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The Behavioral Regulation in Exercise Questionnaire (BREQ-4): Psychometric evidence of introjected approach regulation in Portuguese health club exercisers

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ABSTRACT

The assessment of motivation has been a key aspect to the understanding of exercise participation, and research grounded in self-determination theory has presented valid and reliable instruments for that purpose. Given the need to continually refine this latent construct, the present study aimed to translate, adapt, and psychometrically validate a subscale targeting the approach facet of introjection, and to test the pattern of associations between motives for practice, basic psychological needs satisfaction/frustration, and behavioral regulations encompassing the validated introjection subscale, in a sample of health club exercisers.

For that purpose, two studies were developed with a total of 1216 health club exercisers. In Study I ($n = 806$), Confirmatory Factor Analysis and Exploratory Structural Equation Modeling analysis to test the motivational continuum encompassing the introjected approach subscale were performed. In Study II ($n = 410$) associations and structural models between intrinsic and extrinsic goal contents, basic psychological needs satisfaction and frustration, and behavioral regulations with the new subscale were tested.

The correlated seven-factor model with 21 items in Study I displayed good psychometric properties (CFA: $\chi^2 = 481.977$ (168), $p < .001$, CFI = 0.936, TLI = 0.915, SRMR = 0.037, RMSEA = 0.048; ESEM: $\chi^2 = 178.672$ (84), $p < .001$, CFI = 0.980, TLI = 0.949, SRMR = 0.014, RMSEA = 0.037). The introjected approach regulation added to the preexisting factorial structure did not affect the validity and reliability of the instrument. The results from Study II supported a theoretically expected pattern of associations, in which the introjected regulation of approach is positioned between introjected avoidance and identified regulation along the motivational continuum. Additionally, path estimates depicted criterion validity for the new subscale. All in all, this work presents preliminary evidence for an introjected approach regulation subscale that can be used in health club practices for a better understanding of the motivational quality of exercise practice.

1. Introduction

It is widely acknowledged by scholars and professionals in the realm of sport and exercise psychology that motivation is a key determinant of continuous engagement or dropout. In exercise, individuals with high intrinsic motivation tend to participate in regular physical activity freely as they find the behavior interesting and enjoyable, which offers the opportunity for learning and personal well-being (Teixeira et al., 2012; Wilson et al., 2006). Understanding the why's for engaging in physical activity has been a central research topic in contemporary research, as it comprises the perceived motivations for actively (or not) engaging in some sort of physical activity such as exercise (Rodrigues, Macedo, et al., 2020).

Further understanding of how to address exercise participation and its sustainability has encouraged researchers to continually pursue new facets of known motivational frameworks and how to measure their

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assumptions (Bhavsar et al., 2019). Thus, the aspects related to the validity, reliability, and sensitivity of instruments that assess the latent constructs of motivation are paramount for data interpretation and empirical application. Given the need for continuous testing, development, and refinement of these instruments (Cid et al., 2022; Vlachopoulos et al., 2013), this work addresses an under-researched gap grounded in Self-Determination Theory (SDT) by exploring and measuring introjected regulation from an avoidance-approach perspective, particularly in the exercise domain. This endeavor will be made in the health club setting, a well-known context suffering from adherence problems, which encompasses millions of exercisers worldwide (Sperandei et al., 2016; IHRSA, 2020). Particularly in Portugal, this is also one of the most used settings for exercise practice (European Commission, 2018), thus emerging as a preferential focus for study exploration, especially when considering that it is a supervised context with considerable potential to influence public health.

1.1. Conceptual framework

The SDT framework (Deci & Ryan, 1985; Ryan & Deci, 2017) is a contemporary motivational theory that has received much attention in the physical activity and exercise literature (Teixeira et al., 2012; Wasserkampf & Kleinert, 2016). Ryan and Deci (2017) argue that individuals have a natural tendency for personal growth and optimal functioning. This tendency requires that the social context facilitates the satisfaction of three Basic Psychological Needs (BPN), namely: autonomy (i.e., being able to choose one's behavior and to be in control of one's activities); competence (i.e., the ability to succeed at challenging tasks and attain desired outcomes); and relatedness (i.e., development of emotional connections based on trust and mutual respect). When these three needs are fulfilled, individuals will experience a higher quality of motivation (more self-determined or autonomous motivation), psychological well-being, and will engage and invest more in health-related behaviors (e.g., healthy eating, exercise participation). However, when these needs are thwarted, lower motivational quality, ill-being, and poor health manifestations may occur (Ryan & Deci, 2017; Vansteenkiste & Ryan, 2013).

Several aspects can be determinants of BPN fulfillment or frustration according to SDT, in which the nature of individual goals and reasons can be one of those influencing factors (Ryan & Deci, 2017). As postulated, the goal content can be intrinsic (e.g., when aiming for personal growth or health development) or extrinsic (e.g., when focused on image comparison or social recognition). Hence, it is theoretically proposed that intrinsic goals would be positive and significant factors of BPN fulfillment in several contexts. In the exercise context, intrinsic goals could determine BPN fulfillment and consequently support internalization processes (Gunnell et al., 2014; Teixeira et al., 2012).

One key assumption of the SDT framework is that individuals are naturally inclined to elaborate themselves over their lifespan and are proactive organisms whose natural or intrinsic functioning can be either enabled or hindered by the social environment (Deci & Ryan, 1985). Additionally, it proposes that internalization is the process of transforming external regulations into internal regulations and, when the process functions optimally, integrate those regulations into one's sense of self. These regulations are structured in SDT according to three types of motivation with varying degrees of self-determination: intrinsic motivation, extrinsic motivation, and amotivation. Intrinsic motivation represents the highest degree of self-determined motivation as it is defined as the participation undertaken for the pleasure and enjoyment, satisfaction, and interest derived from the behavior itself (Deci & Ryan, 2000). On the other hand, extrinsic motivation is defined as engaging in an activity to attain an outcome separable from the activity itself and can be divided further into several differentiated regulations: external (to obtain social or material rewards or avoid punishment); introjected (shame, guilt avoidance, or self-worth pursue); identified (to see value and benefits for the activity) and integrated (behavior seen as being part of the self/identity). Lastly, amotivation is interpreted as the lack of intention and willingness to engage in a given behavior (Ryan & Deci, 2017).

