accomplish its main aspiration, achieving new insights on how motivation can impact directly and indirectly exercise participation. The proposed hypothesized model, considering bright and dark sides of motivation will increase substantially our understanding of how exercise professionals should address exercise prescription, and how researchers should approach empirical investigation on human behavior, in this case physical activity.

# Chapter 2

# Can interpersonal behaviors influence the persistence and adherence to physical exercise practice in adults? A systematic review


## Abstract

Motivation seems to be a fundamental indicator of long-term physical exercise adherence. Self-Determination Theory argues that the social environment plays a central role in the satisfaction of basic psychological needs, which might directly affect the quality of one's motivation. Individuals who appear to be more self-determined tend to persist longer at certain behaviors. Therefore, this body of work intends to analyze the relationship between motivational variables and behavioral outcomes in the exercise context, having as theoretical background Self-Determination Theory. This systematic review was conducted through an electronic search on Web of Science, PubMed, SPORTDiscus, and PsycINFO. Data such as instruments, main predictors and results were collected from studies published between 1985 and 2018. A total of 35 empirical studies were considered for a detailed analysis. Results showed the relevance of autonomy support performed by exercise professionals, as well as the major contribution that these behaviors have towards the satisfaction of basic psychological needs, besides the inherent benefits of developing more autonomous regulations. According to the literature, few studies have analyzed interpersonal thwarting behavior and the way this relates to basic psychological needs frustration. Nether less, there seems to be a negative relationship between less self-determined regulations and exercise practice. Despite the existence of numerous cross-sectional studies that demonstrate positive correlations between Self-Determination Theory and behavioral outcomes in the exercise context, longitudinal research that analyzes all six dimensions of interpersonal behaviors and their relationship with persistence and adherence to exercise proves to be crucial. However, according to this review, interventions based on Self-Determination Theory appear to be fundamental when it comes to promote the maintenance of a long-term exercise practice.



**Key-words:** Self-Determination Theory; interpersonal behavior; persistence; adherence.

# Introduction

Physical inactivity is currently one of the largest changeable risk behaviors, being the fourth largest risk factor contribuiting to death (World Health Organization, 2017). As a matter of fact, approximately 3.2 million people die each year from chronic diseases associated with these behaviors. According to Eurobarometer (2018), the main reasons pointed out by people to justify physical inactivity were "lack of time" and "lack of motivation", respectively by 43% and 23%. Caudwell and Keatly (2016) argue that both motives are associated to the psychological state of amotivation, meaning that the person does not feel motivated or lacks of intention to exercise. These high percentages of physical inactivity may be linked to health professionals' (i.e., exercise professionals) behaviors, who use overly forced and commercial approaches, perceiving people only as clients and ignoring their human component (Santos, Ball, Crawford, & Teixeira, 2016; Teixeira, Carraça, Markland, Silva, & Ryan, 2012). The social environment works as a source of personal fulfillment, ultimately contributing to enhance one's motivation quality and consequently, playing a fundamental role in the maintenance of physical activity practice (Hagger & Chatzisarantis, 2008).

Among several theories that analyze motivation, Self-Determination Theory (SDT) stands out by focusing on the personality factors, the surrounding context, as well as on the causes and consequences of self-determined behavior (Deci & Ryan, 2000a). This conceptual framework has been applied in several contexts, namely in education (Grangeia et al., 2016), physical education (Standage, Duda, & Ntoumanis, 2005), sports (Rocchi & Pelletier, 2018) and also in the exercise context (Phillips & Johnson, 2017; Teixeira, Silva, Mata, Palmeira, & Markland, 2012). In addition, some studies (Ntoumanis, 2001; Teixeira, Silva, & Palmeira, 2018) claim that SDT is the most widely motivational construct used by researchers on understanding the influence of human motivation on behavior outcomes in the exercise context.

SDT postulates the existence of three basic psychological needs (BPN; autonomy, competence, and relatedness) innate in all human beings, whose satisfaction translates into a universal experience of physical and psychological well-being (Ryan & Deci, 2000b). The BPN's satisfaction is a strong predictor of more self-determined motivation (Edmunds, Ntoumanis, & Duda, 2007; Vallerand & Young, 2014), therefore being associated with several positive outcomes at behavioral, cognitive, and affective level (Deci & Ryan, 2000; Edmunds, Ntoumanis, & Duda, 2006; Wilson & Rodgers, 2002). Contrarily, BPN's frustration is tied up, in various contexts, with less self-determined forms of motivation, which might lead to inhibition of personal and human development (Bartholomew, Ntoumanis, Ryan, & Thogersen-Ntoumani, 2011b). It is worth to mention that BPN

satisfaction and frustration should be seen as independent constructs, and not as cause-effect between low levels of satisfaction and high levels of frustration (Bartholomew, Ntoumanis, Ryan, Bosh, & Thogersen-Ntoumani, 2011a). When it comes to the exercise context, BPN satisfaction turns out to be a strong predictor of intrinsic motivation (Ryan & Deci, 2000a), being ultimately related with long-term exercise adherence (Teixeira et al., 2012). On the contrary, BPN's frustration predicts amotivation (Bartholomew et al., 2011a; Vansteenkiste & Ryan, 2013), leading to low adherence and high dropout rates (Bartholomew et al., 2011b; Ng, Ntoumanis, Thogersen-Ntoumani, Stott, & Hindle, 2013).

Ryan and Deci (2017) state that the level of motivation depends on the satisfaction of BPN's and that, instead of a dichotomous (intrinsic vs. extrinsic) response, motivation can be manifested in six different ways. The different motivational regulations are spread along a motivational continuum, ranging from amotivation (i.e., lack of motivation or lack of intention to act accordingly to a given behavior) to intrinsic motivation (i.e., pleasure underlying a particular behavior), the last one representing the prototype of self-determined behavior. Extrinsic motivation arises in the middle of this continuum and includes four different types of regulation, two of which are more self-determined (i.e., autonomous regulation): identified regulation (i.e., the individual recognizes the importance of the activity, although he/she may not enjoy to perform it) and integrated regulation (i.e., the person integrates the behavior as inherent to him/herself and perceives it as being aligned with his own values); and other two less self-determined (i.e., controlled regulation): external regulation (i.e., the person performs the behavior in order to satisfy external requirements) and introjected regulation (i.e., the person pressures him/herself to perform the behavior).

This distinction between autonomous and controlled regulation is the core characteristic of the SDT (Ryan & Connell, 1989). Moreover, this theory describes the process responsible for the shift from controlled regulations towards more internalized behaviors, as well as the impact that different regulations have on the behavior itself (Howard, Gagné, & Bureau, 2017). Previous research in the exercise context emphasizes the relationship between the degree of autonomous regulation and several positive behavioral outcomes, such as increased enjoyment (Ruby, Dunn, Perrino, Gillis, & Viel, 2011), and higher levels of persistence and adherence (Fortier, Sweet, O'Sullivan, & William, 2007; Vlachopoulos & Neikou, 2007). On the contrary, less self-determined regulations require external motivational sources to perform a specific behavior, making behavior withdrawal more likely to occur (Ryan & Deci, 2000a).

Enjoyment has been described as the process of experiencing satisfaction, joy and pleasure during the performance of a particular behavior (Dacey, Baltzell, & Zaichkowsky, 2008). Thus, it is also considered to be significant predictor of exercise practice (Moreno-Murcia, González-Cutre, Martínez, Alonso, & López, 2012; Vallerand & Young, 2014). Else ways, controlled regulations tend to lead to the opposite emotional state, characterized by boredom, disinterest and dropout (Teixeira et al., 2018).

Research on the intention to exercise has shown that the exerciser's behavior only becomes a habit when it is maintained for at least six months after the intervention has started (Pavey et al., 2011). Chatzisarantis and Hagger (2009) developed an intervention aiming to analyze the changes in exercise adherence in students during leisure time. Results showed that the intervention group had a greater intention to maintain exercise practice in their free time and affirmed to practice more hours of physical activity, compared to the control group. In another study (Silva et al., 2010) based on SDT, conducted in order to analyze exercise frequency, researchers observed that the target group of intervention demonstrated higher levels of persistence and lower fat mass percentage. These findings suggest that SDT framework can be effective in the internalization of exercise practice, facilitating the persistence and adherence to the behavior.

As previously mentioned, SDT refers to the social context as a predictor of human behavior, since individuals are constantly extracting information from the surrounding people, in order to interpret their own behaviors. Beyond doubt, interpersonal behaviors play a major role in the satisfaction and/or frustration of BPN's, allowing to predict how motivation is regulated (e.g., Bartholomew et al., 2011b). Therefore, social interactions highly impact human motivation in several life aspects (Deci & Ryan, 1985).

According to SDT, people may perceive six different interpersonal behaviors (Rocchi; Pelletier, Cheung, & Baxter 2017): autonomy support (i.e., freedom of choice and presentation of alternatives); competence support (i.e., positive feedback related to a specific task); relatedness support (i.e., demonstration of emotional support); autonomy thwarting (i.e., use of controlled rewards); competence thwarting (i.e., expression of behaviors that emphasize guilt and doubt) and relatedness thwarting (i.e., perception of behaviors of rejection). When perceiving supportive interpersonal behaviors, people perform more self-determined actions. Conversely, when experiencing thwarting behaviors, individuals tend to manifest less self-determined actions (Rocchi, Pelletier, & Desmarais, 2016).

Some recent studies (e.g., Chang, Chen, Tu, & Chi, 2016; Rocchi & Pelletier, 2018) have shown that coaches who adopt supporting behaviors create conditions for individuals to self-regulate their own behavior, while decreasing less self-determined motivation. Moreover, autonomy support behaviors of the fitness instructors perceived by the participants have been positively associated with BPN satisfaction (Edmunds, et al., 2007). Inversely, thwarted interpersonal behaviors adopted by exercise professionals may lead into BPN frustration or more controlled motivational regulations (Ng et al., 2013).

Researchers clearly affirm the relevance of deeper understanding of exercisers' perception on interpersonal behaviors (i.e., supportive and thwarting) of exercise professionals and how they might influence BPN satisfaction or frustration (Bartholomew et al., 2011b; Puente & Anshel, 2010). Some studies show that exercise professionals may influence individual's well-being, as well as persistence and adherence to practice (Vlachopoulos & Karavani, 2009). According to these authors, highly supportive profiles expressed by exercise professionals are important on individuals exercise maintenance over the long run.

As of today, merely one systematic review in the exercise context (Teixeira et al., 2012), having SDT as theoretical background, has analyzed the satisfaction (although not frustration) of basic psychological needs, the motivational regulation, and the way these can predict different physiological outcomes (i.e., energy expenditure, body mass index). Nevertheless, these authors did not study in greater detail exercisers' perception of exercise professionals' interpersonal behaviors. In addition, a search on Web of Science, using the keywords "self-determination" and "exercise", revealed the existence of 650 new entries, published between the date of publication of the systematic review made by Teixeira et al. (2012) and this review. These findings not only sustain the privileged status acquired by the SDT regarding the understanding of the role of motivational variables on exerciser's behaviors, but also emphasizes the importance of explaining the links between different motivational variables, in order to figure out how interpersonal behaviors influence satisfaction or frustration of BPN's that, consequently, impact motivation quality and future behaviors outcomes.

Therefore, the purpose of this review is to analyze the associations between motivational variables (interpersonal behaviors, BPN satisfaction and frustration and motivational regulations) and behavioral outcomes (i.e., enjoyment, intention, persistence and adherence), in healthy exercisers having as conceptual background SDT.

## Methods

The several stages of the present review followed recommendations suggested by the PRISMA protocol (Moher, Liberati, Tetzlaff, Altman, & The PRIMA Group, 2009).

### Research strategy

A broad search of literature was conducted on the following databases: Web of Science, PubMed, SportDISCUS and PsycINFO; from December 23, 2017 until April 30, 2018. Keywords that have been used are “interpersonal behavior”, "behavior* regulation", "basic needs", "need satisfaction", "need frustration", "motiv* regulation", "motiv*", "enjoyment", "exercise*," intention", "persistence"," adherence", "health clubs ","gym", "fitness". These have been used separately or in different combinations, through the inclusion of "AND" or "OR". Bibliographic references were examined in an attempt to include potential studies that met inclusion criteria.

### Inclusion/exclusion criteria

The following inclusion criteria were adopted: 1) experimental and non-experimental studies; 2) published between August 1985 and April 2018 (date of first publication on SDT; date of the end of data collection); 3) written in English; 4) based on SDT; 5) including at least one of the studied variables (interpersonal behavior, basic psychological needs, motivational regulation, enjoyment, intention, persistence, and adherence); 6) sampling exercisers, aged between 18 and 65 years; 7) focusing on apparently healthy individuals (studies that included overweight and/or obese people were also included). Exclusion criteria were as follows: 1) studies published after May 2018; 2) including amateurs or professional athletes, since sport and physical exercise are distinguished concepts (Caspersen et al., 1985); 3) published in physical education classes, since this type of physical activity is different from regular exercise (Caspersen et al., 1985); 4) instrument validation studies; 5) grey literature; 6) evaluation of physiological factors unrelated to previously mentioned variables; 7) systematic reviews.

### Data extraction

Data was extracted by one of the authors using a predefined checklist and was verified and analyzed by two other authors. The following information was extracted: 1) bibliographic information (authors, year of publication, country of research, 2) study design; 3) sample characteristics; 4) instruments; 5) motivational variables predictors; 6) main results; 7) statistical analysis.

### Qualitative analysis of the studies methods

Checklist created by Black & Downs (1998) was used to qualitatively evaluate studies' methodological content. This instrument consists of 27 questions that seek to determine the study's quality by having in mind several parameters, namely study design, adequacy of statistical procedures, description clarity of the main conclusions. However, since one question (question 15 – *was an attempt made to blind measuring the main outcomes of the intervention?)* was not applicable to all studies analyzed, it was removed from the original checklist. Therefore, the modified scale had maximum 26 points from the original one (item 15 was excluded, maximum result: 26). Two reviewers analyzed the selected studies and any discrepancies were resolved consensually.

### Additional analysis

To facilitate the process of analyzing SDT predictors with behavioral outcomes, we used the system created by Teixeira et al. (2012), since it is very simple and practical. If 75% of the sample showed positive associations with behavioral outcomes (e.g., exercise frequency) they were codded with "++", and "+" for percentages between 75% and 50%. Negative associations above 75% were codded "--", and "-" for percentages between 75% and 50%. Null positive associations "0/+" or null negative associations "0/- "where coded if the evidence was divided between any association and positive or negative, respectively.

## Results

### Study selection

During research (Figure 1.1), a total of 1,666 titles were identified, 260 of which were selected as they appeared to be potentially relevant for this systematic review. After carefully reading the titles and abstracts of the abovementioned articles, the selection was shortcut to 32 articles. By analyzing their bibliographical references, 14 other potentially relevant articles on the topic were pinpointed, leading to a total of 46 articles selected, which were fully and attentively analyzed. Studies that did not meet the previously stated inclusion criteria were excluded (n = 11). The final sample consisted, therefore, of 35 articles, of which 19 (54%) are cross-sectional, 12 (34%) experimental, 3 (9%) perspective and 1 (3%) retrospective.

### Study summaries

The present review includes 35 empirical studies published until April 2018. All studies based on SDT interventions in the exercise domain were evaluated. Prospective, experimental, and cross-sectional studies that examined interpersonal behaviors, BPN satisfaction and frustration, motivation regulations, and their impact on behavioral

outcomes (e.g., enjoyment, intention, persistence, adherence) were included. Table 1 presents a synthesis of the data extracted from the 35 studies comprehended in this review. Studies are listed by SDT construct (i.e., interpersonal behaviors, BPN satisfaction and frustration, motivational regulation) and alphabetically organized by author's name.

## Characteristics of the studies

Table 1 summarizes descriptive data of the 35 articles analyzed. The vast majority of the samples consisted of regular exercisers and encompassed an extended age range (i.e., ages 18-64). The 35 studies included in this body of work englobed a total of 40 independent samples. The higher number of samples in comparison to the number of analyzed articles is explained by the fact that some studies have analyzed more than one sample (i.e., Rodgers, Hall, Duncan, Pearson, & Milne, 2010). Altogether, the sample of this review consists of 10482 healthy exercisers, predominantly female.

## Quality of the studies

Methodological quality of the studies was considered reasonable. Of the 26 existent criteria, the study with the highest matching number of criteria (25) was written by Heiestad and colleagues (2016). On the other hand, the article with the lowest number of fulfilled criteria (6) was published by Puente and Anshel (2010). For more details see Table 1.1.

## Additional Analysis

Table 1.2 presents a summary of the sample characteristics (i.e., sample size, age, gender) of all 35 studies included in this review. In Table 1.3, we can observe the analysis made according to the classification system used in another study.

A total of 11 studies analyzing practitioners' perception of exercise professionals' interpersonal behaviors, were included in this review. Of these studies, 5 are transversal, 4 experimental, 1 retrospective and 1 perspective. This review comprised 14 studies that analyzed the impact of BPN satisfaction and/or frustration on motivational regulations and/or behavioral outcomes. Thus, the vast majority (n = 32) of the studies integrated in this review addressed motivational regulations and their relationship with exercise behaviors (i.e., frequency, self-reported physical activity).

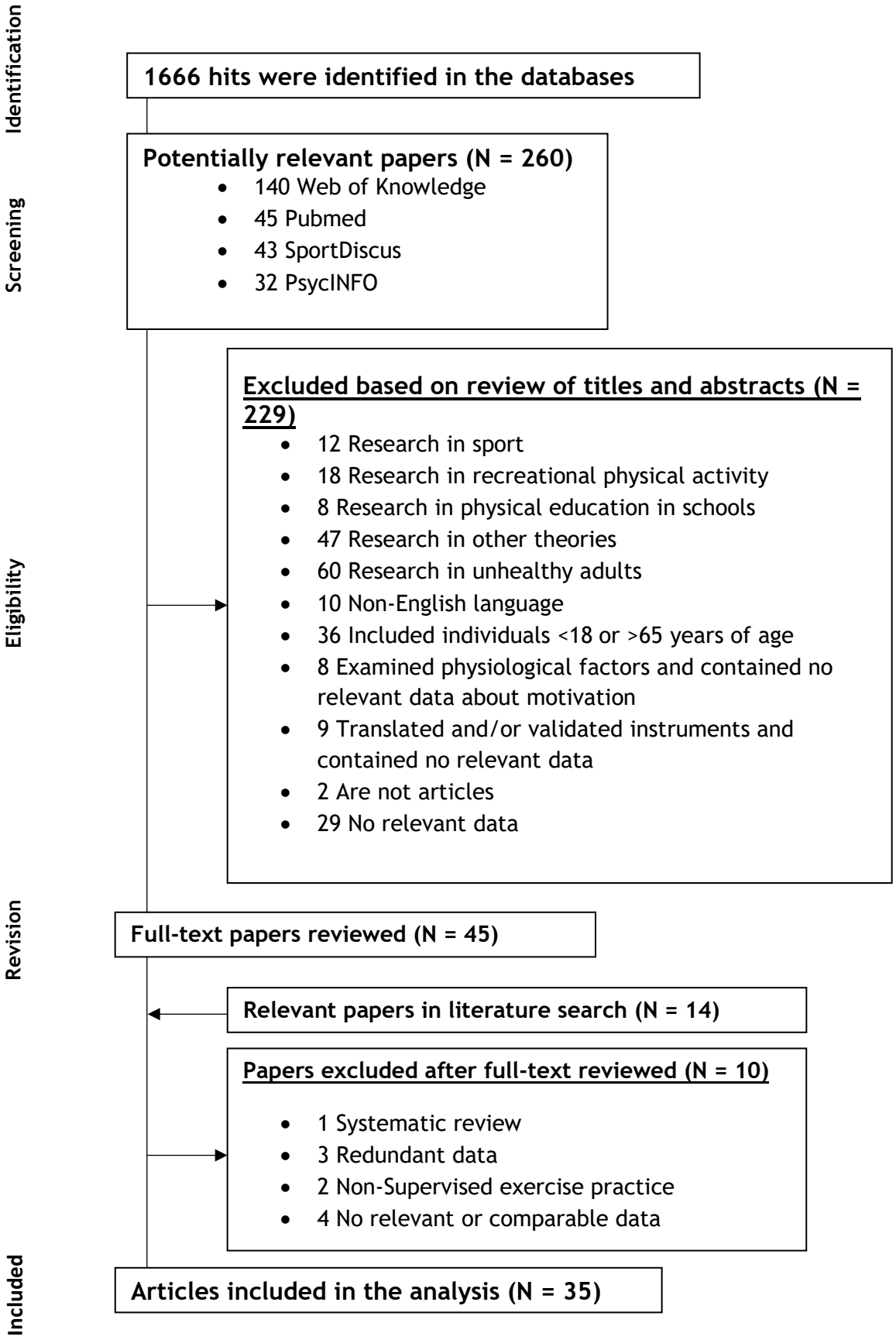



**Figure 1. 1** – Studies chart flow

**Table 1. 1** – Description of reviewed studies

| Author (date) | Location | Design | Size (%F) | Features (M±DP) | Measures | Significant Predictors | Outcomes | Analysis | Quality |
|---|---|---|---|---|---|---|---|---|---|
| *I. Interpersonal behavior* | | | | | | | | | |
| Edmunds et al. (2006) | UK | Cross-sectional | 369(52) | Exercisers (31.86±11.28) | Perceived Autonomy Support (HCCQ) | MV: Autonomy support (+) | Psychological need satisfaction (autonomy, competence, relatedness) | Hierarchical multiple regression analysis | 15 |
| Edmunds et al. (2007) | UK | Prospective (3 months) | 49(84) | Overweight/Obese (44.98±14.61) | Perceived Autonomy Support (HCCQ) | MV: Autonomy support (+) | Exercise self-regulations (identified and integrated regulation, intrinsic motivation) | Hierarchical regression analysis | 18 |
| Edmunds et al. (2008) | UK | Experimental (10 weeks) | 56(100) | Exercisers (31.86±11.28) | Autonomy Support (PESS) | MV: CG Autonomy support (-), EG Autonomy support (+), over time | Intention | Multiple regression analysis | 19 |
| Klain et al. (2015) | Brazil | Cross-sectional | 588(65) | Exercisers (35.00±17.00) | Perceived Autonomy Support (PASECQp) | MV: Autonomy support (+) | Psychological need satisfaction (autonomy, competence, relatedness), Adherence | MANOVA | 17 |
| Moreno-Murcia et al. (2016) | Spain | Cross-sectional | 355(100) | Exercisers (35.30±12.20) | Perceived Autonomy Support (PASSES) | BIV: Autonomy support (+) | Psychological need satisfaction (autonomy, competence, relatedness), Self-reported exercise (total and strenuous PA) | Bivariate correlations; SEM | 8 |
| Ng et al. (2013) | UK | Retrospective (6 months) | 156(80) | Exercisers (31.01±13.21) | Perceived Autonomy Support (HCCQ) | MV: Autonomy support (+) | Psychological need satisfaction (autonomy, competence, relatedness), Self-reported exercise (total and strenuous PA) | Bivariate correlations; One-way ANOVA | 17 |
| Ntoumanis et al. (2016) | UK | Experimental (4 months) | 364(68) | Instructors (37.28±7.65) + Exercisers (39.88±13.12) | Perceived Autonomy Support (HCCQ) | MV: Autonomy support (+) | Intention | MANOVA | 25 |

| Author (date) | Location | Design | Size (%F) | Features (M±DP) | Measures | Significant Predictors | Outcomes | Analysis | Quality |
|---|---|---|---|---|---|---|---|---|---|
| Puente & Anshel (2010) | USA | Cross-sectional | 238(57) | Healthy individuals (20.4±2.16) | Perceived Autonomy Support (SCQ) + Competence Support (PCS) | MV: Autonomy support (+), Competence support | Psychological need satisfaction (autonomy, competence), Adherence | Bivariate correlations; SEM | 6 |
| Silva et al. (2011) | Portugal | Experimental (1 yr + 2yr follow-up) | 221(100) | Overweight/Obese (44.98±14.61) | Perceived Autonomy Support (HCCQ) | BIV: Autonomy support (+) | Exercise self-regulations (autonomous motivation), Adherence | Effect sizes; Independent T-test; SEM | 22 |
| Silva et al. (2010) | Portugal | Experimental (12 months) | 239(100) | Overweight/Obese (intervention: 38.1±7.04; control 37.1±6.99) | Perceived Autonomy Support (HCCQ) | BIV: Autonomy support (+) | Psychological need satisfaction (autonomy, competence), Adherence | Effect sizes; Independent T-test; SEM | 11 |
| Vlachopoulos et al. (2011) | Greece | Cross-sectional | 733(40) | Exercisers (18-64yr) | Perceived Autonomy Support (PAS) | MV: Autonomy support (n.s.) | Psychological need satisfaction (autonomy, competence, relatedness) | Hierarchical regression analysis | 9 |
| ***II. Basic psychological need satisfaction and frustration*** | | | | | | | | | |
| Edmunds et al. (2006) | UK | Cross-sectional | 369(52) | Exercisers (31.86±11.28) | Psychological Need Satisfaction (BNSWS adapted) | BIV: Autonomy (+), Competence (+), Relatedness (+) | Self-reported exercise (total PA) | Bivariate correlations; Regression analysis | 15 |
| Edmunds et al. (2007) | UK | Prospective (3 months) | 49(84) | Overweight/Obese (44.98±14.61) | Psychological Need Satisfaction (PNSS) | MV: Autonomy (n.s.), Competence (n.s.), Relatedness (n.s.) | Adherence | Multiple regression analysis; Paired T-test | 18 |
| Edmunds et al. (2008) | UK | Experimental (10 weeks) | 56(100) | Exercisers (31.86±11.28) | Psychological Need Satisfaction (PNSS) | MV: Autonomy (+), Competence (+), Relatedness (+) | Adherence | Multiple regression analysis | 19 |

| Author (date) | Location | Design | Size (%F) | Features (M±DP) | Measures | Significant Predictors | Outcomes | Analysis | Quality |
|---|---|---|---|---|---|---|---|---|---|
| Klain et al. (2015) | Brazil | Cross-sectional | 588(65) | Exercisers (35.00±17.00) | Psychological Need Satisfaction (BPNESp) | MV: Autonomy (+), Competence (+), Relatedness (n.s.) | Adherence | MANOVA | 17 |
| Moreno-Murcia et al. (2016) | Spain | Cross-sectional | 355(100) | Exercisers (35.30±12.20) | Psychological Need Satisfaction (BNSE) | MV: BPN (+) | Exercise self-regulations (intrinsic motivation); Self-reported exercise (total and strenuous PA) | Bivariate correlations; SEM | 8 |
| Ng et al. (2013) | UK | Retrospective (6 months) | 156(80) | Exercisers (31.01±13.21) | Psychological Need Satisfaction (BNSE) + Frustration (PNTS) | MV: BPN satisfaction (n.s.); BPN frustration (n.s.) | Adherence | Bivariate correlations; One-way ANOVA | 17 |
| Ntoumanis et al. (2016) | UK | Experimental (4 months) | 364(68) | Instructors (37.28±7.65) + Exercisers (39.88±13.12) | Psychological Need Satisfaction (BPNES) | MV: Autonomy (+), Competence (n.s.), Relatedness (+) | Intention | MANOVA | 25 |
| Puente & Anshel (2010) | USA | Cross-sectional | 238(57) | Healthy individuals (20.4±2.16) | Psychological Need Satisfaction (BPNS) | MV: Autonomy (+), Competence (+), Relatedness not measured | RAI, Adherence | Bivariate correlations; SEM | 6 |
| Puigarnau et al. (2017) | Spain | Experimental (6 months) | 56(87) | Healthy individuals (36.02±10.15) | Psychological Need Satisfaction (PNSE) | MV: EG: Autonomy (n.s.), Competence (n.s.), Relatedness (n.s.), CG: Autonomy (+), Competence (n.s.), Relatedness (n.s.) | Adherence | Bivariate correlations; independent T-test; MGM | 7 |
| Silva et al. (2010) | Portugal | Experimental (12 months) | 239(100) | Overweight/Obese (intervention: 38.1±7.04; control 37.1±6.99) | Psychological need satisfaction (LCE + IMI) | MV: Autonomy (+), Competence (+), Relatedness not measured | Exercise self-regulations (introjected, identified and intrinsic motivation) | Effect sizes; Independent T-test; SEM | 11 |

| Author (date) | Location | Design | Size (%F) | Features (M±DP) | Measures | Significant Predictors | Outcomes | Analysis | Quality |
|---|---|---|---|---|---|---|---|---|---|
| Sylvester et al. (2018) | Canada | Cross-sectional | 499(65) | Healthy individuals (female: 34.09±13.27; male: 33.43±12.84) | Psychological Need Satisfaction (PNSE) | MV: PNS (+) | Exercise self-regulations (autonomous motivation) | Multiple mediation analysis; SEM | 7 |
| Teixeira et al. (2018) | Portugal | Cross-sectional | 153(55) | Exercisers (36.21±8.44) | Psychological Need Satisfaction (PNSE) + Frustration (PBNSFS adapted) | MV: PNS (+), PNF (-) | Exercise self-regulations (identified, integrated and intrinsic motivation) | Multiple mediation analysis; SEM | 11 |
| Teixeira et al. (2015) | Portugal | Cross-sectional | 905(61) | Exercisers (36.8±11.96) | Psychological Need Satisfaction (PNSE) | MV: PNS (+) | Emotional outcome (psychological well-being) | Multiple mediation analysis; SEM | 15 |
| Vlachopoulos et al. (2011) | Greece | Cross-sectional | 733(40) | Exercisers (18-64yr) | Psychological Need Satisfaction (PNES) | MV: Autonomy (+), Competence (+), Relatedness (+) | Exercise self-regulations (introjected, identified and intrinsic motivation) | Hierarchical regression analysis | 9 |
| Vlachopoulos & Neikou (2007) | Greece | Prospective (6 months) | 228(52) | Exercisers (F: 27.79±6.28; M: 27.38±8.37) | Psychological Need Satisfaction (BPNES) | MV: F: Autonomy (+), Competence (+), Relatedness (n.s.), M: Autonomy (n.s.), Competence (+), Relatedness (n.s.) | Adherence | Hierarchical regression analysis; SEM | 9 |
| ***III. Motivational regulation*** | | | | | | | | | |
| Blais et al. (2016) | Canada | Experimental (6 months) | 70(76) | Exercisers (44.83±8.78) | Exercise self-regulations (BREQ-3) | MIV: IM (+), INTE (+), IDEN (n.s.), INTR (+), EXT (-), AMO not measured | Change in exercise stages | Mixed Model ANOVA | 9 |
| Caudwell & Keatley (2016) | Australia | Cross-sectional | 100(0) | Exercisers (25.83±6.62) | Perceived Locus of Causality (PLOC) | BIV: AUTO (+), CON (n.s.) | Attendance (adherence) | Hierarchical regression analysis | 15 |

| Author (date) | Location | Design | Size (%F) | Features (M±DP) | Measures | Significant Predictors | Outcomes | Analysis | Quality |
|---|---|---|---|---|---|---|---|---|---|
| Duncan et al. (2010) | Canada | Cross-sectional | 1079(57) | Exercisers (24.15±9.61) | Exercise self-regulations (BREQ-3) | BIV: IM (n.s.), INTE (+), IDEN (+), INTR (n.s.), EXT (n.s.), AMO (n.s.) | Frequency (adherence) | Multiple regression analysis | 11 |
| Edmunds et al. (2006) | UK | Cross-sectional | 369(52) | Exercisers (31.86±11.28) | Exercise self-regulations (BREQ) | BIV: IM (+), IDEN (+), INTR (+), EXT (-) | Self-reported exercise (total PA) | Hierarchical regression analysis; Mediation analysis | 15 |
| Edmunds et al. (2007) | UK | Prospective (3 months) | 49(84) | Overweight/Obese (44.98±14.61) | Exercise self-regulations (BREQ-2 + EMS) | BIV: IM (+), INTE (+), IDEN (-), INTR (+), EXT (-), AMO not measured | Self-reported exercise (total PA), intention, persistence | Bivariate correlations; Multiple regression analysis | 18 |
| Edmunds et al. (2008) | UK | Experimental (10 weeks) | 56(100) | Exercisers (31.86±11.28) | Exercise self-regulations (BREQ-2 + EMS) | MIV: IM (+)), INTE (+)), IDEN (n.s.), INTR (+), EXT (n.s.), AMO (-) | Intention, adherence, CG: decreased over time; EG: increased over time | Multilevel regression analysis | 19 |
| Gast et al. (2011) | USA | Cross-sectional | 181(0) | Healthy individuals (21.43±3.66) | Exercise self-regulations (BREQ) | BIV: IM (+)), IDEN (+), INTR (n.s.), EXT (n.s.) | Self-reported exercise (total and strenuous PA), Eating behavior | Independent T-test; Linear regression analysis | 14 |
| Heiestad et al. (2016) | Norway | Experimental (12 weeks) | 143(100) | Overweight/Obese (39.90±10.50) | Exercise self-regulations (BREQ-2) | BIV: RAI (+), IDEN (+), INTR (+), EXT (n.s.), AMO (n.s.), IM not measured | Self-reported exercise (quality of life), Adherence | One-way ANOVA | 26 |
| Ingledew & Markland (2008) | UK | Cross-sectional | 252(48) | Healthy individuals (40.36±10.96) | Exercise self-regulations (BREQ-2) | BIV: IM (n.s.), IDEN (+), INTR (n.s.), EXT (-), AMO not measured | Self-reported exercise (total and strenuous PA) | Bivariate correlations; SEM | 11 |
| Ingledew et al. (2009) | UK | Cross-sectional | 251(52) | University students (19.48±1.90) | Exercise self-regulations (BREQ-2) | MIV: IM (+), IDEN (+), INTR (n.s.), EXT (n.s.), AMO not measured | Self-reported exercise (total and strenuous PA) | Multiple regressions analysis; SEM | 10 |

| Author (date) | Location | Design | Size (%F) | Features (M±DP) | Measures | Significant Predictors | Outcomes | Analysis | Quality |
|---|---|---|---|---|---|---|---|---|---|
| Klain et al. (2015) | Brazil | Cross-sectional | 588(65) | Exercisers (35.00±17.00) | Exercise self-regulations (BREQ-2) | BIV: IM (+), IDEN (+), INTR (n.s.), EXT (-), AMO (-) | Adherence | MANOVA; SEM | 17 |
| Mack et al. (2015) | Canada | Cross-sectional | 465(49) | Healthy individuals (20.55±1.75) | Exercise self-regulations (BREQ-3) | MIV: IM (+), INTE (+), IDEN (+), INTR (+), EXT (-), AMO not measured | Self-reported exercise (total and strenuous PA) | Multiple mediation analysis | 12 |
| Mullan & Markland (1997) | UK | Cross-sectional | 314(50) | Healthy individuals (female: 36.04±11.07; male: 39.07±11.45) | Exercise self-regulations (BREQ) | BIV: IM (+), IDEN (+), INTR (n.s.), EXT (-) | Change in exercise stages | Bivariate correlations analysis | 7 |
| Ntoumanis et al. (2017) | Greece | Experimental (14 weeks) | 180(56) | Exercisers (30.10±9.60) | Exercise self-regulations (BREQ-2) | MIV: IM (+), IDEN (+), INTR (+), EXT (n.s.), AMO (-), increased over time | Exercise identity | MGM | 10 |
| Ntoumanis et al. (2016) | UK | Experimental (4 months) | 364(68) | Instructors (37.28±7.65) + Exercisers (39.88±13.12) | Exercise self-regulations (BREQ) | BIV: AUTO (n.s.), CON (n.s.), AMO (n.s.) | Intention | MANOVA | 25 |
| Puente & Anshel (2010) | USA | Cross-sectional | 238(57) | Healthy individuals (20.4±2.16) | Exercise self-regulations (SRQ-E) | MV: RAI (+) | Adherence, enjoyment | Bivariate correlations; SEM | 6 |
| Puigarnau et al. (2017) | Spain | Experimental (6 months) | 56(87) | Healthy individuals (36.02±10.15) | Exercise self-regulations (BREQ-3) | BIV: IM (n.s.), INTE (n.s.), IDEN (n.s.), INTR (n.s.), EXT (n.s.), AMO (n.s.), for both groups | Frequency (adherence | Bivariate correlations; independent T-test | 7 |
| Rodgers et al. (2010) | Canada | Prospective | 1572(60) | Healthy individuals (initiates vs: long-term exercisers, 22-51 yr) | Exercise self-regulations (BREQ) | MV: IM (+), IDEN (+), INTR (n.s.), EXT (-), overtime for initiates, but < to long-term exercisers | Self-reported exercise initiate vs. long-term exercisers | MANOVA | 8 |
| Rosa et al. (2015) | Brazil | Experimental (12 months) | 73(78) | Exercisers (34.01±9.71) | BREQ-2 | BIV: RAI (+), IM (+), IDEN (n.s.), INTR | Adherence | Two-way ANCOVA | 11 |

| Author (date) | Location | Design | Size (%F) | Features (M±DP) | Measures | Significant Predictors | Outcomes | Analysis | Quality |
|---|---|---|---|---|---|---|---|---|---|
| Sibley & Bergman (2016) | USA | Experimental (8 weeks) | 461(60) | Healthy individuals (20.20±2.30) | Exercise self-regulations (BREQ) | MIV: RAI (+), IM (+), IDEN (+), INTR (-), EXT (-) | Self-reported exercise (total PA) | Multiple regressions analysis; SEM | 11 |
| Silva et al. (2011) | Portugal | Experimental (1 yr + 2yr follow-up) | 221(100) | Overweight/Obese (44.98±14.61) | Exercise self-regulations (SRQ-E) | BIV: IM (+), IDEN (+), INTR (n.s.), EXT (n.s.), higher 2-year follow-up | Adherence | Effect sizes; Independent T-test; SEM | 22 |
| Silva et al. (2010) | Portugal | Experimental (12 months) | 239(100) | Overweight/Obese (intervention: 38.1±7.04; control 37.1±6.99) | Exercise self-regulations (SRQ-E) | BIV: IM (+), INTE (n.s.), IDEN (+), INTR (+), EXT (n.s.) | Adherence | Effect sizes; Independent T-test | 11 |
| Standage et al. (2008) | UK | Cross-sectional | 52(50) | Healthy individuals (22.27±3.41) | Exercise self-regulations (BREQ) | BIV: IM (+), IDEN (+), INTR (n.s.), EXT (-) | Self-reported exercise (Total and strenuous PA) | Bivariate correlations | 7 |
| Sylvester et al. (2018) | Canada | Cross-sectional | 499(65) | Healthy individuals (female: 34.09±13.27; male: 33.43±12.84) | Exercise self-regulations (BREQ-3) | MIV: AUTO (+), CON not measured | Self-reported exercise (Total and strenuous PA) | Multiple mediation analysis; SEM | 7 |
| Teixeira et al. (2018) | Portugal | Cross-sectional | 153(55) | Exercisers (36.21±8.44) | Exercise self-regulations (BREQ-3P) | MV: IM (+), INTE (+), IDEN (+), INTR (n.s.), EXT (-) | Emotional response to exercise | Multiple mediation analysis; SEM | 11 |
| Teixeira et al. (2015) | Portugal | Cross-sectional | 905(61) | Exercisers (36.8±11.96) | Exercise self-regulations (BREQ-2) | MV: IM (+), IDEN (+), INTR (+), EXT (-), AMO (-) | Emotional outcome (psychological well-being) | Multiple mediation analysis; SEM | 15 |
| Thogersen-Ntoumani & Ntoumanis (2006) | UK | Cross-sectional | 375(51) | Exercisers (38.7±10.9) | Exercise self-regulations (BREQ + AMS) | MV: IM (+), IDEN (+), INTR (n.s.), EXT (-), AMO (-) | Intention, adherence | Multivariate regressions analysis; MANOVA | 9 |
| Thogersen-Ntoumani et al. (2015) | Australia | Experimental | 87(65) | Exercisers (42.00±12.00) | Exercise self-regulations (BREQ-2) | MV: AUTO (+), CON (-), AMO (n.s.) | Body composition; Adherence | Repeated-measures ANOVA; SEM | 13 |

| Author (date) | Location | Design | Size (%F) | Features (M±DP) | Measures | Significant Predictors | Outcomes | Analysis | Quality |
|---|---|---|---|---|---|---|---|---|---|
| Vlachopoulos et al. (2011) | Greece | Cross-sectional | 733(40) | Exercisers (18-64yr) | Exercise self-regulations (BREQ-2) | MV: IM (+), IDEN (+), INTR (+), EXT (-), AMO (-) | Exercise identity | Confirmatory factor analysis | 9 |
| Wilson & Rodgers, 2004 | Canada | Cross-sectional | 276(64) | Healthy individuals (20.86±2.21) | Exercise self-regulations (BREQ-2) | MV: IM (+), IDEN (+), INTR (+), EXT (-), AMO (-) | Intention | Multiple regressions analysis; SEM | 11 |
| Wilson et al., 2003 | Canada | Experimental (12 weeks) | 53(83) | Exercise practitioners (41.80±10.75) | Exercise self-regulations (BREQ) | MV: IM (+), IDEN (+), INTR (n.s.), EXT (n.s.) | Self-reported exercise (total and strenuous PA) | Multiple regressions analysis | 11 |

Note: F, female; M, Male; PA, Physical Activity; BIV, uni/bivariate associations; MV, multivariate associations; IM; intrinsic motivation; INTE, integrated regulation, IDEN, identified regulation; INTR, introjected regulation; EXT, external regulation; AMOT, amotivation; PACES-pros, PACES positive outcomes; Paces-cons, PACES negative outcomes; Auto, autonomous motivation; Cont, controlled motivation; PLOCaut, perceived locus of causality autonomous; PLOCcon, perceived locus of causality controlled; PA, physical activity; RAI, relative autonomy index; PNS, psychological need satisfaction; PNF, Psychological Need Frustration; n.s., not significant; +, positive relation; -, negative relation

**Table 1. 2** - Summary of samples characteristics

| Characteristics | Sample *K* (%) |
|---|---|
| *Sample Size* | |
| ≤ 100 | 12(30) |
| 100-300 | 15(38) |
| 300-500 | 9(22) |
| ≥ 500 | 4(10) |
| *Gender* | |
| Women only | 5(13) |
| Men only | 2(5) |
| Men and Women combined | 33(82) |
| *Location* | |
| America | 18(45) |
| Europe | 20(50) |
| Australia | 2(5) |
| *Mean age,years* | |
| <25 | 12(30) |
| 26-45 | 25(63) |
| 46-65 | 2(5) |
| Unable to determine | 1 (2) |
| *Features* | |
| Exercise practicioners | 24(60) |
| Healthy individuals | 7(17) |
| University students | 5(13) |
| Overweight and obese | 4(10) |
| *Exercise and related outcomes* | |
| Self-reported exercise | 13(26) |
| Change in exercise stages | 1(2) |
| Intention | 4(8) |
| Persistence | 3(6) |
| Adherence | 24(50) |
| Other* | 4(8) |
| Total *K* | 40 |

Note: *exercise identity, eating behavior, enjoyment, emotional outcomes

**Table 1. 3** – Summary of associations between SDT predictors and exercise outcomes

| | Supporting Associations | | | | |
|---|---|---|---|---|---|
| | **N** | **+(%)** | **- (%)** | **0(%)** | **Association** |
| *Interpersonal behavior* | | | | | |
| Autonomy support | 11 | 11(100) | 0(0) | 0(0) | ++ |
| *Basic Psychological Needs* | | | | | |
| Autonomy satisfaction | 11 | 10(90) | 0(00) | 1(10) | ++ |
| Competence satisfaction | 11 | 8(73) | 0(0) | 3(27) | + |
| Relatedness satisfaction | 9 | 5(56) | 0(0) | 4(44) | + |
| Autonomy frustration | 0* | 0(0) | 0(0) | 0(0) | ? |
| Competence frustration | 0* | 0(0) | 0(0) | 0(0) | ? |
| Relatedness frustration | 0* | 0(0) | 0(0) | 0(0) | ? |
| Composite satisfaction score | 3 | 3(100) | 0(0) | 0(0) | ++ |
| Composite frustration score | 2* | 0(0) | 1(50) | 1(50) | ? |
| *Exercise regulations/motivations* | | | | | |
| Intrinsic motivation | 27 | 24(89) | 0(0) | 3(11) | ++ |
| Integrated motivation | 8 | 6(75) | 0(0) | 2(25) | ++ |
| Identified regulation | 27 | 21(78) | 1(4) | 5(18) | ++ |
| Introjected regulation | 27 | 11(40) | 2(8) | 14(54) | 0/+ |
| External regulation | 27 | 0(0) | 15(56) | 12(44) | - |
| Amotivation | 14 | 0(0) | 6(43) | 8(57) | - |
| Relative autonomy (e.g., RAI) | 4 | 4(100) | 0(0) | 0(0) | ++ |
| Composite Autonomous regulations score | 4 | 3(75) | 0(0) | 1(25) | ++ |
| Composite Controlled regulations score | 2* | 0(0) | 1(50) | 1(50) | ? |

Note: N, number of studies; ++, positive associations for percentage ≥75% and (+) for percentages between 50-75%; (--) negative associations for percentage ≥75% and (-) for percentage between 50-75%; (0/+) null positive or (0/-) null negative associations when the evidence was split between no association (0) and either positive or negative associations, respectively; (?) for other results indicating inconsistent findings; *, studies available >3.