The extent to which people experience motivation to engage in exercise and behaviors more or less self-determined is proposed to influence their persistence or withdrawal of the behavior in the future (Rodrigues et al., 2021). Specifically, studies have shown a positive relationship between self-determined regulations and exercise persistence (Teixeira et al., 2012; Rodrigues et al., 2020), while others have found that individuals participating in exercise for controlled reasons tend to withdraw in the short term (Kinnafick et al., 2014; Ntoumanis et al., 2017) and have lower intentions towards continuing exercising (Rodrigues et al., 2019). Hence, interventions aiming to develop self-determined behavior are prone to promote engagement in physical activity, and individuals will likely persist over time and yield the health benefits of regular practice (Ntoumanis et al., 2018; Ntoumanis et al., 2021).

1.2. The measurement of motivation

Self-report measures are amongst the most commonly used measurement tools in motivational research, and SDT has a long track in this remark (Hagger & Chatzisarantis, 2008). On a brief historical note in the exercise context, Mullan et al. (1997) created the Behavioral Regulation in Exercise Questionnaire (BREQ) aiming to test the continuum of behavioral regulation in the exercise domain. Originally, these authors created an initial pool of 30 items derived from other measures of motivation. They used two studies, the first with attendees of a local sports center, and the second with a larger sample of individuals with some experience in physical activity, in order to create and validate the English version of the BREQ. This questionnaire assessed external, introjected, and identified regulations, as well as intrinsic motivation (i.e., four-factors measurement model), comprising 15 items in total (four items per factor, except for introjected regulation with only three items).

Later, Markland and Tobin (2004) in response to the limitation of assessing the motivational regulations proposed by SDT, continued their work by developing a new version of BREQ (i.e., the BREQ-2). In this questionnaire, four items were added for the assessment of amotivation, the most non-self-determined form of motivation that was absent from the previous BREQ version. Hence, *"the BREQ-2 could allow for a more complete assessment of motivation from the SDT perspective"* (Markland & Tobin, 2004, p. 196), and provided advancements in the assessment of behavioral regulation. This new version of BREQ (i.e., BREQ-2, with a five-factors measurement model), comprising 19 items, has become one of the most widely used instruments in exercise motivation studies based on SDT in the last 20 years (Cid et al., 2018; Coimbra et al., 2022; Rodrigues, Macedo, et al., 2020).

Meanwhile, theoretical advances proposed that integrated regulation should also be measured, in order to assess all SDT theoretical constructs, since behaviors that are not only seen as meaningful but an expression of one's identity seems to be related to a more self-determined regulation compared to the identified regulation (Wilson et al., 2006). In this regard, these authors developed a new subscale with four items to measure integrated regulation for exercise, to be included in BREQ-2 and used in empirical settings (Wilson et al., 2006). This advancement has been usually called BREQ-3 (i.e., six-factors), and is proposed to be the most adequate approach when aiming to measure all behavioral regulations according to SDT.

This advancement has been tested in a Portuguese sample of exercisers (i.e., BREQ-3, six-factors/24 items - four items for each regulation, which included an extra item for the introjected regulation – the only subscale with 3 items) as a means to provide evidence of a simplex pattern grounded in SDT (Cid et al., 2018). More recently, BREQ-3 was used and tested in other languages/countries, such as Mexico (Zamarripa et al., 2018), Brazil (Dias et al., 2020), Turkey (Ersöz et al., 2021), China (Luo et al., 2022), and Italy (Cavicchiolo et al., 2022).

1.3. Current study – Introjected avoidance and introjected approach

The SDT framework has been tested continuously and expanded since its origin. Many works have suggested new hypothesis testing to enrich the understanding of human behavior grounded in this theory (Howard et al., 2017). One relevant aspect that has received little attention pertains to a possible double facet of introjected regulation and respective associations with the SDT constructs and relevant outcomes (e.g., well-being). As stated previously, introjected regulation can be understood as feelings of guilt, shame, or self-worth appraisal. This usually reflects the way some values or goals are pressed into an individual behavior by someone deemed relevant or whose approval is sought to be important (Assor et al., 2004; Ryan & Deci, 2017). However, Assor et al. (2009) suggested that the introjected regulation (in their work called introjected motivation) can be experienced according to an avoidance- or approach-based motivational force. As such, they propose that introjected avoidance orientation is related to negative and undesired experiences (e.g., feeling unworthy as opposed to feeling worthy), experienced as more self-pressuring and controlling motivation, to avoid the feeling of unworthiness, shame, or guilt. In contrast, the introjected approach regulation involves a focus on achieving or maintaining feelings of high self-worth and social recognition by meeting the introjected standards. Howard et al. (2017) have previously supported this possibility, showing that introjected regulation was equidistant from both external and identified regulations, presenting positive associations with well-being indicators, but at some times also non-significant or even negative associations. In their study, they claim that "*This pattern is exactly what would be predicted by a factor lying in the center of a continuum and which represents both positive and negative elements (*e.g.*, pride approach and shame avoidance questions)* (Howard et al., 2017, p. 21, p. 21). This distinction may be particularly relevant given that BREQ versions rely only on items that measure introjected avoidance (item example: "*I feel ashamed when I miss an exercise session*"), thus shading a possible influence of introjected approach in several outcomes (Assor et al., 2009; Gagné et al., 2015; Howard et al., 2017).

In fact, Assor et al. (2009) and Gagné et al. (2015) found distinct patterns between introjected regulation of avoidance and approach with other motivation subscales, meaning that there could be some conceptual and empirical distinctiveness between these factors. For example, individuals could exercise in a more controlling manner within self-imposed pressures (introjected avoidance regulation, e.g., I have to exercise because I do not what to let my partner down) or they could participate for reasons that are relatable to self-worth feelings (introjected approach regulation, e.g., I exercise in order to feel proud of myself). While both are still introjected regulation in nature, given that the motivational force to act is controlled by external appraisals, it may be assumed that introjected approach may be less controlling, thus closer to identified regulation.

Further support for a possible continuum gap in the introjected regulation assessment was provided by the meta-analysis developed by Howard et al. (2017). In their study, introjected regulation is suggested to be equidistant from both external and identified regulations, presenting positive, negative, or neutral associations with several outcomes, and thus possibly representing both positive and negative elements (e.g., pride approach and shame avoidance). These issues raise concerns regarding the controlled regulations factor understanding, as the absence of (or limitation to assess) the approach facet, will result in loss of information, reliability issues, and reduced predictive power (Gagné et al., 2015; Howard et al., 2017).

The exploration made by Assor et al. (2009) did show that a sample of athletes differentiated the two proposed introjection facets, thus supporting their distinctiveness, in which introjected avoidance was experienced as more controlling and less autonomous when contrasted to introjected approach regulation. To date, this stands as the first empirical study tested in one of the physical activity domains, providing preliminary evidence of the theoretical distinctiveness of the avoidance-approach dimensions. Thus, along with previous theoretical assumptions, the work conducted by Assor et al. (2009) supported the notion that understanding how self-worth or social approval is used by an exerciser could be relevant for health and sustained exercise participation, particularly in settings where external contingencies may impose controlling factors on one's motivation (e.g., health clubs exercisers strive for body image perceptions of social adequacy). When contemplating this, the understanding of both introjection facets may be relevant for exercise professionals, as pinpoint actions could be performed according to the preponderance of the behavior regulation. Although each individual tends to regulate the exercise behavior differently, and a combination of motives could be present at a given time (Ryan & Deci, 2017), understanding the (new) weight of the controlled vs. autonomous reasons, as for their positioning in the motivational continuum, would ensure a more transparent reading of each individual motivational characteristics and needs.

For future adequate hypothesis testing framed on these assumptions, existing measurement instruments must be upgraded. For that matter, grounded in previous works and theoretical implications, the present study presents two main objectives: i) to translate, adapt, and validate a subscale targeting the approach facet of introjection, since the actual measurement of introjected regulation in the BREQ versions is avoidance-oriented, and ii) to test the pattern of associations and path estimates between goal content in exercise practice, BPN satisfaction and frustration, and behavioral regulations encompassing the two introjected regulations, in a sample of health club exercisers.

For that matter, this work will present two studies. The first study (Study I) will analyze the psychometric properties of the BREQ-4 Portuguese version, testing four items that measure the introjected approach regulation (Assor et al., 2009) in a previous behavioral regulation instrument based on SDT, namely the BREQ-3 Portuguese version (Cid et al., 2018). The second study (Study II) will test the associations and path estimates between intrinsic and extrinsic goals, BPN satisfaction and frustration, and behavioral regulations of the new instrument (BREQ-3, plus items of introjected approach regulation, i.e., BREQ-4) in an independent sample of Portuguese health club exercisers. This second study will provide additional support for the BREQ-4 Portuguese version simplex model understanding and provide criterion validity, thus allowing the exploration of the introjected approach regulation positioning on the motivational continuum, particularly when considering the adjacent regulations (i.e., introjected avoidance and identified regulation).

2. Study I

2.1. Method

2.1.1. Participants

For this cross-sectional study, a total sample of 806 exercisers filled out a battery of questionnaires. The sample was constituted by 464 men and 342 women aged between 17 and 68 years old ($M = 30.87$; $SD = 11.86$), with a BMI mean score of 23.92 kg/m^2 ($SD = 3.17$) and an average exercise experience of 9.12 years of practice ($SD = 4.89$). Data from this sample was collected using the same questionnaires but with two approaches: an online ($n = 578$) and a physical ($n = 228$) data collection. Participants were enrolled in several activities usually performed in health clubs (i.e., resistance training, cardio, group classes, personal training, and water activities). To be eligible to participate in this study, participants had to be at that point enrolled in a Portuguese gym or health club, with a minimum of one attendance per week during the last month.

2.2.1. Procedures

2.2.1.1. Translation of the approach introjection subscale. Considering

the existence of the introjection avoidance items in the BREQ-3, four-items assessing introjected approach regulation were translated from the proposal made by Assor et al. (2009). These items were selected due to their proximity to this study context (sport vs. exercise), and because their prior content validity and psychometric testing displayed adequate results. Four exercise psychology experts translated the items with the help of professional translators. After the translation, minor wording adjustments were made better reflect the exercise (vs. sport) context. The most extensive modification pertains to the initial questioning, where *"I participate in sports …"* (Assor et al., 2009) was changed to *"Why do you engage in exercise?"* in order to be in line with previous BREQ versions recommendations (e.g., BREQ-2: Markland & Tobin, 2004; Portuguese versions of BREQ-2 and BREQ-3: Cid et al., 2012; Cid et al., 2018). This final version was then sent to a panel of four exercise psychology researchers fluent in both languages, which presented their commentaries to the translation proposed. The first panel of four experts created through a consensus the final version of the items. This version was back-translated by a researcher fluent in both languages. Any disagreement with this last step was discussed and resolved at this stage. These procedures were developed according to the recommendations proposed by several authors (Banville et al., 2000; Brislin, 1970, 1980; Cid et al., 2022).

2.2.3. Data collection

Data collection was performed between April 2019 and January 2020. For the online data collection, a link on an online platform (Google forms) was made available and distributed through the health club's internal platforms. Data were collected anonymously from anyone willing to participate and eligible face to inclusion criteria. Physical data collection was made face-to-face in several health clubs. Both data collection methods requested written authorizations from the club managers. Also in both collection methods, a letter of explanation and informed consent were presented. In physical format, signed consent was requested individually before the questionnaires were delivered. In the online form, the questionnaires were presented only after the selection of a box that stated that the participant have read and understood the letter of explanation and informed consent. In both situations, explanations of the expected participation, risks, and confidentiality of given data were detailed. The present study obtained approval from the ethics committee (omitted for review purposes) and followed the Helsinki declaration and later amendments related to Human research.