# Discussion

This review aimed to analyze the literature focused on the relationship between motivational variables and behavioral outcomes in the exercise context, having as a theoretical background Self-Determination theory. As postulated by this motivational construct, BPN's satisfaction and/or frustration is influenced by the individuals' surrounding environment. Moreover, this same environment also plays an important role when it comes to predict more or less self-determined regulations and influence the way a person manifests his/her behavior (Ryan & Deci, 2017).

By looking at the various articles included in this study, one might conclude that research in the exercise context, having as a theoretical background SDT, seems to have been exponentially growing in the recent years. As a matter of fact, 18 (51%) of the analyzed articles were written in the last 6 years (> 2012), while the remaining ones were written previously (1997-2011), thus, demonstrating the increased interest in applying SDT in exercise context. That being written, this systematic review proposes an updated summary of investigations on this topic that has been done up until now, aiming to complement and enhance the previous existent review (Teixeira et al., 2012). In what follows, an analysis of the selected studies grouped by motivational variables, namely: interpersonal behaviors, basic psychological needs and motivational regulation, is provided.

## Interpersonal behavior

According to this body of work, exercisers who perceive autonomy and competence support from exercise professionals tend to have greater BPN satisfaction (Edmunds et al., 2006, Klain, de Matos, Leitão, Cid, & Moutão, 2015; Moreno-Murcia et al., 2016; Ng et al., 2016; Puente & Anshel, 2010; Silva et al., 2010; Vlachopoulos Kaperoni, & Moustaka, 2011). These results are in line with the Self-determination theory's theoretical assumptions, which suggest that support for autonomy, competence and relatedness may be predictors of BPN satisfaction (Deci & Ryan, 2000). Therefore, it seems fundamental that exercise professionals are able to create a supportive context for BPN satisfaction, hence avoiding behavior dropout.

Research demonstrated that there are positive relationships between autonomy support and more autonomous regulations (Edmunds et al., 2008; Silva et al., 2011). In addition, significant relationships between autonomy support and intention to exercise appears to exist (Edmunds et al., 2008; Ntoumanis et al., 2016). This is equally true regarding adherence, which is positively associated with the support of autonomy perceived by overweight and obese exercisers (Silva et al., 2011; Silva et al., 2010). Overweight and obese

exercisers who perceived autonomy support from their exercise professionals, show more autonomous forms of motivation (Edmunds et al., 2007). As a matter of fact, exercisers who feel support from their exercise professionals in decision making tend to maintain exercise practice in the long term. In addition, several studies (e.g., Moreno-Murcia et al., 2016; Ng et al., 2013) show that individuals who perceive greater autonomy support tend to practice more exercise with higher intensities.

However, no study has considered the six dimensions of interpersonal behavior that can be perceived by exercisers, regarding exercise professionals' behaviors. This may be partly related to the lack of validated instruments that englobe all three dimensions of support and of thwarting. According to several authors (e.g., Rocchi et al., 2017; Ryan & Deci, 2017), the analysis of all six interpersonal behaviors' constructs and the way each dimension influences BPN satisfaction or frustration proves to be essential. Only recently, Rocchi et al. (2017) developed and validated for the first time the Interpersonal Behavior Questionnaire (IBQ) and the Interpersonal Behavior Questionnaire - Self (IBQ-Self), a scale aiming at analyzing, respectively, students' perception of teachers' behaviors and the perception teachers have about their own behaviors. However, this scale has not yet been used or validated in the exercise context, which may be related, in part, to the lack of research analyzing the dimensions of support and thwarting of interpersonal behaviors.

### Basic Psychological Needs

The studies provided good evidence on the positive correlation among BPN satisfaction, a more autonomous and self-determined motivation and behavior maintenance. The findings of Edmunds et al. (2008) assumed a paramount relevance by evidencing the predictive role of BPN satisfaction in facilitating the process of self-determination. These authors concluded that exercisers, who experience psychological need's fulfillment, tend to demonstrate a greater autonomous motivation. It is also true in overweight and obese exercisers, where BPN's satisfaction was related to more self-determined motivational regulations (Silva et al., 2010). In point of fact, this proves to be consistent with SDT, which emphasizes that autonomous regulations are fostered by the satisfaction of the basic psychological needs (Deci & Ryan, 2000).

Moreover, when experiencing satisfaction of BPN's, exercisers tend to manifest greater adherence (Edmunds et al., 2007; Edmunds et al., 2008, Klain et al., 2015, Ng et al., 2013, Puente & Anshel; Teixeira & Palmeira, 2015) and greater frequency of self-reported exercise (Edmunds et al., 2006). When examining each BPN separately, findings notice that autonomy satisfaction is a strong predictor of exercise intention (Edmund et al., 2008; Teixeira et al., 2012). Therefore, individuals who perceive freedom of choice are more prone

to maintain a long-term exercise practice. In addition, competence satisfaction is positively related with adherence (Puente & Anshel, 2010). Thus, individuals who acquire new skills or improve existing ones tend to have greater predisposition to maintain exercise frequency (Klain et al., 2015). Finally, relatedness satisfaction presents the lowest number of positive associations, which may be in part related to the preference of some exercisers to train alone (Klain et al., 2015 Moreno-Murcia et al., 2016; Puigarnau et al., 2017).

Only two of the analyzed articles focused on the impact of BPN frustration on motivational and emotional variables (Teixeira et al., 2018; Ng et al., 2013) and only one of them explored their impact on adherence to exercise (Ng et al. al., 2013). According to this studies, BPN frustration is a predictor of exercise dropout. These data corroborate other investigations, namely in sport (Sarrazin, Vallerand, Guillet, Pelletier, & Cury, 2002) or physical activity (Chatzisarantis & Hagger, 2009). However, these studies used different instruments that have not yet been validated in the exercise context. In addition, the small amount of studies focused on analyzing BPN frustration reveals the need for cautiously interpretations.

The frustration of basic psychological needs should be considered as an important variable to be measured (Vansteenkiste & Ryan, 2013) in order to fully understand its impact on motivational regulation and behavioral outcomes in exercise context. Not only to control BPN satisfaction, but to understand the possible existence between needs' frustration, less self-determined regulation, and exercise dropout.

Thus, by taking into consideration the analysis of BPN satisfaction and frustration, these studies are door openers for future research and highlighters of the need to create a specific instrument of analysis for the exercise context.

### Motivational regulation

As mentioned earlier, the majority of the studies addressed motivational regulations. In addition, they analyzed the impact of these motivational regulations on behavior maintenance, persistence, and adherence. A large percentage (84%) of them focused on all forms of motivational regulation, while others used composite factors of autonomous and controlled regulations (Thogersen-Ntoumani et al., 2015) or adopted the Relative Autonomy Index (Sibley & Bergman, 2016).

The results demonstrate a significant relationship between more autonomous regulations and exercise practice (Blais, Mack, Wilson, & Blanchard, 2016; Edmunds et al., 2006; Edmunds et al., 2007; Heiestad et al., 2016; Ingledew & Markland, 2008; Ingledew Markland, & Ferguson, 2009; Mack, Kouali, Gilchrist, & Sabiston, 2015; Rodgers et al.,

2010; Sibley & Bergann, 2016; Standage, Sebire, & Loney, 2008; Sylvester et al., 2018; Wilson, Rodgers, Blanchard & Gessel, 2003), enhanced well-being (Teixeira et al., 2015), enhanced intention to exercise practice (Edmunds et al., 2008; Ng et al., 2013; Thogersen-Ntoumani & Ntoumanis, 2006; Wilson & Rodgers, 2004) and greater adherence (Puente & Anshel, 2010; Rosa et al., 2015, Silva et al., 2011; Silva et al., 2010). Therefore, exercisers, whose motivation is more self-determined, tend to maintain their behavior, hence being more prone to exercise over the long-run. Consequently, by engaging in an autonomous and volitional behavior, the exerciser might experience positive outcomes such as the feeling of enjoyment (Puente & Anshel, 2010), greater physical capacity (Sibley et al., 2013), enhanced body transformation (Thogersen-Ntoumani et al., 2015) and increased exercising frequency (Caudwell & Keatley, 2016; Duncan, Hall, Wilson, & Jenny, 2010).

Intrinsic motivation represents the most self-determined regulation (Deci & Ryan, 2000). According to Table 3, this type of regulation mainly shows positive associations favoring different exercise behaviors, with solely three studies presenting no significant results. As a matter of fact, intrinsic motivation plays a major role for the exercisers to be able perform exercise spontaneously, to experience pleasure, to challenge themselves and to facilitate the behavior maintenance in the long term (Blais et al., 2016; Gast, Madanat, & Nielson 2011; Edmunds et al., 2008).

Integrated regulation prevails the least studied dimension, which might be justified by the fact that most of them so far cannot yet distinguish this regulation from identified regulation, given that both share the same principles (Teixeira et al., 2012). Integrated regulation was firstly analyzed in the review made by Wilson, Rodgers, Loitz, and Scime (2006) on the Behavioral Regulation Exercise Questionnaire 2 (BREQ2: Markland & Tobin, 2004). Although 23 new studies have been published after the review from Wilson et al. (2006), nearly all of them used the previous version of BREQ-2, which does not englobe integrated regulation. Nevertheless, clear findings suggest a robust relationship between this type of motivational regulation, exercise intention (Edmunds et al., 2007; Edmunds et al., 2008) and exercise frequency (Duncan et al., 2010).

Besides, some studies (Edmunds et al., 2006; Ingledew & Markland, 2008; Thogersen-Ntoumani & Ntoumanis, 2006) advocate that identified regulation may be one of the strongest correlations in exercise context, which may be related in part to the effort required for exercise practice. In point of fact, identified regulation has been a key variable in predicting the maintenance of exercise behavior (Teixeira et al., 2012). This may be in part related to the positive health benefits that the individual perceives by exercising.

With regard to controlled regulation, studies show inconsistent results, therefore toughening the analysis. Some studies show significant differences between controlled regulation and behavioral outcomes (Edmunds et al., 2007), in others none (Duncan et al., 2010), and in some negative associations were found (Rosa et al., 2015). However, the literature suggests that this form of regulation is usually associated with negative adaptations such as feelings of guilt and pressure (Ryan & Deci, 2000). People who perceive pressure to engage in exercise are more likely to feel guilty or ashamed if they do not exercise, thus, jeopardizing the potential of experiencing feelings of pleasure and enjoyment (Edmunds et al., 2006; Teixeira et al., 2012).

The positive results in the relationship between introjected regulation and exercise may be associated with an initial phase of self-determination (Gast et al., 2011; Ntoumanis et al., 2016), during the one the perception of the behavior is altered thanks to the recognition of the benefits associated with it, culminating in a greater potential for exercise habit implementation.

External regulation, the least self-determined one, is associated with behavioral dropout (Blais et al., 2016; Klain et al., 2015). Thus, when individuals engage in exercise practice only as a mean of obtaining an external reward, the chances of dropping out the behavior increase dramatically, as the results become dependent of factors one cannot control (Rodgers et al., 2010). Hence, in order to promote the behavior maintenance, the exerciser must recognize the physiological, psychological and emotional benefits of exercising. Only then, can the behavior maintenance be guaranteed (Edmunds et al., 2008).

Finally, amotivation, lying at one end of the motivational continuum, was one of the less studied regulation. This type of regulation was first analyzed in BREQ-2 (Markland & Tobin, 2004), after researchers realized that individuals may demonstrate unwillingness to exercise or that the reasons for their commitment have become less clear. According to this review, data shows a negative association between amotivation, persistence and adherence to exercise (Thogersen-Ntoumani & Ntoumanis, 2006; Thogersen-Ntoumani, Shepherd, Ntoumanis, & Wagenmakers, 2015), which seems somehow expected, since lack of motivation is defined by the absence of the performance of a certain behavior.

## Limitations

During the analysis of the studies, some limitations that might influence data interpretation were observed. One of these constraints is related with the lack of a valid instrument that analyzes all six dimensions of interpersonal behavior in the exercise context. The employment of instruments created for other contexts compromises the comparison

between studies, thus, stressing out the necessity to create and validate scales that can serve as universal method in comparing interpersonal behaviors' perceptions and the way they affect persistence and exercise practice. Future research may also work on the understanding of the relationship between supporting interpersonal behaviors and BPN satisfaction, or the interpersonal behaviors thwarting and BPN frustration. Additionally, we must bear in mind reduced amount of data related with BPN frustration and its impact on motivational regulations (Ng et al., 2013; Teixeira et al., 2018). As analyzed in this review, these studies addressed the composite values of BPN frustration, using instruments yet to be validated in exercise context. As previously stated, the use of instruments developed in other contexts, without prior validation for the domain being studied, might result in skewed results and lead to biased interpretations of the data. Therefore, the validation of an instrument that analyzes BPN frustration urges. Only then, will a closer look at the relationship between frustration and motivational regulation, as well as on the way the person behaves before exercise, be possible. Furthermore, although more self-determined regulations predict intention to exercise, greater persistence, and adherence, there is still a need to examine this relationship in greater depth through longitudinal studies. In addition, studies focusing on emotional outcomes (i.e., enjoyment) derived from more autonomous regulations in exercise seem to be essential, given the lack of a significant number of investigations analyzing this behavior outcome.

We also suggest future research on analyzing in more detail (e.g., systematic reviews, meta-analysis) clinical trials developed with this type of population or in individuals with chronic diseases. This kind of investigation will increase our knowledge about the influence of exercise on behavioral outcomes, and how these exercise habits can improve health markers, having as theoretical background SDT.

Finally, despite the existence of numerous cross-sectional studies that demonstrate positive relationship between motivational variables and behavioral consequences in the physical exercise domain, longitudinal research that analyzes interpersonal behaviors and their relationship with persistence and adherence in exercisers appears to be of the utmost importance.

## Conclusion

This review presents the most current evidence for understanding SDT in exercise context and how this motivational construct appears to promote persistence and adherence to long-term practice. Overall, there is good evidence of the positive influence that autonomy support perceived by exercisers has in the satisfaction of the basic psychological needs. Similarly, the development of more autonomous regulations also appears to be linked to

autonomy support behaviors. In addition, results analyzed in this study show that autonomous regulations predict greater intentions for exercise, regardless of age, group and nationality of the participants being englobed in the sample. To sum up, SDT affirms that supporting interpersonal behaviors perceived by individuals can strongly influence long-term exercise adherence.

# Chapter 3

# The Basic Psychological Need Satisfaction and Frustration Scale in Exercise (BPNSFS-E): validity, reliability, and gender invariance in Portuguese exercisers


## Resumo

The aim of the present study was to translate and validate the Basic Psychological Need Satisfaction and Frustration Scale for Portuguese exercisers. In addition, we sought to analyze gender invariance. We collected data from two independent samples of Portuguese respondents – a calibration sample with 316 participants and a validation sample with 632 participants. Results from CFA supported the original six-factor model in both the calibration sample [$\chi2(237) = 471.814$, $\chi2/df = 1.99$; B-S $p < .001$, CFI = .935, TLI = .924, SRMR= .047, RMSEA = .057 (CI90% = .050, .065)] and the validation sample [$\chi2(237) = 571.796$, $\chi2/df = 2.41$; B-S $p < .001$, CFI = .948, TLI = .940, SRMR= .038, RMSEA = .047 (CI90% = .042, .052)]. Moreover, our analysis revealed acceptable internal consistency, convergent and discriminant validity of the translated version, and invariance between the two samples and between genders as differences across latent means showed that magnitude effects were trivial between samples and between male and female exercisers. These results support the use of the adapted scale among both male and female exercisers.



**Key-words:** Self-Determination Theory; basic psychological needs; measurement invariance; latent means; exercise.

# Introduction

Though it is widely accepted that regular exercise offers health benefits, 46% of Europeans are physically inactive (Eurobarometer, 2018). Awareness of exercise health benefits seems insufficient for changing sedentary behaviors. According to the literature (e.g., Edmunds, Ntoumanis, & Duda, 2008; Rodrigues et al., 2018) motivation plays a major role when it comes to exercise participation (Radel et al., 2017), and it has a significant impact on exercise enjoyment (Murcia, Román, Galindo, Alonso, & González-Cutre, 2008). Motivational factors partly depend on whether basic psychological needs (BPN; Ryan & Deci, 2017) are satisfied or frustrated. Therefore, it is crucial to understand how BPN's influence motivation in exercisers' behavior, making it equally important to measure BPN accurately for exercisers in various countries. Thus, the aim of this study was to translate and validate a measurement scale for BPN, based on self-determination theory (Deci & Ryan, 1985) to analyze basic psychological need satisfaction and frustration among Portuguese exercisers.

## Self-Determination Theory and Basic Psychological Needs in Exercise

Self-Determination Theory (SDT: Deci & Ryan, 1985) is the most relevant theoretical framework for understanding human behavior, and it has been used to assess exercise-related outcomes (Thogersen-Ntoumani, Shepherd, Ntoumanis, & Wagenmakers, 2015; Teixeira et al., 2012). This macro-theory states that the BPN's of autonomy, competence, and relatedness are innate to all human beings regardless of race, gender, and cultural background, and BPN's are responsible for how someone regulates his/her motivation towards a behavior (Chen et al., 2015; Ryan & Deci, 2017). According to Deci and Ryan (2000), autonomy satisfaction refers to an individual's need to control his/her own behavior while enjoying freedom during interactions with the environment. Competence satisfaction involves feeling effective and capable of improving and mastering new skills (Chen et al., 2015). Relatedness satisfaction consists of a person's need to develop emotional connections and affective interactions with others (Vanteenkiste & Ryan, 2013). Satisfaction of the three BPN's carries several positive outcomes by contributing to one's physical and psychological development (Deci & Ryan, 2000).

On the other hand, individuals can also experience BPN frustration. Autonomy frustration involves feelings of being controlled by external or self-imposed pressures (Chen et al., 2015). Competence frustration refers to self-doubt in one's capacity to act efficiently (Cordeiro, Paixão, Lens, Lacante, & Luyckx, 2016). Frustration of relatedness is associated with social exclusion and feelings of loneliness (Bartholomew, Ntoumanis, Ryan, Bosch, & Thogersen-Ntoumani, 2011). When individuals perceive their BPN's to be frustrated, they

experience feelings of ill-being, enhancing the likelihood of exercise dropout behavior (Edmunds et al., 2008).

It is important to distinguish between low levels of BPN satisfaction (or dissatisfaction) and outright frustration. Low levels of satisfaction are not necessarily indicators of high levels frustration; rather, they may simply suggest that the person is not satisfied with how his/her needs are being met (Bartholomew et al., 2011). That is, BPN's frustration is an active process and more significant than the mere absence of satisfaction (Gunnell, Crocker, Wilson, Mack, & Zumbo, 2013). Moreover, difficulties exercisers experience executing a certain exercise may not indicate competence frustration, but, rather, low competence satisfaction. In contrast, exercisers who receive negative feedback from exercise professionals about their exercise technique might experience competence frustration. Differences between needs satisfaction and frustration may result from how the social environment interacts with the individual and how the individual experiences those interactions (Vansteenkiste & Ryan, 2013). This theoretical construct is hard to operationalize, as there is no clear evidence as to whether the participant's experienced feeling is of frustration or low satisfaction towards the same need.

According to SDT, BPN satisfaction predicts more autonomous forms of motivation (labeled as identified regulation, integrated regulation and intrinsic motivation), with intrinsic motivation being the prototype of optimal self-determined behavior in which the individual performs the behavior volitionally (Ryan & Deci, 2017), ultimately leading to a higher likelihood of maintaining the behavior over the long-run (Ng, Ntoumanis, Thogersen-Ntoumani, Stott, & Hindle, 2013). In addition, BPN satisfaction have been associated with enjoyment (Monteiro, Pelletier, Moutão, & Cid, 2018; Murcia et al., 2008). On the other hand, it is likely that BPN frustration is related to more controlled forms of motivation (labeled as external regulation and introjected regulation), leading to higher levels of dropout behavior (Ryan & Deci, 2017; Teixeira, Silva, & Palmeira, 2018). Past research (e.g., Chen et al., 2015; Longo, Alcaraz-Ibánez & Sicillia, 2018) has shown that the frustration of basic psychological needs negatively impacts different behavioral and emotional outcomes, such as satisfaction with life, subjective vitality, and burnout.

Although BPN satisfaction is well described in the literature, BPN frustration based on the SDT framework has only recently been explored empirically. Bartholomew et al. (2011) developed the Psychological Need Thwarting Scale (PNTS) to analyze only BPN frustration in respondents' first participation in sports. Since this scale displayed good consistency and predictive validity, other authors have also used it (Gunnel et al., 2013; Ng et al., 2013).

These studies showed there is a difference between low levels of BPN satisfaction and high levels of BPN frustration.

Later, Chen et al. (2015) developed the Basic Psychological Need Satisfaction and Frustration Scale (BPNSFS) based on two studies, one with a sample of 324 Chinese adolescents and 359 Belgian adolescents, and another with a sample of 1,051 university students drawn from four nations (298 Americans, 309 Chinese, 200 Dutch, and 244 Peruvians). This multidimensional scale simultaneously assesses both BPN satisfaction and frustration simplifying the applicability process (i.e., one scale assessing all six needs), showing good internal consistency and cultural invariance among participants from all four countries. This scale was successfully translated into Italian with an adult population (Costa et al., 2017) and into Portuguese with a college population (Cordeiro et al., 2016).

## Gender differences in the exercise context

SDT research has assumed that BPN constructs can be applied to human beings universally, with no differences across age, gender and ethnicity (Ryan & Deci, 2000). These needs have seemed to be important predictors of motivational regulations universally. However, few studies have compared BPN satisfaction (and none have compared BPN frustration) between genders in the exercise context. Only Vlachopoulos (2008) demonstrated that male and female exercisers experienced BPN satisfaction similarly. More studies are needed to further our understanding of how male and female exercisers from different cultural backgrounds experience BPN satisfaction and especially BPN frustration.

## Current Research

In this study, we aimed to translate and validate the Basic Psychological Need Satisfaction and Frustration Scale for Portuguese exercisers. In addition, we also sought to analyze nomological validity with behavioral regulations and enjoyment, and to analyze presumed gender invariance. According to the literature, BPN constructs are assumed to be universal in their influence on human motivation (Deci & Ryan, 2000), and several studies have supported this view (e.g., Chen et al., 2015; Teixeira et al., 2012). Although Cordeiro et al., (2016) validated the BPNSFS Portuguese version in college students, their scale was not adapted for, nor applicable to, exercisers. In addition, they did not measure temporal stability or invariance between groups, two important analyses to support instrument validity (Chen, 2008). Ryan (1995) suggested that SDT research should be conducted within specific cultural contexts, and argued that scales validated in one context should not be used in another prior to proper cross-cultural validation. Accordingly, Ryan (1995) called for the development and use of adequate questionnaires developed specifically for each given context. This view was also highlighted by Teixeira et al. (2018) when applying the original BPNSFS English version to 153 Portuguese exercisers. Following good exploratory factor analysis indicators, Teixeira et al. (2018) suggested that this instrument should undergo proper

validation. In addition, considering the difference between BPN satisfaction and frustration constructs, Chen et al. (2015) reported the need for additional evidence in other contexts in order to demonstrate the universal application of this broad tool for assessing both BPN satisfaction and BPN frustration in all human beings. Furthermore, neither nomological validity nor gender invariance has been analyzed among Portuguese respondents. Thus, we examined the psychometric properties of the adapted Portuguese scale in exercise settings, including its reliability, construct-related validity (i.e., convergent and discriminant), and nomological validity with behavioral or motivational regulations and enjoyment. In addition, we used a multi-group analysis to assess measurement invariance according to gender.

# Methods

## Participants

We utilized two independent participant samples in this study. The first sample (calibration sample) was composed of 316 adult Portuguese respondents (145 males, 171 females) who exercised regularly at a gym. They were aged 18-69 years ($M$ = 32.47, $SD$ = 10.41), with exercise experience that ranged from 6-420 months ($M$ = 54.47, $SD$ = 54.70). Their weekly attendance at the gym was between 2-8 times ($M$ = 2.97, $SD$ = 0.98), and their exercise sessions lasted 45-90 minutes ($M$ = 60.21, $SD$ = 17.42). With regard to exercise activities performed, 11% had personal training sessions, 34.4% were engaged in recreational bodybuilding and 54.6% attended fitness group classes. The second sample (validation sample) was composed of 642 Portuguese adults attending a gym or an academy (287 males, 345 females), aged 18-73 years ($M$ = 34.10, $SD$ = 11.57) with exercise experience ranging from 6-480 months ($M$ = 68.41, $SD$ = 48.91). Their weekly exercise frequency was between 2-8 times ($M$ = 3.52, $SD$ = 1.29), and their exercise sessions lasted 45-90 minutes ($M$ = 62.93, $SD$ = 16.14). With regard to exercise activities performed, 9.8% had personal training sessions, 46.2% were engaged in recreational bodybuilding and 44.0% attended group classes. The inclusion criterion for this study were: (a) aged older than 18 years, (b) registered in Portuguese gyms or academies for at least 6 months, and (c) regular exercise (≥ 2 times per week).

## Measures

Participants completed the BPNSFS (Chen et al., 2015), translated into Portuguese (see below). This scale assesses the respondent's perceived BPN satisfaction or frustration. It is multidimensional and is divided into six factors: autonomy satisfaction, competence satisfaction, relatedness, autonomy frustration, competence frustration, and relatedness frustration. The scale is composed of 24 items, four for each construct. For its validation in

the exercise context, see the translation procedures described below. The participants indicated their agreement to each item through a 5-point Likert-type scale with response choices that that varied between 1 (totally disagree) and 5 (totally agree). Previous studies support the use of this scale (Chen et al., 2015; Teixeira et al., 2018). Internal consistency coefficients are reported in Table 2.

To translate and adapt the BPNFS from its original language (English) into Portuguese in the exercise context, we followed methodological procedures suggested by Vallerand (1989) and recommended by Banville et al., (2000) except that we chose not to use the technical translation/back translation technique (see Brislin, 1970) proposed by Vallerand (1989). Instead, we applied the committee approach translation methodology (see Brislin, 1980).

Therefore, we used a five-step process as follows:

(a) Preliminary Translation in which we designed the first version of the questionnaire and had three experts with higher education in English-Portuguese languages translate it;

(b) First Evaluation Panel in which an analysis of this initial Portuguese version was reviewed by four specialists, each from different fields of scientific expertise (English-Portuguese teacher, Psychologist, Sports Psychologist, Researcher in sport science) to generate a second version of the questionnaire that incorporated their suggested modifications;

(c) Second Evaluation Panel in which this second Portuguese version of the questionnaire was evaluated by a different panel composed of four other specialists (Psychologist, Sports Psychologist, Researcher in sports sciences) who, together with the first panel of experts came to a consensual judgment of the content of a new version third version. (In this stage, the items of each construct of the scale were already translated and adapted to Portuguese exercisers)

(d) Pilot Study in which the third version of the questionnaire was administered to 40 bilingual college students with exercise experience for testing English/Portuguese semantic and comprehension, resulting in a fourth version; and

(e) Final revision in which two Portuguese teachers reviewed the fourth version for syntax, spelling, and grammar and produced the fifth and final version.

Behavioral Regulation Exercise Questionnaire. We used the Portuguese version of the Behavioral Regulation Exercise Questionnaire-3 (BREQ-3; Cid et al., 2018) to evaluate exercisers' motivational regulations. This questionnaire has 18 items grouped into six factors: amotivation, external regulation, introjected regulation, identified regulation, integrated regulation and intrinsic motivation, based on SDT (Deci & Ryan, 2000). Using a 5-point Likert scale ranging from 0 (totally disagree) and 4 (totally agree), participants were asked to indicate their agreement to each statement. Recent studies have supported reliability and validity of the BREQ3 in a Portuguese exercise context (Cid et al., 2018). Internal consistency ranged from 0.71 to 0.84 in calibration sample, and 0.73 to 0.86 in validation sample.

Physical Activity Enjoyment Scale (PACES). Participants completed the Portuguese version of the PACES (Teques, Calmeiro, Silva, & Borrego, 2017). This questionnaire assesses enjoyment when exercising, through eight items which participants responded to using a Likert-scale ranging from 1 (totally disagree) to 7 (totally agree). Psychometric tests from previous studies in exercise (Teques et al., 2017) and Sport (Monteiro et al., 2017) support the use of present scale. Internal consistency ranged from 0.92 in validation sample to 0.94 in calibration sample.

## Procedure: data collection

The study protocol was approved by the university ethics committee. We recruited the two samples from different gyms in order to evaluate the reliability of the test. We first contacted the technical directors of several gyms in Portugal and explained the objectives of the study, acquiring their approval to proceed. All exercisers were then contacted directly during different time periods; and all of them gave their informed written consent to participate in this study before completing the questionnaire. Time taken to complete the questionnaire was approximately 15 minutes. Twelve months after collecting data from the calibration sample, we collected data from the validation sample, obtaining their consent to participate in the same fashion as described above.

One approach to addressing problems associated with model fitting is to perform a cross-validation strategy, whereby the final model derived from post hoc analyses is tested on a second sample from the same population. As such, in this study the first sample represented a group on which we calibrated the initially hypothesized model and conducted post hoc analyses to attain a well-fitting model. Once this final model was determined, we tested the validity of its structure with participants in the second sample. The data collection period for both the calibration and validation sample was over six months.

## Statistical analysis

We performed a preliminary analysis of the data in order to verify data distribution normality and assess for missing values, and outliers. We performed test-retest analysis in order to test reliability prior to conducting a confirmatory factor analysis (CFA). We used Pearson's *r* coefficient in order to determine test-rest reliability of participants' responses to the BPNSFS. For evaluating test-retest reliability, as recommended by Vallerand (1989) and Banville et al. (2000), 40 Portuguese exercisers were considered, based on several guidelines recommending a minimum of 30 participants for this analysis (e.g., Hill & Hill, 2008). Based on probability theory, a sample size of N = 30 approximates a normal distribution and therefore is considered acceptable and recommended for this type of test (Hair et al., 2019). Although time between survey administrations in past research was not uniform and ranged from 1-4 weeks (Banville et al., 2000; Vallerand, 1989), the interval in this study was four weeks.

Subsequently, to assess data fit (i.e., factorial validity), we performed a CFA using AMOS 23.0. We assumed a 10:1 ratio (i.e., ten subjects for each parameter to be estimated), as suggested by Kline (2016) and used a Maximum Likelihood (ML) method and measurement model adequacy verified by the traditional absolute and incremental indices of Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), Standard Mean Root Square Residual (SRMR), and Root Mean Square Error of Approximation (RMSEA), with a confidence interval of 90%. For these indices, we used cut-off values suggested by several authors (e.g., Byrne, 2010; Hair, Black, Babin, & Anderson, 2014; Marsh, Hau, & Wen, 2004). Specifically, we used CFI and TLI ≥ 0.90, SRMR ≤ 0.8 and RMSEA ≤ 0.8. We analyzed internal consistency through composite reliability and calculated it by Raykov's formula (1997), adopting .70 as the cut-off value (Hair et al., 2014). We calculated Average Variance Extracted (AVE) to evaluate convergent validity, and we defined values >.50 as the cut-off for acceptability. Discriminant validity was achieved when construct AVE values were larger than the squared correlations across constructs of the measurement model (Hair et al., 2014).

Nomological validity. We evaluated correlations (*r*) to assess relationships among all study variables and to determine nomological validity with the motivational regulations via BREQ-3 (Cid et al., 2018) and enjoyment via PACES (Teques et al., 2017).

Multigroup analysis. Multigroup analysis enables assessment of the equivalence of the measurement model between groups with different characteristics (Sass, 2011). Several authors have described the importance of measurement invariance testing between groups (Cheung & Rensvold, 2002) in order to determine whether certain measurements can be applied to different groups with different characteristics. Therefore, we performed multi-

group analysis between samples and gender, according to several authors' recommendations (Byrne, 2010; Cheung & Rensvold, 2002). Specifically, prior guidelines were that: (a) the measurement model should represent a good fit in each of the groups, and (b) there should be configural, metric, scalar and residual invariance. Thus, according to some authors (e.g., Byrne, 2010; Cheung & Rensvold, 2002), residual invariance is optional since it is very difficult to achieve, especially in the field of social sciences as is the case in the exercise context. We verified invariance assumptions through CFI differences (ΔCFI≤.01), in line with recommendations by Cheung and Rensvold (2002). We evaluated invariance models using recommendations (e.g., Chen, 2007), as follows: (a) for metric invariance, we used a change in SRMR (ΔSRMR) of less than .030, and a change in RMSEA (ΔRMSEA) of less than .015 as support for model fit; and (b) for scalar invariance, we used a change in SRMR (ΔSRMR) of less than .010 and a change in RMSEA (ΔRMSEA) of less than .015 as an indication of good invariance.

Latent mean differences analysis. There are two types of measurement invariance (Sass, 2011): (a) one based on an analysis of the psychometric properties of the scale, including its configural, metric, scalar, and residual invariance; and (b) one based on an examination of group differences in variance, covariance and latent means.

According to several authors (e.g., Kline, 2016; Sass, 2011) a comparison across latent means can only be done after obtaining acceptable measurement (or psychometric property) invariance. In other words, latent means are created from the factor loadings and intercepts to ensure that it is possible to compare constructs (Meredith, 1993). These two types of measurement invariance are crucial in order to test if the scale is invariant between groups, and to understand how the constructs interact between the different groups. We used mean and covariance structure analyses to test for latent mean differences across each need satisfaction and frustration construct between samples and genders. Latent mean values for the calibration sample and male sample were always constrained to zero, while it was freely estimated for the validation sample and female sample. The *Z* statistic was used to determine statistical significance between latent means. We calculated Cohen's *d* criteria (1988) to obtain the correspondent effect size, following Kline's (2016) recommendations. We evaluated effect sizes as follows: (a) trivial (0-0.19); (b) small (0.20-0.49), (c) average (0.50-0.79) and (d) large (greater than or equal to 0.80), as suggested by Cohen (1992).

# Results

## Preliminary analysis

Missing values were less than 0.1% and six cases were identified as univariate outliers ($z$ > 3.00) and multivariate outliers ($D^2$ = $p1$ < .001, $p2$ < .001). The data was imputed using

regression procedures of AMOS, and non-responders were excluded ($n$ = 10). Descriptive analysis revealed no violations of the univariate distribution since skewness and kurtosis were contained between -2 and +2, and -7 and +7, at a 95% confidence interval. However, the Mardia coefficient in calibration (240.627), validation (237.55), male (140.145), and female (184.359) exceeded the expected value for multivariate normality (Byrne, 2010). Thus, following recommendations of several authors (Hair et al., 2019; Nevitt & Hancock, 2001), we used a Bollen-Stine Bootstrap of 2,000 samples for the subsequent analysis.

### Test-retest analysis

Correlations from responses given to each item in the first and second administrations of the questionnaire ranged from .77 (Item 4) to .87 (Item 2) as seen in Table 2.1. Thus, there were acceptable test-rests correlations (>0.70), indicating that the BPNSFS had a high degree of temporal reliability.

### Construct validity

Results from CFA supported the original six-factor model by Chen et al. (2015) in both the calibration sample [$\chi2(237) = 471.814$, $\chi2/df= 1.99$; B-S $p < .001$, CFI = .935, TLI = .924, SRMR= .047, RMSEA = .057 (CI90% = .050, .065)] and the validation sample [$\chi2(237) = 571.796$, $\chi2/df= 2.41$; B-S $p < .001$, CFI = .948, TLI = .940, SRMR= .038, RMSEA = .047 (CI90% = .042, .052)]. Factor loadings of individual items ranged from .46 (autonomy support) to .83 (competence satisfaction) in the validation sample, as shown in Figure 2.1.

Table 2.2 shows the descriptive analysis (mean and standard deviation) of the BPNSFS constructs, as well as results regarding reliability, convergent and discriminant validity analysis in both samples. All constructs showed acceptable adjusted levels of internal consistency (CR >.70).

### Nomological validity

Table 2.3 shows correlations between basic psychological needs satisfaction and basic psychological needs frustration with behavioral regulations and enjoyment in validation sample. Moderate positive associations were evident between satisfaction of BPN's and the more autonomous forms of motivation (i.e., identified, integrated and intrinsic regulation) and enjoyment. Conversely, frustration of BPN's exhibited negative and significant associations with more autonomous forms of motivation, as well as enjoyment Amotivation was significantly positively correlated with frustration of BPN's and significantly negatively correlated with satisfaction of BPN's and enjoyment. Enjoyment showed a moderate positive association with more autonomous forms of motivation and a negative association with more controlled forms of motivation and amotivation.

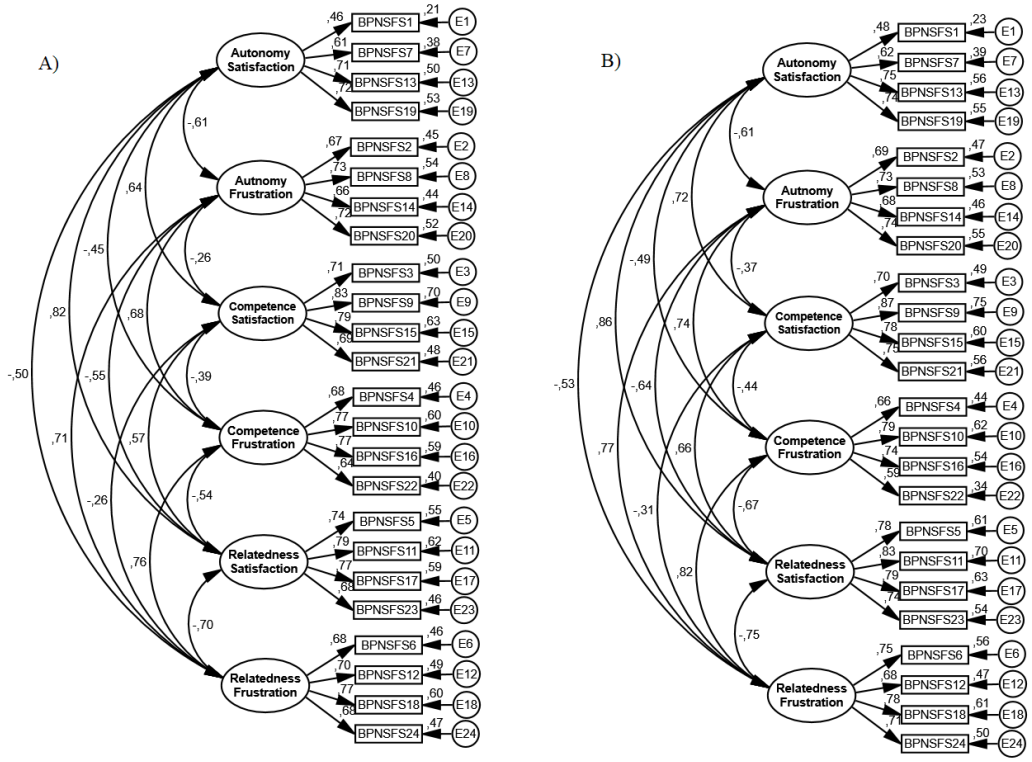



Figure 2. 1 - Standardized model of BPNSFS-E in calibration sample A) and validation sample B)

## Multigroup analysis

Multi-group analysis revealed that the measurement model was invariant between samples and gender, based on recommended criteria that: (a) the measurement model fit was achieved for each group, including both genders: male [$\chi2(237) = 437.126$, $\chi2/df= 1.84$; B-S p = .006, CFI = .935, TLI = .924, SRMR= .048, RMSEA = .054 (CI90% = .046, .056); female [$\chi2(237) = 454.566$, $\chi2/df= 1.91$; B-S p = .003, CFI = .939, TLI = .929, SRMR= .043, RMSEA = .052 (CI90% = .044, .059); (b) invariance variables (configural, metric, and scalar) were confirmed (see Table 2.4).

## Latent mean differences between male and female exercisers

Results related to latent mean differences analysis between samples and genders regarding BPN's satisfaction and frustration constructs are shown in Table 2.5. There were no differences between samples and gender, except that the relatedness-frustration construct differed between male and female exercisers ($z$=2.28; $p$=.023; $d$=.01).

**Table 2. 1** – Test-retest reliability analysis

| Items | M±SD | *r* | *p* | Alpha |
|---|---|---|---|---|
| Item 1 Pre-Post | 3.99±1.01 - 4.06±1.02 | .80 | <.001 | |
| Item 2 Pre-Post | 1.81±.989 - 1.57±.753 | .87 | <.001 | |
| Item 3 Pre-Post | 4.04±.943 - 3.97±.816 | .80 | <.001 | |
| Item 4 Pre-Post | 1.39±.658 - 1.44±.694 | .77 | <.001 | |
| Item 5 Pre-Post | 4.39±.679 -4.37±.705 | .84 | <.001 | |
| Item 6 Pre-Post | 2.00±1.04 -1.91±1.01 | .83 | <.001 | |
| Item 7 Pre-Post | 3.92±.933 -4.19±.786 | .84 | <.001 | |
| Item 8 Pre-Post | 1.86±1.05 - 1.76±1.05 | .80 | <.001 | |
| Item 9 Pre-Post | 4.09±1.02 - 4.03±1.02 | .79 | <.001 | |
| Item 10 Pre-Post | 1.51±.864 - 1.53±.812 | .72 | <.001 | |
| Item 11 Pre-Post | 4.28±.803 - 4.27±.779 | .83 | <.001 | |
| Item 12 Pre-Post | 2.12±1.02 - 2.19±1.12 | .87 | <.001 | |
| Item 13 Pre-Post | 3.97±.950 - 3.91±.880 | .75 | <.001 | |
| Item 14 Pre-Post | 2.01±.929 - 1.83±.851 | .71 | <.001 | |
| Item 15 Pre-Post | 4.07±1.05 - 4.00±1.03 | .88 | <.001 | |
| Item 16 Pre-Post | 1.39±.699 - 1.30±.682 | .73 | <.001 | |
| Item 17 Pre-Post | 4.24±.873 - 4.26±.863 | .84 | <.001 | |
| Item 18 Pre-Post | 1.88±.979 - 1.84±.942 | .71 | <.001 | |
| Item 19 Pre-Post | 3.99±.929 - 4.06±.883 | .81 | <.001 | |
| Item 20 Pre-Post | 1.64±.930 - 1.54±.863 | .77 | <.001 | |
| Item 21 Pre-Post | 3.95±.935 - 3.70±1.04 | .79 | <.001 | |
| Item 22 Pre-Post | 1.69±.920 - 1.80±.894 | .86 | <.001 | |
| Item 23 Pre-Post | 4.04±.784 -4.06±.796 | .84 | <.001 | |
| Item 24 Pre-Post | 1.49±.798 - 1.37±.685 | .72 | <.001 | |
| Autonomy Satisfaction Pre-Post | 3.97±.721 - 4.05±.684 | .88 | <.001 | 0.73 - 0.74 |
| Competence Satisfaction Pre-Post | 1.83±.808 - 1.68±.701 | .79 | <.001 | 0.71 - 0.71 |
| Relatedness Satisfaction Pre-Post | 4.04±.842 - 3.92±.836 | .86 | <.001 | 0.78 - 0.77 |
| Autonomy Frustration Pre-Post | 1.49±.652 - 1.53±.625 | .85 | <.001 | 0.81 - 0.82 |
| Competence Frustration Pre-Post | 4.23±.652 - 4.24±.636 | .77 | <.001 | 0.75 - 0.74 |
| Relatedness Frustration Pre-Post | 1.87±.794 - 1.83±.748 | .73 | <.001 | 0.76 - 0.76 |

**Table 2. 2** - Mean, Standard Deviations, Composite Reliability, Average Variance Extracted, and squared correlations

| | | | | | $r^2$ | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Mean** | **SD** | **CR** | **AVE** | **1** | **2** | **3** | **4** | **5** | **6** |
| *Calibration Sample* | | | | | | | | | | |
| 1. Autonomy Satisfaction | 4.12 | .61 | .75 | .43 | 1 | | | | | |
| 2. Autonomy Frustration | 1.72 | .69 | .83 | .50 | .37 | 1 | | | | |
| 3. Competence Satisfaction | 4.09 | .71 | .86 | .59 | .52 | .13 | 1 | | | |
| 4. Competence Frustration | 1.56 | .59 | .79 | .49 | .24 | .45 | .19 | 1 | | |
| 5. Relatedness Satisfaction | 4.31 | .57 | .86 | .62 | .74 | .41 | .44 | .45 | 1 | |
| 6. Relatedness Frustration | 1.82 | .75 | .82 | .53 | .28 | .50 | .10 | .67 | .56 | 1 |
| *Validation Sample* | | | | | | | | | | |
| 1. Autonomy Satisfaction | 4.03 | .58 | .72 | .41 | 1 | | | | | |
| 2. Autonomy Frustration | 1.8 | .72 | .79 | .49 | .36 | 1 | | | | |
| 3. Competence Satisfaction | 4.01 | .69 | .84 | .58 | .4 | .07 | 1 | | | |
| 4. Competence Frustration | 1.59 | .61 | .81 | .51 | .19 | .46 | .14 | 1 | | |
| 5. Relatedness Satisfaction | 4.25 | .53 | .83 | .56 | .67 | .29 | .31 | .28 | 1 | |
| 6. Relatedness Frustration | 1.89 | .73 | .80 | .51 | .24 | .49 | .06 | .58 | .48 | 1 |

**Table 2. 3** - Mean, Standard Deviations, Range and correlations between study variables

| | | | | *r* | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Factors** | **Mean** | **SD** | **Range** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** |
| 1. Autonomy Satisfaction | 4.03 | .58 | 1-5 | 1 | | | | | | | | | | | | |
| 2. Autonomy Frustration | 1.8 | .72 | 1-5 | -.459** | 1 | | | | | | | | | | | |
| 3. Competence Satisfaction | 4.01 | .69 | 1-5 | .517** | -.219** | 1 | | | | | | | | | | |
| 4. Competence Frustration | 1.59 | .61 | 1-5 | -.329** | .544** | -.342** | 1 | | | | | | | | | |
| 5. Relatedness Satisfaction | 4.25 | .53 | 1-5 | .643** | -.453** | .489** | -.439** | 1 | | | | | | | | |
| 6. Relatedness Frustration | 1.89 | .73 | 1-5 | -.369** | .570** | -.226** | .614** | -.574** | 1 | | | | | | | |
| 7. Amotivation | .31 | .52 | 0-4 | -.215** | .457** | -.188** | .540** | -.340** | .432** | 1 | | | | | | |
| 8. External Regulation | .86 | .80 | 0-4 | -.164** | .427** | -.004 | .343** | -.257** | .389** | .476** | 1 | | | | | |
| 9. Introjected Regulation | 1.87 | .90 | 0-4 | -.030 | .244** | -.001 | .200** | -.106** | .276** | .096* | .298** | 1 | | | | |
| 10. Identified Regulation | 3.27 | .52 | 0-4 | .208** | -.152** | .213** | -.165** | .242** | -.097* | -.320** | -.046 | .414** | 1 | | | |
| 11. Integrated Regulation | 3.18 | .66 | 0-4 | .418** | -.388** | .263** | -.266** | .421** | -.278** | -.371** | -.244** | .231** | .584** | 1 | | |
| 12. Intrinsic Regulation | 3.43 | .57 | 0-4 | .426** | -.444** | .292** | -.301** | .494** | -.316** | -.409** | -.256** | .083* | .481** | .700** | 1 | |
| 13. Enjoyment | 5.44 | 1.11 | 2-7 | .575** | -.181** | .678** | -.283** | .111* | -.274** | -.356** | -.448** | .226** | .274* | .398** | .341** | 1 |

**Table 2. 4** - Invariance analysis in BPNSFS-E between samples groups and gender

| | x2 | df | *x2/df* | Δx2 | Δdf | *p* | CFI | ΔCFI | RMSEA | ΔRMSEA | SRMR | ΔSRMR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Calibration – Validation* | | | | | | | | | | | | |
| Configural Invariance | 996.356 | 474 | 2.102 | - | - | - | .942 | - | .036 | - | .0522 | - |
| Metric Invariance | 1006.601 | 492 | 2.046 | 10.245 | 18 | <.001 | .943 | .001 | .035 | .001 | .0521 | .001 |
| Structural Invariance | 1015.734 | 513 | 1.980 | 19.378 | 39 | <.001 | .944 | .002 | .034 | .002 | .0529 | .007 |
| Residual Invariance | 1030.613 | 537 | 1.919 | 34.257 | 63 | <.001 | .945 | .003 | .033 | .003 | .0531 | .009 |
| *Male – Female* | | | | | | | | | | | | |
| Configural Invariance | 891.711 | 474 | 1.88 | - | - | - | 0.937 | - | .037 | - | .0481 | - |
| Metric Invariance | 917.459 | 492 | 1.86 | 25.748 | 18 | .106 | 0.936 | .001 | .037 | .000 | .0490 | .009 |
| Structural Invariance | 1030.771 | 513 | 2.01 | 139.059 | 39 | <0.001 | 0.927 | .01 | .040 | .003 | .0581 | .010 |
| Residual Invariance | 1093.191 | 537 | 2.03 | 201.48 | 63 | <0.001 | 0.916 | .021 | .041 | .004 | .0652 | .017 |

Note: $x^2$ = chi-square; df = degrees of freedom; $\Delta x^2$ = differences in the value of chi-squared; Δdf = differences in the degrees of freedom; CFI = Comparative Fit Index; ΔCFI = differences in the value of the Comparative Fit Index; CI = configural invariance; MI = measurement invariance; SI = scale invariance; RI = residual invariance

**Table 2. 5** - Latent mean differences between sample and gender on basic needs constructs

| | difference | *z* | *p* | *d* |
|---|---|---|---|---|
| Calibration - Validation | | | | |
| Autonomy Satisfaction | .092 | 1.184 | .237 | .013 |
| Competence Satisfaction | .033 | .308 | .758 | .007 |
| Relatedness Satisfaction | .076 | 1.308 | .191 | .005 |
| Autonomy Frustration | .011 | .210 | .834 | .022 |
| Competence Frustration | .004 | .054 | .957 | .011 |
| Relatedness Frustration | .084 | 1.167 | .243 | .029 |
| Male - Female | | | | |
| Autonomy Satisfaction | -.01 | -.30 | .764 | .151 |
| Competence Satisfaction | -.06 | -1.15 | .250 | .130 |
| Relatedness Satisfaction | -.10 | 1.96 | .051 | .020 |
| Autonomy Frustration | -.02 | -.42 | .677 | .132 |
| Competence Frustration | -.08 | -1.89 | .059 | .033 |
| Relatedness Frustration | .13 | 2.28 | .023* | .014 |

Note: * $p<0.05$

## Discussion

This study aimed to translate the BPNSFS into Portuguese and validate it in an exercise context (BPNSFS-E). In addition, we tested the instrument's nomological validity with behavioral regulations and enjoyment and showed significant relationships between these constructs, based on SDT (Deci & Ryan, 1985). Finally, we tested the measurement analysis between global adjustment and latent mean differences between our two samples and males and females. Our results suggest that the original BPNSFS measurement model for the six-factor solution measuring all six types of basic psychological needs according to the SDT framework did fit well the Portuguese version in both samples and in male and female exercisers.