2.2.4. Instruments

2.2.4.1. Behavioral Regulation in Exercise Questionnaire Portuguese version 4 (BREQ-4). The six-factors, 24 items structure of the Portuguese version *(BREQ-3;* Cid et al., 2018*)* questionnaire was used. Following suggestions regarding the need for further testing of the Portuguese version of BREQ-3 psychometric properties (Cid et al., 2018; Rodrigues, Macedo, et al., 2020), all items (i.e., 24) were included in the present study. However, regarding the authors suggestions to overcome the possible fragility found in some items, the present work consider minor syntax and wording adjustments (e.g., Amotivation, item 1: BREQ-3 *"Não vejo porque tenho de fazer exercício"* was reworded to *"Não vejo porque é que tenho de fazer exercício";* identified regulation, item 26: *"Eu valorizo o exercício e os seus benefícios"* was reworded to *"Valorizo o exercício pelos benefícios da sua prática"*; for more information see Appendix 1). All items were responded on a five-point Likert scale ranging from 0 ("Strongly disagree") to 4 ("Strongly agree").

Considering that BREQ-3 measured introjected regulation of avoidance (*"I feel guilty when I don't exercise; I feel ashamed when I miss an exercise session; I feel like a failure when I haven't exercised in a while; I get restless if I don't exercise regularly"),* four items pertaining introjected approach were added (i.e., Assor et al., 2009 - *I feel proud of myself when I persist; Because I want to prove to myself that I'm able to persist; I can only be satisfied with myself when I continue to participate; I feel better about myself when I continue to participate*). The seven-factor/28 items structure was labeled BREQ-4 (Portuguese version) (Appendix 1).

2.2.5. Statistical analysis

Before the final data set utilization, a visual inspection was made to detect errors or imprecisions. Additionally, data collected online received verification to remove random or similarity fulfilments. Multiple individual fulfillment was checked by crossing general socio-demographic data (e.g., date of birth, height, the club of practice). As a first statistical approach, descriptive statistics of the BREQ-4 items were examined using IBM SPSS Statistics v. 27. Normal univariate distribution was analyzed and skewness between −2 and +2, and kurtosis between −7 and +7, were considered to define the threshold values (Gravetter & Wallnau, 2014).

Second, factor analyses were performed in Mplus 7.4 (Muthén & Muthén, 2010). We considered the Robust Maximum Likelihood estimator to correct any non-normality bias. Full Information robust Maximum Likelihood (FIML) was used to handle the possible small amount of missing data at the item level (missing at random = 3%) as proposed by several authors (Enders, 2010).

As previous theoretical (Ryan & Deci, 2017) and empirical (Assor et al., 2009; Cid et al., 2018; Howard, Gagné, & Morin, 2020, 2020b; Rodrigues, Macedo, et al., 2020) studies gave support for a seven-factor measurement model of the motivational continuum, Confirmatory Factor Analysis (CFA) and Exploratory Structural Equation Modelling (ESEM) were used. Several reasons justify the two analytical approaches. First, the BREQ-3 validation (Cid et al., 2018) was developed using CFA procedures. Given that this structure and items were used as a basis for the inclusion of the introjected approach, and the previous BREQ-3 removed items had received minor syntax adjustments, an adequate comparison of factorial weights and model scores would be more adequate using the same statistical procedure. Second, it is well known that a CFA technique allows model solutions considering all possible construct-relevant information to be modeled, making full use of the multidimensional conceptualization of motivation. Specifically, when considering the continuum according to SDT, motivation is a multidimensional construct that assumes each regulation will contain unique properties (Howard, Gagné, & Morin, 2020; Howard, Gagné, Van den Broeck, et al., 2020). This ensures that CFA is an adequate approach for motivation assessment testing based on multidimensional factorial structures. However, ESEM combines the advantages of CFA and exploratory procedures (Marsh et al., 2014; Morin et al., 2013) and allows for cross-loadings to be modeled on each factor of a multidimensional scale such as the BREQ. In doing so, it maximizes construct relevant information captured by these latent factors and minimizes bias in the estimation of factor loadings and latent factor intercorrelations as has been shown in previous studies (Howard, Gagné, & Morin, 2020). In the CFA, items were allowed to load on their predefined factors, suppressing cross-loadings on unintended factors (Hair et al., 2019). Following previous applications of ESEM specifications (Marsh et al., 2004; Morin et al., 2016), the model was specified with oblique target rotation procedures (Browne, 2010) and factor loadings are estimated in the ESEM model by imposing appropriate restrictions on the factor loading matrix and the factor covariance matrix. Given the study aim and the proposed evolution of the BREQ assessment, the use of CFA to make version comparisons, and ESEM for an in-depth understanding of the factorial structure that now encompasses a new factor, ensures proper understanding from an analytic standpoint.

While the chi-square statistics will be reported for visualization purposes, due to the over-sensitivity of it on large samples sizes and model complexity (Hair et al., 2019), several common goodness-of-fit indices to assess model fit were considered, namely: Tucker-Lewis Index (TLI), Comparative Fit Index (CFI), Root Mean Square Error of Approximation (RMSEA) and its respective Confidence Interval at 90%

(CI 90%), and Standardized Root Mean Residual (SRMR). For CFI and TLI, values ≥ 0.90, are typically interpreted to reflect adequate fit, and for SRMR and RMSEA, values of ≤ 0.08 are indicative of adequate fit to the data (Hair et al., 2019; Marsh et al., 2004). Analysis of the individual items should display significant loadings on the target factor, with weights greater than 0.50 and significant ($p < .05$) explaining at least 25% of the variance (Hair et al., 2019).

In a second phase, to investigate the factor structure of the model specification, the best CFA and ESEM model of the BREQ-4 will be examined for internal consistency, convergent, and discriminant validity. For the assessment of internal consistency, composite reliability coefficients were calculated for the subscale scores, and values ≥ 0.70 were considered acceptable (Raykov, 1997). The Average Variance Extracted (AVE) and the comparison between the squared root of the AVE and squared correlations were used to investigate convergent and discriminant validity, respectively. AVE is an established approach to test convergent validity (Hair et al., 2019) and scores above 0.50 are deemed to be acceptable. Constructs are identified as distinct when the square root of the AVE value is larger than the correlation between the two constructs displaying discriminant validity (Fornell & Larcker, 1981; Hair et al., 2019).