### Factorial validity of the new BPNSFS-E in CFA

Our first step was to develop the Portuguese version of the BPNSFS and analyze its dimensionality and validity. A CFA performed on the 24-item scale on both samples extracted six correlated but distinct factors, assessing satisfaction and frustration of the three basic psychological needs. These results were expected, since other studies in other languages using this scale have found similar outcomes (e.g., Chen et al., 2015; Nishimura & Suzuki, 2016). Our results confirmed that all factors were internally consistent, since values of composite reliability were > 0.70 (Hair et al., 2014), ranging from 0.71 to 0.84.

AVE values indicated that convergent validity of autonomy satisfaction was somewhat below the suggested <.50 level (Hair et al., 2014), but the construct was retained to ensure the complete theory could be tested. Thus, we cautiously interpreted the findings for this construct. Other studies using this scale also identified convergence validity problems with this factor (Chen et al., 2015, Nishimura & Suzuki, 2016). Chen et al. (2015) found convergent validity problems in four of the six factors (i.e., autonomy frustration, competence satisfaction, competence frustration, and relatedness frustration), and Nishimura and Suzuki (2016) found problems in all but the competence frustration factor. These past data would suggest that items regarding Autonomy Satisfaction do not function as intended, but, in our study, all factorial weights were significant in their respective factors with no cross-loadings detected, suggesting good convergent validity (Byrne, 2010; Hair et al., 2014).

We examined and confirmed discriminant validity for 13 of 15 possible comparisons. In our study, satisfaction of each need was negatively correlated with the need's frustration. Similarly, covariance among satisfaction factors was positive and significant. We also similarly verified frustration factors. These analyses suggest that these needs are distinguishable (Hair et al., 2014). Moreover, according to SDT as proposed by Deci and

Ryan (2017), these constructs are indeed different: "*each (need) is independently important, … In addition, SDT sees these three basic needs as interdependent*." (p. 248). As stressed by these authors, *"…needs vary independently (e.g., one feels incompetent while performing a valued activity), SDT expects that the three needs will tend to be highly intercorrelated, especially in measurements that aggregate satisfaction or frustration experience in a domain…*" (p. 249).

According to our analysis, only one item had a factor loading below .50 (autonomy satisfaction) in both samples. In line with suggestions made by Hair et al. (2014), factor loadings below cut-off values should be considered for elimination. But this suggestion was only a guideline (Hair et al., 2014). Other considerations are that this item enhances content validity, removing the item does not improve model fit, and the overall measurement model exhibits good fit. Therefore, we retained item 1 so the scale would remain as close as possible to the original version. Overall, with respect to the model, our results show satisfactory fit (Byrne e al., 2010; Hair et al., 2014; Marsh et al., 2004). Other studies analyzing the psychometric proprieties of BPNSFS (Chen et al., 2015; Costa et al., 2017; Longo, Acabaraz-Ibáñez, & Sicilia, 2018; Nishimura & Suzuki, 2016) found similar outcomes. These results demonstrate that the scale is applicable in a different culture and context from its original development.

### Nomological Validity

Our results showed nomological validity between BPN's satisfaction and frustration, as well as between different forms of motivational regulation. BPN satisfaction exhibited positive associations with more autonomous forms of motivation and negative associations with the more controlled forms of motivation. This evidence is in line with other studies both in exercise (Murcia et al., 2008) and sport (Monteiro et al., 2018). Moreover, BPN's frustration was positively associated with more controlled regulations and negatively associated with more autonomous forms of motivation. Results showed significant positive and negative correlations between amotivation and BPN's frustration and satisfaction, respectively. These results are consistent with SDT conceptualizations (Ryan & Deci, 2017) and other empirical studies (Teixeira et al., 2018; Rocchi & Pelletier, 2017). Considering all BPN under analysis, relatedness satisfaction had the strongest and most significant correlation with intrinsic motivation ($r$=.494), showing that individuals do not always prioritize autonomy satisfaction within the exercise context, but rather may be particularly motivated by positive social interactions and a sense of belonging (Rodrigues et al., 2018; Ryan & Deci, 2017).

The BPNSFS-E also revealed adjusted nomological validity with enjoyment. As enjoyment and BPN satisfaction had a significant positive association, and enjoyment and BPN

frustration had a significant negative association. These results are in line with SDT conceptualizations, since BPN satisfactions are theorized to be the basis for more autonomous motivation, namely intrinsic motivation. In contrast, BPN frustrations are said to be related to controlled forms of motivation (external and introjected regulations) as well as amotivation (Ryan & Deci, 2017). Several studies in different domains, such as exercise (Murcia et al., 2008), physical education (Schneider & Kwan, 2013), work (Ding, Babenko, Koppula, Oswald, & White) and sport (Rocchi & Pelletier, 2017) have also empirically supported this theory. As noted, our results show significant positive correlation between more autonomous forms of motivation, and a significant negative correlation with enjoyment. Specifically, the highest identified correlations between behavioral regulations and enjoyment was integrated regulation ($r$ = .398) and intrinsic motivation ($r$ = .576), meaning that when individuals feel the value of exercise, they self-perceive higher levels of enjoyment. According to SDT, the high correlational pattern found between intrinsic motivation and enjoyment is because intrinsic motivation itself represents inherent enjoyment in the practice of a certain activity (Deci & Ryan, 2000).

## Measurement Invariance

With respect to measurement invariance between our two samples and between males and females, our results support the equivalence of BPNSFS-E across these populations, since all invariance assumptions were met (Byrne, 2010; Chen, 2007; Cheung & Rensvold, 2002). Regardless of sample or gender, all factors of the BNSFS-E had the same number items (configural invariance) and all factorial weights were invariant between male and female exercisers. This demonstrates metric invariance and scalar invariance. A previous study (Sass, 2011) affirmed scalar invariance of the measurement model, supporting comparisons among different groups, even though residual invariance was not met. Hair et al. (2014) noted that higher levels of invariance are seldom achieved and recommended moving ahead when configural and metric invariance are confirmed, as was the case in this study. Therefore, our data confirmed the applicability of BPNSFS-E between gym samples and between male and female Portuguese exercisers.

## Latent mean differences

Our study found no significant differences in terms of latent means between genders, except for relatedness frustration. No previous study has analyzed BPN satisfaction and frustration latent mean differences between genders in an exercise context. Vlachopoulos et al. (2013) compared means of respondents from four different countries (e.g., Portugal, Greece, Spain, and Turkey) in the exercise context and found differences between them such that those from Western countries (Portugal and Spain) were likely to value more interdependence and less social interactions, but these differences did not suggest validity

issues in applying the instrument. Our finding of differences in relatedness frustration between male and female exercisers suggests that female exercisers (relative to male exercisers) may derive more support from the social context (e.g., exercise professionals) and then feel less frustrated. This proposition needs to be further tested, however, to better understand the influence of interpersonal behaviors on exercise motivation (Rocchi, Pelletier, Cheung, Baxter, & Beaudry, 2017). Of importance, all magnitude effects were trivial in this comparison, showing that that variance was minimal between male and female BPN satisfaction and frustration experiences.

## Limitations

Our study has several limitations. First, this research was limited to Portuguese exercisers, and findings cannot be easily generalized to other countries. Second, our study was cross-sectional, and longitudinal research would better address assessments of time invariance in the exercise context. We believe it is possible that BPN satisfaction and frustration might fluctuate over time in the exercisers' experiences (e.g., weeks, months, years), since individuals may experience activities differently on daily basis (Cordeiro et al., 2016). Future research should aim to address this gap. Third, although we found solid relationships between BPN satisfaction and more autonomous regulations and enjoyment, and between BPN frustration and more controlled forms of motivation, there are links in the theoretical framework of SDT that should be investigated further. Future research should examine the relationship between basic psychological need satisfaction and frustration within the social context, and how supportive or thwarting social behaviors may influence the exercisers' experience, perhaps particularly for female exercisers. Several studies in other contexts (e.g., Rocchi et al., 2017) report that supportive social behaviors may lead to BPN satisfaction and thwarting social behaviors to need frustration. Therefore, this relationship needs to be tested for context invariance.

Overall, our results support the factorial and construct validity of the BPNSFS-E, providing new evidence for construct distinctiveness of BPN satisfaction versus frustration, in line with the theoretical framework of SDT. The present work reinforced the importance of analyzing satisfaction and frustration as distinct factors, affirms that satisfaction is correlated to more autonomous forms of motivation, and that frustration of BPN's are more related to controlled forms of motivation. Finally, our study demonstrated that this scale is reliable in measuring BPN's satisfaction and frustration of Portuguese male and female exercisers.

# Chapter 4

# Assessing need satisfaction and frustration in Portuguese exercise instructors: scale validity, reliability and invariance between gender


## Abstract

The aim of the present study was to validate the Basic Psychological Need Satisfaction and Frustration Scale in Exercise for fitness instructors. Data from 477 exercise professionals (319 males, 158 females) was collected. CFA supported the adapted and validated six-factor model: [$\chi 2(237) = 1096.796$, $\chi 2/df = 4.63$; B-S $p < .001$, CFI = .930, TLI = .918, SRMR= .0366, RMSEA = .079 (CI90% = .069, .089)], assessing satisfaction and frustration of basic psychological needs in Portuguese exercise professionals. Moreover, the analysis revealed acceptable composite reliability, and construct validity of the adapted version. Results revealed nomological validity, as well as invariance between male and female. No differences were found across latent means, and magnitude effects were trivial between gender. These results support the use of the adapted scale in exercise professionals, showing measurement invariance between gender. This scale is able to measure how exercise professionals experience satisfaction and frustration of basic needs when prescribing exercise to individuals in fitness context.



**Key-words:** Self-Determination Theory; exercise; basic needs; interpersonal behaviors; exercise instructors.

# Introduction

Previous research has shown that when exercisers experience Basic Psychological Need (BPN) satisfaction, they are more likely to maintain the behavior (i.e., physical exercise practice) itself longer (Teixeira et al., 2012). However, to date, most of the research has only given attention to exercisers and has not taken into contemplation how exercise instructors experience satisfaction and frustration of BPN when interacting with gym practitioners (Edmunds, Ntoumanis, & Duda, 2007). Since exercise professionals play an important role in adherence to regular exercise practice (Rodrigues et al., 2018) researchers should analyze exercise instructors' BPN experience. Till date, there has been no attempt in creating or validating a scale that measures BPN in fitness instructors. Therefore, in order to fill the gap in literature, we intend to validate a scale that taps into satisfaction and frustration of basic needs in exercise fitness instructors.

## Self-Determination Theory and Basic Psychological Needs

Our study was grounded on the theoretical framework of Self-Determination Theory (SDT), since it explains how humans act as active beings in order to satisfy their BPN (Ryan & Deci, 2017). In other words, satisfaction of the BPN is related to positive outcomes such as well-being, enjoyment), healthy eating in children (Girelli, Manganelli, Alivernini, & Lucidi, 2016), more self-determined motivation (Pardo, Castrillón, Pedreño, & Moreno-Murcia, 2014), and contributes efficient functioning of individuals behaviors (Chen et al., 2015). In exercise context, several authors have shown that exercisers who feel that their BPN are being satisfied, entail positive consequences, such as well-being (Teixeira, Marques, & Palmeira, 2018) and adherence (Rodrigues et al., 2018). In addition, results shown that perceived supporting interpersonal behaviors from peers (e.g., exercise professionals) are related to BPN satisfaction (Hernández, Mora, & Rodríguez, 2018; Marholz, 2017; Silva et al., 2011). Thus, despite our search, few (or none) studies have analyzed BPN in exercise professionals when interacting with fitness exercisers.

According to SDT, there are three BPN: autonomy (i.e., the need to control his/her own behavior); competence (i.e., feeling efficient and skilled to advance and master new abilities), and; relatedness (i.e., person's need to interact emotionally with others). BPN satisfaction bears several positive outcomes, namely by contributing to physical and psychological development (Deci & Ryan, 2000).

On the other hand, individuals may also perceive BPN frustration. Frustration of autonomy involves the experience of controlled behavior derived from self-imposed pressures. Competence Frustration refers to the feeling of self-doubt in one's own capacity.

Relatedness Frustration is associated with feelings of loneliness and social exclusion from others (Chen et al., 2015).

It is worth to mention that BPN satisfaction and frustration are two distinct constructs (Ryan & Deci, 2017; Teixeira, Marques, & Palmeira, 2018). Differences between needs' satisfaction and frustration may be the result of how the social environment interacts with the individual, and how the person experiences those behaviors. Rocchi and Pelletier (2018) found positive associations with BPN satisfaction and supporting behaviors, and with BPN frustration and thwarting interpersonal behaviors in sport coaches. Other authors found similar results, where autonomy support was related to BPN satisfaction (Balaguer, Castillo, Duda, 2008; Cantú-Berrueto et al., 2016; Pulido, Leo, Chamorro, & García-Calvo, 2015). In exercise context, we hypothesize that exercise professionals experience of satisfaction will be related to increase supporting style when interacting with exercisers. However, this needs to be tested in exercise context, with fitness instructors in order to avoid biased conclusions.

## Gender differences in the exercise context

According to SDT, BPN constructs are hypothesized to be universal, implying that there are no differences across age, gender and ethnicity (Ryan & Deci, 2017). In addition, BPN satisfaction and frustration are important predictors in how individuals regulate their own motivation (Teixeira et al., 2018). However, according to our research, there are few studies who have analyzed measurement invariance between gender or other characteristic (e.g., age, cultural background) of the BPN constructs in exercise context. In addition, several studies found convergent results in measuring satisfaction of BPN. Rodrigues et al. (2018) found only differences in relatedness frustration between male and female exercisers. Other studies (e.g., Vlachopoulos, 2008) demonstrated that male and female exercisers experience BPN's satisfaction similarly. Therefore, more studies are needed since no study has ever tested BPN constructs in exercise professionals. In addition, a gap remains in the literature on how male and female fitness instructors experience BPN's satisfaction and/or frustration in an exercise context.

## BPN evaluation in Exercise Professionals

According to Caspersen et al. (1985), physical activity, exercise and sport are similar but distinct concept. Physical activity is bodily movement through skeletal muscles, resulting in energy expenditure. Exercise incorporates all physical activity characteristics, thus it is planned, structured, and regularly repeated as a habit. Although sports encompass physical activity and exercise, its also have a set of rules and excel in athlete's performance and skills. Several studies have analyzed BPN in individual's physical activity (e.g., Ntoumanis, 2012),

in exercisers (e.g., Teixeira, Silva, & Palmeira, 2018) and in athletes (e.g., Monteiro, Pelletier, Moutão, & Cid, 2018). Thus, when considering "supervisors" (e.g., teachers, coaches, fitness professionals), studies are scarce. Therefore, it is important to examine BPN satisfaction and frustration in fitness professionals, since they are responsible for how individuals participate actively in physical exercise (Rodrigues et al., 2018).

There has been no attempt to analyze BPN satisfaction and frustration among exercise professionals. This may be due to the lack of a validate scale that taps into how fitness instructors experience satisfaction and frustration of autonomy, competence and relatedness during their interactions with gym and academy exercisers. Only recently, Chen et al. (2015) has created a scale, the Basic Psychological Need Satisfaction and Frustration Scale (BPNSFS), assessing satisfaction and frustration of all three needs. The scale was validated for the general population. This scale was translated in Portuguese by Cordeiro et al. (2016), with Portuguese students, showing measurement invariance. They suggest that this scale needs to be tested in other populations in the same context to test invariance.

### Current Research

The aim of the present study is to address the limitations in analyzing BPN satisfaction and frustration in exercise professionals. Therefore, we intend to validate the BPNSFS (Chen et a., 2015) in fitness instructors. Afterwards, we will analyze the distinctiveness of BPN constructs and how they are related to own interpersonal behaviors. In addition, we will examine measurement invariance between gender and compare latent means of all factors between male and female exercise professionals.

## Methods

### Participants

477 Portuguese exercise professionals working a gym or academy facilities (319 males, 158 females) between the ages of 18 and 73 ($M$ = 34.10, $SD$ = 11.57) with professional experience that ranged from 0.5 to 41 years ($M$ = 58.41, $SD$ = 68.91) participated in this study. With regard to the fitness activities, 15,7% were personal trainers, 50.5% were fitness instructors and 33.8% were group class instructors. In terms of academic education, exercise professionals had bachelor degree (47%), master degree (39.6%), doctoral degree (2.1%) or post-graduate certification (20.2%). For inclusion, participants needed to be licensed professionals with minimum of 6 months experience, aged over 18 years, and work as personal trainer, gym instructor or group class instructor at a gym or academy.

## Measures

*Psychological Need Satisfaction and Frustration*. Participants completed the Portuguese version of the Basic Psychological Need Satisfaction and Frustration Scale (it was translated and validated by the authors and was submitted for publication) in exercise context. This scale assesses their perceived BPN's satisfaction or frustration in exercise. This multidimensional questionnaire is split into six factors. Three factors consider the experience of BPN's satisfaction and three the BPN's frustration. The scale is composed of 24 items, four for each construct. The items received slight semantic adjustments to exercise professionals, using the stem "I prescribe exercise because…" These changes were made by four specialists in exercise psychology and semantic issues where corrected by four Portuguese teachers with higher degree. The participants indicated their agreement to each item through a 7-point Likert-type scale that varied between 1 (totally disagree) and 7 (totally agree). Several previous studies (Chen et al., 2015; Cordeiro et al., 2016) showed acceptable internal consistency as well as construct validity.

*Interpersonal Behavior*. Participants completed the translated Portuguese version of the IBQ-SELF (it was translated and validated by the authors and was submitted for publication) measuring their own perceived behaviors when engaging with exercisers, using the stem "when I'm with my clients ….". Participants indicated their agreement with each item using a Likert-type scale ranging from 1 (completely disagree) to 7 (completely agree). This instrument consists of six subscales (Autonomy-Support, Competence Support, Relatedness Support, Autonomy Thwarting, Competence Thwarting, Relatedness Thwarting) tapping on their interpersonal behaviors when interacting with their clients. The data fit the model: [$\chi2(237) = 1345.567$, $\chi2/df = 5.68$; B-S $p < .001$, CFI = .918, TLI = .907, SRMR= .0412, RMSEA = .067 (CI90% = .057, .077)], and internal consistency was acceptable in all factor (>78).

## Procedure: data collection

After approval from the Ethical Committee of Beira Interior University, with the registration number CE-UBI-pJ-2018-044:ID683, the authors got directly in touch with exercise professionals through online research in different social media (e.g., LinkedIn, Facebook). Participants were asked to participate voluntary in this study. Study objectives were explained and they signed informed consent prior to data collection. Both informed consent and questionnaire were obtained through an online survey (i.e., surveymonkey.com). Participants received no monetary reward for their contribution, but were thanked for their participation.

## Statistical analysis

A preliminary analysis of the data was performed, in order to verify normality, missing values, and outliers. Subsequently, to assess data fit (i.e., factorial validity), a Confirmatory Factor Analysis (CFA) using AMOS 23.0 was performed. CFA was performed through Maximum Likelihood method and measurement model adequacy verified by the Goodness-of-Fit indexes: Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), Standard Mean Root Square Residual (SRMR), and Root Mean Square Error of Approximation (RMSEA), and its confidence interval (90% CI). For these indexes, cut-off values suggested by several authors (e.g., Byrne, 2010; Hair, Black, Babin, & Anderson, 2014; Marsh, Hau, & Wen, 2004) were used. Specifically: CFI and TLI ≥ 0.90, SRMR and RMSEA ≤ 0.8. Internal consistency was analyzed through composite reliability and calculated by Raykov's formula (1997). Average Variance Extracted (AVE) was calculated to evaluate convergent validity, with cut-off >.50. Discriminant validity was achieved when construct AVE values were larger than the squared correlations (Hair et al., 2014).

## Nomological analysis

Correlations (*r*) were evaluated to assess relationships among all study variables. The correlations were used to determine nomological validity with the IBQ-Self (Rocchi, Pelletier, Cheung, Baxter, & Beaudry, 2017) adapted to Portuguese by the authors.

## Multigroup analysis

Measurement invariance was performed according to several authors recommendations (Byrne, 2010; Cheung & Rensvold, 2002), specifically: i) measurement model should represent a good fit in each of the groups; ii) configural, metric, scalar and residual invariance. Thus, according to some authors (e.g., Byrne, 2010; Cheung & Rensvold, 2002), residual invariance is optional since it is very difficult to achieve especially in the field of social sciences, which englobes the exercise context. Invariance assumptions were verified through the differences of CFI (ΔCFI≤.01) in line with Cheung & Rensvold (2002). Invariance models were evaluated using several recommendations (e.g., Chen, 2007), specifically: for metric invariance, change in SRMR (ΔSRMR) of less than .030, and change in RMSEA (ΔRMSEA) of less than .015 would support model fit; for scalar invariance a change in SRMR (ΔSRMR) of less than .010 and change in RMSEA (ΔRMSEA) of less than .015 and would indicate good invariance.

## Latent mean differences analysis

Comparison between latent mean differences was only possible after the multi-group model confirmed invariance (Kline, 2016). Mean and covariance structure analyses were used to test for latent mean differences between each need satisfaction and frustration construct.

Latent mean values for the male sample was always constrained to zero, while it was freely estimated for the female sample. The *Z* statistic was used to determine statistical significance between latent means. Cohen's *d* criterion (1988) was calculated to obtain the correspondent effect size, following Kline's (2016) recommendations. Effect sizes were evaluated as: trivial (0-0.19); small (0.20-0.49), average (0.50-0.79) and large (greater than or equal to 0.80), as suggested by Cohen (1992).

# Results

## Preliminary analysis

Missing values were less than 0.1%. No univariate or multivariate outliers were identified. Descriptive analysis exhibited no violations of the univariate distribution, since Skewness and Kurtosis were contained between cut-off values, - 2 to +2 and -7 to +7, respectively (Byrne, 2010). However, a Bollen-Stine Bootstrap of 2000 samples was used, since the Mardia coefficients' value of 304.555 exceeded for multivariate normality (Byrne, 2010).

## Construct validity

Results support the original 24-item, 6 factors, model as shown in Table 3.1. The lowest factor loading was .58 in Competence Frustration, and the highest was .95 in autonomy satisfaction. For more details see Table 3.2.

Descriptive analysis is shown in Table 3.3. Results regarding composite reliability exhibited adjusted level (CR >.70). Convergent validity was achieved in all constructs, except competence frustration (.46), since AVE values were <.50 level (Hair et al., 2014). Competence frustration was retained to ensure the complete theory could be tested. According to the analysis, squared correlations between: AS-CS; AS-RS; CS-RS; AF-CF; AF-RF; and CF-RF were higher than the AVE values (r> AVE), revealing discriminant validity problems.

## Nomological validity

According to our results, moderate positive associations were found between BPN satisfaction and supporting interpersonal behaviors, and negative associations (some of them significant) with thwarting behaviors. On the other hand, BPN frustration was negatively and significantly associated with supporting behaviors, and significantly positive associated with autonomy-thwarting, competence-thwarting and relatedness-thwarting. These results support the scales nomological validity. For more detail see Table 3.4.

## Multigroup analysis

Regarding Table 3.5, analysis revealed that the measurement model is invariant between gender based on recommended criteria (Byrne, 2010; Cheung & Rensvold, 2002), namely:: i) measurement model fit data in each group: male [$\chi 2(237) = 928.191$, $\chi 2/df = 3.92$; B-S $p<.001$, CFI = .917, TLI = .903, SRMR= .048, RMSEA = .080 (CI90% = .075, .085); and female [$\chi 2(237) = 547.763$, $\chi 2/df = 2.31$; B-S $p = .004$, CFI = .922, TLI = .909, SRMR = .043, RMSEA = .081 (CI90% = .071, .091)]; ii) variables invariance were confirmed: configural, metric, scalar and residual. All values were below cut-off values proposed by Chen's (2007) recommendations for measurement invariance.

## Latent mean differences between male and female exercisers

Results related to differences in latent means between gender exercise professionals regarding BPN constructs are synthetized in Table 3.6. Our analysis revealed no differences between satisfaction and frustration constructs in male and female participants.

**Table 3. 1** – Description of reviewed studies

| | *x2* | df | *x2*/df | CFI | TLI | SRMR | RMSEA | RMSEA 90% CI |
|---|---|---|---|---|---|---|---|---|
| Original version[a] | 372.71 | 231 | 1.61 | .97 | n.r. | .04 | .03 | n.r. |
| Japanese version[b] | 645.03 | 237 | 2.72 | .90 | .89 | .055 | .055 | .050-.061 |
| Portuguese General version[c] | 519.13 | 237 | 2.19 | .95 | n.r. | .06 | .05 | n.r. |
| Portuguese Exercise version[d] | 571.796 | 237 | 2.41 | .94 | .94 | .038 | .047 | .042-.052 |
| Present study | 1096.796 | 237 | 4.63 | .93 | .918 | .037 | .079 | .069-.089 |

Note: *x2* = chi-square; *df* = degrees of freedom; *x2*/*df* = normative chi-square; CFI = comparative fit index; TLI = Tucker-Lewis index; SRMR = standardized root mean square residual; RMSEA = root mean squared error of approximation; 90% CI = confidence interval of RSMEA; n.r. = not reported; [a] Chen et al. (2015); [b] Nishimura & Suzuki (2016); [c] Cordeiro et al. (2015); [d] Rodrigues et al. (it was translated and validated by the authors and was submitted for publication).

**Table 3. 2** - Standardized Factor Loadings and Squared Factor Loadings of the model

| | FL | $\lambda^2$ |
|---|---|---|
| *Autonomy Satisfaction* | | |
| Item 1 | .80 | .65 |
| Item 7 | .89 | .79 |
| Item 13 | .95 | .90 |
| Item 19 | .94 | .89 |
| *Autonomy Frustration* | | |
| Item 2 | .65 | .43 |
| Item 8 | .74 | .55 |
| Item 14 | .73 | .53 |
| Item 20 | .79 | .63 |
| *Competence Satisfaction* | | |
| Item 3 | .92 | .84 |
| Item 9 | .92 | .84 |
| Item 15 | .94 | .88 |
| Item 21 | .92 | .84 |
| *Competence Frustration* | | |
| Item 4 | .58 | .33 |
| Item 10 | .66 | .44 |
| Item 16 | .77 | .59 |
| Item 22 | .68 | .46 |
| *Relatedness Satisfaction* | | |
| Item 5 | .93 | .87 |
| Item 11 | .92 | .85 |
| Item 17 | .95 | .90 |
| Item 23 | .94 | .89 |
| *Relatedness Frustration* | | |
| Item 6 | .73 | .53 |
| Item 12 | .73 | .53 |
| Item 18 | .71 | .51 |
| Item 24 | .71 | .50 |

**Table 3. 3** - Mean, Standard Deviations, Composite Reliability, Average Variance Extracted, and squared correlations

| | | | | | $r^2$ | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | SD | CR | AVE | 1 | 2 | 3 | 4 | 5 | 6 |
| Autonomy Satisfaction | 4.88 | 1.17 | .94 | .81 | 1 | | | | | |
| Autonomy Frustration | 1.63 | .66 | .82 | .54 | .48 | 1 | | | | |
| Competence Satisfaction | 4.85 | 1.18 | .96 | .85 | .94 | .42 | 1 | | | |
| Competence Frustration | 1.44 | .51 | .77 | .46 | .42 | .73 | .46 | 1 | | |
| Relatedness Satisfaction | 5.02 | 1.09 | .97 | .88 | .96 | .45 | .95 | .46 | 1 | |
| Relatedness Frustration | 1.52 | .60 | .81 | .52 | .47 | .62 | .39 | .68 | .55 | 1 |

**Table 3. 4** - Mean, Standard Deviations, Range and correlations between study variables

| | | | | *r* | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Factors | Mean | SD | Range | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 1. Autonomy Satisfaction | 4.88 | 1.17 | 1-7 | 1 | | | | | | | | | | | |
| 2. Autonomy Frustration | 1.63 | .66 | 1-7 | -.63** | 1 | | | | | | | | | | |
| 3. Competence Satisfaction | 4.85 | 1.18 | 1-7 | .92** | -.58** | 1 | | | | | | | | | |
| 4. Competence Frustration | 1.44 | .51 | 1-7 | -.59** | .69** | -.60** | 1 | | | | | | | | |
| 5. Relatedness Satisfaction | 5.02 | 1.09 | 1-7 | .95** | -.60** | .95** | -.60** | 1 | | | | | | | |
| 6. Relatedness Frustration | 1.52 | .60 | 1-7 | -.65** | .60** | -.59** | .63** | -.68** | 1 | | | | | | |
| 7. Autonomy Support | 5.29 | .96 | 1-7 | .09 | -.14 | .10 | -.18* | .07 | -.15 | 1 | | | | | |
| 8. Autonomy Thwarting | 3.44 | 1.29 | 1-7 | -.04 | .27** | -.04 | .24** | -.07 | .16* | -.20* | 1 | | | | |
| 9. Competence Support | 6.43 | .62 | 1-7 | .11 | -.29** | .13 | -.33** | .14 | -.27** | .24** | -.15 | 1 | | | |
| 10. Competence Thwarting | 2.02 | .83 | 1-7 | -.15 | .27** | -.17* | .33** | -.15 | .17* | -.16* | .41** | -.27** | 1 | | |
| 11. Relatedness Support | 6.18 | .64 | 1-7 | .21** | -.46** | .26** | -.44** | .21** | -.29** | .40** | -.24** | .59** | .35** | 1 | |
| 12. Relatedness Thwarting | 1.47 | .69 | 1-7 | -.11 | .32** | -.12 | .41** | -.12 | .25** | -.25** | .15 | -.48** | .34** | -.55** | 1 |

Note: * p<0.05; ** p<0.01

**Table 3. 5** - Gender invariance models

| Invariance | x2 | df | Δx2 | Δdf | *p* | CFI | ΔCFI | SRMR | ΔSRMR | RMSEA | ΔRMSEA |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Configural | 1476.146 | 474 | - | - | - | 0.918 | - | .0439 | - | .067 | - |
| Metric | 1488.626 | 492 | 12.48 | 18 | .106 | 0.919 | .001 | .0401 | .0038 | .065 | .002 |
| Structural | 1529.662 | 513 | 53.516 | 39 | <0.001 | 0.917 | .002 | .0424 | .0015 | .065 | .002 |
| Residual | 1615.202 | 537 | 139.056 | 63 | <0.001 | 0.912 | .006 | .0438 | .0001 | .065 | .002 |

Note. $\chi^2$ = chi-square; df = degrees of freedom; $\Delta\chi^2$ = differences in the value of chi-squared; Δdf = differences in the degrees of freedom; CFI = Comparative Fit Index; ΔCFI = differences in the value of the Comparative Fit Index; CI = configural invariance; MI = measurement invariance; SI = scale invariance; RI = residual invariance

**Table 3. 6** - Latent mean differences between gender on basic psychological needs constructs

| | Difference | *z* | *p* | *d* |
|---|---|---|---|---|
| Autonomy Satisfaction | -.105 | -1.092 | .275 | .111 |
| Competence Satisfaction | -.039 | -.906 | .365 | .007 |
| Relatedness Satisfaction | -.001 | -.012 | .990 | .131 |
| Autonomy Frustration | -.029 | -.727 | .467 | .080 |
| Competence Frustration | -.137 | -1.371 | .170 | .060 |
| Relatedness Frustration | .128 | 1.910 | .056 | .184 |

Note: z = z-scores; *p* = level of significance.

## Discussion

This study's aim was to validate the BPNSFS into exercise instructors and test its invariance across gender. In addition, we analyzed nomological validity with interpersonal behaviors, based on the theoretical framework of SDT (Ryan & Deci, 2017).

### Factorial validity

CFA performed on the 24-item scale extracted six highly correlated but distinct factors, tapping in satisfaction and frustration of autonomy, competence and relatedness. These results were expected since other studies found similar outcomes in Portuguese participants (Cordeiro et al., 2016). Results confirmed that all factors were internally consistent, since values of composite reliability were > 0.7 (Hair et al., 2014). It is worth to mention that no item had factor loading below .50.

The factors displayed values of AVE above recommended, except for competence frustration (.46). Several studies using the BPNSFS have also identified problems with this factor (Chen et al., 2015; Nishimura & Suzuki, 2016). This would suggest that items measuring competence frustration are not adjusted. However, according to other authors (Byrne, 2010; Hair et al., 2014), if the factor weights are significant in its respective factor, they should be maintained. Therefore, and since no cross-loadings were detected, our results suggest good convergent validity of all factors.

Although some discriminant validity issues were found in our analysis, satisfaction of each need was negatively correlated with BPN frustration factors (all p's < .05). Likewise, covariance among satisfaction factors was positive and significant. The same was verified regarding frustration factors. This suggests that statistically, these factors are distinguishable (Hair et al., 2014).

In addition, theoretically these constructs are indeed different, according to SDT proposed by Ryan and Deci (2017). Citing these authors: "*each (need) is independently important, … In addition, SDT sees these three basic needs as interdependent*." (p. 248). As stressed by these authors: *"needs vary independently (e.g., one feels incompetent while performing a valued activity), SDT expects that the three needs will tend to be highly intercorrelated, especially in measurements that aggregate satisfaction or frustration experience in a domain…"* (p. 249).

Our model exhibits satisfactory fit to the data, following several authors (Byrne et al., 2010; Hair et al., 2014; Marsh et al., 2004). recommendations. Other studies who have analyzed the BPNSFS (Cordeiro et al., 2016; Chen et al., 2015; Nishimura & Suzuki, 2016) found

similar results. Therefore, this scale is applicable in different domains and cultural backgrounds.

### Nomological Validity

Results showed satisfactory correlations between satisfaction and frustration of BPN and interpersonal behaviors constructs. BPN satisfaction exhibited positive associations with supporting behaviors and negative associations with autonomy, competence and relatedness thwarting. Moreover, BPN's frustration was positively associated with thwarting interpersonal behaviors and negatively related to autonomy, competence and relatedness support. Rocchi et al. (2018) found similar results relating BPN constructs with behavioral regulations. These authors exhibited positive associations of BPN satisfaction with more autonomous forms of motivation. Moreover, BPN's frustration was positively associated with more controlled regulations of motivation. In addition, relatedness support had the strongest and most significant correlations with all BPN satisfaction constructs. These may be related to the fact that exercise professionals who feel their needs being satisfied are more likely to experience more positive and supporting social interactions with exercisers. However, this needs to be tested for proper validation.

### Measurement Invariance

Results support measurement invariance of BPNSFSE for male and female exercise professionals since all invariance assumptions were met, following Byrne (2010), and Chen (2007) recommendations. Findings indicate configural, metric, scalar and residual invariance. Other studies analyzing measurement invariance of this scale found similar results (Chen et al., 2015). These results are in accordance to SDT assumption, which they refer that BPN satisfaction and frustration are universal, independent of cultural background, age, gender, ethnicity, and context (Ryan & Deci, 2017).

### Latent mean differences

Regarding latent means between gender, our results found no significant differences. In addition, magnitude effects were trivial (<.19) in all factors. This demonstrates the dimensionality of BPN constructs. This mean that male and female exercise instructors experience in the same way basic psychological needs when interacting with exercise participants. Previous studies using the same scale found similar results (the Portuguese exercisers version which, was translated and validated by the authors and was submitted for publication) except for relatedness frustration factor. However, these authors report trivial effect in this construct, and suggest that male exercisers may experience differently from female based on how they perceive interpersonal behaviors from the social context. It

is worth to mention that this is the first study analyzing measurement invariance between male and female exercise instructors. Therefore, results need to interpreted with caution.

# Conclusion

## Practical Implications

This study is up most important since this scale analyzes how exercise instructors experience basic psychological need satisfaction or frustration when prescribing exercise. In addition, results showed that BPN satisfaction are positively related to supporting interpersonal behaviors. Therefore, knowing how they feel when working at a gym or academy, can be related to perceived supporting behaviors from fitness exercisers. This association is relevant since perceived support behaviors by exercisers are predictors BPN satisfaction in individuals and adherence to physical exercise practice (Edmunds et al., 2007; Rodrigues et al., 2018). In addition, this sequence based on SDT shows that perceived supporting interpersonal behaviors by individuals are positively related to physical exercise practice (Moreno-Murcia et al., 2016).

## Limitations

Despite our research being based on a strong theoretical framework, the present studies show some limitations. The present research was applied in Portuguese exercise instructors. Therefore, more cultural analysis is warranted for its applicability in the exercise domain. In addition, this study is cross-cultural in its nature. Future studies should analyze the scale in a longitudinal way for time invariance confirmation. We suspect that exercise professionals may fell satisfaction and frustration of needs differently across professional experience (e.g., years). Lastly, future investigations should analyze BPN constructs with behavioral regulations in exercise domain with instructors. Rocchi et al. (2018) found positive associations between BPN satisfaction and more autonomous forms of motivation, and positive associations between BPN frustration and more controlled forms in sports coaches. However, this needs to be tested in exercise context, with exercise instructors, given that they are poorly studied.

Considering our analysis, these results support the applicability of the BPNSFS in exercise professionals, adding new evidence for construct distinctiveness of BPN satisfaction and frustration, based on SDT framework. The present work reinforces the importance to analysing basic needs satisfaction and frustration in exercise professionals, in order to understand how they behave in supporting and thwarting interpersonal behaviors. BPNSFS is reliable in measuring feelings of basic psychological needs in Portuguese exercise

instructors. This scale needs further analysis in order to test its applicability in other domains.

# Chapter 5

# Initial validation of the Interpersonal Behavior Questionnaire (IBQ & IBQ-Self) in exercise: measurement invariance and latent mean differences


## Abstract

The aim of the present research is to examine the factor structure of the Interpersonal Behavior Questionnaire (IBQ), and the Interpersonal Behavior Questionnaire Self (IBQ-Self), two scales developed for the purpose of measuring supportive and thwarting interpersonal behaviors. Structural equation modeling was used to examine the psychometric proprieties, the nomological validity with the basic needs' satisfaction and frustration as well as the measurement invariance between gender, and differences across latent means. For the IBQ, 837 Portuguese gym members aged between 18 to 63 years old (M=34.58; SD=11.35) participated in this study. They had been practicing physical exercise for about 43.00±37.00 months. For IBQ-Self, 612 trainers, with a professional experience that ranged from 12 to 492 months (M=88.54; SD=77.89), participated in this study. The analysis revealed that both scales had good fit, achieving convergent and discriminant validity. In addition, they show acceptable internal consistency and invariance between gender. Nomological validity displayed projected results, according to theoretical and empirical literature. Regarding analysis of the psychometric proprieties, IBQ and IBQ-Self can be applied to Portuguese exercisers and exercise physiologist to measure perceived behaviors from others and self-reported behaviors, respectively.



**Key-words:** exercise psychology; interpersonal behavior; fitness; Self-Determination Theory; multigroup analysis.

# Introduction

According to Self-Determination Theory (SDT; Ryan & Deci, 2017), motivation orientations in contexts like exercise differ in their quality. When reasons for practicing exercise are more internalized, gym clients experience autonomous motivation and this is shown to results in positive outcomes such as greater interest, increased exercise satisfaction and higher intentions to continue in the future (Rodrigues et al., 2018). When the reasons are less internalized, exercisers experience controlled motivation, which has been shown to lead to negative outcomes like less enjoyment, and drop out (Hagger & Chatzisarantis, 2007; Pelletier, Rocchi, Vallerand, Deci & Ryan, 2013). However, according to the SDT framework, the social environment has an impact on how one experiences the satisfaction or frustration of basic needs, leading to differentiated behavior regulations when exercising. As shown by Edmunds, Ntoumanis and Duda (2008), exercisers who perceive fitness professionals as supportive tend to experience positive results such as greater exercise participation and commitment. On the other hand, perception of thwarting behaviors has led to negative experiences and higher rates of individuals withdrawing from exercise (Ng et al., 2013). One possible issue regarding previous studies is related with the nature of the instruments used to evaluate interpersonal behaviors, since no contextual validation was made to ensure a feasible and reliable measure of the aforementioned constructs.

Another matter to be considered is the assessment of self-perceived behaviors. Most studies (e.g., Edmunds et al., 2008) have focused solely on how others (e.g., students, athletes, exercisers) perceive persons in key position (e.g., teachers, coach, fitness professionals). Thus, measuring self-perceived behaviors seems crucial since it has been associated with the satisfaction of basic psychological needs (Rocchi & Pelletier, 2018), a fundamental "nutrient" for experiencing positive outcomes such as well-being and intrinsic motivation. Therefore, it seems crucial the validation of a scale, assessing not only exercisers perceived behaviors from fitness professionals, but likewise how fitness professionals perceive themselves as supportive and thwarting.

## Self-Determination Theory and Basic Psychological Needs

In order to foster the process of internalization, exercisers require the support and satisfaction of three basic needs (autonomy, competence, and relatedness). SDT represents a theoretical framework that explains how the three basic psychological needs (BPN) not only promote differentiated behavioral regulations (for review see Rodrigues et al., 2018) but also are affected by the context (ex. competitive environment) and the people (ex., coaches, trainers or parents) in the exercise context. Over the last 20 years, research guided by SDT has shown that the BPN (autonomy, competence, and relatedness) are important

determinants of motivation, well-being, and performance across a wide variety of contextual domains, including physical activity, exercise, and sport (Hagger & Chatzisarantis, 2007). More specifically, the need to experience a sense of choice, volition, and psychological freedom (autonomy), the need to feel effective and agency when interaction with one's environment (competence), and the need to relate and feel connected to others (relatedness) play a crucial role in the emergence of autonomous motivation or self-determined goal-directed behaviors. In opposition, the frustration of these three needs is associated with several negative outcomes such as ill-being, controlled motivation, lower levels of performance and persistence, and psychological distress (Ryan & Deci, 2017). Specifically, the interpersonal behaviors that are characterized as need supportive versus need thwarting, are critical for the study of motivation in exercise and sport.

## Interpersonal Behaviors

SDT proposes that, there are six types of interpersonal behaviors that influence BPN satisfaction or frustration. These interpersonal behaviors are defined as following: (a) Autonomy Support (AS) refers to encouragement of personal choices and volitional decision making (Edmunds et al., 2008); (b) Autonomy Thwarting (AT) behaviors refers to the use of coercion, intimidations and making demands without providing rational or justification (Rocchi, Cheung, Baxter, & Beaudry, 2017) (c) Competence Satisfaction (CS) is related to the provision of positive feedback regarding a specific task and believing in the athlete's capacity to overcome barriers (Puente & Anshel, 2010) (d) Competence Frustration (CF) refers to the expression of behavior that emphasizes guilt and doubt (Rocchi, Pelletier, Desmarais, 2016); (e) Relatedness Satisfaction (RS) refers to the demonstration of emotional support and the provision of care about one's feelings (Sheldon & Filak, 2008); (f) Relatedness Thwarting (RT) behaviors are related to rejections of athletes and low emotional connections with them (Rocchi & Pelletier, 2018).

Past research has relied on a variety of distinct tools to assess need supportive and need thwarting behaviors. The majority of previous studies (e.g., Baard, Deci, & Ryan, 2004; Deci, La Guardia, Moller, Scheiner, & Ryan, 2006; Gagné, 2003; Gillet, Vallerand, Amoura, & Baldes, 2010) have focused mainly on the assessment of autonomy support, thus ignoring the potentially important role of relatedness and competence. Additional studies (e.g., Haerens et al., 2013; Legault, Green-Demers, & Pelletier, 2006) have relied on an assessment of interpersonal behaviors related to all three needs, although remaining focused on either need supportive behaviors or on need thwarting behaviors, rather than the assessment of both types of interpersonal behaviors. Yet a third group of studies (e.g., Haerens, Aelterman, Vansteenkiste, Soenens, & Van Petergem, 2015; Mabbe, Soenens, Vansteenkiste, van der Kaap-Deeder, & Mouratidis, 2018; Reeve, Jang, & Jang, 2018) have

relied on an assessment of need supportive and need thwarting behaviors using a variety of distinct measures that, when taken together, may overlap among themselves and that may lead to a lack of conceptual differences between the different scales, and measurement inconsistencies.

More specifically in the context of physical activity, recent studies have focused on specific types of interpersonal behaviors that could affect BPN satisfaction or frustration. Again, no study has considered all six dimensions of interpersonal behaviors at once in the exercise context. For instance, the majority of scales have only focused on autonomy support (e.g., Edmunds et al., 2008; Klain, Matos, Leitão, Cid, & Moutão, 2015) and/or competence support (e.g., Puente & Anshel, 2010) in the exercise context. In addition, to the best of our knowledge, no studies up to now have ever analyzed thwarting behaviors in this domain. Therefore, the employment of an instrument that could measure all six dimensions of interpersonal behaviors as proposed by SDT and that is adapted specifically to the domain of physical activity and exercise represent an important endeavor (Rodrigues et al., 2018).

In response to these limitations, Rocchi and colleagues (Rocchi et al., 2017; Rocchi et al., 2016) have recently developed the Interpersonal Behavior Questionnaire (IBQ), an integrative questionnaire that measures simultaneously autonomy, relatedness, and competence need supportive and need thwarting behaviors. This questionnaire was created with three specific purposes in mind. The first purpose was to develop a scale that could assess all six dimensions proposed by SDT. The second purpose was to develop a scale that could be used in different life domains so that researchers could compare participants' perceptions in one life domain to the perceptions of participants in another life domain. The third purpose was to develop a scale that could be used to assess how one perceives the interpersonal behaviors of a specific target (ex., teacher, coach, supervisor), and how the target reports their own interpersonal behaviors (IBQ-Self). The IBQ was developed through a comprehensive series of distinct studies (Rocchi et al., 2016, Rocchi et al., 2017) which supported the a priori six-factor structure of the IBQ when used to assess participants' reports of the need supporting and thwarting behaviors of: (a) people in their lives in general; (b) themselves (IBQ-Self) when interacting with peoples in their lives in general; (c) their coaches in the context of sport practices; and (d) their own coaching behaviors (IBQ-Self). These studies also supported the measurement invariance of IBQ ratings across gender, as well as their criterion-related validity in relation to participants' ratings of need satisfaction and frustration (autonomy, relatedness, and competence), well-being (positive and negative affect, vitality, and life satisfaction), and motivation (autonomous and controlled).

In sum, in agreement with several authors (e.g., Rocchi et al., 2017; Ryan & Deci, 2017), the analysis of all six interpersonal behaviors and the way they are related to satisfaction and frustration of BPNs proves to be essential. It is also important to measure invariance between groups with different characteristics (e.g., gender), in order to examine empirically the universality and the generalizability of the different dimensions of interpersonal behavior constructs related to the satisfaction and the frustration of BPN as defined by SDT.

### Current Research

The purpose of the present study was to translate the IBQ and IBQ-Self (Rocchi et al., 2017) in Portuguese and to validate both scales in the context of exercise. These scales consist of 24-items, grouped into six factors, three of them representing need supportive behaviors and three representing need thwarting behaviors.

According to Rocchi et al. (2017), the IBQ and IBQ-Self were developed to make the measurement applicable to different social contexts. However, in order to confirm its universality and applicability to multiple social contexts and different cultures, it is imperative to analyze the scales in different contexts. We also intend to analyze the latent mean difference in order to examine factor means between groups. First, the IBQ and IBQ-Self will be translated for the purpose of examining their perceptions of their exercise physiologists' interpersonal behaviors and their own, respectively. Afterwards, we will examine the factorial structure of the scale and its invariance across gender before we examine the nomological validity of the adapted scale by relating the scale to BPN satisfaction and BPN frustration. It is hypothesized that: a) the translated versions of both scales will be a reliable to measure interpersonal behaviors with Portuguese exercisers; b) measurement model will be invariant between gender; c) there will be no differences in latent means between male and female exercisers, and; d) interpersonal behaviors are predictors of BPN satisfaction and frustration, as proposed both in SDT framework (Ryan & Deci, 2017) and recent empirical studies (e.g., Rocchi et al., 2018).

## Methods

### Participants

A total of 837 Portuguese gym exercisers (495 female), aged between 18 and 63 years (M=34.58; SD=11.35) completed the Portuguese versions of the IBQ. Their mean exercise experience was approximately 43.00±37.00 months. They were training on average 3.68±1.30 sessions per week and on average, 64.75±17.52 minutes per session.

A total of 612 Portuguese exercise trainers (330 female) completed the Portuguese version of the IBQ-Self; 16.15% were personal trainers, 53.8% gym instructors, and 30.1% group

class trainers. Their age varied between 19 and 54 years (M=31.37; SD=6.91) and they had between 12 and 492 months (M=88.54; SD=77.89) of professional experience. All participant were licensed professionals for exercise prescription: 47,4% had a bachelor's degree, 31.6% a master's degree, 2.4% a doctoral degree, and 18.5% postgraduate studies.

## Procedure: Data collection

Approval from the Ethical Committee before proceeding with the research was obtained. Once approved, researchers got in touch with gym managers to obtain permission to contact their members and exercise physiologists. After obtaining consent, participants were contacted at the reception desk of the different training facilities during different times of the day. They were asked to participate voluntarily in this study. Data were collected before the participants' exercise session. Participants received no monetary reward for their contribution.

## Procedure: Translation of the questionnaire

The translation of the IBQ and the IBQ-Self from English to Portuguese was done through the committee approach methodology (see Brislin, 1980) as suggested by Banville, Desrosiers and Genet-Volet (2000). The process includes five steps: 1) Preliminary translation: this first step was carried out by the researchers with the help of three translators with higher education in English-Portuguese languages, which resulted in the first version of the questionnaire; 2) First Evaluation Panel: an analysis of the initial version of the IBQ was done individually by four specialists from different areas, such as English-Portuguese Languages, Psychology, Sports Psychology, and Sports Sciences. Few items were then slightly modified following the modifications proposed by the evaluation panel; 3) Second Evaluation Panel: a revised version of the questionnaire was again submitted for evaluation, this time to a board composed by four other specialists in Psychology, Sports Psychology, and Sports Sciences. This time the board examined all the items together until an agreement between all specialists regarding the new version (third version) could be reached; 4) Pilot Study: a group of 40 exercisers completed the revised version of the IBQ to determine if the items were clear and comprehensible; 5) Final revision: finally, two Portuguese teachers revised the final version of the IBQ for the purpose of identifying the syntax of the items, spelling, and grammar errors. Here are some examples of how the items were adapted to the context of exercise: i) item for autonomy support in its original "*My coach… gives me the freedom to make my own choices*" was adapted to "*My exercise physiologist… gives me options on which exercises to perform*"; ii) item for competence support in its original "*My coach… encourages me to improve my skills*" was adapted to "*My exercise physiologist… provides me with positive feedback when I do the exercise correctly*", and; iii) item for relatedness thwarting in its original "*My coach… does not*

*comfort me when I am feeling low*" was adapted to "*My exercise physiologist… does not care about my feelings when exercising*".

### Instruments: Exercisers

Interpersonal Behaviors. Participants completed the Interpersonal Behavior Questionnaire (IBQ; Rocchi et al., 2016), translated into Portuguese and adapted to the exercise context, measuring the perceptions of their instructor's interpersonal behavior. As described above, this 24-item multidimensional instrument consists of six subscales (4 items per subscale) that measures the use of Autonomy Support (AS; item 1: "My exercise instructor supports my choices"), Competence Support, (CT; item 9: "My exercise instructor encourages me to improve my skills"), Relatedness Support (RS; item 5: "My exercise instructor really likes to spend time with me"), Autonomy Thwarting (AT; item 8: "My exercise instructor imposes his opinions"), Competence Thwarting (CT; item 22: "My exercise instructor questions my ability to overcome challenges"), and Relatedness Thwarting (RT; item 24: "My exercise instructor does not build empathy with me") behaviors. The exercisers indicated their agreement with each statement using a 7-point scale ranging from 1 ("do not agree at all") to 7 ("completely agree"). Previous studies (Rocchi & Pelletier, 2018; Rocchi et al., 2017; 2016) support the use of present scale on measuring perceived interpersonal behaviors from others.

Need Satisfaction and Frustration. Participants completed the Basic Psychological Need Satisfaction and Frustration Scale in Exercise (BPNSFS; Chen et al., 2015) Portuguese version in exercise context (Rodrigues et al., 2019) to assess their experience of basic needs satisfaction and frustration during the exercise session. The 24-item scale consists of six subscales (4 items each) measuring participants of autonomy (item 1: "When I exercise I feel a sense of choice and freedom in the exercises I undertake"), competence (item 5: "When I exercise I feel confident that I can do exercises well"), and relatedness (item 9: "When I exercise I feel connected with others in the gym") satisfaction, as well as autonomy (item 8: "When I exercise I feel forced to do training sessions I would not choose to do"), competence (item 12: "When I exercise I feel disappointed with my performance"), and relatedness (item 6: "When I exercise I feel that the relationships I have at the gym are just superficial") frustration. Participants responded to each item using a 5-point scale anchored from 1 ("totally disagree") to 5 ("totally agree"). Several studies have shown cultural invariance as well as adjusted internal consistency, convergent and discriminant validity (Chen et al., 2015; Teixeira, Silva, & Palmeira, 2018). In present study, this scale showed acceptable fit to the data (see Table 4.1) as well as acceptable internal consistency (>.75).

## Instruments: Exercise Physiologists

Interpersonal Behaviors. Participants completed the Interpersonal Behavior Questionnaire Self; Rocchi et al., 2016), translated to Portuguese and adapted to the exercise context measuring their own perceived behaviors when engaging with exercisers. This 24-item multidimensional instrument consists of six subscales (4 items per subscale) that measures the use of AS (item 1: "When I am with my clients I support their decisions"), CT (item 9: "When I am with my clients I provide valuable feedback"), RS (item 5: "When I am with my clients I take the time to get to know them"), AT (item 8: "When I am with my clients I limit their choices"), CT (item 22: "When I am with my clients I question their capacity to improve"), and RT (item 24: "When I am with my clients I do not connect with them") behaviors. Exercise physiologists indicated their agreement with each item using a 7-point scale ranging from 1 ("do not agree at all") to 7 ("completely agree"). Previous studies (Rocchi & Pelletier, 2018; Rocchi et al., 2017; 2016) support the use of present scale on measuring self-perceived interpersonal behaviors.

Basic Psychological Need Satisfaction and Frustration. Exercise physiologists completed the Basic Psychological Need Satisfaction and Frustration Scale for exercise physiologists (BPNSFS; Rodrigues et al., 2019). This 24-item scale consists of six subscales (4 items each) and was validated specifically for fitness professionals regarding their BPN when prescribing exercise, measuring autonomy (item 7: "When I prescribe exercise I feel a sense of choice and autonomy"), competence (item 12: "When I program exercise trainings I feel confident that I can do them right"), and relatedness (item 9: "When I train clients I feel connected with them") satisfaction, as well as autonomy (item 2: "When I train my clients I feel forced to do exercise sessions I would not choose to do"), competence (item 19: "When I train clients I feel disappointed with my performance"), and relatedness (item 6: "When I prescribe exercise sessions I feel that the relationships I have with gym clients are just superficial") frustration. Participants responded to each item using a 5-point scale anchored from 1 ("totally disagree") to 5 ("totally agree"). In present study, this scale showed acceptable fit to the data (see Table 4.1) as well as acceptable internal consistency (>.73). Previous studies (e.g., Rodrigues et al., 2019), supported the validity and reliability of this scale assessing fitness professionals' BPN satisfaction and frustration.

## Statistical Analysis

A two-step Maximum Likelihood approach suggested by Kline (2016) was performed with AMOS 23.0 (Arbuckle, 2014). First, a Confirmatory Factorial Analysis (CFA) was performed to test the psychometric properties of each measurement model. Then, Structural Equation Modeling (SEM) was conducted in order to test the nomological validity across interpersonal behaviors and all six basic psychological needs. For both analyses the

recommendations from several authors (Byrne, 2010; Hair, Black, Babin, & Anderson, 2014; Kline, 2016; Marsh, Hau, & Wen, 2004) were used and the following goodness-of-fit indexes were adopted: Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), Standard Mean Root Square Residual (SRMR), and Root Mean Square Error of Approximation (RMSEA) and its Confidence Interval (90% CI), Adjusted Goodness-of-Fit Index (AGFI), and Parsimonious Comparative Fit Index (PCFI). The following cut-off values were assumed: CFI, TLI, and AGFI ≥ 0.90, SRMR ≤ 0.80 and RMSEA ≤ 0.80 (Byrne, 2010; Hair et al., 2014; Kline, 2016; Marsh et al., 2004). Additionally, PCFI was performed to compare non-nested models and scores greater than or equal to > 0.50 are considered acceptable (Byrne, 2016). Raykov's formula (1997) was used to analyze internal consistency of each subscale, alpha ≥.70 were considered indicative of good composite reliability. Average Variance Extracted (AVE) was estimated to evaluate convergent validity and values >.50 were considered acceptable. Discriminant validity was achieved when AVE of each construct had values above squared correlations between all factors of the model (Hair et al., 2014). For the SEM analysis, GPower 3.1 (Faul, Erdfelder, Buchner, & Lang, 2009) was used to determine the required sample size. For this analysis, the following parameters were considered: effect size f 2 = 0.1; α = .05; statistical power = 0.95; and 6 predictors. Results revealed that the required sample was 215, which was respected for both samples in the present study.

## Nomological validity

Nomological validity between interpersonal behaviors and basic psychological needs satisfaction and frustration was analyzed. The 95% CI values were considered significant when the interval did not include zero (Williams & Mackinnon, 2008).

## Multigroup analysis and latent mean differences analysis

The multigroup analysis was performed to determine if the measurement model was invariant between groups with diverse characteristics (Sass, 2011, Byrne, 2010, Cheung & Rensvold, 2002; Chen, 2007). First, we examined whether the measurement model presented a good fit to the data for each group. Second, configural, metric, scalar and residual invariance were performed. The following criteria were used: configural invariance ΔCFI less than .01 (Cheung & Rensvold, 2002); metric invariance ΔSRMR less than .030 and ΔRMSEA less than .015 (Chen, 2007); scalar invariance ΔSRMR less than .010, and; measurement invariance ΔRMSEA less than .015 (Chen, 2007).

Structure analyses of means and covariances were used to test for latent mean differences between samples and gender for each factor. The latent mean values for the male samples were always constrained to zero, while it was freely estimated for the female samples. To

determine if there was a statistical significance between the latent means of both sample groups and genders, the z statistic was used. Latent mean differences were only compared after obtaining a strong invariance multi-group model (Kline, 2016).

# Results

## Preliminary analysis

Missing values (<0.1%) were imputed using the regression procedures in AMOS 23. Descriptive analysis revealed no violations of univariate distribution since Skewness and Kurtosis where contained between - 2 to +2 and -7 to +7, respectively, and no univariate and multivariate outliers were found. Next, we followed Nevitt and Hancock's (2001) recommendations using Bolle-Stine Bootstrap (2000 samples) since Mardia's coefficient exceeded expected value (>5) for multivariate kurtosis in all samples under analysis. The IBQ and IBQ-Self measurement model (Table 4.1) demonstrated acceptable fit to the data in all samples and values in the present study are very close to both the original version (Rocchi et al., 2017) as well as the sports version (Rocchi et al., 2016). In addition, all items presented factor loadings equal or greater than cut-off values (0.50) as seen Table 4.2, explaining at least 25% of variance of the latent factor in mutually scales. Regarding composite reliability, all subscales demonstrated scores above recommended (CR >.70) for both scales, suggesting that items measure the same construct. IBQ and IBQ-Self revealed no problems of convergent validity presenting scores above 0.70. In addition, discriminant validity was achieved, since squared correlations values were below AVE (see Table 3).

## Nomological validity

For the SEM analysis, Variance Inflation Factor (VIF) was conducted to determine the collinearity diagnosis between interpersonal behaviors and basic psychological needs satisfaction and frustration. Results revealed that all values were less than 10 as recommended by Hair et al. (2014), showing conditions for regression analysis. In sum, the results indicated that the conditions were met for the regression models.

Results revealed that the structural model fit the data well, for both the IBQ: [$\chi 2$= 3212.946 (1014); $\chi 2/df$ = 3.16; B-p < .001, TLI = .905, CFI = .915, SRMR = .048, RMSEA = .051 (90%CI = .049, .054)] and the IBQ-SELF: [$\chi 2$= 2190.530 (1014); $\chi 2/df$ = 2.16; B-p < .001, TLI = .908, CFI = .918, SRMR = .052, RMSEA = .046 (90%CI = .044, .049)]. These results support the nomological validity of the IBQ and the IBQ-Self.

The direct effects of all six types of interpersonal behaviors on basic needs are shown in Table 4.4 and 4.5 (IBQ and IBQ-self, respectively). Results show that supportive interpersonal behaviors positively predicted basic psychological needs satisfaction and negatively predicted basic psychological needs frustration. However, in IBQ, the effects between autonomy support → competence frustration, autonomy thwarting → relatedness satisfaction and relatedness satisfaction → competence frustration were not significant. In contrast, thwarting interpersonal behaviors positively predicted basic psychological needs frustration and negatively predicted basic psychological needs satisfaction.

### Measurement Invariance latent mean differences

Multi-group analysis revealed that both scales were invariant between gender since invariance assumptions adopted in methodology were respected. Specifically results revealed the following: i) the IBQ and IBQ-SELF model fit the data (see Table 4.1), and; ii) both models displayed configural, metric, scalar, and residual invariance between gender. Furthermore, ΔRMSEA and ΔSRMR showed invariance according to recommendations for measurement invariance, as seen in Table 4.6. Data revealed no differences between the gender, which means that all interpersonal behaviors are perceived equally both in male and female gym exercisers, as well as both male and female fitness instructors (see Table 4.7).

**Table 4. 1** – Measurement fit indexes of the Interpersonal Behavior Questionnaire and Self (including other existing versions), and other scales used in present study

| | *x2* | df | *x2*/df | B-S p | CFI | TLI | SRMR | RMSEA | RMSEA 90% CI | AGFI | PCFI |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Interpersonal Behavior Questionnaire* | | | | | | | | | | | |
| Original version[a] | 367.030 | 237 | 1.55 | - | .94 | .93 | .04 | .04 | .04 - .05 | - | - |
| Version in sports[b] | 296.230 | 237 | 1.25 | - | .95 | .95 | .05 | .05 | .04 - .06 | - | - |
| Present study | 828.906 | 237 | 3.95 | <.001 | .92 | .94 | .04 | .05 | .05 - .06 | .91 | .81 |
| Male Sample – Present Study | 554.876 | 237 | 2.34 | <.001 | .90 | .91 | .05 | .06 | .06 - .07 | .90 | .80 |
| Female Sample – Present Study | 589.640 | 237 | 2.49 | <.001 | .93 | .94 | .04 | .05 | .05 - .06 | .92 | .84 |
| *Interpersonal Behavior Questionnaire - Self* | | | | | | | | | | | |
| Original version[a] | 342.830 | 237 | 1.46 | - | .96 | .95 | .04 | .03 | .03 - .04 | - | - |
| Version in sports[b] | 303.040 | 237 | 1.28 | - | .93 | .92 | .04 | .06 | .03 - .05 | - | - |
| Present study | 547.432 | 237 | 2.31 | <.001 | .95 | .94 | .04 | .05 | .04 - .05 | .91 | .78 |
| Male Sample – Present Study | 451.404 | 237 | 1.91 | <.001 | .93 | .92 | .05 | .06 | .05 - .07 | .90 | .80 |
| Female Sample – Present Study | 422.858 | 237 | 1.78 | <.001 | .95 | .94 | .04 | .05 | .04 - .05 | .93 | .83 |
| *Basic Psychological Need Satisfaction and Frustration Scale* | | | | | | | | | | | |
| Exercisers | 431.238 | 237 | 1.82 | <.001 | .91 | .92 | .05 | .05 | .05 - .06 | .90 | .83 |
| Exercise Physiologists | 401.214 | 237 | 1.69 | <.001 | .92 | .93 | .04 | .04 | .04 - .06 | .91 | .81 |

Note: [a]Rocchi et al. (2017); [b]Rocchi et al. (2016); *x2* = chi-square; *df* = degrees of freedom; *x2*/*df* = normative chi-square; B-S p = Bollen-Stine Significance level; CFI = Comparative Fit Index; TLI = Tucker-Lewis Index; SRMR = Standardized Root Mean Square Residual; RMSEA = Root Mean Squared Error of Approximation; 90% CI = Confidence Interval of RSMEA; AGFI = Adjusted Goodness-of-Fit Index; PCFI = Parsimony Comparative Fit Index.

**Table 4. 2** – Standardized Factor Loadings of the IBQ and IBQ-Self

| Constructs | Interpersonal Behavior Questionnaire | | Interpersonal Behavior Questionnaire - Self | |
|---|---|---|---|---|
| | FL | $\lambda^2$ | FL | $\lambda^2$ |
| *Autonomy Support* | | | | |
| Item 1 | .51 | .26 | .56 | .32 |
| Item 7 | .76 | .58 | .74 | .55 |
| Item 13 | .73 | .53 | .79 | .62 |
| Item 19 | .78 | .61 | .73 | .53 |
| *Autonomy Thwarting* | | | | |
| Item 2 | .71 | .50 | .66 | .44 |
| Item 8 | .74 | .54 | .76 | .57 |
| Item 14 | .66 | .43 | .67 | .45 |
| Item 20 | .72 | .51 | .74 | .55 |
| *Competence Support* | | | | |
| Item 3 | .68 | .46 | .68 | .47 |
| Item 9 | .84 | .71 | .83 | .69 |
| Item 15 | .77 | .59 | .76 | .58 |
| Item 21 | .71 | .50 | .71 | .50 |
| *Competence Thwarting* | | | | |
| Item 4 | .70 | .49 | .66 | .43 |
| Item 10 | .80 | .63 | .79 | .62 |
| Item 16 | .74 | .55 | .78 | .60 |
| Item 22 | .62 | .38 | .64 | .41 |
| *Relatedness Support* | | | | |
| Item 5 | .76 | .52 | .73 | .53 |
| Item 11 | .80 | .64 | .76 | .58 |
| Item 17 | .80 | .65 | .74 | .54 |
| Item 23 | .68 | .46 | .69 | .47 |
| *Relatedness Thwarting* | | | | |
| Item 6 | .70 | .49 | .70 | 49 |
| Item 12 | .69 | .48 | .72 | .51 |
| Item 18 | .77 | .59 | .78 | .62 |
| Item 24 | .80 | .49 | .69 | .47 |

**Note:** FL = Factor Loading; $\lambda^2$ = Squared Factor Loadings

**Table 4. 3** – Descriptive Statistics, convergent and discriminant validity, and correlation matrix

| | | | | | | Correlation Matrix | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | M | SD | CR | AVE | | 1 | 2 | 3 | 4 | 5 | 6 |
| *Interpersonal Behavior Questionnaire* | | | | | | | | | | | |
| 1. Autonomy Support | 5.25 | .80 | .70 | .70 | $r$<br>$r^2$ | 1 | | | | | |
| 2. Autonomy Thwarting | 3.08 | 1.23 | .78 | .71 | $r$<br>$r^2$ | -.58**<br>.34 | 1 | | | | |
| 3. Competence Support | 5.86 | .88 | .82 | .75 | $r$<br>$r^2$ | .67**<br>.46 | -.36**<br>.10 | 1 | | | |
| 4. Competence Thwarting | 1.92 | .92 | .79 | .72 | $r$<br>$r^2$ | -.43**<br>.19 | .71**<br>.50 | -.38**<br>.15 | 1 | | |
| 5. Relatedness Support | 5.15 | .95 | .80 | .76 | $r$<br>$r^2$ | .64**<br>.41 | -.58**<br>.34 | .60**<br>.37 | -.57**<br>.33 | 1 | |
| 6. Relatedness Thwarting | 2.15 | 1.01 | .81 | .74 | $r$<br>$r^2$ | -.29**<br>.24 | .66**<br>.44 | -.24**<br>.06 | .67**<br>.46 | -.69**<br>.48 | 1 |
| *Interpersonal Behavior Questionnaire Self* | | | | | | | | | | | |
| 1. Autonomy Support | 5.25 | .93 | .77 | .71 | $r$<br>$r^2$ | 1 | | | | | |
| 2. Autonomy Thwarting | 3.11 | 1.21 | .74 | .71 | $r$<br>$r^2$ | -.68**<br>.48 | 1 | | | | |
| 3. Competence Support | 5.90 | .86 | .85 | .75 | $r$<br>$r^2$ | .64**<br>.42 | -.28**<br>.08 | 1 | | | |
| 4. Competence Thwarting | 1.77 | .81 | .70 | .72 | $r$<br>$r^2$ | -.47**<br>.23 | .69**<br>.48 | -.39**<br>.16 | 1 | | |
| 5. Relatedness Support | 5.20 | .93 | .73 | .73 | $r$<br>$r^2$ | .71**<br>.50 | -.58**<br>.34 | .60**<br>.36 | -.59**<br>.34 | 1 | |
| 6. Relatedness Thwarting | 2.14 | 1.01 | .77 | .72 | $r$<br>$r^2$ | -.58**<br>.34 | .71**<br>.50 | -.27**<br>.07 | .65**<br>.42 | -.72**<br>.52 | 1 |

**Note:** M = Mean; SD = Standard Deviations; CR = Composite Reliability; AVE = Average Variance Extracted; r = correlation; $r^2$ = squared correlation; * $p$ <0.05; ** $p$ <0.01**;** *** $p$ <0.001

**Table 4. 4** – Nomological validity between IBQ and BPNSF-E

| Path | β | CI-95% |
|---|---|---|
| Autonomy Support →Autonomy Satisfaction | .27 | [.218., .330] |
| Autonomy Support →Autonomy Frustration | -.17 | [-.224., -.105] |
| Autonomy Support →Competence Satisfaction | .24 | [.161, .250] |
| Autonomy Support →Competence Frustration | -.04 | [-.100, .168] |
| Autonomy Support →Relatedness Satisfaction | .11 | [.116, .237] |
| Autonomy Support →Relatedness Frustration | -.10 | [-.120, .102] |
| Autonomy Thwarting →Autonomy Satisfaction | -.15 | [-.197, -.098] |
| Autonomy Thwarting →Autonomy Frustration | .24 | [.214, .311] |
| Autonomy Thwarting →Competence Satisfaction | -.25 | [-.168, -.265] |
| Autonomy Thwarting →Competence Frustration | .18 | [.064, .112] |
| Autonomy Thwarting →Relatedness Satisfaction | -.03 | [-.049, .131] |
| Autonomy Thwarting →Relatedness Frustration | .10 | [.188, .267] |
| Competence Support →Autonomy Satisfaction | .13 | [.078, .184] |
| Competence Support →Autonomy Frustration | -.09 | [-.285, -.038] |
| Competence Support →Competence Satisfaction | .19 | [.130, .208] |
| Competence Support →Competence Frustration | -.14 | [-.191, -.081] |
| Competence Support →Relatedness Satisfaction | .04 | [.039, .125] |
| Competence Support →Relatedness Frustration | .01 | [-.079, .030] |
| Competence Thwarting →Autonomy Satisfaction | -.14 | [-.189, -.044] |
| Competence Thwarting →Autonomy Frustration | .20 | [.144, .235] |
| Competence Thwarting →Competence Satisfaction | -.16 | [-.196, -.096] |
| Competence Thwarting →Competence Frustration | -.12 | [-.123, -.086] |
| Competence Thwarting →Relatedness Satisfaction | .09 | [.029, .242] |
| Competence Thwarting →Relatedness Frustration | -.05 | [-.108, -.002] |
| Relatedness Support →Autonomy Satisfaction | .13 | [.073, .195] |
| Relatedness Support →Autonomy Frustration | -.06 | [-.108, -.007] |
| Relatedness Support →Competence Satisfaction | .10 | [.150, .276] |
| Relatedness Support →Competence Frustration | .01 | [-.072, .032] |
| Relatedness Support →Relatedness Satisfaction | .18 | [.124, .220] |
| Relatedness Support →Relatedness Frustration | -.10 | [-.283, -.154] |
| Relatedness Thwarting →Autonomy Satisfaction | -.16 | [-.224, -.105] |
| Relatedness Thwarting →Autonomy Frustration | .04 | [.045, .184] |
| Relatedness Thwarting →Competence Satisfaction | -.14 | [-.134, -.033] |
| Relatedness Thwarting →Competence Frustration | .13 | [.077, .196] |
| Relatedness Thwarting →Relatedness Satisfaction | -.15 | [-.131, -.045] |
| Relatedness Thwarting →Relatedness Frustration | .22 | [.168, .265] |

**Note:** β = effect; CI-95% = Confidence Interval

**Table 4. 5** – Nomological validity between IBQ-SELF and BPNSF-E

| Path | β | CI-95% |
|---|---|---|
| Autonomy Support → Autonomy Satisfaction | .46 | [.608., .830] |
| Autonomy Support → Autonomy Frustration | -.22 | [-.615., -.296] |
| Autonomy Support → Competence Satisfaction | .40 | [.477, .691] |
| Autonomy Support → Competence Frustration | -.19 | [-.362, -.147] |
| Autonomy Support → Relatedness Satisfaction | .34 | [.416, .653] |
| Autonomy Support → Relatedness Frustration | -.25 | [-.561, -.297] |
| Autonomy Thwarting → Autonomy Satisfaction | -.26 | [-.431, -.236] |
| Autonomy Thwarting → Autonomy Frustration | .39 | [.531, .774] |
| Autonomy Thwarting → Competence Satisfaction | -.31 | [-.497, -.272] |
| Autonomy Thwarting → Competence Frustration | .44 | [.403, .562] |
| Autonomy Thwarting → Relatedness Satisfaction | -.26 | [-.425, -.228] |
| Autonomy Thwarting → Relatedness Frustration | .36 | [.391, .597] |
| Competence Support → Autonomy Satisfaction | .34 | [.341, .536] |
| Competence Support → Autonomy Frustration | -.22 | [-.497, -.232] |
| Competence Support → Competence Satisfaction | .39 | [.377, .556] |
| Competence Support → Competence Frustration | -.24 | [-.360, -.185] |
| Competence Support → Relatedness Satisfaction | .37 | [.379, .573] |
| Competence Support → Relatedness Frustration | -.27 | [-.488, -.270] |
| Competence Thwarting → Autonomy Satisfaction | -.25 | [-.500, -.265] |
| Competence Thwarting → Autonomy Frustration | .32 | [.482, .783] |
| Competence Thwarting → Competence Satisfaction | -.39 | [-.649, -.440] |
| Competence Thwarting → Competence Frustration | .62 | [.742, .907] |
| Competence Thwarting → Relatedness Satisfaction | -.32 | [-.599, -.367] |
| Competence Thwarting → Relatedness Frustration | .53 | [.757, .982] |
| Relatedness Support → Autonomy Satisfaction | .36 | [.479, .734] |
| Relatedness Support → Autonomy Frustration | -.21 | [-.636, -.287] |
| Relatedness Support → Competence Satisfaction | .20 | [.600, .826] |
| Relatedness Support → Competence Frustration | -.31 | [-.569, -.343] |
| Relatedness Support → Relatedness Satisfaction | .33 | [.432, .691] |
| Relatedness Support → Relatedness Frustration | -.28 | [-.661, -.376] |
| Relatedness Thwarting → Autonomy Satisfaction | -.18 | [-.320, -.124] |
| Relatedness Thwarting → Autonomy Frustration | .27 | [.315, .566] |
| Relatedness Thwarting → Competence Satisfaction | -.27 | [-.403, -.224] |
| Relatedness Thwarting → Competence Frustration | .41 | [.370, .528] |
| Relatedness Thwarting → Relatedness Satisfaction | -.24 | [-.399, -.205] |
| Relatedness Thwarting → Relatedness Frustration | .34 | [.335, .559] |

Note: β = effect; CI-95% = Confidence Interval.

**Table 4. 6** - Measurement invariance analysis between gender

| | x2 | df | Δ x2 | Δdf | *p* | CFI | ΔCFI | RMSEA | ΔRMSEA | SRMR | ΔSRMR |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Interpersonal Behavior Questionnaire (male-female)* | | | | | | | | | | | |
| Configural Invariance | 1183.782 | 474 | - | - | - | .923 | - | .042 | - | .042 | - |
| Metric Invariance | 1202.800 | 492 | 19.018 | 18 | .391 | .923 | .000 | .042 | .000 | .041 | .001 |
| Structural Invariance | 1234.754 | 513 | 50.972 | 39 | .095 | .922 | .001 | .041 | .001 | .040 | .002 |
| Residual Invariance | 1315.207 | 537 | 131.425 | 63 | <.001 | .915 | .008 | .042 | .000 | .039 | .003 |
| *Interpersonal Behavior Questionnaire Self (male-female)* | | | | | | | | | | | |
| Configural Invariance | 853.618 | 474 | - | - | - | .940 | - | .040 | - | .049 | - |
| Metric Invariance | 881.084 | 492 | 27.465 | 18 | <.001 | .939 | .001 | .040 | .000 | .049 | .000 |
| Structural Invariance | 1003.698 | 513 | 150.080 | 39 | <.001 | .936 | .004 | .036 | .004 | .048 | .001 |
| Residual Invariance | 1090.865 | 537 | 237.247 | 63 | <.001 | .931 | .009 | .035 | .005 | .047 | .002 |

Note: $\chi 2$ = chi-square; df = degrees of freedom; *p* = level of significance; CFI = Comparative Fit Index; ΔCFI = differences in CFI; RMSEA = Root Mean Squared Error of Approximation; ΔRMSEA = differences in RMSEA; SRMR = Standardized Root Mean Square Residual; ΔSRMR = differences in SRMR.

**Table 4. 7** – Measurement invariance between gender in IBQ and IBQ-Self

| | diference | *z* | *p* |
|---|---|---|---|
| *Interpersonal Behavior Questionnaire* | | | |
| Autonomy Support | -.03 | -.82 | .42 |
| Autonomy Thwarting | .02 | .37 | .71 |
| Competence Support | -.01 | -.16 | .87 |
| Competence Thwarting | -.02 | -.41 | .68 |
| Relatedness Support | .01 | .09 | .93 |
| Relatedness Thwarting | .01 | .17 | .86 |
| *Interpersonal Behavior Questionnaire Self* | | | |
| Autonomy Support | -.01 | -.35 | .72 |
| Autonomy Thwarting | -.04 | -.69 | .49 |
| Competence Support | .10 | 1.96 | .07 |
| Competence Thwarting | -.02 | -.44 | .66 |
| Relatedness Support | -.09 | -.195 | .06 |
| Relatedness Thwarting | .13 | 2.18 | .06 |

Note: z = z-scores; *p* = level of significance.

## Discussion

The aim of the present study was to translate the IBQ and the IBQ-Self in Portuguese and then examine the factorial structure and the nomological validity of both versions of the scale. In addition, we examined measurement invariance and latent mean differences in order to examine factor means between groups.

Our results suggest that the original measurement model for the six-factor solution assessing all interpersonal behaviors according to the SDT framework did fit well the Portuguese versions of both the IBQ and the IBQ-Self in both samples of exercisers and exercise physiologists, respectively. Regarding the internal consistency, the results of the present research showed that all factors coefficients for both scales had good levels of internal consistency (Hair et al., 2014), and that these coefficients were similar to the ones found in original studies (Rocchi et al., 2016; Rocchi et al., 2017). All factors displayed adjusted convergent validity (AVE > .50). Also, all factor loadings in the 24-item version were significant, they were loading on their respective factor and no cross-loadings were detected, suggesting acceptable convergent validity (e.g., Byrne, 2010; Hair et al., 2014). In addition, discriminant validity was achieved since squared correlations among subscales showed scores below AVE. The results of the CFA revealed that the three supporting behaviors were negatively correlated with the three thwarting behaviors. Similarly, covariances among supporting factors as well as covariances among thwarting factors were positive and significant, suggesting that each supporting and each thwarting factors were significantly distinct from each other (Hair et al., 2014). Overall, these results are in agreement with the theoretical framework proposed by SDT, and recent empirical studies on supportive and thwarting interpersonal behaviors (Rocchi et al., 2017).

### Nomological Validity

The CFA model exhibited good fit indices for both the IBQ and the IBQ-Self (e.g., Byrne, 2010; Hair et al., 2014). In addition, SEM showed good fit to the data and provided support for the nomological validity between interpersonal behaviors constructs and BPN satisfaction and frustration. Significant predictions were found between construct under analysis in both scales. Supporting behaviors displayed positive correlations with BPN satisfaction and negative correlations with BPN frustration. Thwarting behaviors showed positive and significant correlations with BPN frustration and significant negative correlations to satisfaction of BPN. These results are very similar to the ones reported by Rocchi et al. (2017) that showed that the satisfaction and the frustration of BPNs are specifically related to their corresponding perceived interpersonal behaviors.

### Measurement Invariance and latent mean differences

The 24-item model was invariant between male and female exercisers, in IBQ and IBQ-Self. All invariance assumptions were met according to several authors (e.g., Byrne, 2010; Chen, 2007) for measurement invariance between sample groups and gender.

Our study found no significant differences in terms of latent means between samples in

the IBQ and IBQ-Self. This means that both genders perceived similar levels of interpersonal behaviors, and that these levels were independent of being exercisers or exercise physiologists. In other words, these results suggest that males and females appear to experience the practice of exercise in a similar manner. In sum, these results support the effectiveness of the IBQ and the IBQ-Self for the assessment of supportive and thwarting interpersonal behaviors with exercisers and exercise physiologists.

## Conclusion

### Limitations

Despite our research being based on a strong theoretical framework, the present studies have some limitations. First, the present research was the first attempt to translate the IBQ and the IBQ-Self scales into a different language (Portuguese) and to validate the scales in the exercise context. Therefore, our findings cannot be generalized to other countries or to other contexts, as more studies are necessary to establish the validity of the scales in different contexts and with different cultures. However, the original 24-item model exhibited acceptable fit, showing similar results reported by Rocchi et al. (2016; 2017). This means that Portuguese participants have interpreted similarly the meaning of supportive and thwarting interpersonal behaviors when compared to Canadian participants (native English language).

Second, although we found solid relationships between supporting interpersonal behaviors and BPN's satisfaction and thwarting behaviors with BPN's frustration, there are other determinants of interpersonal behaviors that should still be investigated further. For instance, a recent study done with the IBQ and the IBQ-Self has shown that autonomous motivation reported by coaches may lead to more supporting behaviors (e.g., Rocchi & Pelletier, 2018). However, this needs to be tested in exercise context.

In addition, in that recent study, Rocchi and Pelletier (2018) examined the relationship between coaches' self-reports of their interpersonal behaviours, and athletes' perceptions of these same behaviours. Specifically, the authors examined whether coaches and athletes were in agreement or disagreement and explored whether having an agreement or

disagreement between coaches and athletes had any impact on athletes' need satisfaction and dissatisfaction. Also, this study examined whether there are any coach characteristics that can explain whether coaches are in agreement or not with their athletes. Rocchi and Pelletier (2018) found support for a match in nearly 1/3 of the cases, supporting that for those pairs of coaches and athletes, the athlete perceives what the coach reports they do. In the cases where there was a match, or where the athlete rated the coach more favourably than the coach rated themselves, this was associated with increased need satisfaction on the need-supportive factors, and decreased need dissatisfaction for the need-thwarting factors. In the instances where coaches rated themselves more positively than their athletes reported them (i.e., more need-supportive and less need-thwarting than perceived by the athletes), this had no impact on athletes' need satisfaction and dissatisfaction. Again, in exploring the factors that lead coaches to inflate their positive behaviour, the authors observed that only coaches' autonomous motivation for coaching predicted that they were less likely to positively inflate their behaviours. We think that these results could have important implications for a context like physical activity and that exercise professionals' self-perception and exercisers perception of their behaviors needs to be examined further to determine the level of agreement between the groups. When compared to exercisers, exercise professionals may overestimate (or underestimate) their supporting behaviors, and this may affect the extent to which this affects the exercisers' motivation (Rocchi & Pelletier, 2018).

## Practical Implcations

In sum, overall our results provide support for the construct validity of the original 24-Item IBQ and IBQ-Self, adding new evidence for the construct distinctiveness of supporting and thwarting interpersonal behaviors. The present work reinforces the importance of assessing exercisers perceived interpersonal behaviors, since they are predictors of BPN satisfaction and frustration, ultimately forecasting behavioral regulations towards exercising.

The fitness industry should use current scales in gym and health clubs to measure exercisers perception of fitness professionals use of supportive and thwarting behaviors as a way to understand how gym clients feel when exercising. In addition, measuring exercise physiologists self-perceived behaviors is relevant, since self and other-perception of interpersonal behaviors do not always align, as shown in previous literature (Rocchi & Pelletier, 2018). Analyzing fitness professionals' behaviors in advance could give club managers the necessary tools to create adequate training programs so exercise physiologist would use more supportive behaviors and hinder thwarting conducts.