To test multigroup analysis between sex and fitness activity (individual vs. group activities), several levels of measurement invariance were considered according to several authors (Hair et al., 2019; Morin et al., 2016). The process of analyzing measurement invariance is essentially the testing of a series of increasingly restrictive hypotheses. These levels are: configural invariance (i.e., factor structure is the same between groups; same items associated with the same factors); weak factorial invariance (i.e., factor structure and factor loadings are equal between groups); strong factorial invariance (i.e., item factor structure, factor loadings, and item thresholds are equal between groups), and strict factorial invariance (i.e., item factor structure, factor loadings, item thresholds, and item residuals are equal between groups). Model comparisons were made according to several assumptions, specifically: a) differences in CFI ≤.01, and b) differences in SRMR <0.03 and RMSEA ≤0.015 (Byrne, 2016; Chen, 2007; Cheung & Rensvold, 2002). The syntaxes used can be seen in Appendix 2.

3. Results

After data screening, no missing data was found. Participants used the full range scores of the scale (0–4) and presented higher means for the items measuring autonomous motivation (identified regulation, $M = 3.23$; integrated regulation, $M = 2.75$; intrinsic regulation, $M = 3.41$), and lower scores in the items measuring controlled motivation (external regulation, $M = 0.37$; introjected avoidance regulation, $M = 1.65$; introjected approach regulation, $M = 2.05$) and amotivation ($M = 0.26$) constructs. As seen in Table 1, the skewness and kurtosis scores generally indicate a normal univariate distribution to the data.

The psychometric properties of the measurement model tested in several subsamples are shown in Table 2. As seen, the correlated seven-factor model with 28 items showed poor fit in the CFA and ESEM analysis. After analyzing the standardized factors loading (λ) based on ESEM calculations (see Table 3), items with a score <0.50 were removed (Amotivation: item 1; external: item 2; avoidance introjection: item 10; approach introjection: item 18; identified: item 26; integrated: item 27; intrinsic: item 7). The revised correlated seven-factor model with 21 items presented good psychometric properties (see Table 2) and adjusted factorial weights (>0.50; Table 4), which was used for subsequent analysis.

Internal consistency was achieved since composite reliability coefficient scores were equal to or above 0.70, except for amotivation (0.69) in the ESEM analysis (see Table 4). Regarding convergent validity, the root square of AVE scores was above the cut-off value (0.50) in the CFA and ESEM models (see Table 5 and Table 6, respectively). For discriminant validity, the CFA analysis depicted one issue regarding amotivation-external regulation. For ESEM, and according to the squared correlations and AVE scores in Table 6, all factors demonstrated adequate discriminant validity in the ESEM analysis.

Finally, considering the results showing good model fit in both

Table 1
Descriptive analysis of the BREQ-4 Portuguese version items.

	Skewness	z-value	Kurtosis	z-value
Item 1 (Amotivation)	2.35	27.20	4.46	25.63
Item 2 (External)	2.12	24.52	3.99	22.94
Item 3 (Introjected Avoidance)	.27	3.07	−1.03	−5.96
Item 4 (Introjected Approach)	.28	3.26	−1.23	−7.14
Item 5 (Identified)	−1.8	−20.99	2.89	16.59
Item 6 (Integrated)	−.83	−9.58	−0.19	−1.16
Item 7 (Intrinsic)	−.76	−8.81	−0.40	−2.36
Item 8 (Amotivation)	2.83	32.78	7.49	43.08
Item 9 (External)	2.06	23.79	4.15	23.88
Item 10 (Introjected Avoidance)	1.37	15.83	1.16	6.65
Item 11 (Introjected Approach)	−.32	−3.65	−1.02	−5.91
Item 12 (Identified)	−1.36	−15.77	1.10	6.31
Item 13 (Integrated)	−.65	−7.49	−0.50	−2.90
Item 14 (Intrinsic)	−1.84	−21.29	3.54	20.32
Item 15 (Amotivation)	3.31	38.25	10.83	62.34
Item 16 (External)	2.92	33.82	9.11	52.43
Item 17 (Introjected Avoidance)	.32	3.73	−1.24	−7.18
Item 18 (Introjected Approach)	−.08	−0.89	−1.22	−7.09
Item 19 (Identified)	−1.00	−11.60	−0.03	−0.24
Item 20 (Integrated)	−.63	−7.25	−0.58	−3.39
Item 21 (Intrinsic)	−1.62	−18.80	2.27	13.01
Item 22 (Amotivation)	4.33	50.03	19.96	114.89
Item 23 (External)	2.79	32.26	8.02	46.15
Item 24 (Introjected Approach)	.30	3.49	−1.11	−6.44
Item 25 (Introjected Approach)	−.52	−5.96	−0.45	−2.61
Item 26 (Identified)	−.10	−1.16	−1.10	−6.41
Item 27 (Integrated)	−.82	−9.46	0.10	0.52
Item 28 (Intrinsic)	−2.00	−23.19	4.60	26.43

Table 2
Psychometric properties of the tested models.

Model	χ2	df	CFI	TLI	SRMR	RMSEA
Total sample original model (28-item)						
Correlated seven-factor CFA	1327.084*	329	.858	.837	.054	.061
Correlated seven-factor ESEM	744.568*	203	.923	.857	.022	.058
Total sample revised model (21-item)						
Correlated seven-factor CFA	481.977*	168	.936	.915	.037	.048
Correlated seven-factor ESEM	178.672*	84	.980	.949	.014	.037
Male sample (21-item)						
Correlated seven-factor CFA	389.340*	168	.933	.909	.048	.063
Correlated seven-factor ESEM	92.652*	84	.996	.990	.016	.017
Female sample (21-item)						
Correlated seven-factor CFA	319.864*	168	.941	.926	.040	.044
Correlated seven-factor ESEM	134.197*	84	.980	.951	.016	.036
Individual activities sample (21-item)						
Correlated seven-factor CFA	240.249*	168	.932	.915	.054	.048
Correlated seven-factor ESEM	130.125*	84	.957	.936	.023	.054
Group activities sample (21-item)						
Correlated seven-factor CFA	389.340*	168	.903	.879	.048	.063
Correlated seven-factor ESEM	189.908*	84	.954	.904	.017	.061

Note. χ2 = qui-square test; df = degrees of freedom; CFI = Comparative Fit Index; TLI = Tucker Lewis Index; SRMR = Standardized Root Mean Square Residual; RMSEA = Root Mean Square Error of Approximation; *$p < .001$.