# Chapter 6

# Self-report and other perceptions of interpersonal behaviors: the effects of agreement on exercisers' psychological needs using polynomial regression analysis


## Abstract

The aim of the present research is to compare fitness professionals' self-reports of their interpersonal behaviors towards individual exercisers and exercisers' perceptions of their trainer's interpersonal behaviors, and analyze the effects of the levels of agreement/disagreement on exercisers basic need satisfaction and frustration, using polynomial regression analysis with response surface methodology. A total of 130 fitness professionals (87 males; 43 females) aged 19 to 65, and a total of 640 gym exercisers (290 males; 350 females) aged 18 to 65 years participated in this study. Current findings show that the majority of fitness professionals tended to overreport their need supportive interpersonal and underreport their need thwarting interpersonal behaviors. In general, the level of in-agreement behaviors was nearly 30%. Results showed that when there was agreement between fitness professionals and exercisers perception of interpersonal behaviors, basic needs satisfaction tended to increase, however this effect was greater for exercisers that rated their trainer high on relatedness support. Fitness professionals should be self-aware of their interpersonal behaviors when engaging with exercisers, and interventions based on self-determination theory could represent a promising avenue to improve the quality of exercisers experience. Finally, polynomial regression analysis with response surface methodology seems to be a powerful statistical analysis in order to compare interpersonal behaviors from different perspectives and to examine how the levels of agreement between the different sources could be used to predict basic needs satisfaction and frustration.



**Key-words:** interpersonal behavior; basic psychological needs; exercise psychology; polynomial regression; response surface methodology.

# Introduction

## Theoretical framework

Exercisers often rely on fitness professionals to guide them and motivate them in their practice of physical activity (Ntoumanis, 2012). Through their interactions with the exercisers, fitness professionals create a context that could lead to increased satisfaction, better performances and more persistence over time (Ntoumanis, Thogersen-Ntoumani, Quested, & Hancox, 2017). Fitness professionals can also create a context that could have negative effects, that undermine the exercisers' experience and that can lead to decreased satisfaction and dropout (Rodrigues et al., 2018). The quality of the exercisers' experience is therefore highly contingent on the climate created by their fitness professional. One theory that has been useful to explain how interpersonal behaviors could have positive or negative effects of motivation and the quality of exercisers' experience is Self-Determination Theory (SDT; Ryan & Deci, 2017). This theory widely used in contexts like education (Grangeia et al., 2016), physical education (Standage, Duda, & Ntoumanis, 2005), sports (Rocchi & Pelletier, 2017), and exercise (Ntoumanis, Thogersen-Ntoumani, Quested, & Hancox, 2017), proposed that the interpersonal behaviors of a person in a supervising role could have an impact on a subordinate's motivation through the satisfaction or the thwarting of three basic psychological needs (BPN): autonomy, competence, and relatedness.

Still according to this theoretical framework, these six types of interpersonal behaviors affect the extent to which individuals perceive that their three BPN are satisfied or frustrated. According to Chen et al. (2015) there are six types of BPN, directly associated with their respective need supportive or thwarting interpersonal behaviors: autonomy satisfaction (i.e., the perception of individual control on own behavior); competence satisfaction (i.e., the experience of efficiency and capacity to improve skills); relatedness satisfaction (i.e., the need to develop emotional interactions with others); autonomy frustration (i.e., the perception of external or self-imposed constrains), competence frustration (i.e., self-doubt to act efficiently with the environment); and, relatedness frustration (i.e., the experience of feeling exclusion and loneliness). It is worth mentioning that satisfaction and frustration are distinct construct, since low levels of needs satisfaction is not necessarily related to high levels of needs frustration (Bartholomew, Ntoumanis, Ryan, & Thogersen-Ntoumani, 2011).

Needs' satisfaction and/or needs' frustration are based on how the individual perceives actively the social context (Vansteenkiste & Ryan, 2013). That is, exercisers' BPN are result on how they perceive supportive and/or thwarting behaviors. Thus, when individuals

perceive that needs are satisfied, they experience autonomous motivation, that is a form of motivation where individuals enjoy practicing an activity, they want to improve their skills and fitness, and they choose to train (Mageau & Vallerand, 2003). In opposition, when individuals perceive that their needs are thwarted or frustrated, they experience controlled motivation, that is a motivation where they feel coerced or pressured, they do an activity to obtain a reward, or to avoid disappointing others (Sheldon & Filak, 2008).

In sum, when individuals experience supporting interpersonal behaviors, their BPN are satisfied and they experience a form of motivation that is more autonomous, and this form of motivation leads to positive outcomes (Rocchi & Pelletier, 2018). Conversely, when individuals experience thwarting behaviors, their BPN are frustrated, they experience a form of motivation that is controlled, and that form of motivation leads to negative outcomes (Rocchi, Pelletier, Cheung, Baxter, & Beaudry, 2017). Therefore, according to SDT, fitness professionals can influence the satisfaction and frustration of exercisers' BPN that they train, and depending on how exercisers perceive their interpersonal behaviors, which will impact their motivation and the quality of their training experience.

### Self-report versus perceptions of interpersonal behaviors

Past literature on the effects of interpersonal behaviors on the BPN and motivation has typically considered that the person in key position (e.g., coaches, supervisors, teachers, bosses, fitness professionals) self-reported use of needs satisfaction (or frustration) interpersonal behaviors were the same as the subordinates' perceptions of the same interpersonal behaviors (Ntoumanis, 2012). However, recent research suggest that it may not always be the case (Rocchi & Pelletier, 2018). In the context of sport for example, coaches may have a tendency to overreport their own behavior by evaluating it more positively or evaluating it less negatively than they actually are (Gjesdal, Stenling, Solstad, & Ommundsen, 2018; Rocchi & Pelletier, 2018) . Also, when coaches report on their interpersonal behavior, they typically report how they behave in general not in regard to how they behave with each of their athletes individually. Reporting on how a coach or a trainer behaves interpersonally in general may be problematic because their perception of their behavior in general may not be representative of how they treat each individual more specifically. For example, individuals, like athletes or exercisers, may have characteristics (e.g., personality, level of competence) or motivational orientation that could affect how coaches or fitness professionals treat each individual more specifically. For instance, past research suggest that person in key position may be more autonomy supportive when dealing with subordinates that are intrinsically motivated but they become more controlling when dealing with subordinates that are extrinsically motivated (Pelletier & Vallerand, 1996). Finally, although coaches may over-report sometimes their positive interpersonal

behaviors (and under-report their negative behaviors), SDT research generally considers that athletes' perceptions of their coaches' behaviors are more important than their actual coaches' behaviors (Horn, 2002) as long as the athletes' perceptions of their coaches' interpersonal behaviors are positive. That is, when athletes perceive that their coaches are supportive of their needs, athletes should experience needs satisfaction, autonomous motivation, and, as a consequence, positives outcomes (Blanchard, Amiot, Perreault, Vallerand, & Provencher, 2009). However, these studies have measured the independent effect of interpersonal behaviors, although supporting and thwarting behaviors may co-occur in a given context (Gjesdal et al., 2018).

A recent study conducted by Rocchi and Pelletier (2018) has raised some limitations with this analysis. Assessing coaches supportive and thwarting interpersonal behaviors when dealing individually with each athlete (the Interpersonal Behavior Questionnaire – Self; IBQ-self), and a scale measuring how each athlete perceived the same interpersonal behaviors in their coaches (the IBQ), the authors reported that the level of agreement between coaches and athletes mattered. Their results suggested that nearly 30% of coaches may overreport their need supportive behaviors and underreport their need thwarting behaviors. Moreover, about 30% may do the opposite (i.e., underreport their need supportive behaviors and over-report their need thwarting behavior), while about 30% of the coaches may report levels of both behaviors that correspond to the levels reported by their athletes. According to Rocchi and Pelletier (2018), and in agreement with SDT, when coaches and athletes' perception of supportive behaviors were high, athletes experienced BPN satisfaction. However, when the authors examined the consequences of the levels of agreement and disagreement behaviors, athletes with coaches who underreported their need supportive behaviors (and over-reported their need thwarting behaviors) experienced additional need satisfaction and less need frustration. In contrast, athletes with coaches who overreported their need supportive behaviors (and under-reported their need thwarting behaviors) perceived less need satisfaction and more need frustration. Results from Rocchi and Pelletier's (2018) study have crucial implications regarding behavioral regulation towards training, since higher levels of BPN satisfaction are related to higher percentage of athletes' sports persistence (Pelletier, Fortier, Vallerand, & Brière, 2001). On the other hand, BPN frustration athletes experience during sport participation are strongly associated with drop-out (Bartholomew, Ntoumanis, Ryan, Bosch, & Thogersen-Ntoumani, 2011; Jowett et al., 2017). Nevertheless, the study conducted by Rocchi and Pelletier (2018) had some limitations. First, their research included only women athletes. Second, it was context specific (i.e., sports), preventing from drawing conclusions to other domains. Third, their study was conducted with a homogenous sample of Canadian athletes. Because to date no

study has replicated their methodology in different contexts, it is not clear if their conclusion applies to the exercise context, to a population composed of men and women, and to people with a different cultural background.

Also, to the best of our knowledge, only this one study (Rocchi & Pelletier, 2018) measured the levels of agreement between coaches' self-report and athletes perceptions of coaches' interpersonal behaviors and examine the effect of the level of agreement of the two perspectives on BPN satisfaction and frustration, using Polynomial Regression (PR) analysis with Response Surface Methodology (RSM). PR with SRM analysis considers both the independent as well as the interaction of two distinct but similar variables on one dependent outcome (Edwards, 2007). This methodology has been used in several other studies (Benson, Eys, & Irving, 2016; Brunet, Gunnell, Gaudreau, & Sabiston, 2015; Gjesdal et al., 2018; Utesch, Dreiskamper, Naul, & Geukes, 2018) to assess different outcomes, however, these studies measured latent constructs in only one group (e.g., students, athletes). Understanding how fitness professional's interpersonal behavior impacts BPN in exercisers using PR with SRM could give relevant insight on how to promote BPN satisfaction and avoid BPN frustration, as a way to increase exercise adherence (Ntoumanis et al., 2017).

## Current Research

Therefore, the aim of the present research is to address the limitations of the existing literature by exploring the relationship between fitness professionals self-report of their interpersonal behaviors and exercisers perceptions of fitness professionals' interpersonal behaviors. This study has two objectives: 1) compare fitness professionals' self-reports of their interpersonal behaviors towards specific individual exercisers and exercisers' perceptions of their trainer's interpersonal behaviors, and analyze the level of agreement/disagreement between trainers and exercisers for all six types of interpersonal behaviors; 2) examine the effects of the levels of agreement between trainers and exercisers regarding supporting and thwarting behaviors on exercisers BPN satisfaction and BPN frustration using PR analysis with RSM.

For the first objective, based on available literature (Rocchi & Pelletier, 2018) we hypothesized that fitness professionals and exercisers' perception of interpersonal behaviors' would be equally distributed across three different behavior patterns (i.e., over-reporting, under-reporting, and in-agreement).

For the second objective, in agreement with the results reported by (Rocchi & Pelletier, 2018), agreement between fitness professionals and exercisers should lead to increased

exercisers' BPN satisfaction; over-report of needs supportive and under-report of needs thwarting behaviors should lead to less needs satisfaction and more needs frustration; while under-report of needs supportive and over-report of needs thwarting behaviors should lead to more needs satisfaction and less needs thwarting.

# Methods

## Participants

A total of 130 fitness professionals or trainers (43 females) aged 19 to 65 years (M = 31.58; SD = 7.65) participated in this study. According to their academic background, 14.6% had a trainer certification for exercise prescription; 51.5% had bachelor degree, 30.8% had master degree, and 3.1% had doctoral degree. Exercise prescription experience ranged from 6 months to 480 months (M = 88.54; SD = 77.89).

Regarding exercisers, 640 individuals (350 females) aged 18 to 65 years (M = 34.23; SD = 11.59) participated in this study. Exercise experience ranged from 6 to 120 months (M = 56.34; SD = 10.81) The number of training sessions per week ranged from 2 to 6 (M = 2.67; SD = .76) and the training periods lasted between 30 and 90 minutes (M = 60.17; SD = 14.98). Exercisers were enrolled in fitness group classes (e.g., Pilates, Crosstraining, Pump) and/or in cardio-resistance training.

In order to be eligible for this study, fitness professionals needed to be hired workers at a gym during this study. For exercisers to be eligible, they needed to be 18 years or older, they had to be training for more than 6 months, train at least 2 times per week, and train with the same fitness professionals under analysis for at least 4 months.

## Procedure

Approval for this study was obtained from the Ethical Committee with the registration number CE-UBI-pJ-2018-044:ID683. Researchers contacted gym managers to grant permission to conduct present research. At this stage, the objectives of the study were explained and endorsement from each participant was obtained. Fitness professionals were asked prior to training session to report the ways they interacted with one specific exerciser by completing the IBQ-self for each exerciser individually. Exercisers were asked to report before training session their perceptions of the corresponding fitness professional interpersonal behaviors using the IBQ in a general experience. Lastly, fitness professionals and their respective exercisers were contacted before their work or training session. Confidentiality was guaranteed and all subjects signed informed consent before filling out the survey. Time taken to complete questionnaires was approximately 12 minutes.

## Instruments

Fitness professionals and exercisers completed the Portuguese version of the Interpersonal Behavior Questionnaire (IBQ-Self and IBQ) (Rocchi et al., 2017) in the context of exercise (Rodrigues et al., 2019). Both 24-item scales measure all six types of interpersonal behaviors according to SDT, that is, 12 items (i.e., 4 items per needs for autonomy, competence, and relatedness) representing need supporting behaviors and 12 items (i.e., 4 items per needs for autonomy, competence, and relatedness) representing need thwarting behaviors. The IBQ-Self measures how fitness professionals perceive their own behaviors when they interact with an exerciser, and the IBQ measures how exercisers perceive their fitness professional supporting and thwarting behaviors. The participants rated the items on a Likert-type scale ranging from 1 ("Do not agree at all") to 7 ("totally agree"). Composite Reliability (CR) coefficient in current study were above acceptable (Raykov, Gabler, & Dimitrov, 2015) for IBQ (CR = .77) and IBQ-Self (CR = .81)

Exercisers completed also the Basic Psychological Need Satisfaction and Frustration Scale (Chen et al., 2015) Portuguese version adapted to the context of exercise (Rodrigues, Hair, et al., 2019). This scale is composed by 24 items (4 items for the 6 factors), that measure satisfaction and/or frustration of the BPN. Exercisers responded on a Likert-type scale ranging from 1 ("totally disagree") to 5 ("totally agree") according to their perceived feelings during training session and during exercise prescription. The coefficient for CR in present study for this scale was above cutoffs (CR = .75).

## Statistical Analysis: Interpersonal Behaviors Agreement/Disagreement

For objective 1, the level of agreement between fitness professionals and exercisers ratings of the six dimensions of interpersonal behaviors was calculated in order to determine which behaviors between fitness professionals and exercisers were in agreement or not. This was done for all supporting and thwarting behaviors, following the same procedures described in previous studies (Fleenor, McCauley, & Brutus, 1996; Gjesdal et al., 2018; Rocchi & Pelletier, 2018). All factors related to interpersonal behaviors were standardized (z-scores) as suggested by Fleenor et al. (1996). Afterwards, exercisers scores were subtracted from the fitness professionals' scores, following same criteria as several authors (Atwater, Ostroff, Yammarino, & Fleenor, 2006; Atwater & Yammarino, 1992), in order to determine: i) the percentages of behaviors in agreement (i.e., less than one half standard deviation between both groups scores); ii) the percentages of over-reporting behaviors (i.e., average scores of instructors' behaviors are one half standard deviation above exercisers perception), or; iii) the percentages of under reporting behaviors (i.e., average scores are below on half standard deviation). Exercisers ratings were chosen as the criterion for determining agreement since according to Atwater and Yammarino (1992), perceptions from subordinates may be the

utmost reliable measure of leaders' behaviors. In a following step, descriptive analysis was conducted in order to measure discrepancy across all three behaviors.

### Statistical Analysis: Polynomial Regression with Response Surface Methodology

For objective 2, PR were conducted in order to examine the effect of the levels of agreement between self-reported interpersonal behaviors from fitness professionals and exercisers perceptions of interpersonal behaviors, on exercisers' BPN. This statistical analysis is a potentially useful but far overlooked approach in analyzing associations of two independent variables on predicting a dependent variable (Edwards, 2007). RSM explores the congruence of two distinct but similar predictors using a three-dimensional model based on PR coefficients (Shanlock, Baran, Gentry, Pattison, & Heggestad, 2010). This type of analysis assesses two crucial aspects: convergence (i.e., when scores on each dimension are essentially equal), and differentiation (i.e., high scores on one dimension but low on another).

For conducting PR and RSM, more than 10% of discrepancy is needed according to Edwards (2007) recommendations. Interpersonal behavior factors from both groups were first centered at scale midpoint as separate predictors (x1 and x2), along with the squared of these centered predictors (x3 and x4), and the product of both predictors (x5). According to several authors (Cohen, Cohen, West, & Aiken, 2003), centering both predictors reduces multicollinearity. In addition, Variance Inflation Factor was considered for possible multicollinearity issues, accepting scores >5 (Fox, 2016). In the second step, regression coefficients were transformed into four surface scores (a1, a2, a3, a4) using Kazén and Kuhl (2011) formulas. These values were used to examine the degree of agreement and differentiation, and the direction of the differentiation between interpersonal behaviors from fitness professionals and exercisers related to each basic need. Based on those values and to aid interpretations, a three-dimensional model of each regression was created (see Table 5.1 for interpreting each surface value).

**Table 5. 1** – Surface values, formulas, meaning and interpretations

| Value | Formula | Meaning | Interpretation |
|---|---|---|---|
| $a_1$ | $x_1 + x_2$ | Reflects the linear relationship between the degree of agreement between behaviors and the outcome | + $a_1$ = as the degree of agreement between IBF and IBE increases so does the outcome; - $a_1$ = as the degree of agreement between IBF and IBE decreases so does the outcome. |
| $a_2$ | $x_3 + x_4 + x_5$ | Reflects the non-linear relationship between the degree of agreement between behaviors and the outcome | + $a_2$ = as the effect of agreement between IBP and IBE becomes more pronounced at higher levels of agreement; - $a_2$ = as the effect of agreement between IBP and IBE diminishes at higher levels of agreement. |
| $a_3$ | $x_1 - x_2$ | Reflects how the direction of the differentiation between behaviors is related to the outcome | + $a_3$ = higher IBF relative to IBE is associated with higher scores on the outcome; - $a_3$ = higher IBF relative to IBE is associated with lower scores on the outcome. |
| $a_4$ | $x_3 - x_4 + x_5$ | Reflects how the degree of differentiation in behaviors is related to the outcome | + $a_4$ = a greater positive differentiation between IBF and IBE (i.e., IBF is higher than IBE) is associated with higher scores on the outcome; - $a_4$ = a greater positive differentiation between IBF and IBE (i.e., IBF is lower than IBE) is associated with lower scores on the outcome. |

**Note:** IBF = Interpersonal Behavior Fitness Professional; IBE = Interpersonal Behaviors Exercisers.

# Results

## Interpersonal Behaviors Agreement/Disagreement

No univariate outliers were found when examining the data. Missing data was found in seven exercisers (less than 3%), and data was imputed using regression procedures in SPSS Statistics v. 23. The descriptive statistics for all study variables are summarized in Table 5.2.

In Table 5.3 are represented the frequencies of all behaviors, including the over-reporting, under-reporting, and in-agreement means. Current findings show that a higher percentage of fitness professionals tend to over-report in all behaviors, except for relatedness support. In general, the means range from 30-40% and the level of in-agreement behaviors are approximately 30%. Discrepancy was over 10% in all behaviors, presenting conditions to perform PR analysis.

## Polynomial Regression with Response Surface Methodology

VIF scores were below cutoffs (3.67) suggestion on problems of multicollinearity. Results from PR analyses and response surface values on exercisers need satisfaction and

frustration are shown in Table 5.4. Results from all analysis undertaken supported that the regression models were significant and explained variance that ranged from 18% (autonomy thwarting) to 31% (competence support) in athletes reported autonomy, competence, and relatedness satisfaction and frustration.

The surface testing scores for the role of autonomy, competence and relatedness supporting behaviors on each need satisfaction (Figure 5.1, 5.3, and 5.5), showed that when there was agreement between trainers' self-report of their behaviors and exercisers perception of interpersonal behaviors, BPN satisfaction tended to increase (significant positive a1 score). This effect was greater for exercisers that rated their fitness professional high on relatedness support (significant positive a2 score). As seen in Figure 5.1-5.3, if fitness professionals were underrating their own interpersonal behaviors (exercisers perception is above trainers self-reported scores), exercisers experienced further satisfaction for each need (significant negative a3 score).

Regarding the effects of autonomy, competence and relatedness thwarting on exercisers BPN frustration (Figure 5.2, 5.4, and 5.6), when trainers and exercisers were in agreement and self-reported and perceived behaviors increased, so did need frustration (significant positive a1 score). The effects were similar for exercisers who rated their respective fitness professional higher on autonomy and relatedness thwarting behaviors than the fitness professionals themselves (significant positive a2 score). However, when there was a disagreement and that fitness professionals were underreporting the need thwarting behaviors, exercisers BPN frustration was even higher (significant negative a3 score). Furthermore, as self-reported and perceived autonomy and relatedness thwarting increased, so did exercisers autonomy and relatedness frustration, respectively (significant positive a4 score).

**Table 5. 2** – Descriptive statistics of all study variables

| | Fitness Professionals | | | Exercisers | | |
|---|---|---|---|---|---|---|
| | M | SD | Range | M | SD | Range |
| Autonomy Support | 5.09 | .08 | 1 – 7 | 5.28 | .94 | 1 – 7 |
| Autonomy Thwarting | 3.67 | 1.05 | 1 – 7 | 3.39 | 1.40 | 1 – 7 |
| Competence Support | 6.27 | .56 | 1 – 7 | 5.95 | .86 | 1 - 7 |
| Competence Thwarting | 1.77 | .75 | 1 – 7 | 1.71 | .94 | 1 – 7 |
| Related Support | 5.74 | .07 | 1 – 7 | 5.28 | .91 | 1 – 7 |
| Relatedness Thwarting | 1.58 | .59 | 1 – 7 | 2.01 | 1.04 | 1 – 7 |
| Autonomy Satisfaction | - | - | - | 4.05 | .59 | 1 – 5 |
| Autonomy Frustration | - | - | - | 1.82 | .75 | 1 – 5 |
| Competence Satisfaction | - | - | - | 4.01 | .71 | 1 – 5 |
| Competence Frustration | - | - | - | 1.62 | .64 | 1 – 5 |
| Relatedness Satisfaction | - | - | - | 4.26 | .55 | 1 – 5 |
| Relatedness Frustration | - | - | - | 1.89 | .77 | 1 – 5 |

**Table 5. 3** – Frequencies of agreement/disagreement interpersonal behaviors

| Groups | % | Mean Fitness Professionals | Mean Exercisers |
|---|---|---|---|
| *Autonomy Support* | | | |
| Under-report | 37.0 | 4.54 | 6.05 |
| Agreement | 25.4 | 5.01 | 5.16 |
| Over-report | 37.6 | 5.69 | 4.61 |
| *Autonomy Thwarting* | | | |
| Under-report | 35.4 | 2.82 | 4.32 |
| Agreement | 27.4 | 3.84 | 3.62 |
| Over-report | 37.2 | 4.34 | 2.33 |
| *Competence Support* | | | |
| Under-report | 33.9 | 5.86 | 6.52 |
| Agreement | 25.8 | 6.38 | 6.04 |
| Over-report | 40.3 | 6.67 | 5.21 |
| *Competence Thwarting* | | | |
| Under-report | 30.9 | 1.28 | 2.64 |
| Agreement | 33.5 | 1.49 | 1.43 |
| Over-report | 35.6 | 2.46 | 1.17 |
| *Relatedness Support* | | | |
| Under-report | 36.0 | 5.17 | 5.93 |
| Agreement | 30.5 | 5.74 | 5.32 |
| Over-report | 33.5 | 6.27 | 4.65 |
| *Relatedness Thwarting* | | | |
| Under-report | 32.7 | 1.22 | 3.03 |
| Agreement | 33.3 | 1.357 | 1.61 |
| Over-report | 34.0 | 2.18 | 1.41 |

**Table 5. 4** – Explained variance, surface values and regression coefficients

| | Variance | Surface values | | | | Regression coefficients | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $r^2$ | $a_1$ | $a_2$ | $a_3$ | $a_4$ | $x_1$ | $x_2$ | $x_3$ | $x_4$ | $x_5$ |
| Autonomy Support | .30 | .69* | .09 | -.65* | .07 | .02(.02)[-.12, .10] | .67(.03)*[.56, .72] | -.03(.02)[-.07, .12] | .11(.04)*[.02, 20] | .01(.01)[-.03, .16] |
| Autonomy Thwarting | .18 | .28* | .15 | -.40* | .11 | -.06(.05)[-.11, 02] | .34(.06)*[.27, 44] | -.04(.09)[-.13,05] | .02(.02)[-.04, .10) | .17(.01)*[.11, .27] |
| Competence Support | .31 | .60* | .05 | -.74* | -.03 | -.07(.03)[-.10, .07] | .67(.09)*[.51, .77] | -.06(.04)[-.10, .05] | .07(.03)[-.01, .11] | .04(.01)[-.03, .09] |
| Competence Thwarting | .24 | .80* | .17* | -.40* | .15* | .20(.08)*[.12, .31] | .60(.07)*[.50, .69] | .07(.04)[-.04, .11] | .09*(.03)[.01, .17] | .01(.01)[-.8, .14] |
| Related Support | .28 | .35* | .14* | -.45* | -.04 | -.05(.02)[-.11, .09] | .40(.05)*[.28, .49] | -.05(.03)[-.09, .12] | .10(.02)*[.06, .21] | .09(.06)*[.05, .17] |
| Relatedness Thwarting | .29 | .68* | .25* | -.32* | .19* | .18(.01)*[.11, .27] | .50(.02)*[.40, .63] | .01(.01)[-.02, .010] | .12(.05)*[.10, .20] | .03(.03)[-.04, .09] |

Note. ß = unstandardized beta coefficient; () = errors. [] = 95% confidence intervals. * p < .05.

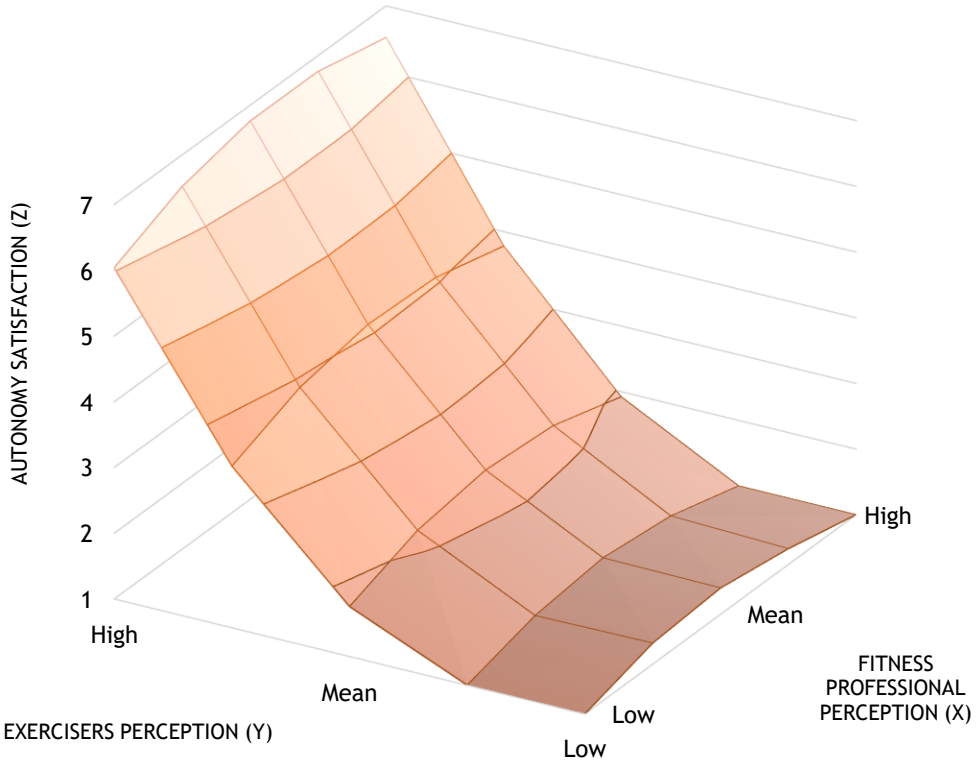



**Figure 5. 1** – Autonomy Support on Autonomy Satisfaction

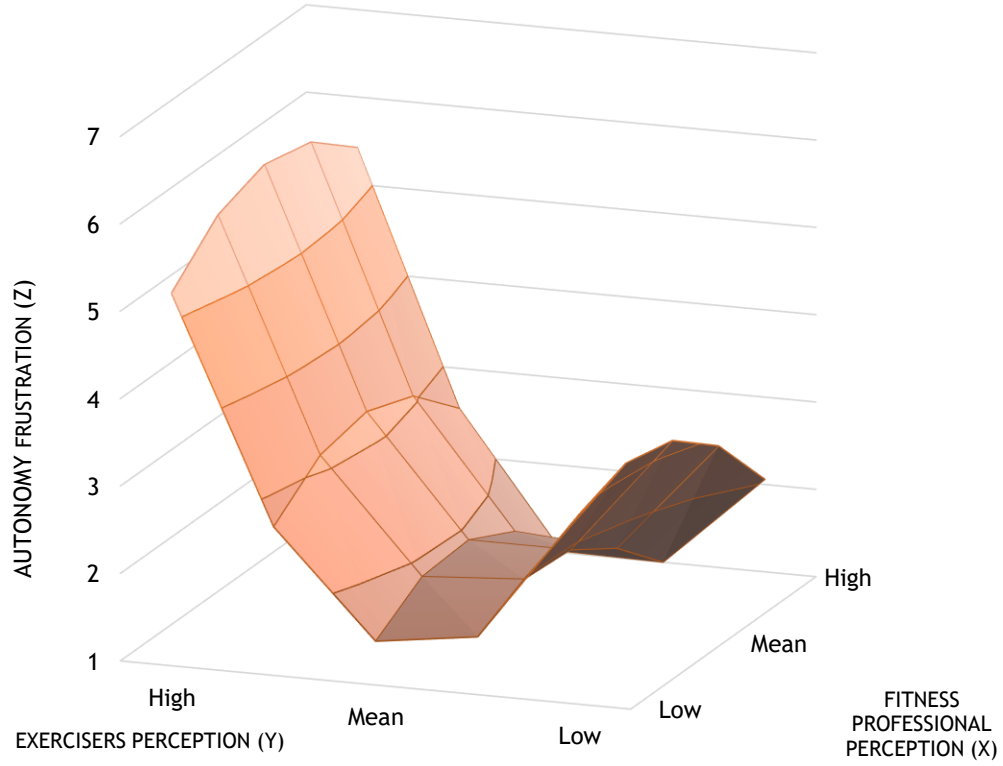



**Figure 5. 2** - Autonomy Thwarting on Autonomy Frustration

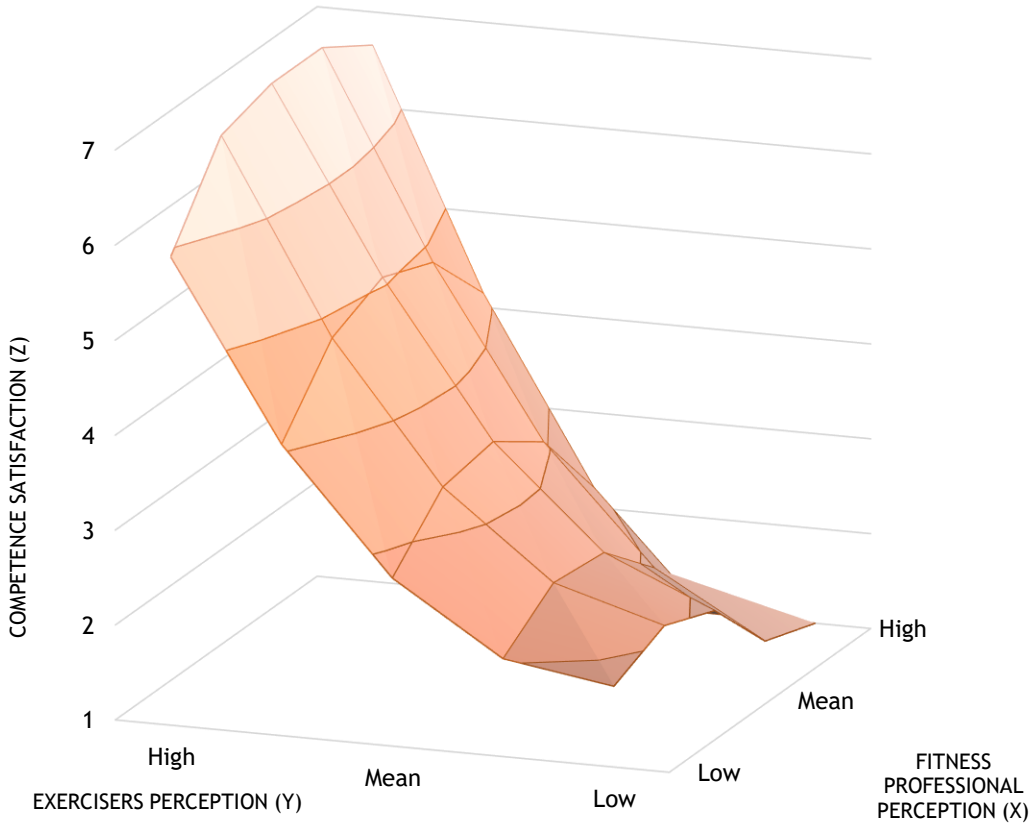



**Figure 5. 3** - Competence Support on Competence Satisfaction

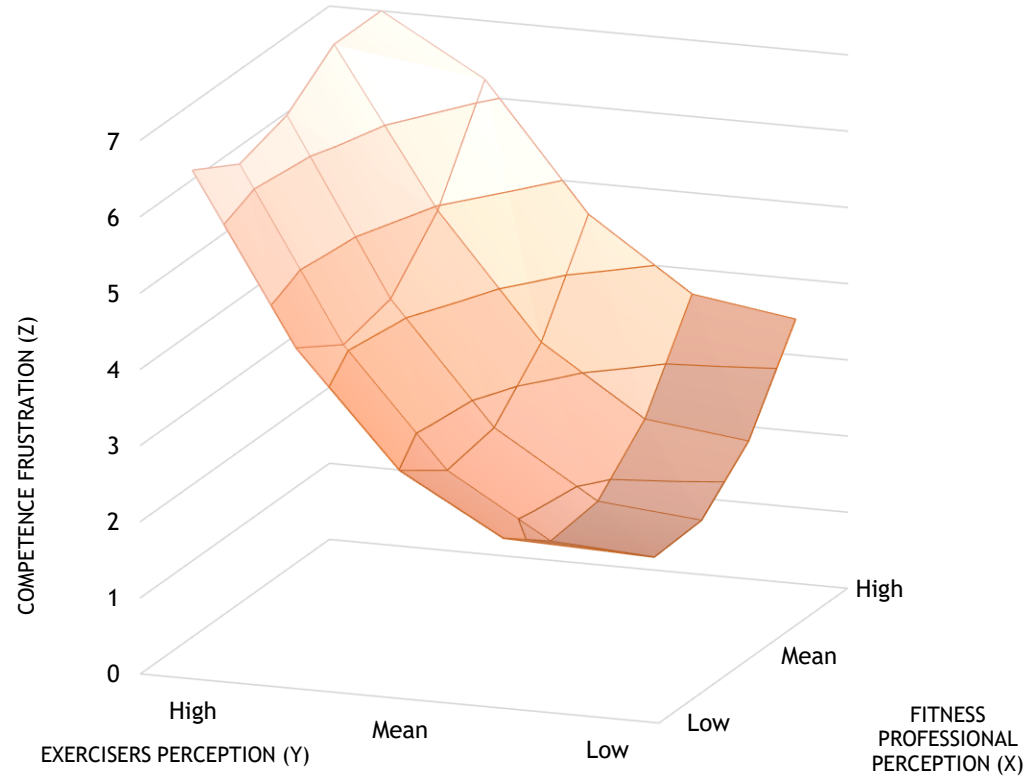



**Figure 5. 4** – Competence Thwarting on Competence Frustration

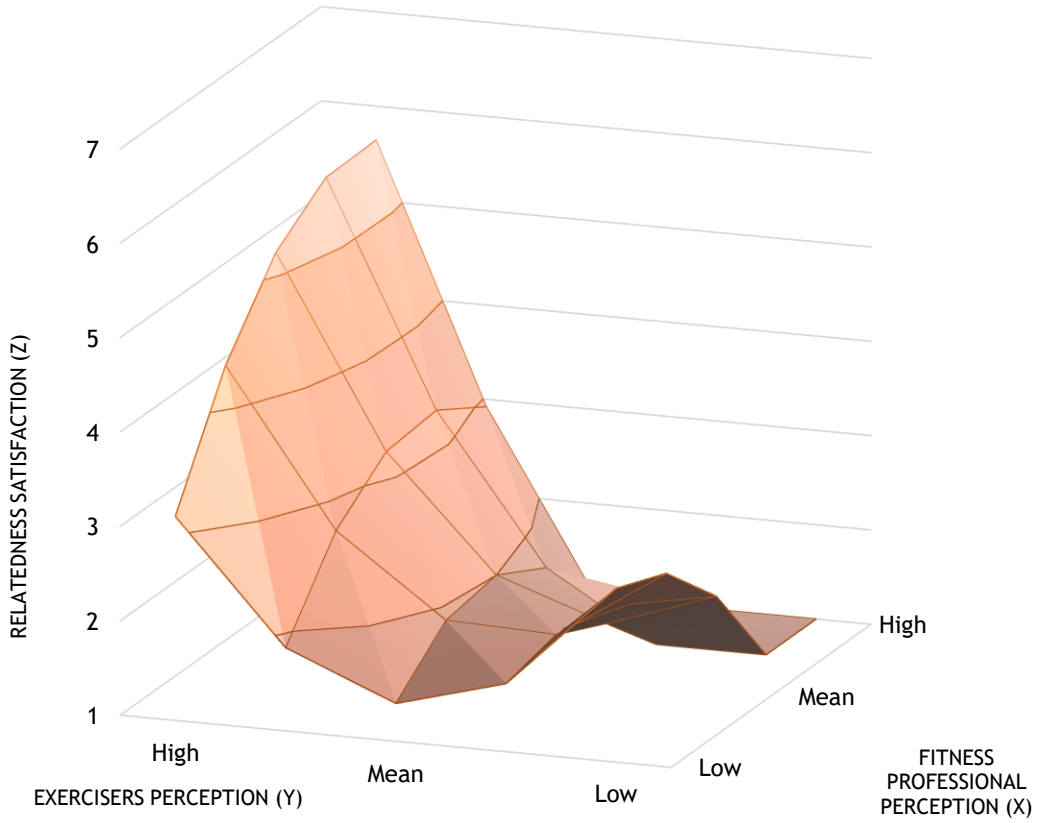



**Figure 5. 5** – Relatedness Support on Relatedness Satisfaction

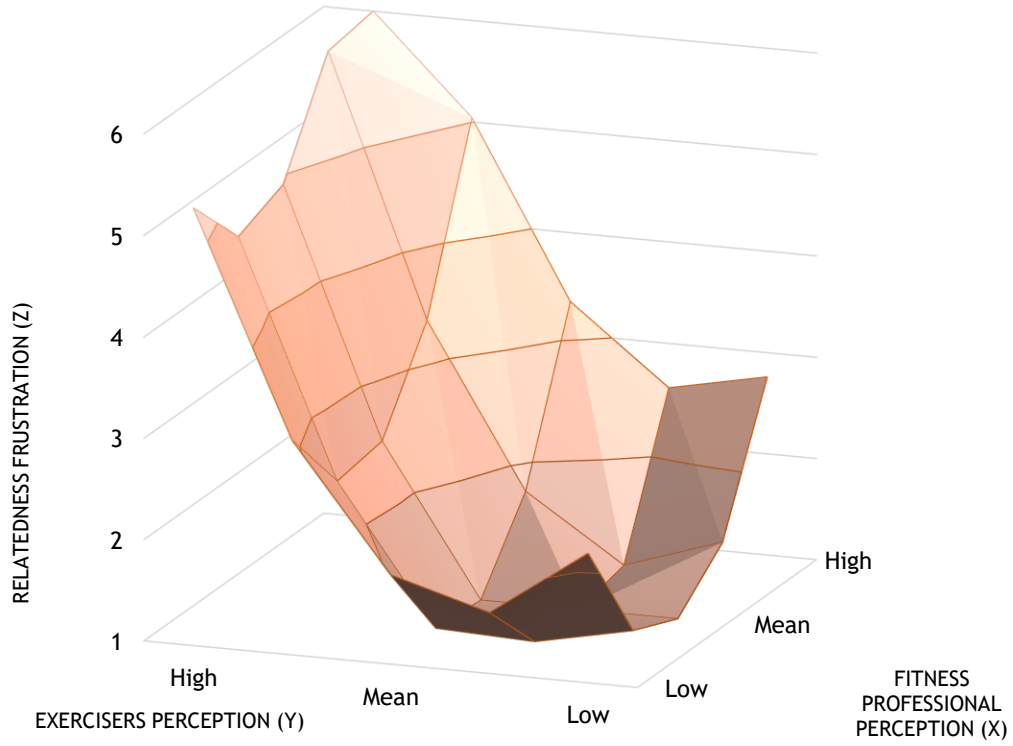



**Figure 5. 6** – Relatedness Thwarting on Relatedness Frustration

# Discussion

The purpose of present research was to examine the degree of agreement and disagreement between self-reported and perceived supportive and thwarting behaviors from fitness professionals and exercisers. The second aim was to examine the effects of the level of agreement between the trainers and the exercisers' perceptions on the exercisers BNS. Current findings will be discussed based on existing literature.

## Agreement/Disagreement Behaviors

Regarding objective one, this was the first attempt to explore the level of agreement/disagreement of interpersonal behaviors between exercisers and fitness professionals perceived and auto-reported behaviors. To the best of our knowledge, only one study (Rocchi & Pelletier, 2018) have assessed interpersonal behaviors between coaches and athletes, and one study (Fleenor et al., 1996) examined the levels of agreement between managers and subordinates. Overall, our results are in agreement with the results reported by (Rocchi & Pelletier, 2018). Our results also show that the effects related to the levels of agreement between person in key position self-report of their interpersonal behaviors and subordinates' perceptions of the same interpersonal behaviors could be replicated in the context of physical activity. Although we could not examine more specifically whether the results could be replicated for different pairs of men or women trainers and men or women exercisers because the number of different pairs of participants were not high enough, our results replicated most the results reported by Rocchi and Pelletier (2018) with a sample composed of men and women. In sum, our results provide further support not only for the validity of the IBQ and the IBQ-self, but also to the importance of considering both the perspectives of the trainers and the exercisers when examining the effects of need supportive or need thwarting interpersonal behaviors in the context of physical activity, with a sample of male and female participants, and a in different cultural context.

An important observation that may be specific to the present study is that fitness professionals tended to over-report their need-supportive and need-thwarting behaviors, except for relatedness support. The levels of in-agreement behaviors ranged from 25.4% (autonomy support) and 33.5% (competence support), and under-reported behaviors percentages ranged from 30.9% in competence thwarting to 37% in autonomy support, which was very close to over-reporting behaviors. These results are similar with other studies, who have reported that individuals in a position of authority (e.g., coaches, teachers) have a tendency to over-report their positive behaviors (Fleenor et al., 1996; Ntoumanis, 2012; Rocchi & Pelletier, 2018). Nevertheless, percentages across behaviors are

relatively balanced and similar to the proposed "benchmark" of 30% reported by Rocchi and Pelletier (2018).

## Polynomial Regression with Response Surface Methodology

Regarding our second objective, PR with RSM suggest that the levels of agreement between fitness professionals' reports of their own behavior and exercisers perception of these behaviors influences the exercisers' degree of BPN satisfaction or frustration. Looking at the effects of autonomy, competence and more specifically relatedness support, on their respective BPN satisfaction, the present findings show that as the degree of agreement between fitness professionals and exercisers increases, so does BPN satisfaction. When fitness professionals had underrated (exercisers perception is above self-reported scores), exercisers experienced further satisfaction in each need. These results are similar to those found by Rocchi and Pelletier (2018) and they provide further support for the importance of exploring the effects of supportive behaviors on basic need satisfaction. Disagreement between fitness professionals and exercisers behaviors would still lead to BPNs satisfaction, when fitness professional had under-reported compared to exercisers. This shows the importance of exercisers' perceptions play compared to others perception, supporting previous studies in the sport context (Rocchi & Pelletier, 2018) and in the military (Atwater & Yammarino, 1992).

Regarding the effects of need thwarting interpersonal behaviors on exercisers BPN frustration, in agreement with SDT, our results show that the more the trainers' interpersonal behaviors were need thwarting, the higher BPN frustration were in exercisers. However, in agreement with Rocchi and Pelletier (2018), competence and relatedness frustration was even higher in exercisers who perceived higher levels on competence and relatedness thwarting behaviors than trainers reported. Studies analyzing thwarting behaviors and BPN frustration in exercise context are scarce. However, in similar physical activity settings, Bartholomew, Ntoumanis, Ryan, Bosch, et al. (2011) have shown that perceived controlled behaviors were significantly associated with BPN frustration. Perceiving that the social environment actively thwarts our needs will ultimately lead to negative outcomes, such as BPN frustration (Bartholomew, Ntoumanis, Ryan, Bosch, et al., 2011; Jowett et al., 2017).

Exercisers BPN frustration was even higher when fitness professionals were underrating their thwarting behaviors, and as self-reported and perceived autonomy and relatedness thwarting increased, so did exercisers autonomy and relatedness frustration, respectively. Overall these results suggest that the ways one person behaves toward another may not accurately reflect what goes on between both parties (Jowett et al., 2017).

An interesting and intriguing question is then what may lead individuals like fitness professionals to either over-report, under-report or accurately report their interpersonal behaviors? It may be possible that fitness professionals could also feel BPN frustration (e.g., when self-taught gym exercisers wish to train alone without professional support, they experience pressure from the gym owners to get results with their clients) or have low scores on BPNs satisfaction (e.g., difficulty when interacting with exercisers, low recognition from exercisers) and this may result not only in different types of interpersonal behaviors but also in a motivation to report inaccurately the ways they interact with exercisers. In other words, the multiplicity of situations that are inherited in gyms and wellness center can influence how fitness professionals will interrelate with exercisers. Given that social factors do not only impact the target of interpersonal behaviors (i.e., exercisers) but likewise the transmitter (i.e., fitness professional), analyzing fitness professionals' determinants of their interpersonal behaviors could possibly shed some light on the reasons why some trainers may overreport or underreport their interpersonal behaviors (Rocchi & Pelletier, 2017).

## Limitations and future research

Since this study is context specific, future studies should examine similarities or differences in how agreement/disagreement of interpersonal behaviors could predict how BPN are being satisfied or frustrated in other context (e.g., physical education). As illustrated in the present research and in the study by Rocchi and Pelletier (2018) the levels of agreement between trainers and exercisers perceptions of interpersonal behaviors still lead to more BPN satisfaction but the reasons for the levels of agreement between trainers and exercisers is not well understood.

More specifically, it is not clear why some individuals in a position of authority (ex., trainers) may overreport or underreport the extent to which their interpersonal behaviors are need supportive or need thwarting. Future studies should analyze how the fitness professionals' context (e.g., administration support, exercisers perceived motivation) influences trainers' BPN satisfaction and frustration, and in turn, the ways they interact with subordinates like exercisers. Past research in the sport context has shown that, lower levels support from colleagues, lower administration support, lower athletes' motivation, and higher time constraints were predictors of BPN frustration (Rocchi & Pelletier, 2017). It may be possible that the work context may also influence the extent to which coaches or trainers overreport or underreport their interpersonal behaviors.

Last, future research should examine differences in exercisers enrolled predominantly in fitness group classes and cardio-resistance training. There could emerge interesting results

since different levels of exposure to the fitness professionals/trainers could lead to distinct results.

## Conclusion

Taken together, present findings provide relevant practical implications to how interpersonal behaviors impact basic needs experience. As the current findings show, only about 30% of the times behaviors were aligned, and discrepancies could lead to additional BPN satisfaction and frustration. Fitness professionals should be aware of their behaviors when engaging with exercisers, and interventions based on SDT could represent a promising avenue to improve the quality of exercisers experience. As shown by Ntoumanis et al. (2017), being perceived as supportive by exercisers impacts positively BPN satisfaction. Another way to increase behavior consciousness is to rely on videotaping fitness professionals' behaviors and letting them examine how they interact with exercisers. Looking at themselves when working with others might give trainers a new perspective, lead them to adopt more need supportive behaviors, and possibly lead them to have a more balanced or accurate perception of their own interpersonal behaviors. If done in an informative climate, we think that fitness professionals could be evaluated regularly by exercisers, peers and superiors in terms of professional conduct. Triangulating these assessments could give important knowledge to fitness professionals on how they behave and how their behaviors are perceived by others. This may lead trainers to adapt their behaviors as a way to promote BPN satisfaction.

Finally, PR analysis with RSM seems to be a powerful statistical analysis to examine how two perspectives on interpersonal behaviors could be related, and how this relation could affect BPN satisfaction and frustration. This approach is not only useful statistically to show that fitness professionals' self-reported behaviors do not always correspond to the behaviors perceived by exercisers, it is useful from a practical point of view to illustrate the implications of having behaviors that are perceived to be in agreement or in disagreement In a context like physical activity, since BPN satisfaction are related to positive outcomes, it is important that fitness professionals be aware of their own interpersonal behaviors in order to align their perceptions with those from exercisers.

# Chapter 7

# The satisfaction and frustration of basic psychological needs on behavioral regulations: are we seeing the whole picture?


## Abstract

The aim of this study was to analyze the independent and interaction effect of basic psychological need satisfaction and frustration on exercisers behavioral regulations, using polynomial regression analysis with response surface methodology. In total, 1277 individuals (520 females; 757 males) aged 18-54 years (M = 34.13; SD = 12.02) participated in this study. Exercise frequency ranged from 2-5 times per week (M = 2.57; SD = .98) and training sessions lasted between 30-90 minutes (M = 63.34; SD = 4.23). Participants responded to two validated scales in exercise context, one assessing basic needs satisfaction and frustration, and one measuring their behavioral regulation towards exercise participation. Basic psychological needs satisfaction predicted all forms of motivation, except for amotivation. On the other hand, basic psychological needs frustration forecasted controlled forms of motivation, and negatively predicted integrated and intrinsic motivation. The interaction between basic needs can predict both amotivation and autonomous forms of motivation. In overall, basic needs satisfaction and frustration are distinct factor that can be experienced simultaneously. The interaction of needs is an important variable to consider in order to measure how individuals will regulate their motivation towards exercising.



**Key-words:** need satisfaction; need frustration; behavioral motivation; polynomial regression; response surface methodology; self-determination theory.

# Introduction

Self-Determination Theory (SDT; Ryan & Deci, 2017) explains human motivation based on social-contextual factors, as well as on personality aspects. Relatively to the nature of motivation, Deci and Ryan (2008) state the existence of a self-determination continuum, in which amotivation (i.e., acting on the behavior without intent) stands as the least form of self-determined motivation. As we progress the continuum, external regulation (i.e., acting out of the desire for external rewards) arises followed by introjected regulation (i.e., a way to seek approval and/or avoid shame). These two regulations stand as controlled motivation, in which they reflect engaging in behaviors for externally referenced reasons (Howard, Gagne, & Bureau, 2017). Next, identified (i.e., the behavior is personally important to the individual) and integrated (i.e., the desire to be self-aware) regulations emerge, ending the continuum with intrinsic motivation (i.e., inherent interest in the activity). These three regulations are part of autonomous motivation, which reflect a self-determined drive to act on the behavior (Ryan & Deci, 2017).

Different behavioral regulations impact differently a person's cognitive, behavioral, and affective conduct (Howard et al., 2017). According to Ryan and Deci (2017), autonomous forms of motivation are expected to predict positive outcomes, whereas controlled forms of motivation are associated with negative consequences. Nevertheless, humans can experience a variety of behavioral regulations across time. This process is explained by Organismic Integration Theory (Deci & Ryan, 1985), that describes the process by which external regulations can be internalized, leading to more self-determined behaviors. For this process to occur, individuals have to experience a sense of Basic Psychological Needs (BPN), which has been shown in a recent meta-analysis (Howard et al., 2017).

According to SDT, there are three BPN innate to all human beings that can be satisfied or frustrated (Ryan & Deci, 2017): autonomy satisfaction represents the need to act volatilely and self-endorsed; competence satisfaction represents the need to learn new skills and master the actual environment; and, relatedness satisfaction represents the need to feel connected with others. On the other hand: autonomy frustration represents the need to feel self-imposed or external pressures; competence frustration represents the need to fail about one's efficacy; and, relatedness frustration represents the need to feel rejection or jealousy.

As stated by several authors (Bartholomew, Ntoumanis, Ryan, Bosch, & Thogersen-Ntoumani, 2011; Gunnell, Crocker, Wilson, Mack, & Zumbo, 2013) BPN satisfaction and frustration are not orthogonal constructs. That is, low levels of BPN satisfaction are not representative of outright BPN frustration and vice-versa. In fact, on measuring BPN in exercisers, Rodrigues et al. (2019) reported that individuals can experience high levels on

both constructs. However, this distinction is hard to instrumentalize, as there are few evidences as to whether participant's feeling of BPN represent which outcome (Rodrigues, Hair, Neiva, Teixeira, Cid , et al., 2019).

## Basic psychological needs and motivation in exercise

The association between BPN and motivation has long been studied in the exercise context. A recent systematic review has shown that BPN satisfaction are associated with more autonomous forms of motivation, especially intrinsic motivation (Rodrigues et al., 2018). Contrarily, exercisers' autonomy, competence and relatedness frustration has been related to more controlled forms of motivation, being particularly significant predictors of amotivation (Rodrigues et al., 2019; Teixeira, Silva, & Palmeira, 2018).

Individuals endorsing in exercise based on controlled forms of motivation are more prone to experience negative outcomes such as behavior drop-out (Teixeira, Carraça, Markland, Silva, & Ryan, 2012) or ill-being (Teixeira et al., 2018). However, exercisers who regulate their behavior more autonomously are more likely to experience positive results such as long-term exercise practice (Rodrigues et al., 2018), increased well-being (Teixeira & Palmeira, 2015) and increased enjoyment (Puente & Anshel, 2010). Thus, it seems crucial that exercisers feel higher levels of BPN satisfaction compared to BPN frustration, so that autonomous motivation arises, in turn leading to positive physical and psychological outcomes.

## Current Research

As described by Rodrigues et al. (2019), BPN satisfaction and frustration may not be dichotomic responses, but may cohabit in the same individual. Thus, to the best of our knowledge, BPN satisfaction and frustration as a product predicting motivation is still inexistent. In fact, the interaction of BPN requests investigations since literature speculates that the product between these constructs could be associated to both autonomous or controlled forms of motivation, depending on the levels of satisfaction and frustration experience (Rodrigues, Hair, Neiva, Teixeira, Cid , et al., 2019; Teixeira, Silva, et al., 2018). In other words, BPN satisfaction may predict amotivation or controlled forms of motivation if they interact with BPN frustration, or BPN frustration can influence more (or less) self-determined motivation, when interacting with BPN satisfaction.

The lack of literature regarding the interaction of both BPN on behavioral regulations could rely on the limitations of traditional statistical procedures. Conventional regression analyses provide a two-dimensional view of the relationships between predictor and outcome variable. In addition, with traditional regression analysis, one also cannot assess

whether there is a non-linearity and a product relationship along the line of agreement between two independent variables related to the dependent variable (Shanlock, Baran, Gentry, Pattison, & Heggestad, 2010).

One innovative method to approach these statistical limitations is by using polynomial regression analysis with Response Surface Methodology (Edwards, 2007). Polynomial Regression (PR) is a useful method in analyzing associations of two independent similar but distinct variables on predicting a dependent variable (Atwater, Ostroff, Yammarino, & Fleenor, 2006). Response Surface Methodology (RSM) simplifies the interpretation of results by creating three-dimensional models, considering both predictors on X and Y axis, and the dependent variable on the Z axis. By using PR with RSM, researchers can analyze the degree of agreement, the degree of discrepancy, and the direction of discrepancy. Hence this methodological procedure seems to be a fashionable approach to analyze the independent, as well as the interaction effect of both BPN on behavioral regulations (Shanlock et al., 2010).

Considering limitations of past literature and agenda for future research, the aim of this study was to explore the interaction effect between BPN satisfaction and frustration on exercisers motivation. This research will use innovative statistical procedures, namely Polynomial Regression (PR) with Surface Response Methodology (SRM) to analyze the product of similar but distinct constructs on all six behavioral regulations based on SDT. Regarding past literature, it is hypothesized that the independent effect of BPN satisfaction and BPN frustration would lead to positive and negative outcomes respectively (Ryan & Deci, 2017; Rodrigues et al., 2018). However, significant interaction between BPN satisfaction and BPN frustration could still lead to autonomous forms of motivation, based on the assumption that BPN satisfaction are more powerful than BPN frustration, hindering the effect of BPN frustration (Eynon, O´Donnell, & Williams, 2017)

# Methods

## Participants and Procedures

In total, 1277 individuals (520 females; 757 males) aged 18-54 years (M = 34.13; SD = 12.02) participated in this study. Exercise frequency ranged from 2-5 times per week (M = 2.57; SD = .98) and training sessions lasted between 30-90 minutes (M = 63.34; SD = 4.23). Regarding fitness activities: 45.3% participated in fitness group classes (e.g., indoor cycling), and 54.7% were engaged in cardio-weightlifting training sessions. Approval from the University Ethical Committee was granted prior to research (registration reference: CE-UBI-pJ-2018-044:ID683). Subsequently, authors contacted gym managers to obtain permission to conduct this research. After agreement, exercisers were contacted at

reception desk during different times of the day by the researchers and were asked to participate voluntary in this study. The study objectives were explained and informed consent was obtained. Data were collected before training session and time taken to fill the multi-section survey was approximately 15 minutes.

## Measures

*Basic Psychological Need Satisfaction and Frustration*. For this study, we used the Basic Psychological Need Satisfaction and Frustration Scale in Exercise (Rodrigues, Hair, Neiva, Teixeira, Cid , et al., 2019). This scale encompasses factors of basic needs satisfaction and frustration, namely: autonomy satisfaction (e.g., "*I feel that I can chose which exercises to do"*); competence satisfaction (e.g., "*I feel able to do advanced training sessions*"); relatedness satisfaction (e.g., "*I feel connected to the people that train with me*"); autonomy frustration (e.g., "*I feel obligated to train when I do not want to*"); competence frustration (e.g., "*I fell doubt about my exercise technique*"), relatedness frustration (e.g., "*I feel that the people at the gym do not like me*"). Exercisers replied to 24 items (4 for each factor) on a Liker-type scale anchored from 1 ("*totally disagree*") to 5 ("*totally agree*").

*Motivation*. We used the Behavioral Regulation in Exercise Questionnaire Portuguese version (Cid et al., 2018) to assess six types of motivation, namely: amotivation (e.g., "*I do not know why I exercise*"), external regulation (e.g., "*People tell me I need to exercise*"), introjected regulation (e.g., "*I feel guilty when I skip training session*"), identified regulation (e.g., "*It is important for me to exercise regularly*"), integrated regulation (e.g., "*Exercise is aligned with my personal objectives*") and intrinsic motivation (e.g., "*I like my training sessions*"). Exercisers answered to 18 items (3 for each factor) using a 5-point Likert-type scale ranging from 0 ("*strongly disagree*") to 5 ("*strongly agree*").

## Statistical analysis

For PR analysis with SRM, recommendations from several authors (Edwards, 2007; Shanlock et al., 2010) were followed. BPN satisfaction and BPN frustration composite scores were centered ($x_1$ and $x_2$) to reduce multicollinearity (Cohen, Cohen, West, & Aiken, 2003). Afterwards, the centered variables were squared ($x_3$ and $x_4$). Finally, the interaction of both variables was calculated ($x_5$). Afterwards, unstandardized coefficients and errors, and covariances between all five predictors were imputed in Kazén and Kuhl (2011) formulas to compute the surface values ($a_1$, $a_2$, $a_3$, and $a_4$). These four surface scores were used to analyze the degree of agreement, differentiation and the direction of differentiation between BPN satisfaction and BPN frustration related to behavioral regulations. For interpretation, three-dimensional models were created (Shanlock et al., 2010). For formulas, meaning and interpretation of the surface values see Table 6.1.

**Table 6. 1** – Surface values, formulas, meaning and interpretations

| Value | Formula | Meaning | Interpretation |
|---|---|---|---|
| $a_1$ | $x_1 + x_2$ | Reflects the linear relationship between the agreement of BPN satisfaction and frustration | + $a_1$ = as the degree of agreement between BPN constructs increases so does the outcome; - $a_1$ = as the degree of agreement between BPN constructs decreases so does the outcome |
| $a_2$ | $x_3 + x_4 + x_5$ | Reflects the non-linear relationship between the degree of agreement of BPN satisfaction and frustration | + $a_2$ = as the effect of agreement between BPN constructs becomes more pronounced at higher levels of agreement; - $a_2$ = the effect of agreement between BPN constructs diminishes at higher levels of agreement |
| $a_3$ | $x_1 - x_2$ | Reflects how the direction of the differentiation of BPN satisfaction and frustration | + $a_3$ = higher BPN satisfaction relative to BPN frustration is associated with higher scores on the outcome; - $a_3$ = higher BPN satisfaction relative to BPN frustration is associated with lower scores on the outcome |
| $a_4$ | $x_3 - x_4 + x_5$ | Reflects how the degree of differentiation in BPN satisfaction and frustration | + $a_4$ = a greater positive differentiation between BPN constructs (i.e., satisfaction is higher than frustration) is associated with higher scores on the outcome; - $a_4$ = a greater positive differentiation between BPN constructs (i.e., satisfaction is lower than frustration) is associated with lower scores on the outcome |

# Results

## Preliminary analysis

Missing data was found in 11 exercisers and was therefore imputed using Multiple Imputation procedures. Looking at descriptive statistics, exercisers reported higher levels of BPN satisfaction and autonomous forms of motivation, compared to BPN frustration and controlled forms of motivation. Nevertheless, results show normal distribution, since skewness and kurtosis were contained within cutoffs (+2/-2, and +7/-7, respectively). Bivariate correlations showed that BPN satisfaction was positively associated with all forms of autonomous motivation, whereas it was negatively correlated with amotivation and external regulation. On the other hand, BPN frustration was positively associated with amotivation and both controlled forms of motivation, while it was negatively correlated with all forms of autonomous motivation. For detailed information see Table 6.2.

**Table 6. 2** – Descriptive statistics and correlation matrix among variables

| Factors | M | SD | Range | S | K | Correlation Matrix | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 1. BPN Satisfaction | 4.08 | .50 | 1 – 5 | -.34 | .76 | 1 | | | | | | | |
| 2. BPN Frustration | 1.81 | .62 | 1 – 5 | 1.05 | 1.66 | -.53** | 1 | | | | | | |
| 3. Amotivation | .31 | .57 | 0 – 4 | 1.90 | 4.92 | -.24** | .53** | 1 | | | | | |
| 4. External Regulation | .84 | .82 | 0 – 4 | .82 | .18 | -.11* | .44** | .47** | 1 | | | | |
| 5. Introjected Regulation | 2.15 | 1.01 | 0 – 4 | -.25 | -.54 | -.03 | .28** | .10** | .28** | 1 | | | |
| 6. Identified Regulation | 3.50 | .49 | 0 – 4 | -1.00 | 1.33 | .35** | -.28** | -.47** | -.21** | .18** | 1 | | |
| 7. Integrated Regulation | 3.19 | .67 | 0 – 4 | -.71 | .84 | .40** | -.33** | -.29** | -.21** | .30** | .56** | 1 | |
| 8. Intrinsic Motivation | 3.47 | .59 | 0 – 4 | -1.36 | 2.72 | .46** | -.42** | -.43** | -.28** | .14** | .60** | .66** | 1 |

**Note:** BPN = Basic Psychological Needs; M = Mean; SD = Standard Deviation; S = Skewness; K = Kurtosis.
* p <.05; ** p<.01

## Polynomial regression analysis with surface response methodology

BPN satisfaction and BPN frustration explain behavioral regulations between 11% (i.e., introjected regulation) and 34% (i.e., amotivation). Looking at unstandardized regression coefficients, BPN satisfaction, as an independent construct, was a significant predictor on all regulations, except for amotivation. In addition, its non-linear regression (BPNS squared) explained additional prediction on identified regulation. Regarding the independent effect of BPN frustration on behavioral regulations, it predicted positively and significantly amotivation and both controlled forms of motivation. In fact, its non-linear relationship with amotivation was also significant. However, it was significantly negative on integrated regulation and intrinsic motivation. The interaction between both BPN satisfaction and BPN frustration predicted amotivation, integrated regulation, and intrinsic motivation (see Table 6.3).

The surface values for behavioral regulations show that, as the degree of agreement between BPN satisfaction and frustration increased, so did all regulations, except for identified and intrinsic motivation (surface value a1). In other words, when exercisers reported high on both BPN, the behavioral regulation displayed also higher levels (corner in the back is at its highest in Figures 6.1-6.4). Consequently, when exercisers report low on both BPN, low levels of behavioral regulations are expected (corner in the front is at its lowest). Curiously, the effect of agreement between BPN became more noticeable at higher levels of agreement, predicting more amotivation, integrated regulation, and intrinsic motivation (surface value a2). Looking at Figure 6.1, 6.5 and 6.6, it is possible to observe a convex surface, indicating that behavioral regulations could increase or decrease more sharply as both BPN satisfaction and BPN frustration become lower or higher at some point. Considering the direction of the discrepancy between needs related to the outcome (surface value a3), results show a significant negative surface value on amotivation and controlled forms of motivation. That is, these behavioral regulations are relatively high when BPN frustration was higher than BPN satisfaction (see Figure 6.1-6.3). This is represented by the left corner of the graphics being higher compared to the right corner. On the other hand, autonomous forms were still high when exercisers BPN satisfaction was high but and low on BPN frustration. As shown in Figure 6.4-6.6, the right corner is higher compared to the left corner, showing significance of BPN satisfaction on autonomous forms of motivation. Last, looking at the degree of discrepancy between BPN satisfaction and BPN frustration on behavioral regulations (surface value a4), no significant results emerged.

**Table 6. 3** - Results from Polynomial Regressio analyses and response surface values on behavioral regulations

| | Variance | Surface values | | | | Unstandardized regression coefficients | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $r^2$ | $a_1$ | $a_2$ | $a_3$ | $a_4$ | BPNS ($x_1$) | BPNF ($x_2$) | BPNS Squared ($x_3$) | BPNF Squared ($x_4$) | Interaction ($x_5$) |
| Amotivation | .34 | .34* | .26* | -.38* | .03 | -.02(.05) [-.11, .07] | .36(.11) [.27, .46] | -.06(.05) [-.15, .04] | .20(.04) [.13, .27] | .11(.05) [.01, .22] |
| External Regulation | .21 | .80* | .02 | -.44* | -.14 | .18(.07) [.03, .33] | .62(.08) [.47, .77] | -.15(.08) [-.29, .03] | .07(.06) [-.04, .18] | .08(.09) [-.09, .24] |
| Introjected Regulation | .11 | .89* | .07 | -.31* | -.15 | .29(.01) [.09, .49] | .60(.10) [.40, .80] | .01(.11) [-.21, .23] | -.05(.07) [-.20, .10] | .11(.12) [-.12, .34] |
| Identified Regulation | .13 | .21* | .19 | .36* | .02 | .28(.05) [.19, .38] | -.08(.05) [-.17, .02] | .11(.05) [.03, .21] | -.01(.04) [-.08, .07] | .08(.06) [-.03, .19] |
| Integrated Regulation | .21 | .18 | .39* | .63* | .01 | .40(.06) [.28, .53] | -.22(.06) [-.35, -.10] | .13(.07) [-.01, .26] | .07(.05) [-.02, .16] | .19(.07) [.06, .33] |
| Intrinsic Motivation | .26 | .05 | .23* | .62* | .01 | .33(.05) [.23, .44] | -.29(.05) [-.39, -.18] | .05(.06) [-.06, .17] | .07(.04) [-.01, .14] | .16(.06) [.02, .23] |

**Note:** BPNS = Basic Psychological Need Satisfaction; BPNF = Basic Psychological Need frustration; () = unstandardized errors. [] = 95% Confidence Intervals; * p <0.05

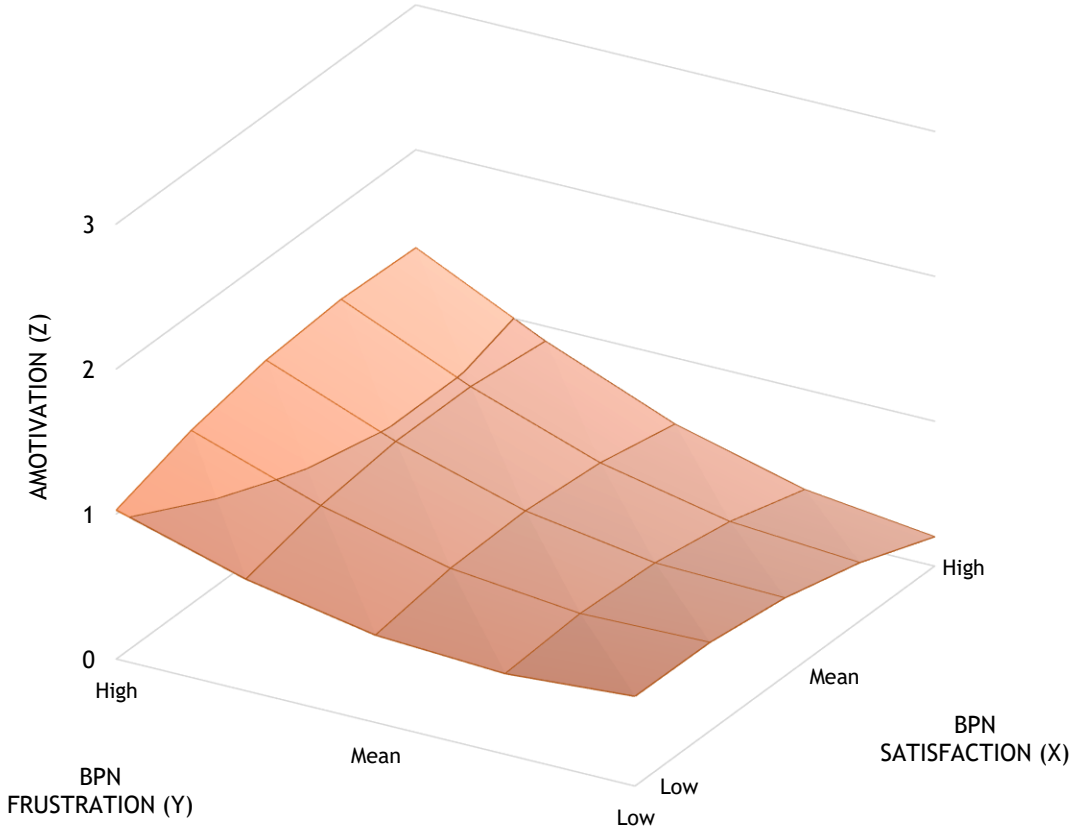



**Figure 6. 1** – Needs satisfaction and frustration on amotivation

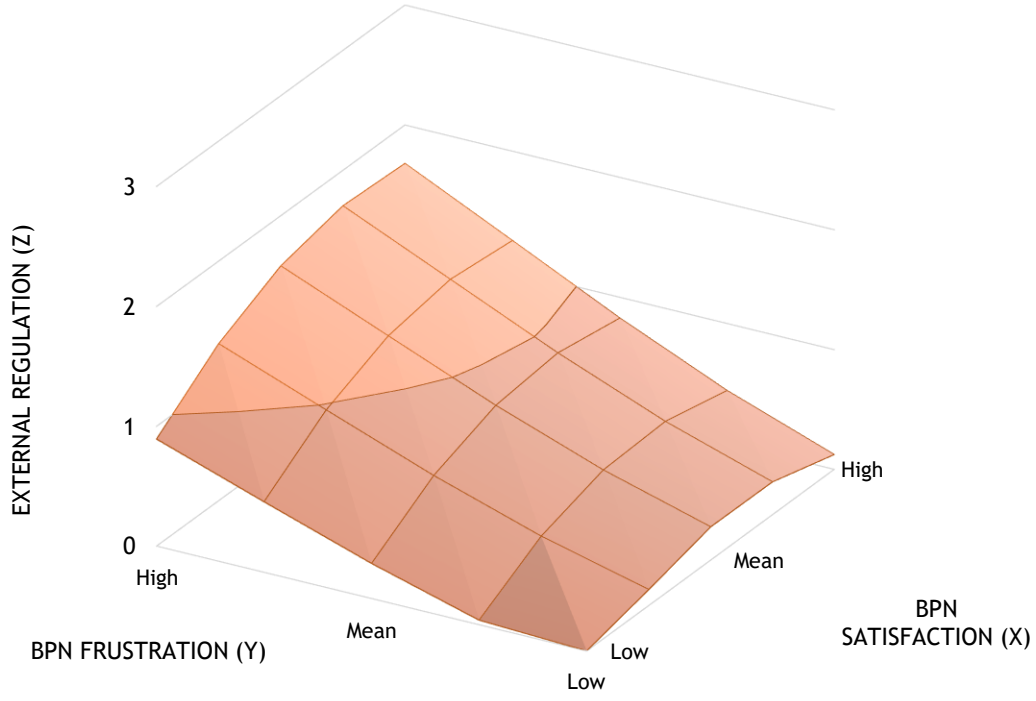



**Figure 6. 2** – Needs satisfaction and frustration on external regulation

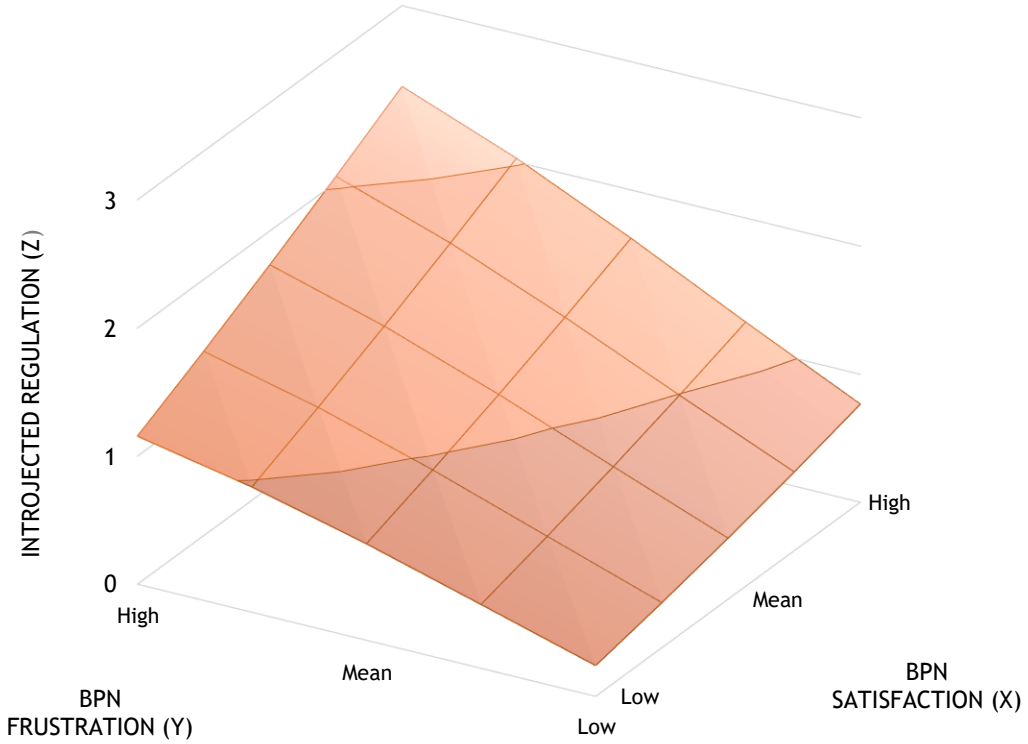



**Figure 6. 3** – Needs satisfaction and frustration on introjected regulation

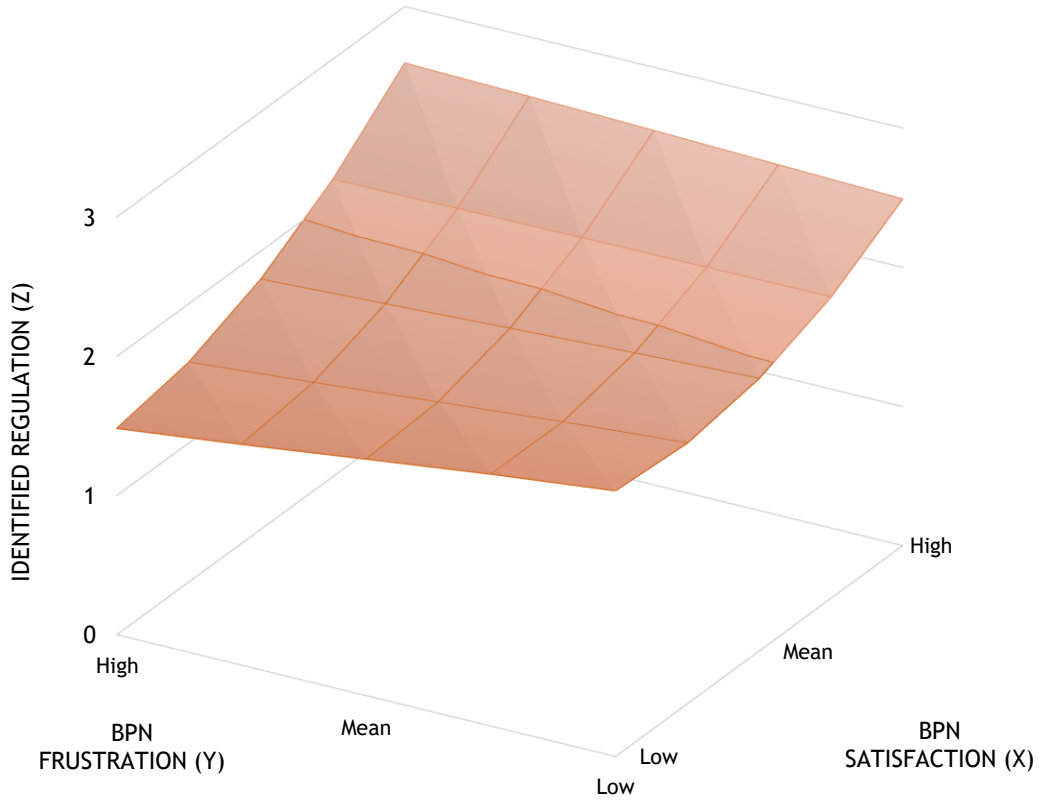



**Figure 6. 4** – Needs satisfaction and frustration on identified regulation

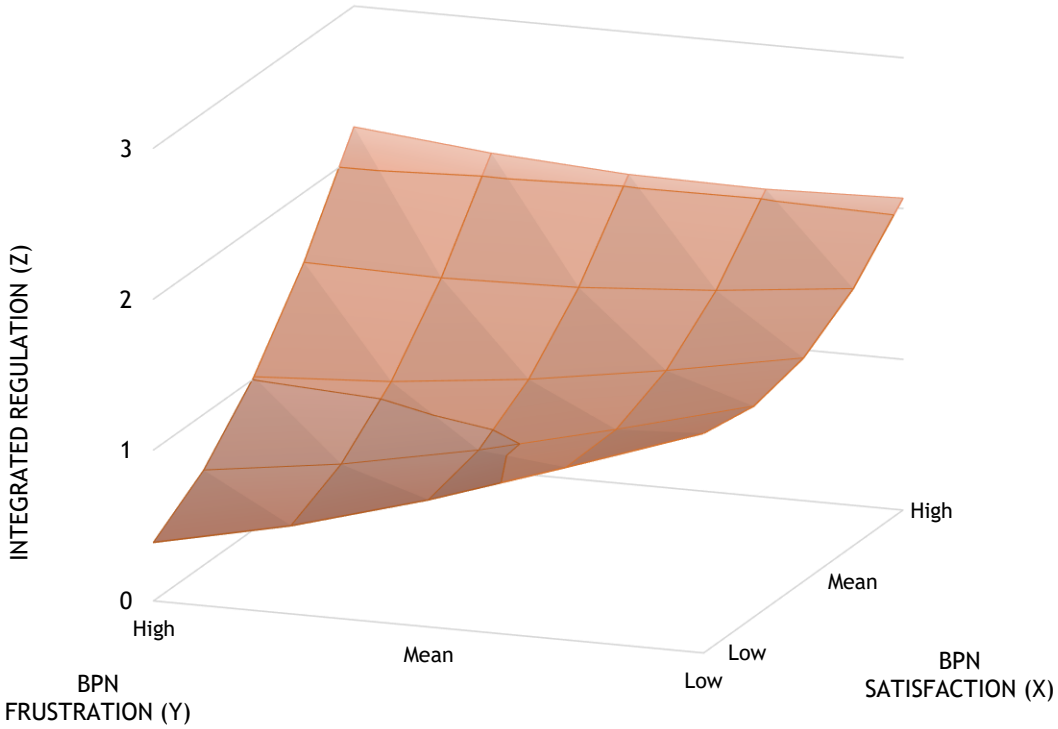



**Figure 6. 5** – Needs satisfaction and frustration on integrated regulation

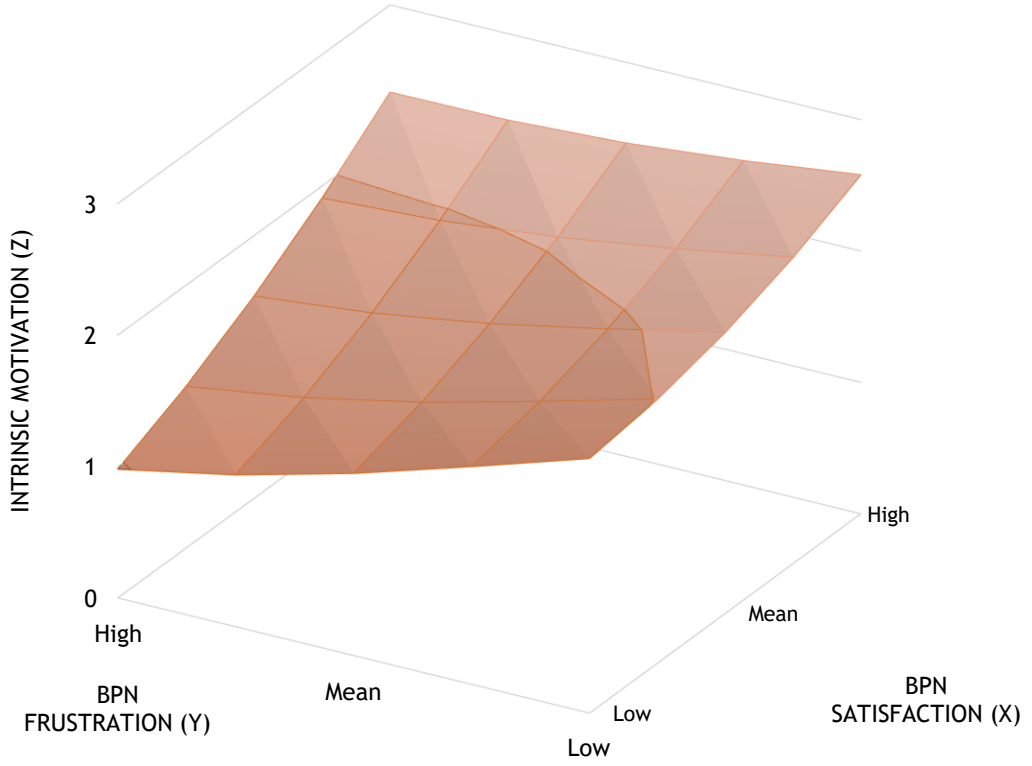



**Figure 6. 6** – Needs satisfaction and frustration on intrinsic motivation

# Discussion

The purpose of current study was to analyze the interaction effect of BPN satisfaction and BPN frustration on all six behavioral regulations proposed by SDT, using polynomial regression analysis with response surface methodology. Present results offer important new insights, since till date research has only focused on the independent effect of BPN on motivation, putting aside the possibility of BPN satisfaction and frustration interacting together on all six motivational regulations individually (Rodrigues et al., 2019).

The surface values showed that increased levels of agreement between BPN constructs is related to increased amotivation, controlled forms of motivation, and even identified regulation (a1). This could be related to the significant prediction of both BPN satisfaction and BPN frustration on these behavioral regulations. As seen in Figure 6.1-6.4, when BPN satisfaction and BPN frustration are high, the outcome is at its highest. Consequently, when exercisers report low on both BPN, low levels of behavioral regulations are exhibited. These results are contradictory since past literature has stated that BPN satisfaction would have a negative relationship with amotivation and controlled forms of motivation (Costa, Ntoumanis, & Bartholomew, 2014; Howard et al., 2017; Rodrigues et al., 2018). However, current research is relatable to results shown by Pulido, Sanchez-Oliva, Amado, Gonzalez-Ponce, and Sanchez-Miguel (2014), in which autonomy, competence, and relatedness satisfaction predicted positively controlled forms of motivation. These results reinforce the notion that BPN satisfaction and BPN frustration are distinct constructs that may cooccur within the same individual in the exercise context, promoting differentiated outcomes (Bartholomew, Ntoumanis, Ryan, Bosch, et al., 2011; Rodrigues et al., 2019).

The effect of BPN constructs became more noticeable at higher levels of agreement, predicting also amotivation, integrated regulation, and intrinsic motivation (a2), indicating that behavioral regulations could increase or decrease more sharply as both BPN satisfaction and BPN frustration become lower or higher at some point. However, scores obtained in this study are only significant if there was likewise significant interaction between constructs on these behavioral regulations. These results corroborate with Vansteenkiste and Ryan (2013), showing that individuals need to feel some kind of frustration in order to promote changes on different behaviors, provided that needs satisfaction is experienced. In other words, perceiving actively that the environment is promoting needs frustration could actually endorse positive impact on self-determined regulation, when individuals are already facing BPN satisfaction (see front corner in Figure 6.5 and 6.6). Contrarily, BPN frustration's predictive power could hinder the significance of BPN satisfaction at some degree on amotivation. Exercisers who feel that the social context

is engaging sharply on thwarting or passive behavior, it could be susceptible to impact negatively BPN satisfaction. However, while BPN satisfaction is low, a small "spark" of it may translate into changes in behavioral regulation, and may endorse individuals to actively engage in exercise in a self-determined manner over time, as explained by Ryan and Deci (2017).

Last, higher levels of BPN satisfaction relative to BPN frustration was associated with higher scores on autonomous forms of motivation, whereas contrary results were indicative of controlled forms of motivation and amotivation (a3). In other words, high levels of BPN frustration still leads to significant prediction of amotivation and controlled forms of motivation (see corner in the left of Figure 6.1-6.3), but not when BPN satisfaction displays high scores. Contrarily, high levels of BPN satisfaction continues to forecast on a significant level integrated regulation and intrinsic motivation (see corner in the right of Figure 6.4-6.6) even when BPN frustration is low. These results support previous studies on the independent effect of BPN satisfaction and frustration on autonomous and controlled forms of motivation, respectively (Rodrigues et al., 2018; Teixeira, Silva, et al., 2018; Teixeira et al., 2012). As hypothetically predicted, BPN satisfaction was a strong forecaster of identified and integrated regulation, as well as on intrinsic motivation. On the other hand, BPN frustration predicted significantly amotivation, external and introjected regulation. Nevertheless, one should bear in mind that BPN facets are not strict and predetermined constructs, but rather they can fluctuate over time, as previously reported (Cordeiro, Paixao, Lens, Lacante, & Luyckx, 2016).

Current results present new knowledge on the interaction effect of BPN satisfaction and frustration on all six behavioral regulations based on SDT that could not be explained by past research using traditional regression procedures. This is related to the fact that previous research has focused only on the independent effect of both BPN constructs on autonomous and controlled forms of motivation (Bartholomew, Ntoumanis, Ryan, & Thogersen-Ntoumani, 2011; Costa et al., 2014; Teixeira et al., 2018). With current research, new doors open to further assessment of the interaction effect of BPN satisfaction and BPN frustration on other relatable outcomes such as positive and negative affect (Sheehan, Herring, & Campbell, 2018; Teixeira, Marques, & Palmeira, 2018; Teixeira et al., 2018) and enjoyment (Puente & Anshel, 2010).

### Limitations

There are some limitations related with the present study that should be considered for interpreting its results and upcoming work. First, this study was conducted within the exercise context. Although BPN are innate to all human beings, we cannot generalize these

results to other domains. Second, we did not test each need independently on all six behavioral regulations. It would be interesting to see the different impact of the interaction (e.g., autonomy satisfaction x autonomy frustration) on each behavioral regulation, and examine which impacts more motivation.

As future directions researchers should attempt to analyze how interpersonal behaviors may affect BPN satisfaction and frustration using PR with RSM. Past studies (Atwater et al., 2006; Rocchi & Pelletier, 2018) have demonstrated that individuals who do perceive support from persons in key positions, tended to feel increased levels of positive outcomes.

## Conclusion

In sum, experiencing BPN frustration can still lead to autonomous forms of motivation, provided by significant BPN satisfaction independently and in interaction with needs frustration. Current research offers an initial demonstration of how BPN satisfaction and BPN frustration distinct constructs that cooccur in every individual. Specifically, this study demonstrated that the levels of agreement and differentiation of both BPN constructs are associated with all six behavioral regulations in a way that generally matches past literature on SDT. However, this is only exhibited using innovative statistical procedures such as PR with RSM. This underscores the importance of considering innovative statistical approaches that can analyze both BPN constructs, in order to understand the effects on motivation.

In a theoretical point-of-view, although the selection of the statistical methods is dependent on the studies' objective, current research has tried to illustrate the beneficial use of PR with RSM in future investigations. In fact, it allows future research to hold the advantages of linear regression scoring of BPN satisfaction and BPN frustration, adding the value of non-linear prediction of both constructs, as well as the effects related with the direction and differentiation between satisfaction and frustration of needs.

Looking at empirical implications, health and exercise professionals should consider and measure both sides of BPN as they present distinct behavioral regulations. As stated by systematic reviews (Rodrigues et al., 2018; Teixeira et al., 2012) the support perceived by exercisers is crucial, since it predicts BPN satisfaction. Contrarily, thwarting interpersonal behaviors displayed by exercise professionals forecast BPN frustration. Hence, supportive behaviors and motivational climates induced by persons in key positions (e.g., personal trainers) stands as an critical variable since it impacts BPN, and consequently, motivation (Vallerand, 1997).