Table 3
Factor structure of the 28-item correlated seven-factor models.

	CFA	ESEM						
	λ	AMO λ	EXT λ	AVO λ	APP λ	IDE λ	INT λ	IMO λ
Amotivation (AMO)	*.77*	*.66*						
Item 1	**.49****	**.34****	−12	.02	.02	−.05	.02	.10
Item 8	**.72****	**.63****	.15	.06	.04	−.01	−.02	.03
Item 15	**.78****	**.55****	.25*	.07	−.03	−.04	.09	−.10
Item 22	**.69****	**.73****	.38*	.05	−.02	−.05	.09	−.12
External Regulation (EXT)	*.80*		*.69*					
Item 2	**.69****	.37**	**.38****	−.02	−.05	.04	−.17*	.17*
Item 9	**.75****	.17	**.65****	−.07	−.05	.06	−.12	.13
Item 16	**.72****	.14	**.62****	.08	.07	−.06	.09	−.08
Item 23	**.67****	−.04	**.72****	.07	−.02	−.06	−.04	−.03
Introjected Avoidance (AVO)	*.65*			*.65*				
Item 3	**.62****	.11	−.04	**.53****	.02	.28	.08	−.18
Item 10	**.46****	.02	.25	**.41****	.03	.04	.15	−.23*
Item 17	**.70****	.11	−.04	**.63****	−.00	.22	.13	−.19
Item 24	**.45****	−.01	.06	**.67****	−.01	−.05	.14	.24
Introjected Approach (APP)	*.72*				*.72*			
Item 4	**.68****	−.04	−.06	.01	**.67****	.00	−.03	.03
Item 11	**.72****	−.04	.07	−.02	**.73****	.05	−.04	.02
Item 18	**.47****	.02	.04	.01	**.48****	−.05	.01	.09
Item 25	**.62****	.05	−.09	.08	**.62****	−.03	−.01	−.05
Identified Regulation (IDE)	*.77*					*.55*		
Item 5	**.64****	−.04	−.05	.10	−.01	**.56****	.01	.25*
Item 12	**.76****	.02	−.13	.15	−.06	**.58****	.24*	.27*
Item 19	**.67****	−.13	.09	.27	−.01	**.62****	−.14	.04
Item 26	**.62****	−.09	.04	.65**	−.04	**.13**	.15	.40*
Integrated Regulation (INT)	*.83*						*.72*	
Item 6	**.64****	−.03	−.01	.05	−.01	.17	**.53****	.00
Item 13	**.79****	.08	−.13	.09	−.00	−.10	**.83****	.07
Item 20	**.81****	.03	−.04	.16	−.02	.09	**.65****	.07
Item 27	**.72****	−.08	.03	.11	−.04	.03	**.45***	.32
Intrinsic Motivation (IMO)	*.75*							*.56*
Item 7	**.46****	−.11	.09	−.22	.09	.04	.21	**.07**
Item 14	**.69****	.01	−.03	−.17	−.06	.23	.21	**.64****
Item 21	**.70****	.05	−.01	−.14	.04	.32	.18	**.60****
Item 28	**.66****	−.06	.11	−.02	.06	.21	.18	**60****

Note. SF = Specific Factor; λ = standardized factor loadings; target loadings are in bold; composite reliability coefficients are in italic; *$p < .05$; ***$p < .001$. Analyses on the correlated seven-factor CFA and ESEM model with 21 items revealed that item loadings on the targeted factor were greater than 0.50 and loaded significantly lower than $p < .001$, explaining at least 25% variance. In addition, no cross-loadings were detected since factor loadings on the non-targeted factor were below 0.15 and not significant (for more details see Table 4).

genders and the type of activities (individual activities vs. group activities) subsamples, measurement invariance analysis was performed using the 21-item ESEM model. Results showed support for invariance assumptions, namely: a) the same number of factors were present in each paired group and remained associated with the same items (thus ensuring configural invariance), b) items presented a similar understanding in all groups (weak factorial invariance), c) latent and observable means were valid in all paired groups when compared (strong factorial invariance), and d) comparison between observable items were verified (strict factorial invariance). For more details see Table 7.

4. Discussion

Grounded in SDT, the factor structure of the new BREQ-4 Portuguese version was analyzed. The 21-item correlated seven-factors model revealed good psychometric properties. Specifically, the current research examined the dimensionality of the behavioral regulations based on the motivational continuum considering both facets of introjected regulation, and in doing so, adding empirical evidence and validity of this measure in the exercise context.

The analysis performed on the 28-item initial model allowed us to retest the BREQ-3 (Cid et al., 2018) questionnaire with the inclusion of four items measuring introjected approach regulation (Assor et al., 2009). The present study confirms the previous alternative model of BREQ-3 (18 items) validated by Cid et al. (2018). These results reinforce that the 18 items still represent the best-adjusted model for the assessment of behavioral regulation in the Portuguese language.

Also, in the initial model encompassing 28 items, the four introjected approach items were tested (the introjected avoidance items already existed in BREQ-3). In the case of introjected approach regulation, both CFA and ESEM testing showed that item 18 (*"I can only be satisfied with myself when I continue to exercise"*) presented the lowest factorial weight (λ = 0.47 and λ = 0.48, respectively), thus justifying its removal (Hair et al., 2019). Thus, the final 21-item model emerged as the better solution for the assessment of the seven behavioral regulations grounded in SDT (Portuguese health club exercisers).

Given the need to ensure the distinctiveness of the introjected approach regulation, particularly regarding the adjacent introjected avoidance and identified regulations, construct validity and reliability procedures were developed. As seen in the results section (Tables 4, 5, and 6), all constructs presented adequate reliability, and convergent and discriminant validity. Thus, no issues regarding the consistency of these subscales, relevant item cross-loadings, or construct overlaps were detected, suggesting that participants did in fact understood and conceptualize these latent constructs as distinct.