# Chapter 8

# The bright and dark sides of motivation as predictors of enjoyment, intentions, and exercise persistence


## Abstract

The present study aimed to examine the bright and dark sides of motivation, based on Self-Determination Theory, as predictors of enjoyment, intention to continue exercising, and exercise persistence. In addition, we analyzed the mediation role of each variable and tested the model invariance between male and female exercisers. A total of 575 gym exercisers (345 male) aged between 18 and 65 years (M = 34.07; SD = 1.47) participated in this study. All participants had at least 6 months of regular exercise practice; exercise frequency of the participants ranged from 2 to 7 sessions per week (M = 3.52; SD = 1.28) and training sessions lasted approximately 30 and 120 minutes (M = 61.54; SD = 17.64). Participants completed a multisection questionnaire assessing interpersonal behaviors, basic psychological needs satisfaction and frustration, behavioral regulations, enjoyment, and intentions to continue exercising. Exercise persistence was assessed 6 months after baseline assessment using gym computer system attendance records. Several analyses, namely, Confirmatory Factor Analysis, Structural Equation Modeling, Serial Mediation Analysis and Structural Invariance testing, were performed to increase theoretical and empirical knowledge. Positive associations were observed among the bright side of motivation, and enjoyment, intention to continue exercising and persistence. On the other hand, the dark side of motivation was negatively associated with the bright side constructs, enjoyment, intention, and exercise persistence. Both measurement [$\chi2(370) = 1496.708$, $\chi2/df = 4.05$; B-S $p<.001$, CFI = .907, TLI = .901, SRMR = .056, RMSEA = .073 (CI90% = .063, .083)] and structural models [$\chi2(393) = 2484.994$, $\chi2/df= 6.323$; B-S $p<.001$, CFI = .908, TLI = .900, SRMR= .075, RMSEA = .071 (CI90% = .067, .075)] displayed acceptable fit to the data. The results also showed that basic psychological needs satisfaction, autonomous motivation, enjoyment, and intention to continue exercising were significant mediators. However, enjoyment had the highest effect on exercise persistence. In addition, structural model invariance was confirmed between male and female exercisers. Motivational determinants have implications for predicting emotional, cognitive, and behavior-related

outcomes. Individuals should perceive exercise instructors as supportive and exercising as a fun activity to endorse long-term exercise persistence.

**Key-words:** hierarchical model; brigh side motivation; dar side motivation; enjoyment; exercise persistence.

# Introduction

Exercise participation is of the upmost importance, as it represents a healthy way to reduce chronic diseases and mortality. However, according to the last Eurobarometer survey, (EC, 2018) over 65% of the European population is physically inactive, and individuals report lack of time and motivation as the main reasons for being sedentary. In fact, motivation seems to be the most important variable explaining exercise participation. In recent years, Self-Determination Theory (SDT; Ryan & Deci, 2017) has been used as the "go to framework" for defining the impact of motivational determinants on emotional, cognitive, and behavioral outcomes in an exercise context. (Rodrigues et al., 2018) In this regard, Vallerand (1997) proposed the Hierarchical Model of Intrinsic and Extrinsic Motivation (HMIEM) to explain how different levels of generality – global (environment), contextual (domains in life), and situational (personal state) – are responsible for an individual's behavior. According to the HMIEM sequence, social factors (e.g., perceived interpersonal behaviors from exercise instructors) affect different types of motivation, depending on how Basic Psychological Needs (BPN: autonomy, competence and relatedness) are met. Contingent on the quality of behavior motivation (autonomous and controlled motivation), behavior motivation can lead to different emotional (Pulido, Sanchez-Oliva, Amado, Gonzalez-Ponce, & Sanchez-Miguel, 2014), cognitive (Ntoumanis, Thogersen-Ntoumani, Quested, & Hancox, 2017), or self-reported behavioral outcomes (Edmunds, Ntoumanis, & Duda, 2008).

Nevertheless, few studies have tested the full sequence of the HMIEM by considering the bright and dark sides of the SDT tenets (Bartholomew, Ntoumanis, Ryan, & Thogersen-Ntoumani, 2011). In addition, several studies (Gardner, Magee, & Vella, 2016; Monteiro, Pelletier, Moutão, & Cid, 2018) suggest that the theoretical sequence can be extended, whereby an emotional outcome (i.e., enjoyment) could predict a cognitive outcome (i.e., intention to perform the behavior in the future). Since intention to continue exercising is the most proximal determinant of behavior enactment (Ajzen, 1991), it is possible to speculate that higher levels of enjoyment would predict higher levels of intention, resulting in higher rates of behavior commitment (e.g., exercise persistence). Thus, to test this hypothetical model is of the upmost importance, since, to the best of our knowledge, no study has ever considered "expanding" the HMIEM by considering both sides of motivation and objectively measuring behavioral persistence in the exercise context.

## Theoretical Framework

The first part of the HMIEM explains how the environment (e.g., social factors) influences psychological mediators. In other words, perceived interpersonal behaviors from others (in

this study, exercise instructors' behaviors) will determine the satisfaction or frustration of BPN. In terms of exercise, several studies (Edmunds, Ntoumanis, & Duda, 2006, 2007; Edmunds et al., 2008) have shown that perceived supportive behaviors (e.g., perception of positive feedback and emotional connection from the exercise instructor) are positively associated with BPN satisfaction. On the other hand, thwarting behaviors (e.g., perception of negative feedback and social exclusion) have been associated with BPN frustration. (Ng, Ntoumanis, Thogersen-Ntoumani, Stott, & Hindle, 2013) Ryan and Deci (2017) propose that perceived supportive and thwarting behaviors would have a significant association with BPN satisfaction and frustration, respectively.

The next part of the causal sequence explains how the satisfaction and/or frustration impacts behavioral regulation toward exercising. Teixeira, Silva, and Palmeira (2018) have revealed in exercise settings that BPN satisfaction is positive and significantly related to autonomous motivation (i.e., individuals partake in the behavior because they value the activity), whereas negative and significantly associated with controlled motivation (i.e., the person engages in the behavior to obtain external rewards or to avoid negative consequences such as guilt). Conversely, BPN frustration has an negative relationship with autonomous and a positive with controlled motivation, as demonstrated theoretically (Rodrigues et al., 2018) and empirically (Teixeira et al., 2018).

The last part of the HMIEM explains how motivational regulations are associated with cognitive, emotional and behavioral consequences. In the context under analysis, previous results show that autonomous motivation has a positive, although controlled motivation a negative, relationship with enjoyment (Puente & Anshel, 2010). In addition, higher levels of autonomous motivation have been shown to represent higher degrees of intention toward exercising in the future (Hagger et al., 2014; Ntoumanis et al., 2017). Other studies have demonstrated that autonomous motivation was positively associated with exercise persistence (Edmunds et al., 2008) and adherence, (Heiestad, Rustaden, Bo, & Haakstad, 2016) whereas controlled motivation had an inverse effect.

Recently, Monteiro et al. (2018) tested the impact of enjoyment (i.e., emotional outcome) on intention to continue practicing sports (i.e., cognitive outcome) in 799 swimmers. The results showed a positive and significant association between these factors, explaining the mediating role of enjoyment between autonomous motivation and intention. In this regard, higher levels of intention to continue behavior performance seem crucial, since Ajzen (1991) has stated it theoretically as the most proximal determinant. Higher levels encourage exercise participation; thus, acting without intent is more likely to promote drop-out. (Armitage, 2005; Hagger, 2019) Therefore, autonomous motivation may not necessarily be

a single determinant of exercise participation, since enjoyment and intention to continue can likewise influence its performance on the long term.

### Present Research

To the best of our knowledge, few studies have tested the HMIEM sequence in exercise, (Puente & Anshel, 2010) or in similar domains (Gardner et al., 2016; Monteiro et al., 2018). However, studies considering the bright (perceived supportive behaviors, BPN satisfaction, and autonomous motivation) and dark (perceived thwarting behaviors, BPN frustration, and controlled motivation) sides of motivation are scarce, (Bartholomew et al., 2011) and, in an exercise context, these studies are almost nonexistent. In addition, studies expanding the HMIEM, considering the prediction of one outcome to another (e.g., enjoyment → intention), are uncommon (Monteiro et al., 2018) and to the best of our knowledge, no study has measured and added observable outcomes, such as behavior persistence on the model sequence. This gap in the literature regarding the effect of enjoyment on behavioral intentions and behavioral performance has been previously reported (Gardner, Magee, & Vella, 2017) and highlighted by systematic reviews, (Balish, McLaren, Rainham, & Blanchard, 2014; Crane & Temple, 2014) showing the particular importance of enjoyment and intentions on behavior enactment.

In the present study, in addition to the hypothetical model based on HMEIM, two mediation models will be carried out: one model testing the dark side and the other model considering the bright side of motivation constructs. Invariance analysis will also be performed to examine the adequacy of the structural model between male and female exercisers.

## Methods

### Participants and Procedures

Examining sample characteristics, 575 Portuguese gym exercisers (345 male) aged between 18 and 65 years (M = 34.07; SD = 11.47) participated in this study. All participants had at least 6 months of regular exercise practice, the exercise frequency ranged from 2 to 7 sessions per week (M = 3.52; SD = 1.28) and each training session lasted between 30 and 120 minutes (M = 61.54; SD = 17.64).

Ethical approval (registration reference: CE-UBI-pJ-2018-044:ID683) was obtained prior to data collection. Subsequently, the study's objectives and data collection procedures were explained to several gym managers. After approval, gym members were contacted at the reception desk during different periods of the day and were asked to participate voluntarily in this study. We specifically asked for permission to collect data regarding the frequency of the use of their gym, reinforcing anonymity and confidentiality. Informed consent was

obtained before delivering the questionnaires and membership number to observe if exercise persistence had been attained.

Data regarding motivational determinants, enjoyment, and intention were collected at baseline, and participants' exercise persistence was assessed 6 months after baseline assessment using gym attendance system computer records. Gym exercisers received no compensation for their participation. The time required for the completion of the questionnaires was approximately 15 min.

## Measures

Perceived interpersonal behaviors**.** The Interpersonal Behavior Questionnaire (IBQ) Portuguese version in exercise (Rodrigues et al., 2019), assessing supportive and thwarting behaviors, was used. The 24-item scale (four items per factor) measures autonomy *(*item 1: *"My exercise instructor supports my choices"),* competence *(*item 9: *"My exercise instructor encourages me to improve my skills"),* and relatedness *(*item 5: *"My exercise instructor really likes to spend time with me")* support, as well as autonomy *(*item 8: *"My exercise instructor imposes his opinions),* competence *(*item 22: *"My exercise instructor questions my ability to overcome challenges*"), and relatedness *(*item 24: *"My exercise instructor does not build empathy with me")* thwarting, regarding exercisers' perception of fitness instructors' behaviors during gym activities. Participants responded using a Likert-type scale ranging from 1 - *"do not agree"* to *7 - "totally agree"* for each item, and two composite factors were created: perceived supportive and thwarting interpersonal behaviors. The Confirmatory Factor Analysis (CFA) of the IBQ in the present study displayed the following fit*:* [$\chi2(237) = 473.030$, $\chi2/df = 1.799$; B-S $p<.001$, CFI = .950, TLI = .930, SRMR= .041, RMSEA = .045 (CI90% = .036, .053)].

Basic Need Satisfaction and Frustration. The Basic Psychological Need Satisfaction and Frustration Scale Portuguese version in exercise (BPNSFS-E) (Rodrigues et al., 2019) was used to assess autonomy *(*item 1: *"When I exercise I feel a sense of choice and freedom in the exercises I undertake"),* competence *(*item 5: *"When I exercise I feel confident that I can do exercises well"),* and relatedness *(*item 9: *"When I exercise I feel connected with others in the gym")* satisfaction, as well as autonomy *(*item 8: *"When I exercise I feel forced to do training sessions I would not choose to do"),* competence *(*item 12: *"When I exercise I feel disappointed with my performance*"), and relatedness *(*item 1: *"When I exercise I feel that the relationships I have at the gym are just superficial")* frustration. Participants responded to items using a 5-point scale ranging from 1 - *"totally disagree"* to *5 - "totally agree",* and two composite factors were created, one composite factor for BPN satisfaction and one composite factor for BPN frustration. Similar procedures have been used in the past

(Teixeira et al., 2018), and those previous procedures support the use of this scale in Portuguese exercisers. The CFA of the BPNSFS in the present study displayed the following fit: [$\chi2(237) = 831.845$, $\chi2/df = 2.78$; B-S $p<.001$, CFI = .961, TLI = .949, SRMR= .071, RMSEA = .064 (CI90% = .0759, .069)].

Behavioral Regulations. The Behavioral Regulation Exercise Questionnaire (BREQ-3) Portuguese version (Cid et al., 2018) was used, measuring all six behavioral regulations according to the SDT motivational continuum. This 18-item version scale measures amotivation *(*item 1: *"I do not see why I have to exercise"),* external *(*item 14: *"I exercise because others will be dissatisfied with me if I do not"),* introjected *(*item 3: *"I exercise because I feel guilty when I fail a training session"),* identified *(*item 16: *"I exercise because I value the benefits of exercising"),* integrated *(*item 5: *"I exercise because it is related to my life goals"),* and intrinsic *(*item 12: *"I exercise because I like my training sessions")* motivation. Participants answered items using a 5-point scale anchored from 0 - "*totally disagree*" to 4 - "*totally agree*" on how they perceive their motivation when exercising, and two composite factors were created, one composite factor for autonomous (intrinsic motivation, integrated and identified regulation) and another composite factor for controlled motivation (introjected and external regulation, and amotivation), reducing the number of parameters to be estimated and to avoid collinearity issues. It is worth noting that although some authors suggest that amotivation stands for "the lack to act on a certain behavior" (Pelletier, Fortier, Vallerand, & Brière, 2001) and should therefore not be considered as controlled motivation, we use this term because of several scientific advances. Jowett et al. (2017) have shown that amotivation is located on the same continuum as the other behavior regulations, next to external regulation without discontinuity. These authors also explain that the mere occurrence of the behavior indicates that at least some motivation is present, even if the individual feels confused or helpless with respect to behavior participation. *P*ast studies support the use of this scale for measuring behavioral regulations in Portuguese exercisers. (Cid et al., 2018; Teixeira et al., 2018) The measurement model of BREQ-3 in the present study displayed the following fit: [$\chi2(120) = 384.421$, $\chi2/df = 3.20$; B-S $p<.001$, CFI = .938, TLI = .921, SRMR= .057, RMSEA = .062 (CI90% = .055, .069)].

Enjoyment. The Physical Activity Enjoyment Scale (PACES) Portuguese version (Teques, Calmeiro, Silva, & Borrego, 2017) was used. This 8-item *(e.g., "It is very stimulating")* scale assesses the level of agreement on enjoyment when exercising using a 7-point scale ranging from 1 - *"totally disagree"* to *7 - "totally agree".* Recent studies support the use of this scale in Portuguese exercisers. (Teques et al., 2017) *The* measurement model of PACES in the present study displayed the following fit: [$\chi2(21) = 304.006$, $\chi2/df = 14.48$; B-S $p<.001$, CFI = .933, TLI = .911, SRMR= .049, RMSEA = .054 (CI90% = .044, .64)].

Intention to continue exercising. We followed Ajzen (2006) recommendations and created three items to evaluate intention to continue exercising after 6 months: *"I will continue to exercise in the next 6 months as I currently do or in a very similar way (same type, frequency, duration and intensity)", "I plan to continue practicing physical exercise in the next six months as I do today or in a very similar way (same type, frequency, duration and intensity)",* and *"I will continue to practice physical exercise in the next six months as I currently practice or in a very similar way (same type, frequency, duration and intensity)".* A 7-point Likert scale anchored from 1 - "*absolutely not*" to 7 - "*absolutely yes*" was used to respond to these items.

Exercise Persistence. Researchers coded participants' persistence as 1 (i.e., if they were still active after six months of baseline assessment) or 0 (if they were not active after six months of baseline assessment) based on gym attendance system computer records. Gucciardi and Jackson (2015) and Sarrazin, Vallerand, Guillet, Pelletier, and Cury (2002) have also used this dichotomic coding system in the past, presenting reliable results. The 6-months criterion used in this study was based on the following: i) drop-out rates are approximately 50% in the first six months, thus stabilizing from this period onwards, (Buckworth & Dishman, 2002) and ii) individuals who exercise regularly for at least six months have lower intention to drop-out. (Prochaska & DiClemente, 1982).

## Statistical analysis

Data from questionnaires with missing values ≤ 5% were imputed using the Multiple Imputation (MI) method according to Allison (2000) using IBM SPSS Statistics v23. Participants were excluded for analysis if they had missing values > 5%. Possible univariate ($z > 3.00$) and multivariate ($D2 = p1 < .001$, $p2 < .001$) outliers were also excluded from analysis (Byrne, 2016).

The mean, standard deviations, bivariate correlations and composite reliability were observed for all study variables. Next, a two-step maximum likelihood (ML) approach following Kline (2016) recommendations was performed using IBM SPSS AMOS v23. First, a CFA was conducted to test the psychometric properties of the model. Average Variance Extracted (AVE) to evaluate convergent validity was calculated, and scores ≥0.50 were defined as acceptable (Hair, Black, Babin, & Anderson, 2014). Discriminant validity was confirmed when AVE scores were higher than the squared correlation across constructs of the measurement model (Byrne, 2016; Hair et al., 2014). Second, a Structural Equation Model (SEM) to test model fit was performed, and direct and indirect effects among all constructs were analyzed. Analysis of both CFA and SEM were performed according to the

traditional absolute and incremental indexes: Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), Standard Root Mean Residual (SRMR), Root Mean Square Error of Approximation (RMSEA) and its Confidence Interval of 90% (CI: 90%). For these indexes, recommendations from several authors (Byrne, 2016; Hair et al., 2014; Marsh, Hau, & Wen, 2004) were followed: CFI and TLI ≥ 0.90, SRMR and RMSEA ≤ 0.8.

Regarding the parameters to be estimated (i.e., 72 parameters), Kline (2016) recommends a 10:1 ratio (participants per parameter to be estimated), which was not performed in present study. However, according to Worthington and Whittaker (2016) and Hair et al. (2014), a 5:1 ratio is acceptable to conduct CFA and SEM analyses, as used in this study. As a complementary sample size analysis, G*Power v3.1 (Faul, Erdfelder, Buchner, & Lang, 2009) software was used to calculate the minimum required sample size. Past studies (Monteiro et al., 2018; Teques, Calmeiro, Martins, Duarte, & Holt, 2018) have used this program as a way of determining sample size when the number of participants did not adhere to the recommended 10:1 ratio or the minimum 5:1 ratio. Thus, as a complementary analysis, G*Power 3.1 was used to calculate the required sample size (Faul et al., 2009), including the following parameters: anticipated effect size of f 2 = .01, α = .05, and statistical power = .95, suggesting a minimum of 287 participants, which was respected in this study.

## Serial Mediation Analysis

To further understand the proposed model, serial mediation procedures according to Hayes (Hayes, 2018) recommendations were performed using SPSS PROCESS v3.3. This analysis adds details about understanding the mediator's role on the outcome variable.

Considering the hypothetical SEM previously analyzed, no pre-defined serial mediation model presented by SPSS PROCESS v3.3 could adequately analyze the direct and indirect effects accounting for other possible interactions. Therefore, based on model 6 in SPSS PROCESS v3.3, which allows several serial mediators analyses, a specific matrix and syntax in order to account for this issue was created. Examining mediation Model I (BPN satisfaction, autonomous motivation, enjoyment and intention) and mediation Model II (BPN frustration, controlled motivation, enjoyment and intention), both models contained four serial mediators, and covariances were integrated along with specific mediation paths in order to account for possible variable interactions, better representing the hypothetical model. Adding covariances without restricted path interactions in mediation models may affect all mediators and dependent variables and possibly reduce model understanding (Hayes, 2018). Considering the theoretical implications and previous SEM model specifications, in model I, thwarting interpersonal behaviors (on all mediators and the dependent variable), BPN frustration (on controlled motivation, enjoyment, intention to

continue exercising and the dependent variable) and controlled motivation (on enjoyment, intention to continue exercising, and the dependent variable) were defined as specific path covariates. In model II, the same approach was used with the bright side of motivation constructs. Bootstrap with 10,000 samples was used and the confidence interval (95%) estimate was calculated. In the case of mediation, the ratio of total indirect effect over total effect (PM) will be presented to quantify the strength of mediation (Shrout & Bolger, 2002).

### Multigroup Analysis

In terms of multigroup analysis, our aim was to test structural invariance between male and female exercisers and to assess model adequacy in groups with different characteristics; to this end, an analysis was performed in line with previous authors (Byrne, 2016; Cheung & Rensvold, 2002). First, we analyzed if the structural model presented a good fit to the data in male and female exercisers. Multigroup analysis was then performed according to Byrne [36], comparing the unconstrained model with the constrained models in terms of measurement weights, structural weights, measurement intercepts, structural residuals, and measurement residuals. Invariance assumptions were verified through the differences in CFI ($\Delta$CFI) using <0.01 as cut-off values (Byrne, 2016; Cheung & Rensvold, 2002). IBM SPSS AMOS v23 to perform multigroup analysis was used.

## Results

### Preliminary Analysis

The data were imputed in five participants who showed missing values < 5% in all questionnaires; thus, no univariate or multivariate outliers were found. Descriptive statistics indicated no deviations from normality (skewness ranged from -1.98 to +1.98; kurtosis ranged from -7 to +7). However, Mardia's coefficient for multivariate kurtosis exceeded expected values (>5). Therefore, a Bollen-Stine (B-S) of 2,000 samples for the subsequent analysis was imputed following Nevitt and Hancock (2001) recommendations. Last, to verify possible collinearity issues, the Variance Inflation Factor (VIF) was analyzed. The VIF results showed scores below 10, rejecting the hypothesis of collinearity issues and ensuring the conditions to test the regression model. (Hair et al., 2014) Regarding bivariate correlations, bright side motivational constructs were positively correlated with each other, as well as with enjoyment, intention to continue exercising and exercise persistence. Conversely, dark side motivational constructs were positively and significantly correlated with each other and negatively associated with enjoyment, intention to continue exercising and exercise persistence. For details, see Table 7.1.

Of the total sample, 472 exercisers (82%) were still exercising 2 times per week after 6 months, while the other 103 participants in the present study withdrew from exercising during the first 2 to 4 months after completing questionnaires at baseline.

## Confirmatory Factorial Analysis and Structural Equation Model

Results from the CFA showed that the model fit the data: [$\chi2(370) = 1496.708$, $\chi2/df = 4.05$; B-S $p<.001$, CFI = .907, TLI = .901, SRMR = .056, RMSEA = .073 (CI90% = .063, .083)]. Convergent and discriminant validity was achieved, and composite reliability reported scores above acceptable, except for controlled motivation (see Table 7.2). As in the CFA, the SEM model showed acceptable fit: [$\chi2(393) = 2484.994$, $\chi2/df= 6.323$; B-S $p<.001$, CFI = .908, TLI = .900, SRMR= .0754, RMSEA = .071 (CI90% = .067, .075)]. As seen in Figure 7.1, all factor weights were above the cut-off values, except for perceived autonomy thwarting and introjected regulation.

Positive and significant predictions were observed among all the constructs (see Table 3), except for perceived supportive behavior → BPN satisfaction; perceived supportive behavior → BPN frustration; and perceived thwarting behavior → BPN satisfaction. The results display several indirect effects between constructs (see Table 7.4), enjoyment being the variable with the highest indirect effect on exercise persistence. Looking at explained variance, intentions to continue exercising explained variance was 11% in exercise persistence, and SEM model explained variance was 14% in exercise persistence. To examine construct interactions on persistence in more detail, mediation analysis was conducted.

## Serial Mediation Analysis

In Figure 7.2, it is possible to observe the serial mediation effects of different constructs on exercise persistence. In Model I, a full mediation appears between supportive behaviors and exercise persistence ($\beta = .45$ [.34 - .53]; PM = .90). Additionally, enjoyment presented the highest effect on persistence ($\beta = .83$ [.80 - .86]). As for mediation sequential influence, autonomous motivation had the highest effect on enjoyment ($\beta = .85$ [.72-.99]).

In Model II, no mediation appears between thwarting behaviors and exercise persistence ($\beta = .03$ [-.06 - .01]), and motivational variables did not have a significant effect on persistence. Nevertheless, the individual path between enjoyment and exercise persistence presented a significant effect ($\beta = .83$ [.80 - .86]), as did the individual path between intention and persistence ($\beta = .04$ [.01 - .07]).

## Multigroup Analysis

The structural model had adequate fit in male [$\chi2(393) = 1458.796$, $\chi2/df = 3.712$; B-S $p<.001$, CFI = .915, TLI = .904, SRMR= .081, RMSEA = .076 (CI90% = .070, .082)] and female exercisers [$\chi2(393) = 1430.063$, $\chi2/df = 3.639$; B-S $p<.001$, CFI = .906, TLI = .899, SRMR= .079, RMSEA = .067 (CI90% = .062, .073)]. The results showed model invariance between both groups, since invariance assumptions were met (see Table 7.5).

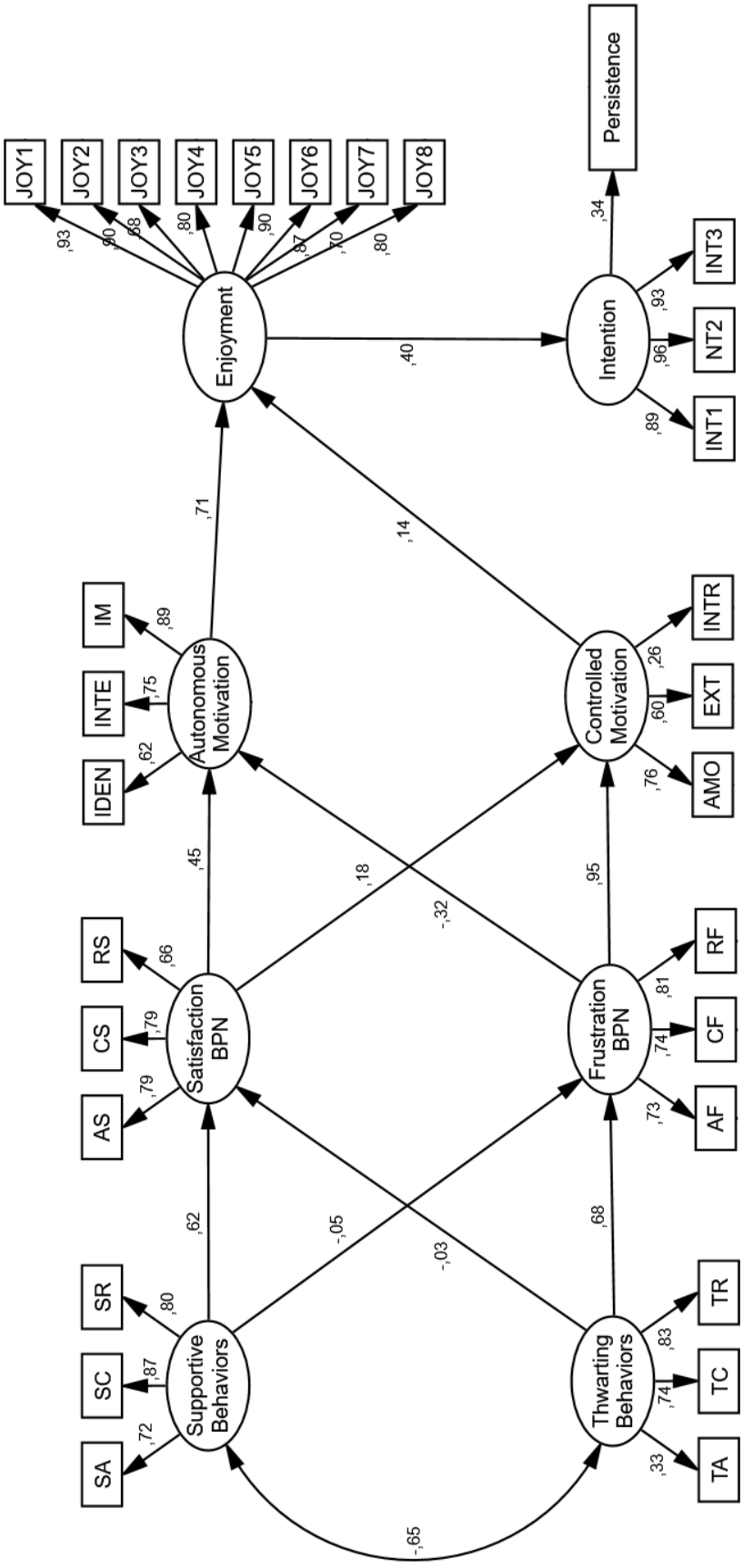



**Figure 7. 1** - Structural equation model

**Table 7. 1** – Mean, Standard Deviation, Range and correlations between constructs

| | M | SD | Range | *r* | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 1. Supportive Behaviors | 4.58 | .64 | 1-7 | 1 | | | | | | | | |
| 2. Thwarting Behaviors | 1.13 | .82 | 1-7 | -.722** | 1 | | | | | | | |
| 3. BPN Satisfaction | 3.13 | .42 | 1-5 | .511** | -.732** | 1 | | | | | | |
| 4. BPN Frustration | .41 | .23 | 1-5 | -.392** | .783** | -.859** | 1 | | | | | |
| 5. Autonomous | 2.05 | .29 | 0-4 | .564** | -.423** | .575** | -.633** | 1 | | | | |
| 6. Controlled | .74 | .41 | 0-4 | -.660** | .420** | -.764** | .461** | -.663** | 1 | | | |
| 7. Enjoyment | 6.85 | 1.07 | 1-7 | .553** | -.266** | .323** | -.261** | .704** | -.481** | 1 | | |
| 8. Intention | 4.32 | .64 | 1-5 | .182** | -.099* | .101* | -.104* | .199** | -.126** | .409** | 1 | |
| 9. Persistence | 3.21 | .43 | 0-1 | .611** | -.393** | .389** | -.378** | .673** | -.505** | .859** | .328** | 1 |

**Table 7. 2** - Composite Reliability, Average Mean Extracted and squared correlations between constructs

| | CR | AVE | $r^2$ | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 1. Supportive Behaviors | .84 | .80 | 1 | | | | | | | | |
| 2. Thwarting Behaviors | .70 | .63 | .43 | 1 | | | | | | | |
| 3. BPN Satisfaction | .79 | .72 | .35 | .11 | 1 | | | | | | |
| 4. BPN Frustration | .81 | .77 | .19 | .43 | .49 | 1 | | | | | |
| 5. Autonomous | .80 | .76 | .25 | .13 | .35 | .25 | 1 | | | | |
| 6. Controlled | .57 | .51 | .10 | .50 | .13 | .62 | .33 | 1 | | | |
| 7. Enjoyment | .94 | .84 | .26 | .05 | .19 | .08 | .42 | .05 | 1 | | |
| 8. Intention | .93 | .93 | .03 | .01 | .01 | .01 | .03 | .01 | .15 | 1 | |
| 9. Persistence | | | .32 | .13 | .22 | .13 | .40 | .13 | .71 | .10 | 1 |

Note: CR = Composite Reliability; AVE = Average Variance Extracted; $r^2$ = squared correlation; BPN = Basic Psychological Needs.

**Table 7. 3** - Path estimates among constructs

| Path | β | $R^2$ | CI-95% | p |
|---|---|---|---|---|
| Supportive Behaviors → BPN Satisfaction | .620 | .384 | -.488 / .815 | .195 |
| Supportive Behaviors → BPN Frustration | -.052 | .002 | -.334 / .117 | .650 |
| Thwarting Behaviors → BPN Satisfaction | -.028 | .000 | -1.158 / .192 | .728 |
| Thwarting Behaviors → BPN Frustration | .684 | .467 | .328 / .697 | .002 |
| BPN Satisfaction → Autonomous Motivation | .450 | .202 | .299 / .568 | .003 |
| BPN Satisfaction → Controlled Motivation | .183 | .033 | .062 / .378 | .017 |
| BPN Frustration → Autonomous Motivation | -.323 | .104 | -.468 / -.203 | .001 |
| BPN Frustration → Controlled Motivation | .949 | .900 | .855 / .958 | .002 |
| Autonomous Motivation → Enjoyment | .711 | .505 | .643 / .775 | .001 |
| Controlled Motivation → Enjoyment | .142 | .020 | .051 / .241 | .012 |
| Enjoyment → Intention | .404 | .163 | .336 / .468 | .001 |
| Intention → Persistence | .336 | .112 | .271 / .399 | .001 |

Note: BPN = Basic Psychological Needs; β = direct effects; $R^2$ = variance explained; CI-95% = confidence interval; p = level of significance.

**Table 7. 4** - Path estimates of indirect effects

| Path | β | $R^2$ | CI-95% | p |
|---|---|---|---|---|
| Supportive Behaviors → Autonomous Motivation | .296 | .087 | -1.5983.285 | .234 |
| Supportive Behaviors → Controlled Motivation | .064 | .004 | -.171 / .442 | .593 |
| Supportive Behaviors → Enjoyment | .219 | .047 | -.302 / .309 | .193 |
| Supportive Behaviors → Intention | .089 | .007 | -.086 / .131 | .163 |
| Supportive Behaviors → Persistence | .030 | .000 | -.086 / .049 | .134 |
| Thwarting Behaviors → Autonomous Motivation | -.234 | .054 | -2.156 / -.085 | .019 |
| Thwarting Behaviors → Controlled Motivation | .644 | .414 | .352 / 2.684 | .002 |
| Thwarting Behaviors → Enjoyment | -.075 | .005 | -.691 / .003 | .111 |
| Thwarting Behaviors → Intention | -.030 | .000 | -.298 / .000 | .098 |
| Thwarting Behaviors → Persistence | -.010 | .000 | -.103 / .000 | .094 |
| BPN Satisfaction → Enjoyment | .346 | .119 | .242 / .440 | .001 |
| BPN Satisfaction → Intention | .140 | .019 | .094 / .185 | .001 |
| BPN Satisfaction → Persistence | .047 | .002 | .028 / .070 | .001 |
| BPN Frustration → Enjoyment | -.095 | .009 | -.220 / .003 | .113 |
| BPN Frustration → Intention | -.038 | .001 | -.091 / .001 | .114 |
| BPN Frustration → Persistence | -.013 | .000 | -.034 / .000 | .100 |
| Autonomous Motivation → Intention | .057 | .003 | .223 / .339 | .001 |
| Autonomous Motivation → Persistence | .019 | .000 | .066 /.132 | .001 |
| Controlled Motivation → Intention | .287 | .082 | .023 / .103 | .008 |
| Controlled Motivation → Persistence | .097 | .009 | .008 / .038 | .008 |
| Enjoyment → Persistence | .136 | .018 | .093 / .185 | .001 |

Note: BPN = Basic Psychological Needs; β = indirect effects; $R^2$ = variance explained; CI-95% = confidence interval; p = level of significance

**Table 7. 5** - Measurement invariance between male and female

| | x2 | df | *x2*/df | Δ x2 | Δdf | *p* | CFI | ΔCFI |
|---|---|---|---|---|---|---|---|---|
| Unconstrained Model | 2888.913 | 786 | 3.675 | - | - | <.001 | .906 | - |
| Measurement Weights | 2904.335 | 808 | 3.594 | 15.422 | 22 | <.001 | .907 | .001 |
| Structural Weights | 2909.039 | 819 | 3.552 | 20.126 | 33 | <.001 | .907 | .001 |
| Structural Covariances | 2917.474 | 822 | 3.549 | 28.561 | 36 | <.001 | .906 | .000 |
| Structural Residual | 2931.360 | 828 | 3.540 | 42.447 | 42 | <.001 | .906 | .000 |
| Measurement Residual | 2979.550 | 858 | 3.566 | 90.637 | 72 | <.001 | .901 | .005 |

Note: χ2 = qui-square; df = Degrees of Freedom; Δ χ2 = differences in qui-square; Δdf = differences in df; *p* = level of significance; CFI = Comparative Fit Index; ΔCFI = differences in CFI.

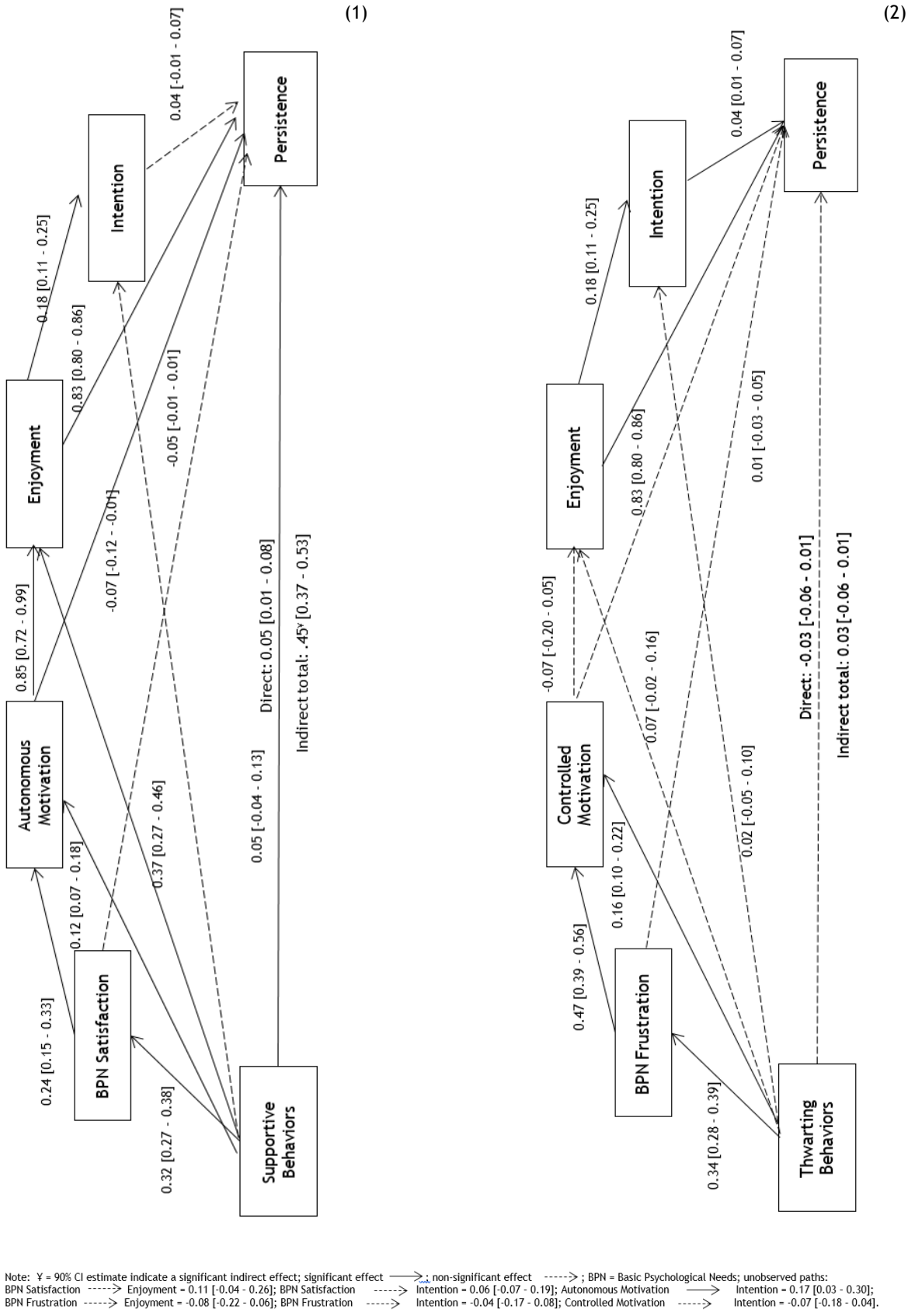



**Figure 7. 2** – Serial mediation analysis for Model (1) controlling for dark side of motivation constructs, and Model (2) controlling for bright side of motivation constructs

# Discussion

The aim of the present study was to test an extended HMIEM (Vallerand, 1997) exploring the relationship between the bright and dark sides of motivation constructs on enjoyment, intention to continue exercising, and exercise persistence after a 6-month time period. This analysis was conducted according to a previously proposed hypothesis (Gardner et al., 2016; Monteiro et al., 2018).

Examining correlations, positive and significant associations were observed among bright side motivational determinants, enjoyment, intention to continue and persistence. On the other hand, dark side motivational constructs were positively and significantly correlated with each other, and negatively with bright side constructs, enjoyment, intention and persistence. These results have been theoretically (Ryan & Deci, 2017) and systematically supported in exercise settings (Rodrigues et al., 2018; Teixeira, Carraca, Markland, Silva, & Ryan, 2012).

## Confirmatory Factor Analysis and Structural Equation Model

The model for CFA and SEM had a good fit to the data according to several authors (Byrne, 2016; Hair et al., 2014). In addition, convergent and discriminant validity was achieved, and composite reliability was above the cut-off values, except for controlled motivation (see Table 7.2 and Figure 7.1). Perceived autonomy thwarting and introjected regulation had factor weights <0.50 and should have been excluded from the model according to Hair et al. (2014). However, these items increased content validity, and their exclusion did not improve model fit. In addition, Hair et al. (2014) suggest that rules of thumb are only guidelines and that if the overall measurement model exhibit good fit, then the items should be maintained. The hypothesis for perceived autonomy thwarting's low factor weight could be explained by participants' gym activities. Since exercisers participated in several different activities (e.g., indoor cycling, recreational bodybuilding, or personal training) their perception of fitness instructors' behaviors could vary to some degree. For example, fitness group instructors execute their preprogrammed classes, and all gym exercisers are encouraged to follow their movements. However, in the cardio/resistance training room, participants exercise according to their own training program, thus having more freedom to select which exercises to perform, in which order and when to perform them. Looking at introjected regulation, the results could be explained by the new theoretical advances made in distinguishing this regulation as more controlled (e.g., "I must go to the gym to increase my physical fitness") or more autonomous (e.g., "I am going to work out because I want to increase my physical fitness") regulated. Past studies (Assor, Vansteenkiste, & Kaplan, 2009; Sheldon, Osin, Gordeeva, Suchkov, & Sychev, 2017) suggest that introjected

regulation can be perceived as approach (i.e., more proximal to identified regulation) or as avoidance (i.e., more proximal to external regulation), resulting in different outcomes. This difference, in turn, could have been accounted for controlled motivation's low composite reliability score.

## Mediation Analysis

The results in this study displayed that bright side and, in part, dark side motivational constructs had some indirect effects on persistence. Since significant indirect effects were found between variables under analysis, Hair et al. (2014) suggest the need to analyze mediation to support the observed predictions. In addition, to corroborate with SDT universality tenets and HMIEM's causal sequence, it is important to measure the effect of each variable on this contextual setting.

In serial mediation models, the bright side motivational model presented a full mediation (β = .45 [.34 - 53]; $P_M$ = .90), which reinforces this study's previous findings regarding similar model testing and mediators' influence on persistence. In this model, only the enjoyment mediator presented significant positive indirect effects on persistence (β = .30 [.22 - .39]). However, the sequential mediators' influence across the model is always significant (supportive behaviors → BPN satisfaction → autonomous motivations → enjoyment → intention → persistence), which aligns with the SDT framework and previously reported studies on bright side constructs on enjoyment, intention and persistence. Curiously, the dark side of the motivation model did not present significant direct or indirect effects on persistence. Even enjoyment as an isolated mediator showed a high regression score with persistence (β = .83 [.80 - .86]) but decreased its indirect effect on persistence in this model (β = .06 [-.03 - .14]) and does not account for an indirect significant effect. Moreover, despite the absence of BPN frustration and controlled motivation's significant indirect effects on persistence, it is possible to observe that perceived thwarting behavior had positive significant effects on these mediators, supporting expected sequential path interactions (Ryan & Deci, 2018). This observation could be in part responsible for the lower/absence of mediating effects of enjoyment.

## Measurement Invariance

The structural model displayed invariance (Δ CFI <0.01) between male and female exercisers, meaning that both similarly perceive the impact of motivational determinants, enjoyment, and intention to continue exercising on exercise persistence. To the best of our knowledge, no study has ever tested between genders the HMIEM sequence, or structural invariance, much less the current hypothesized model in the exercise context. Nevertheless, existing studies testing multigroup analysis on motivational determinants have shown that

male and female individuals experience exercise participation in a similar manner (Vlachopoulos & Neikou, 2007), regulate their behavior toward exercise equally (Cid et al., 2018), and perceive enjoyment in a similar way when exercising (Teques et al., 2017).

## Overall Considerations

Examining the overall hypothesized model, the current research ads new insights into how the HMIEM can be extended, considering both sides of motivation on emotional, cognitive, and behavioral outcomes. Starting with the bright side of motivation sequence, supportive interpersonal behaviors had a significant indirect effect on autonomous motivation via BPN satisfaction, leading to significant estimates on enjoyment and higher levels on intention to continue exercising and ultimately resulting in increased rates of exercise persistence. The present results support previous studies considering only parts of this sequence, specifically the predictions of interpersonal behaviors on basic needs satisfaction (Edmunds et al., 2006, 2007; Rocchi & Pelletier, 2018), the effect of basic need satisfaction on behavioral regulation (Bartholomew et al., 2011; Ng et al., 2013), behavioral regulation on enjoyment (Puente & Anshel, 2010), enjoyment on intention to continue exercising, (Monteiro et al., 2018; Pulido et al., 2014) and ultimately the impact of intentions toward exercising in the future on persistence. (Ntoumanis et al., 2017) BPN satisfaction had an indirect effect on enjoyment via autonomous motivation, showing that the satisfaction of basic needs is essential for promoting autonomous motivation, proving itself to be a strong predictor of positive outcomes, including enjoyment, and thus corroborating past literature (Gardner et al., 2016; Monteiro et al., 2018; Teixeira, Marques, & Palmeira, 2018).