Considering previous suggestions regarding continuous improvement and validation of measures (Cid et al., 2022), and particularly regarding BREQ-3 (Cid et al., 2018; Rodrigues, Macedo, et al., 2020), as a means to provide a valid and reliable measure for groups with different characteristics, multigroup analysis was performed. The measurement model depicted invariance for both sexes. These results support previous studies using BREQ versions (e.g., Cid et al., 2018; Rodrigues, Macedo, et al., 2020), suggesting that the BREQ-4 Portuguese version provides

Table 4
Factor structure of the 21-item correlated seven-factor models.

	CFA	ESEM						
	λ	AMO λ	EXT λ	AVO λ	APP λ	IDE λ	INT λ	IMO λ
Amotivation (AMO)	*.74*	*.69*						
Item 8	**.69***	**.72****	.03	.01	.03	−.00	−.03	.04
Item 15	**.77***	**.65****	.14	.05	−.03	−.05	.05	−.05
Item 22	**.62***	**.59****	.30**	−.03	−.02	.00	.09	−.12*
External Regulation (EXT)	*.76*		*.71*					
Item 9	**.69***	.26**	**.59****	.00	−.05	−.11	−.14	.12
Item 16	**.77***	.22*	**.63****	.12	.06	.03	.02	.01
Item 23	**.70***	−.16	**.79****	−.03	−.01	.03	−.01	−.04
Introjected Avoidance (AVO)	*.74*			*.71*				
Item 3	**.61***	.04	.00	**.51****	.02	.19*	.04	−.08
Item 17	**.71***	.02	−.06	**.87****	−.02	−.03	−.02	−.02
Item 24	**.76***	−.08	.15*	**.61****	−.02	.06	.18*	.10
Introjected Approach (APP)	*.73*				*.73*			
Item 4	**.64***	−.03	−.03	−.02	**.64****	.02	.02	−.02
Item 11	**.74***	−.01	.02	.02	**.74****	−.01	−.04	.03
Item 25	**.69***	.02	.02	−.02	**.69****	−.01	.05	.01
Identified Regulation (IDE)	*.76*					*.70*		
Item 5	**.72***	.04	−.04	−.08	.01	**.81****	.05	.06
Item 12	**.84***	−.03	−.04	.07	−.06	**.63****	.28*	.20
Item 19	**.57***	−.06	.05	.28**	.01	**.53****	−.15*	.06
Integrated Regulation (INT)	*.80*						*.73*	
Item 6	**.64***	.05	−.01	−.05	.01	.31*	**.56****	−.12
Item 13	**.80***	−.00	−.03	.04	−.06	−.14	**.91****	.07
Item 20	**.83***	.05	−.04	.17	.00	.04	**.58****	.12
Intrinsic Motivation (IMO)	*.73*							*.70*
Item 14	**.70***	−.09	.04	−.09	−.06	.03	.06	**.70****
Item 21	**.70***	.06	−.05	−.01	.04	.10	−.04	**.68****
Item 28	**.65***	−.04	.04	.10	.05	.08	.06	**.61****

Note. SF = Specific Factor; λ = standardized factor loadings; target loadings are in bold; composite reliability coefficients are in italic; *$p < .05$; **$p < .001$.

Table 5
Convergent and discriminant validity of the 21-item CFA model.

	AVE	√ AVE	1.	2.	3.	4.	5.	6.	7.
1. Amotivation	.48	.69	1	.79	.05	.00	.03	.00	.02
2. External Regulation	.52	.72		1	.05	.00	.03	.00	.02
3. Introjected Avoidance Regulation	.48	.69			1	.00	.39	.40	.18
4. Introjected Approach Regulation	.48	.69				1	.00	.00	.00
5. Identified Regulation	.52	.72					1	.51	.60
6. Integrated Regulation	.58	.76						1	.45
7. Intrinsic Motivation	.47	.68							1

Note. AVE = Average Variance Extracted; above diagonal line: squared correlations.

Table 6
Convergent and discriminant validity of the 21-item ESEM model.

	AVE	√ AVE	1.	2.	3.	4.	5.	6.	7.
1. Amotivation	.43	.65	1	.42	.04	.00	.03	.01	.00
2. External Regulation	.38	.61		1	.04	.00	.01	.00	.02
3. Introjected Avoidance Regulation	.46	.68			1	.00	.20	.18	.09
4. Introjected Approach Regulation	.48	.69				1	.00	.00	.00
5. Identified Regulation	.44	.66					1	.22	.31
6. Integrated Regulation	.49	.70						1	.31
7. Intrinsic Motivation	.44	.66							1

Note. AVE = Average Variance Extracted; above diagonal line: squared correlations.

good indices for empirical application in both male and female exercisers. Additionally, considering that fitness activities can be performed individually or in group, an invariance analysis was conducted. The measurement model indicated an adequate final factorial structure between fitness activities (i.e., group vs. individual), further supporting a psychometric evaluation in the exercise setting that can differentiate introjected approach and avoidance regulations, as well as the previously well-established behavioral regulations.

The psychometric testing performed thus advocates for an introjected regulation dual facet relevant for future research endeavors, providing additional evidence for the multidimensional nature of extrinsic motivation, and giving insight regarding the controlled regulations that may vary in the degree of self-determined behavior. Hence, the purpose of the second study (Study 2) was to explore the association pattern between SDT known antecedents (goal content, and BPN satisfaction/frustration), and the behavioral regulations in an independent sample of exercisers. With this, the new subscale can be tested for criterion validity purposes, adding to the understanding of its distinctiveness and possible motivational relevance.

Table 7
Multigroup analysis between gender and fitness activity.