As for the dark side of motivation, our results corroborate those of Rocchi and Pelletier, (Rocchi & Pelletier, 2018) showing that perceived thwarting behaviors predicted basic needs frustration. In turn, as current results show, BPN frustration was positive and significantly related to controlled motivation, explaining that when people feel controlled by the environment, they tend to act on behavior for controlled reasons (e.g., “I exercise because my exercise instructors says so”). Similar results have been shown in the contexts of exercise, (Ng et al., 2013) sport,(Bartholomew et al., 2011) and physical education. (Moreno-Murcia, Huescar Hernandez, & Ruiz, 2018) Gunnel et al. (2013) have shown that when individuals perceive BPN frustration, negative outcomes are more likely to occur. Interestingly, contrarily to past theoretical literature associating controlled motivation with diminished function and negative outcomes, (Vansteenkiste & Ryan, 2013) a significant positive direct effect on enjoyment was found. Nevertheless, no mediation effects were found on the dark side of motivation analysis. This finding should be interpreted with caution, as there might have been interpretation issues in gym exercisers’ differing approaches and avoidance of introjected regulation. More research is warranted to measure

the effect of controlled regulations, as a composite score or as independent constructs, on emotional outcomes.

Regarding intention, although it had a significant effect on exercise persistence, it only explained 11% of variance. Hence, the structural model overall, considering direct and indirect effects, explained 14% of variance. This result shows that having intentions to continue acting on a behavior does not always translate into the behavior itself, as explained by Hagger and Chatzisarantis, (2002). In addition, concerning total rates of individuals exercising after six months, the results showed that 82% were still exercising regularly. This percentage is above the 50% drop-out rate after 6 months, as explained by the drop-out exercise curve, (Buckworth & Dishman, 2002) and the maintenance phase from the transtheoretical model. (Prochaska & DiClemente, 1982) We suspect that these percentages of exercise persistence could be related to the high levels of enjoyment perceived by exercisers and/or because of their training experience (<6 months). Current results show that enjoyment had the strongest effect on exercise persistence, explaining the need to feel pleasure and joy when acting on a certain behavior as a way of maintaining its commitment in the long term. The results corroborate the notion that engaging in regular exercise because of volitional choice and satisfaction is crucial as a way of persisting. Nevertheless, emotional outcomes have not received enough attention in terms of their prediction of intention, specifically in an exercise context, and more studies are warranted.

The present results are relevant, since they corroborate previous literature, (Balish et al., 2014; Monteiro et al., 2018; Puente & Anshel, 2010) showing significant interaction across motivational determinants, enjoyment, and intention on behavior persistence, even in the context under analysis. In addition, it was demonstrated that enjoyment is a strong predictor for promoting physical exercise persistence. Exercise instructors should create fun and pleasurable environments. Understanding what makes people enjoy exercising in gyms and health clubs, as well as how to generate an enjoyable atmosphere with others, seems crucial to increasing their persistence in exercising. For example, promoting exercise variability in training sessions according to exercisers' feedback and suggestions could increase individuals' exercising commitment (Sylvester, Curran, Standage, Sabiston, & Beauchamp, 2018). Fitness professionals should generate effective questions during training sessions in order to be perceived as attentive and mindful.

## Limitations

A limitation of the present study that should be acknowledged is that we measured SDT constructs, enjoyment, and intention to continue exercising at baseline, and exercise persistence six months after baseline assessment. It would be interesting in future studies

to explore the extent to which these constructs fluctuate over time and how this influences exercise persistence. Likewise, assessing persistence over a longer period of time (e.g., 1 year) could be of interest in measuring the impact of motivational determinants. In addition, since this was the first study to consider both the bright and dark sides of motivation determinants, as well as enjoyment, intention to continue exercising, and exercise persistence in an exercise context, further studies are needed to better understand this dynamic. Future studies should also test our hypothesized model under similar contexts (e.g., sports) and in different cultures.

Composite scores had to be created in order to reduce the number of parameters to be estimated and to reduce possible collinearity issues, as past studies have done. (Monteiro et al., 2018; Pulido et al., 2014) Future studies should make an effort to collect larger samples as a way of measuring associations between each SDT construct independently, enjoyment, intention to continue exercising, and exercise persistence

The results of this study can encourage future researchers to test this hypothesized sequence on health-related outcomes (e.g., healthy eating). Silva et al. (2010) in a sample with obese individuals, revealed that a 1-year SDT intervention is capable of increasing physical activity adherence. Similarly, other experimental studies (Ntoumanis et al., 2017; Silva et al., 2011) have shown that supportive behaviors are associated with higher intentions toward exercising and self-reported exercise commitment.

# Conclusion

As empirically demonstrated, supportive interpersonal behaviors are key aspects to successfully promote BPN satisfaction, and hence autonomous motivation, enjoyment, intention to continue exercising, and ultimately exercise persistence in both male and female individuals. The complexity of the hypothesized model considering the bright and dark sides of motivation, enjoyment, intention to continue exercising, and exercise persistence provides professionals with the crucial tools to promote exercise participation. According to current research, exercisers should experience enjoyment when exercising, as a way of maintaining exercise participation for at least six months.

## Practical Implications

Fitness professionals should endorse supportive behaviors when interacting with gym clients and avoid using negative feedback; fitness professionals should also not pressure clients to perform only preprogrammed exercises. Instead, gym clients should be encouraged to improve their technique, and exercisers should receive some volitional choice of which exercises to perform that are aligned with the main structure of the individual's

exercise program. In fact, in the present study, in terms of the bright and dark sides of motivation, enjoyment always has the same tendency. It might be hypothesized that even exercisers who train for external reasons or under self-imposed pressure can still experience pleasure when exercising. Nevertheless, in the dark side sequence, the other constructs had no relevant effect on exercise persistence, contrary to the bright side sequence. Exercisers must experience supportive behaviors in order to induce greater levels of enjoyment, eventually leading to exercise persistence in the long run.

# Chapter 9

# The influence of motivational antecedents, intentions to continue, and past behavior on future exercise adherence: 1-year assessment


## Abstract

The present research aimed to examine a multi-theoretical model of motivational and cognitive determinants, considering past exercise frequency, on future exercise adherence. In total, 298 individuals (170 Female; 134 Male) aged between 18 and 65 years (M = 36.43, SD = 11.34), with an exercise frequency ranging from 2 to 6 times per week (M = 3.31, SD = 1.19) were enrolled in present study. At baseline, participants completed a multi-section questionnaire assessing motivational determinants and intentions to continue exercising in the future, as well as exercise frequency in the last 6-months using computer records. After 6-months, computer records were again used to calculate the total amount of exercise frequency. A Confirmatory Factor Analysis to examine model adequacy and Structural Equation Modelling to analyze direct and indirect effects were performed. The measurement and the structural model had a good fit to the data and direct and indirect effects were observed. Intentions to continue exercising in the future and past exercise behavior were positive and significant predictors of future habitual behavior. Results will be discussed according to existing literature regarding behavior maintenance. Gym and health club managers should create supportive environments to promote basic need satisfaction, leading to increased levels of autonomous motivation, resulting in increased rates of future exercise frequency. Higher exercise participation is crucial since it represents a decrease in sedentary lifestyles, potential chronic diseases and early mortality.



**Key-words:** multitheoretical model; one-year approach; exercise adherence; habitual behavior.

## Introduction

Turning physical exercise into a regular behavior is a complex process. Thus, exercising, a structured and recurrent form of physical activity, requires in the early stages effort and purpose to increase its recurrence in the future (Prochaska & DiClemente, 1982). Nevertheless, Hagger (2019) explains that repeating a certain behavior during a specific time period may lead to habitual performance, even in compound activities such as physical exercise.

Several theories (Ajzen, 1991; Ryan & Deci, 2017) have been tested in the context of exercise showing interesting results on short-term adherence (Edmunds, Ntoumanis, & Duda, 2006; Gomes, Gonçalves, Maddux, & Carneiro, 2017). But, looking at the long-term, they present several limitations by not considering important cues like intentions to continue exercising in the future (Ntoumanis, Thogersen-Ntoumani, Quested, & Hancox, 2017), past behavior (Sommer, 2011), and/or self-regulation (Hagger, 2019) as crucial predictors. Integrating concepts into one multi-theoretical model could give us some interesting insights on what determines future exercise adherence on a motivational and cognitive level. Results could give health and exercise professionals the necessary tools to increase physical activity participation among population and decrease current rates of physical inactivity.

## Theoretical Framework

Hagger and Chatzisarantis (2009) have referenced several theories on understanding human behavior and its prediction of causal maintenance, being Self-Determination Theory (SDT; Ryan & Deci, 2017) one of them. SDT, a macro theory of human motivation concerned on understanding the natural tendencies to behave efficiently with the environment, considers motivational indicators as agents for affective, cognitive and behavioral outcomes. To simplify the casual sequence of SDT constructs, Vallerand (1997) developed the Hierarchical Model of Intrinsic and Extrinsic Motivation (HMIEM), referring that the social context is in charge for the satisfaction or frustration of Basic Psychological Needs (BPN; autonomy, competence, and relatedness). In exercise context, several studies (Edmunds, Ntoumanis, & Duda, 2008; Klain, de Matos, Leitao, Cid, & Moutao, 2015) have shown that greater perceived support from exercise instructors was significantly related to BPN satisfaction, hence Ng, Ntoumanis, Thogersen-Ntoumani, Stott, and Hindle (2013) in a study conducted with 156 exercisers, showed that perceived thwarting behaviors was positively related to BPN frustration.

Following the model sequence, Ryan and Deci (2017) stated that the satisfaction or frustration of BPN would lead to different behavior regulations. Looking at past literature on the context under analysis, BPN satisfaction has been pointed out as being associated with more autonomous (i.e., the person values the behaviors or engages in it because of pleasure) forms of motivation (Ntoumanis et al., 2017; Teixeira, Silva, & Palmeira, 2018), whereas BPN frustration being related to controlled (i.e., individuals engage in exercise because of external rewards or self-imposed pressures) forms of motivation (Puente & Anshel, 2010). Ryan and Deci (2017) also specified that BPN frustration and satisfaction have a negative and significant association with controlled and autonomous motivation, respectively.

The last part of the HMIEM explains that emotional, cognitive, and behavioral outcomes are dependent on the motivational regulation each individual feel when acting on the behavior. For example, Moreno-Murcia, Belando, Huéscar, and Torres (2017) have shown a significant negative association between controlled motivation and intentions to continue exercising in the future, leading more likely to behavior withdrawal. Contrarily, Ntoumanis et al. (2017) have shown that higher levels of autonomous motivation were related to higher intentions to continue exercising in the future.

Intentions, a Theory of Planned Behavior (TPB; Ajzen, 1991) cognitive construct, is assumed to be the proximal determinant of physical exercise participation in the future (Hagger et al., 2014). In short, TPB states that cognitive principles (attitudes, subjective norms, perceived behavioral control) shape the intention that someone has towards a specific behavior. However studies applying this theory in exercise settings have sustained more explained variance on intentions than on the behavior itself, since constructs explain significantly intentions, but this does not translate into increased behavior maintenance (Hagger, Chatzisarantis, & Biddle, 2002).

Recent systematic (Hagger et al., 2014) and other theoretical studies (Sommer, 2011) claim that introducing other determinants could explain more efficiently how intentions towards acting on the behavior in the future could explain the behavior performance itself. For example Gomes et al. (2017) and Wilson and Rodgers (2004) have come to the conclusion that intention could be predicted by autonomous motivation, translating into significant forecast in exercise adherence. This suggests that integrating the HMIEM sequence on intentions could be a crucial improvement on explaining behavior enactment. Although under-researched in exercise context, past behavior (i.e., is what the individual has experienced when acting on the actual behavior) has been likewise pointed out as a strong forecaster of intention and has a relevant predictive value on future behavior (Sommer,

2011). Repeating the behavior is responsible to how someone perceives his control when performing a given behavior, and this has been supported by Hagger (2018), emphasizing the importance of past behavior as an additional independent predictor. This approach esteems the notion that higher levels of recapping the behavior in the past (in this study physical exercise frequency) could increase the possibility for it to be repeated in the future. Therefore, understanding cues like motivation and past behavior could explain exercise adherence or drop-out.

## Past Research

Although the full sequence of the HMIEM has been tested in the past (Monteiro, Pelletier, Moutão, & Cid, 2018; Pulido, Sanchez-Oliva, Amado, Gonzalez-Ponce, & Sanchez-Miguel, 2014), only one research in the context of exercise has considered motivational determinants on emotional and psychological outcomes (Ng et al., 2013). In addition, studies considering intention and observed measures in exercise context are limited, thus one study has analyzed intentions and exercise adherence on a 3-month time period (Gomes et al., 2017). However, this time spectrum seems trivial since it only explained 11% variance, showing that it was short on assessing exercise adherence. In addition, other studies using similar approaches do not consider past behavior or contemplate only intention without measuring the behavior itself (Monteiro et al., 2018; Ntoumanis et al., 2017).

Researchers (Rhodes, McEwan, & Rebar, 2019) have call for studies on determining the cues behind maintenance in physical exercise and explain the need to develop dynamic theoretical models using real-time data (i.e., observed measures). In this regard, the HMIEM can give valuable evidence on how the motivational determinants can impact behavior outcomes, and studies have shown autonomous motivation to predict intentions to exercise in the future and how it could lead to behavior enactment (Ntoumanis et al., 2017). In addition, as explained by Sommer (2011), past behavior has a predictive value on future behavior performance, explaining that the more an individual recaps the behavior, the more it will be performed in the future.

As it is seen, integrating all theoretical models addressed into one comprehensive model could give us key tools on analyzing future exercise adherence. In other words, we will encompass the HMIEM casual sequence with intention, and past behavior as a way to analyze their predictability to future exercise adherence.

## Present Research

Some limitations ascend within the theoretical frameworks addressed. For example, HMIEM based on SDT tenets, could give valuable evidence on how the social perception

could explain psychological mediators and their prediction on behavioral regulations. SDT postulates motivation as a predictor of different outcomes, but does not encompasses intention as the gateway to human behavior. Intention analysis is needed since it acts on how individuals will behave or not in the future (Ajzen, 1991). However, TPB does not consider motivation, expecting that cognitive constructs will determine the level of intention. Although PBC has a direct and indirect (via intention) effect on a specific behavior, research shows that its "power" is based on how the person has experienced the behavior in the past (Ajzen, 2002). Past behavior is not considered as a construct in TPB, and neither in SDT, but it could explain more rationally, who are the significant determinants for forthcoming behavior, such as physical exercise adherence (Hagger, 2018).

As it is seen, all theories and theoretical models present some limitations, although they give us key tools on analyzing human behavior, including in exercise settings. Their extensive work helps researchers on integrating their assets into one comprehensive and simple model. Results from this study aim on explaining which determinants predict intention and compare its explained variance with past on future adherence. This research will test different behavioral theories into one integrative model, aiming to understand the model's dynamic by encompassing several constructs to determine future behavior. HMIEM's casual sequence, TPB's intention, and past behavior (six months) will be analyzed on their predictability to long-term commitment (six months).

# Methods

## Participants

For the present study, exercise frequency 298 gym exercisers (170 Female; 128 Male) aged between 18 and 65 years (M = 36.43, SD = 11.34) was measured. Regarding gym activities, 49% were enrolled in fitness group classes (e.g., indoor cycling), 10% in personal training, and 41% in cardio/resistance training. Exercise frequency per week ranged from 2 to 6 times (M = 3.31, SD = 1.19), and training session endured between 30 and 90 minutes (M = 57.91, SD = 18.64).

## Procedures

After obtaining approval by the University Ethical Committee (reference number: CE-UBI-pJ-2018-044:ID683), gym and health club managers were contacted, and objectives were explained. Since computer records were needed for analyzing past and future behavior, data protection and confidentiality was explained by researchers to potential participants. In order to partake in this study, potential participants had to be aged between 18 and 65 years,

have at least six months of exercise experience, train at least exercise 2 times per week, and have only 6 months of exercise experience. Gym clients were contacted at reception desk and asked to participate voluntarily in this research. Those willingly to participate signed informed consent prior to filling a multi-section questionnaire, needing approximately 20 minutes to finish it.

## Measures

*Perceived Interpersonal Behaviors*. The 24-item Interpersonal Behavior Questionnaire (Rocchi, Pelletier, Cheung, Baxter, & Beaudry, 2017) was used and composite scores for supporting and thwarting behaviors were calculated. Participants indicated their agreement with each statement using a 7-point scale ranging from 1 (*do not agree at all*) to 7 (*completely agree*).

*Basic Need Satisfaction and Frustration*. The 24-item Basic Psychological Need Satisfaction and Frustration Scale in exercise (Rodrigues et al., 2019) was used and composite scores for BPN satisfaction and frustration were calculated. Participants responded to each item using a Likert-type scale ranging from 1 (*totally disagree*) to 5 (*totally agree*).

*Behavioral Regulations*. The 18-item Behavioral Regulation Exercise Questionnaire (Cid et al., 2018) was used, and composite scores for autonomous (identified and integrated regulation, and intrinsic motivation) and controlled motivation (introjected and external regulation, and amotivation) were calculated, based on SDT. Amotivation was considered to be part of controlled motivation since several authors suggest that acting on a specific behavior without intent has still some motivation attached to it (Jowett et al., 2017). In addition, amotivation is stringed in the motivational continuum next to external regulation, representing the lowest form of motivation (Ryan & Deci, 2017). Response options raged from 0 (*totally disagree*) 4 (*totally agree*).

*Intention*. We followed Ajzen (2006) recommendation on creating a 3-item factor examining intentions towards exercise adherence: "*I will continue to exercise frequently in the next 6 months as I currently do*"; "*It is in my plans to continue practicing physical exercise in the next six months as it is practiced today at the same frequency*", and; "*Exercise frequency will be the same in the next six months*". Participants responded to each item using a 5-point Likert scale ranging from 1 (*no, for sure*) to 5 (*yes, for sure*).

*Exercise Adherence*. Computer records were used to measure exercise frequency (i.e., training sessions). Past behavior (6-months prior) and future behavior (6-months after baseline) gym attendance was summed up into two scores, respectively. Similar procedures has been used in exercise settings (Gomes, Gonçalves, Maddux, & Carneiro, 2017) and observable measures are more reliable compared to self-reported questionnaires (Liu et al., 2016). The six-month criterion was based on: a) the drop-out curve (Prochaska & DiClemente, 1982); and, b) the Transtheoretical Model in physical activity, namely the maintenance phase (Buckworth, Dishman, O'Connor, & Tomporowski, 2013).

## Statistical analysis

Data with less than 5% of missing values was imputed using the Multiple Imputation (MI) method (Allison, 2000). Participants with >5% of missing values, univariate ($z > 3.00$) and multivariate ($D2 = p1 < .001, p2 < .001$) outliers were excluded, as recommended by (Byrne, 2016). Descriptive statistics (i.e., means and standard deviations), correlations were considered for all variables.

We conducted a two-step maximum likelihood (ML) approach for testing the hypothesized model, as recommended by Kline (2016), using AMOS v23. First, model fit for Confirmatory Factor Analysis (CFA), convergent and discriminant validity, as well as internal consistency was examined according to several authors (Byrne, 2016; Hair, Black, Babin, & Anderson, 2014). To evaluate convergent validity, Average Variance Extracted (AVE) was calculated and values >.5 were defined as acceptable. Squared correlations scores of each construct below AVE confirmed discriminant validity. For internal consistency, values >.7 was used as cut-off (Kline, 2016). After accepting CFA model, a Structural Equation Modelling analysis was conducted, measuring model fit, direct and indirect effects. The following absolute and incremental indices were used in CFA and SEM: Comparative Fit Index (CFI), Normalized Fit Index (NLI), Standard Root Mean Residual (SRMR), and Root Mean Square Error of Approximation (RMSEA) with its Confidence Interval (CI: 90%). For these indices, scores of CFI and TLI $\geq 0.90$, SRMR and RMSEA $\leq 0.8$ were considered acceptable (Byrne, 2016; Hair et al., 2014; Marsh, Hau, & Wen, 2004)

Even though our sample size was below 10:1 (ten participants per parameter to be estimated) recommendations by (Kline, 2016), it was above the acceptable 5:1 ratio suggested by several authors (Hair et al., 2014; Worthington & Whittaker, 2016). In addition, to test for collinearity issues, Variance Inflation Factor analysis was performed. Results presented scores below 2, rejecting possible collinearity issues, moving ahead to test regression models (Hair et al., 2014).

# Results

## Preliminary Analysis

Two individuals showed missing values below 5%, thus data was imputed using MI method. One participant was excluded (missing values >5%) and three univariate and multivariate outliers were found. Results presented no deviations from normality (skewness -1.98 to +1.98; kurtosis -7 to +7), however Mardia's coefficient for multivariate kurtosis exceeded expected value (>5). Consequently, a Bollen-Stine (B-S) bootstrap of 2000 sample in CFA and SEM was imputed. Descriptive statistics are presented in Table 8.1.

## Confirmatory Factorial Analysis

Results show that the model had good fit: $\chi2(196) = 524.867$, $\chi2/df = 2.67$; B-S p = <.001, CFI = .916, TLI = .901, SRMR= .059, RMSEA = .077 (CI90% = .066, .081). Convergent and discriminant was achieved, and composite reliability scores where above acceptable, as shown in Table 8.1.

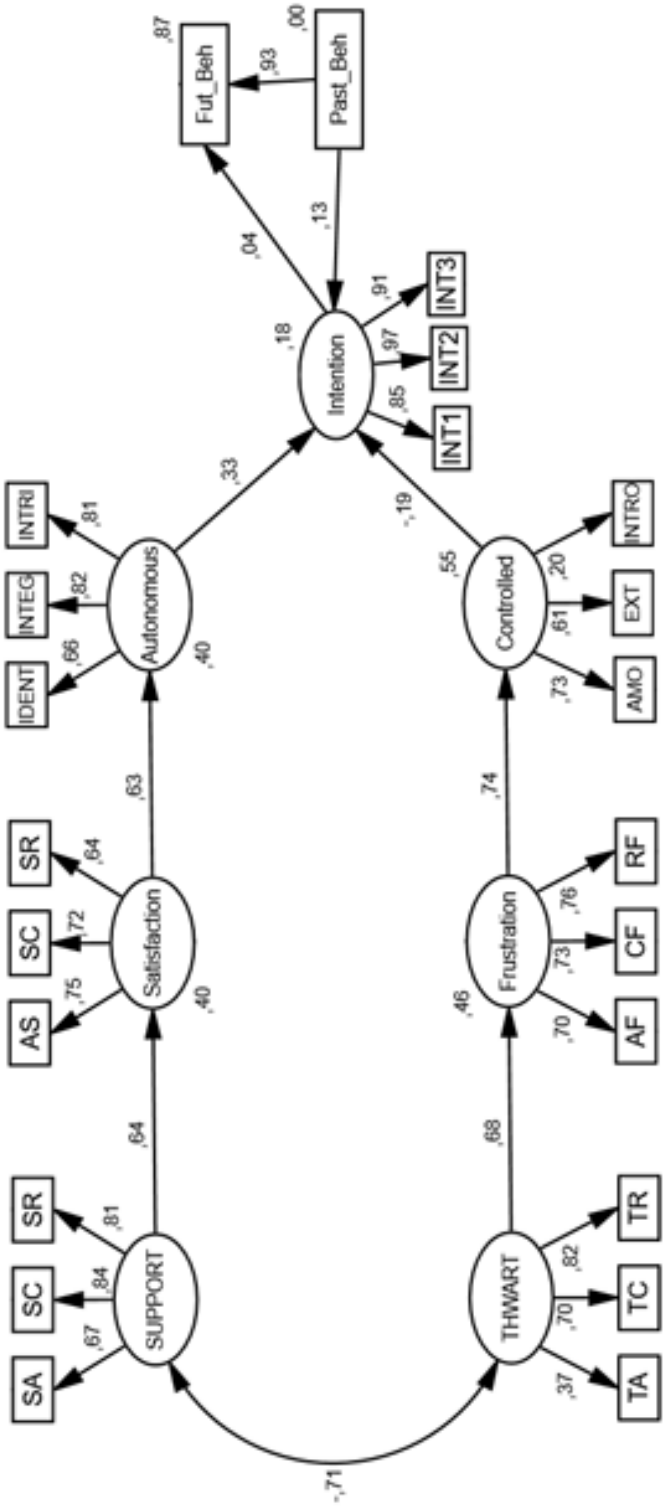
## Structural Equation Model

The model (see Figure 8.1) had an acceptable fit: $\chi2(222) = 765.985$, $\chi2/df = 3.45$; B-S p = <.001, CFI = .910, TLI = .900, SRMR= .077, RMSEA = .073 (CI90% = .065, .080). All regressions were significant except for controlled motivation → intention (see Table 8.2). Results show positive and significant indirect effect of supportive behaviors, BPN satisfaction and autonomous motivation on future behavior, whereas thwarting behaviors had a negative and significant indirect effect on controlled motivation and on intention (see Table 8.3).

**Table 8. 1** – Descriptive statistics, Composite Reliability, Average Variance Extracted, and squared correlations matrix

| | M | SD | CR | AVE | $r^2$ | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 1. Supportive Behaviors | 5.27 | .79 | .82 | .77 | 1 | | | | | | | |
| 2. Thwarting Behaviors | 2.49 | .87 | .70 | .63 | .48 | 1 | | | | | | |
| 3. BPN Satisfaction | 4.04 | .51 | .75 | .70 | .13 | .11 | 1 | | | | | |
| 4. BPN Frustration | 1.80 | .57 | .77 | .72 | .22 | .37 | .66 | 1 | | | | |
| 5. Autonomous Motivation | 3.32 | .49 | .81 | .76 | .27 | .13 | .34 | .35 | 1 | | | |
| 6. Controlled Motivation | .04 | .34 | .65 | .51 | .12 | .34 | .16 | .43 | .45 | 1 | | |
| 7. Intention | 4.46 | .71 | .94 | .91 | .07 | .05 | .19 | .10 | .31 | .13 | 1 | |
| 8. Past Behavior | 69.52 | 29.74 | - | - | .01 | .01 | .01 | .01 | .07 | .03 | .05 | 1 |
| 9. Future Behavior | 67.59 | 31.58 | - | - | .01 | .01 | .01 | .01 | .07 | .03 | .06 | .87 |

**Note:** M = Mean; SD = Standard Deviation; CR = Composite Reliability; AVE =Average Variance Extracted; $r^2$ = squared correlation matrix; BPN = Basic Psychological Needs.




Note: SA = Supportive Autonomy; SC = Supportive Competence; SR = Supportive Relatedness; AS = Autonomy Satisfaction; CS = Competence Satisfaction; RS = Relatedness Satisfaction; IDEN = Identified regulation; INTE = Integrated Regulation; IM = Intrinsic Motivation; TA = Thwarting Autonomy; TC = Thwarting Competence; TR = Thwarting Relatedness; AF = Autonomy Frustration; CF = Competence Frustration; RF = Relatedness Frustration; AMO = Amotivation; EXT = External regulation; INTR = Introjected regulation; INT1-3 = items regarding Intention; → = regression paths.

**Figure 8. 1** - Structural Equation Model under analysis

**Table 8. 2** - Path estimates among constructs

| Path | β | $R^2$ | CI-95% | *p* |
|---|---|---|---|---|
| Perceived Supportive Behavior → BPN Satisfaction | .610 | .37 | .460 / .735 | .002 |
| Perceived Thwarting Behavior → BPN Frustration | .666 | 44 | .528 / .781 | .002 |
| BPN Satisfaction → Autonomous Motivation | .653 | .43 | .484 / .771 | .002 |
| BPN Frustration → Controlled Motivation | .713 | .51 | .569 / .850 | .001 |
| Past Behavior → Autonomous Motivation | .245 | .06 | .151 / .348 | .002 |
| Past Behavior → Controlled Motivation | -.150 | .02 | -.275 / -.023 | .028 |
| Past behavior → Future Behavior | .926 | .86 | .898 / .949 | .002 |
| Autonomous Motivation → Intention | .345 | .12 | .144 / .526 | .003 |
| Controlled Motivation → Intention | -.193 | .04 | -.429 / -.074 | .039 |
| Intention → Future Behavior | .042 | .002 | .002 / .095 | .041 |

**Note:** β = direct effects; $R^2$ = explained variance; CI-95% = confidence interval; *p* = level of significance; BPN = Basic Psychological Needs.

**Table 8. 3** - Path estimates indirect effects

| Path | β | $R^2$ | CI-95% | *p* |
|---|---|---|---|---|
| Perceived Supportive Behavior → Autonomous Motivation | .398 | .16 | .233 / .534 | .002 |
| Perceived Thwarting Behavior → Controlled Motivation | .474 | .22 | .313 / .615 | .002 |
| Perceived Supportive Behavior → Intention | .137 | .02 | .055 / .241 | .002 |
| Perceived Thwarting Behavior → Intention | -.092 | .01 | -.212 / -.001 | .051 |
| Perceived Supportive Behavior → Future Behavior | .006 | .00 | .001 / .016 | .021 |
| Perceived Thwarting Behavior → Future Behavior | -.004 | .00 | -.015 / -.001 | .045 |
| BPN Satisfaction → Intention | .225 | .05 | .099 / .363 | .002 |
| BPN Frustration → Intention | -.138 | .02 | -.314 / .180 | .058 |
| BPN Satisfaction → Future Behavior | .010 | .00 | .001 / .024 | .024 |
| BPN Frustration → Future Behavior | -.006 | .00 | -.022 / .000 | .052 |
| Autonomous Motivation → Future Behavior | .015 | .00 | .001 / .036 | .026 |
| Controlled Motivation → Future Behavior | -.008 | .00 | -.032 / .000 | .054 |
| Past Behavior → Intention | .005 | .00 | .000 / .180 | .028 |

**Note:** β = indirect effects; $R^2$ = explained variance; CI-95% = confidence interval; *p* = level of significance; BPN = Basic Psychological Needs.

# Discussion

The aim of the present study was to test a multi-theoretical model, analyzing motivational and cognitive determinants on future exercise adherence. In addition, this work intended to analyze the importance of past behavior on intention to continue exercising in the future and the performance on the behavior itself. Current results may explain physical exercise maintenance and will be discussed in the light of previous research.

The hypothesized model showed significant direct effect between constructs; thus, past exercise behavior had a higher prediction, compared to intention, on future exercise adherence. In addition, significant indirect effect in bright side constructs, intention, and future behavior were found, and past behavior had a direct and indirect effect (via intention to continue exercising) on future behavior. According to present results, repeating the behavior consistently could increase its frequency in the future (Buckworth, Dishman, O'Connor, & Tomporowski, 2013). However, as it seems, in order to maintain exercise frequency, gym clients need to experience high levels of intentions to continue exercising, which is significantly predicted by "bright" side motivational determinants (i.e., perceived supportive behaviors, BPN satisfaction, and autonomous motivation). In an empirical manner, individuals engaging in exercise need to perceive fitness professionals as supportive (e.g., receiving positive feedback from exercise instructors and feeling connected with them), in order to experience higher levels of BPN satisfaction, and ultimately autonomous motivation. Ryan and Deci (2017) have theoretically proven this, and several studies in sports (Monteiro, Pelletier, Moutão, & Cid, 2018), physical education (Moreno-Murcia, Huescar Hernandez, & Ruiz, 2018) and exercise (Wilson & Rodgers, 2004) sustain with present results.

Regarding "dark side" motivational determinants (perceived thwarting behaviors, BPN frustration, and controlled motivation), results exhibited thwarting interpersonal behavior as being the only construct with a significant negative indirect effect on future exercise behavior. Imbalanced behaviorism, such as today "I feel pressured by my exercise instructor so I will exercise today" and "I will not exercise tomorrow because by exercise instructor is always complaining about my technique and he does not feel empathy" might be subject to decrease intentions towards exercising, leading ultimately to withdrawal episodes or even drop-out. Several studies have shown that supervisors (e.g., teacher, coach) who use controlled behaviors are perceived as being accountable for BPN frustration (Bartholomew, Ntoumanis, Ryan, Bosch, & Thogersen-Ntoumani, 2011; Gunnell, Crocker, Wilson, Mack, & Zumbo, 2013). This is likely to promote controlled forms of motivation, being individuals' actions related to external or self-induced forces, decreasing their intention to maintain the behavior.

Identifying the appropriate determinants could be useful on physical exercise maintenance. Lally, van Jaarsveld, Potts, and Wardle (2010) explain that repeating a behavior, for example exercising, in response to specific cues (e.g., feeling supported by exercise instructors) could promote higher levels of its performance in the future. However, the required level of consistency and the time frame for it to become "habitual" is not full known. Studies regarding regular exercise stability (Dishman & Buckworth, 1996;

Prochaska & DiClemente, 1982) propose that the ratio of drop-out decreases approximately 50% after six months. Looking at present results, past behavior (6-months) explained 86% of future behavior (6-months), a ratio above the one found by previous authors. However, we suspect that present results may be related to total amount of exercise participation, since these authors did not assess exercise frequency. Our sample had at least a 2-time per week frequency and 6-months of exercise, which could have influenced current results. Future studies should examine model with new gym clients or exercisers with more than 6-months of exercise experience.

These results are novel, since virtually no study has tested the bright and dark side of motivation on intention, considering past exercise behavior on future exercise adherence. Equally, strengths of the present research are the use of objective measurement (i.e., computer records of exercise frequency) and a one-year longitudinal design. Results confirm the predictive value of past behavior on forthcoming behavior (Sommer, 2011), both directly and indirectly via intention. In addition, we support in part Hagger (2019) avenue for future research, by showing the prediction of motivational antecedents on intention, and on future exercise adherence. Behavior maintenance could be based on repeating the behavior regularly at least two times per week for at least six-months, thus, for this to happen, exercisers should perceive fitness professionals as supportive, in order to promote BPN satisfaction and autonomous motivation.

## Limitations

To the best of our knowledge, this was the first attempt to test a multi-theoretical model, considering past exercise behavior, on predicting future exercise adherence. Moreover, this longitudinal prospective approach focused on the possibility on explaining exercise maintenance based on motivational and cognitive determinants. Future research is needed to develop effective interventions to sustain these results.

Second, this study used composite scores of the motivational determinants to avoid collinearity problems and parameters to be estimated. Although we overpassed minimum ratio sample size, results are limited to the compound scores from each construct and we cannot deduce which factor has more impact on intention and future exercise adherence. Forthcoming studies should fill this gap by expanding the causal sequence to every SDT tenets, considering the large sample size needed.

Third, this study is context specific. While some authors (Ryan & Deci, 2017Ryan & Deci, 2017; Vallerand, 1997) argue the universality of constructs, inferring results to other domains could bias interpretations. Researchers should examine this multi-theoretical

model in similar settings, like physical education or sports. Interesting results could emerge and comparing with this work could increase the notion of health-related behavior maintenance.

## Conclusion

Although initiating an exercise program is crucial for a healthy lifestyle, creating interventions that helps society in adhering to long-term physical exercise participation are paramount. Results from the present study give health promoters and researchers key aspects on how training programs should be oriented to promote supportive interpersonal behaviors, as a way to encourage individuals on being physically active. Endorsing in these behaviors by exercise instructors could increase BPN satisfaction, resulting in increased self-determined motivation towards exercising. As intentions to continue exercising is predicted by autonomous motivation, repeating the behavior because of joy and pleasure could increase its occurrence in the future. Therefore, repeating the behavior regularly and perceiving support from exercise instructors, could create stable conditions to promote long-term exercise adherence.

# Chapter 10

# General Discussion

The main purpose of this research was to assess the bright and dark side of motivation o exercise persistence and adherence. To achieve this goal, eight investigations were conducted, each one with its relevance on the final objective. The initial work of this thesis was to perform a systematic review, considering past studies on all motivational determinants (i.e., interpersonal behaviors, basic psychological needs, and behavioral regulations) according to SDT. Likewise, data from studies considering intention and enjoyment were well-thought-out, since both have shown to represent behavior action in the exercise context. Overall solid evidence was found between previously mentioned variables and their impact on exercise adherence and persistence. The major contribution of this review was the assessment of interpersonal behaviors, and the addition of the dark side motivation tenets, something well under-researched. This review updated the previous one (Teixeira et al., 2012) and gives new and relevant insights on the bright and dark side of motivational determinants on exercise-related outcomes.

The following research (studies 2, 3, and 4) were conducted to translate and validate four scales, two on assessing basic psychological needs satisfaction and frustration, and the others on supportive and thwarting interpersonal behaviors. The Basic Psychological Need Satisfaction and Frustration Scale (Chen et al., 2015) and Interpersonal Behavior Questionnaire (Rocchi et al. 2017) were adapted to exercise context and applied to exercise physiologists and exercisers. Regarding analysis of the psychometrics proprieties, these scales can be applied to Portuguese exercisers and exercise physiologists to measure supportive and thwarting interpersonal behaviors, as well as basic need satisfaction and frustration. Assessing interpersonal behaviors are important to understand how basic psychological needs could affect motivational regulations.

Study 5 gives continuity to the thesis sequence, exploring the interaction between fitness professionals and participants' perceived interpersonal behaviors on their BPN satisfaction and frustration. In order to conduct this study, we used polynomial regression analysis with surface response methodology, a statistical approach testing the independent and interaction effect of two distinct but similar variables on one outcome. Present findings were relevant since only 30% of self-reported and perceived behaviors from others were in-agreement. This led to BPN satisfaction and frustration, thus exercisers experienced higher levels when fitness professionals had under-reported their behaviors. Promoting BPN

satisfaction is essential given that it is associated with autonomous forms of motivation (Ntoumanis et al., 2016).

Considering previous statistical analysis, similar procedures were used in study 6, exploring the interaction between BPN satisfaction and frustration on all six behavioral regulations, based on SDT. In sum, experiencing BPN frustration can still lead to autonomous forms of motivation, provided by BPN satisfaction significance independently and in interaction with need frustration. This knowledge can give exercise professionals some insight when actively impacting exercisers BPN satisfaction and frustration, since the degree of these needs is related to autonomous motivation, leading to increased rates of exercise participation.

Study 7, encompassing previous studies, we assessed for the first time the bright and dark sides of motivational tenets on enjoyment, predicting intentions, and how intentions is related to exercise persistence. In sum, the present research advances current knowledge by displaying the motivational determinants' impact on enjoyment, consequently in long-term exercise persistence. Fitness club managers, as well as exercise physiologists, should create a helpful and enjoyable climate for exercisers to perceive them as supportive, and in consequence, maintain physical exercise participation.

Lastly, in study 8 we aimed to understand habitual behavior development, testing the direct and indirect effect of interpersonal behaviors, basic psychological need, behavioral regulation, and intention on future exercise adherence. In addition, we added past behavior in the proposed model, since theorists have shown this variable to be a strong predictor of future exercise adherence (Hagger, 2019). It seems that rotine behavior could be measured by considering motivational determinants and past behavior as predictors. Adherence to exercise could be based on perceiving supportive behaviors from fitness professionals and repeating the behavior regularly at least two times per week for at least six months. For this to happen, exercisers should perceive fitness professionals as supportive, in order to promote BPN satisfaction and autonomous forms of motivation.

All in all, research on exercise psychology could have an important impact on changing human behavior since we want to participate in different activities for social bonds, positive emotional outcomes, and motives to drive for self-efficacy and self-determined motivation (Teixeira, Silva, & Palmeira, 2018). It seems that exercise physiologists should foster a supportive environment for gym clients in order to promote exercise as an automatic behavior. Additionally, positive feedback should be given and clients should have the chance to select the exercises they appreciate to perform. Moreover, promoting empathy and social support seems to be important for stimulating more self-determined motivation. In

addition, exercisers are emotional human beings and therefore, social interactions play a major role when it comes to affectional bonding with fitness professionals. Taking everything into account, one should bear in mind that the social environment (i.e., gym managers, technical coordinators, and exercise physiologists) is the connection between exercisers and their exercise participation on the long-run.

# Chapter 11

# General Conclusion

Looking at the main objectives of the present thesis, regarding our systematic review, translation and validation of four scales, two studies using polynomial regression analysis, one research on exercise persistence, and another on adherence, the results can be summarized in the following key-points:

i) The systematic review showed several gaps in the literature, specifically interpersonal behaviors and basic need frustration measurement. In addition, this research updated the first review by encompassing more studies in more detail, considering the full sequence of SDT's (i.e., HMIEM) bright and dark sides of motivation;

ii) The translated and validated scales can be used with a high degree of reliability and validity in exercisers and exercise physiologists, measuring basic psychological need satisfaction and frustration, and perceived support and thwarting interpersonal behaviors. The scales presented invariance between gender showing good psychometric proprieties;

iii) The level of discrepancy between exercisers' perception of exercise physiologists' behaviors self-perceived behavior is high, showing that exercise physiologists over or under-report their behaviors. This translated into different outcomes concerning the levels of basic need satisfaction and frustration. Greater alignment between perceived behaviors are more likely to promote basic need satisfaction;

iv) Basic needs satisfaction and frustration interaction can still promote autonomous forms of motivation and likely introjected regulation. Results show that satisfaction "buffs" the weight of needs frustration scores, thus some degree of frustration is needed to endorse in self-determined behavior promotion, since frustration has a stronger impact on outcomes compared to satisfaction;

v) Exercisers perceived interpersonal behaviors are predictors of basic psychological needs. In turn, they are the ones who forecast autonomous or controlled motivation. Autonomous compared to controlled motivation will predict positively enjoyment, leading to higher levels of intention and therefore higher exercise persistence rates;

vi) Enjoyment is the strongest predictor of exercise persistence. Individuals should perceive exercise as a fun activity in order to maintain their persistence of exercising on the long-run;

vii) Past exercise adherence forecast future exercise adherence with a high degree of reliability. Results show that when individuals engage in exercise on a regular basis of two times per week during several months, the level of adherence will be higher;

viii) Measuring the bright and dark sides of motivation are crucial for exercise related-outcomes assessment. Although dark side constructs are more propone for negative results, our research showed that they contribute to model adequacy, predict positively in some degree motivational determinants and when interacting with bright side constructs, can estimate positive outcomes.

In this regard, it is possible to give fundamental guidelines for the fitness industry (e.g., gym managers and exercise physiologists), specifically:

a) Promote basic need satisfaction, by giving exercisers some autonomy, transmitting positive feedback and creating social connections with them. Humans are emotional and therefore psychological variables should be considered when prescribing exercise programs;
b) Endorse in fun activities to increase levels of enjoyment. This can be done by varying exercises, by creating regularly different gym group classes, by interacting more with exercisers, and/or by considering the needs that each individual has when he/she engages in gym activities;
c) Engage in supportive behaviors that are perceived likewise by exercisers. Over or under-reporting is not adequate enough and therefore self-consciousness and self-awareness is needed to balance the self-perceived and other perceived supportive behaviors to promote positive exercise related-outcomes;
d) Be aware of exercisers' gym frequency. Withdrawal episodes or below two times per week frequency seems to predict drop-out. Professionals should be attentive to how exercisers are being supervised and avoid them skipping training sessions. Asking exercisers *"when will you come to the next training session?"* could be one way to "compel" exercisers to give an answer and stick to it;
e) Reduce emphasis on fitness and performance outcomes and more on emotional and behavioral outcomes. Reducing fat mass is important to reduce chronic diseases, and increase lean mass is important to reduce fall risk and other related outcomes. However, none of this is important if individuals perceive exercise as a painful

experience or look at gym and wellness centers as pure “marketing and commercial machines”.

In overall, we consider accomplishing the proposed objectives and give at hand fitness professionals and researchers the necessary tools to promote exercise persistence and adherence, and to increase knowledge on exercise behavior, respectively. Knowledge of how physical exercise habit develops provides valuable guidance for empirical and theoretically interested in developing behavior change interventions that are effective in fostering long-term exercise participation.

# Chapter 12

# Future Research

Although the current thesis work did substantial advances in analyzing exercisers behaviors, it has its limitations that should be considered for future research. Some forthcoming studies have been already mentioned in the discussion section of each study, thus we would like to suggest more investigations. Therefore, some suggestions are provided for further investigations:

i) To measure the peak of habit automaticity in exercisers, considering when does the adherence hits its highest;
ii) To measure exercise adherence invariance according to the proposed model in study 8, between gender, weekly exercise frequency, and exercise experience;
iii) To develop a meta-analysis considering study 1, considered as an advance on the study's content quality on analyzing the motivational determinants of exercise behavior;
iv) To analyze which contextual determinants impact exercise physiologists' behavioral regulation, predicting different interpersonal behaviors, as these professionals are likewise affected by the social/contextual environment;
v) Add cognitive constructs from the Theory o Planned Behavior on the multi-theoretical model tested in study 8. Attitude, subjective norms, and perceived behavioral control should be considered between behavioral regulation and intention;
vi) To measure motives for exercise drop-out and persistence for analyzing their impact on how interpersonal behaviors can predict different outcomes;
vii) To create and validate a scale considering behavioral regulation introjected of approach and avoidance and how they could be considered controlled and/or autonomous motivation;
viii) To validate a scale that measures habit;
ix) Follow-up exercise adherence up till 2-years or more and compare the differences across years of exercise frequency;
x) To create an intervention considering behavior change strategies and the theoretical model proposed in study 7 and 8 to test its applicability in real context.

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