Model	χ2	df	CFI	ΔCFI	TLI	ΔTLI	SRMR	ΔSRMR	RMSEA	Δ RMSEA
Gender										
Configural Invariance	226.038*	168	.988	–	.969	–	.016	–	.029	–
Weak Factorial Invariance	338.545*	266	.985	.003	.976	.007	.021	.005	.026	.003
Strong Invariance	363.166*	287	.984	.004	.976	.007	.021	.005	.026	.003
Strict Factorial Invariance	407.390*	308	.979	.009	.971	.002	.025	.009	.028	.001
Fitness Activity										
Configural Invariance	241.211*	168	.984	–	.961	–	.016	–	.033	–
Weak Factorial Invariance	266.757*	266	.984	.000	.963	.002	.020	.004	.032	.001
Strong Invariance	260.899*	287	.983	.001	.961	.000	.018	.002	.033	.000
Strict Factorial Invariance	291.487*	308	.980	.001	.954	.007	.021	.005	.034	.001

Note. ΔCFI = differences in CFI; ΔTLI = differences in TLI; ΔSRMR = differences in SRMR; ΔRMSEA = differences in RMSEA; *$p < .001$.

5. Study II

5.1. Method

5.1.1. Participants

A sample of 410 exercisers (M_{age} = 30.01 years, SD = 10.69; females = 220) enrolled in several Portuguese health clubs participated voluntarily in this study. Participants had an average training experience of 8.43 years (SD = 6.25), and 49% were enrolled in individual (e.g., exercise room, personal training), 28% in group (e.g., aerobics), and in both fitness activities (23%). Inclusion criteria stated in study 1 were considered for this study.

5.1.2. Procedures

Data collection was made between January and April 2020 through an online questionnaire made available through social media networks. The link provided presented a study explanation letter and an informed consent describing the expected participation, risks, possibility of discontinuation, guarantee of anonymity and secure data processing, and the institutional email of a researcher for additional questioning. These were all provided before the presentation of the questionnaire. The present study data collection was approved by the ethics committee (CE-UBI-pJ-2018-044:ID683) and followed the Helsinki declaration and its later amendments related to Human research. Participation was screened for eligibility and 3.4% of the participants were removed for subsequent analysis since they did not meet specified inclusion criteria.

5.1.3. Instruments

5.1.3.1. Goal content for Exercise Questionnaire (GCEQ). To assess exercise goal content as postulated by SDT, the GCEQ Portuguese version (Antunes et al., 2017) was used. This questionnaire possesses 17 items grouped into five factors. Of these factors, three represent intrinsic motives such as social affiliation (three items), health management (four items), skills development (three items), and two extrinsic motives, namely, image (three items) and social recognition (four items). Items were answered on a Likert-type scale, with 7 response options anchored between 1 (*"Totally disagree"*) to 7 (*"Fully agree"*).

5.1.3.2. Behavioral Regulation in Exercise Questionnaire Portuguese version (BREQ-4). The previously validated BREQ-4 Portuguese version was used to measure behavioral regulations towards exercise practice. Composite scores were calculated for each behavioral regulation following recommendations proposed by Howard, Gagné, Van den Broeck, et al. (2020).

5.1.3.3. The basic psychological needs satisfaction and frustration scale in exercise (BPNSFS-E). The BPNSFS Portuguese version (Rodrigues et al., 2019) was used to measure BPN satisfaction and frustration in exercise. This scale contains 24 items that evaluate BPN satisfaction (12 items, three per construct; e.g., Autonomy: *"I have a feeling of freedom and choice in the things I make"*; competence: *"I feel confident that I can do things right"*; relatedness: *"I feel that the people how I care for, also care for me")*, and BPN frustration (12 items; three per construct; e.g., autonomy: *"I feel the majority of the things I do out of obligation"*; competence: *"I feel insecure of my abilities"*; relatedness: *"I feel excluded from the group I want to belong")*. The stem "*Considering your exercise practice at this fitness center …*" is followed by each item and answers are given using a 5-point Likert scale ranging from 1 (*"Totally disagree"*) to 5 (*"Totally agree"*). Composite scores were calculated for autonomy, competence, and relatedness satisfaction as well as for each need frustration following recommendations proposed by Teixeira et al. (2018).

5.1.4. Statistical analysis

For study purposes, data were screened for missing data, and normality (i.e., Kolmogorov-Smirnov) was assessed and compared to Gravetter and Wallnau (2014) recommendations. Afterward, descriptive (mean, standard deviation, maximum and minimum) and correlation (Pearson bivariate) procedures were developed for all tested variables. Reliability through Cronbach's Alpha was calculated and values higher than 0.70 are considered acceptable (Hair et al., 2019). All these procedures were developed using IBM SPSS Statistics v. 27 and the significance level was defined at $p < .05$.

To further add to the criterion validity testing, factor analyses (model 1: intrinsic motives and extrinsic motives → all behavioral regulations; model 2: BPN satisfaction and BPN frustration → all behavioral regulations) were developed and tested following Kline's (2016) recommendations (e.g., measurement model and structural equation model). The following goodness-of-fit indices and cut-off values to assess model fit were used: Tucker-Lewis Index (TLI) and Comparative Fit Index (CFI) both ≥0.90, Root Mean Square Error of Approximation (RMSEA) and its respective Confidence Interval at 90% (CI 90%), and Standardized Root Mean Residual (SRMR) both ≤0.08 (Hair et al., 2019; Marsh et al., 2004). The CFA analyses were performed using Mplus 7.4 (Muthén & Muthén, 2010). Besides model fit analysis, path estimates were calculated between each predictor and individual behavioral regulations.

The models were defined following SDT assumptions, given that goals and BPN are determinants of behavioral regulations. Composite factors for intrinsic and extrinsic goals, as for BPN satisfaction and frustration, were created ensuring an acceptable sample size/parameters to be estimated ratio based on Hair et al. (2019) recommendations and considering previous testing with these variables in similar contexts (e.g., Gunnell et al., 2014; Teixeira et al., 2018).

6. Results

Descriptive statistics and the correlation matrix are reported in Table 8. Results displayed no violations of the univariate distribution since skewness and kurtosis were contained between previously reported cutoffs (Gravetter & Wallnau, 2014). Additionally, no outliers were found. As seen in Table 8, participants used in general the full range of the instrument's scores. Regarding SDT variables, the three

Table 8
Descriptive and reliability analysis of SDT variables.

	α	Min	Max	M	SD
Social affiliation	.82	1	7	4.02	1.51
Image	.83	1	7	5.19	1.23
Health management	.82	1	7	6.09	.89
Social recognition	.86	1	7	2.75	1.37
Skills development	.77	1	7	5.64	1.07
Autonomy satisfaction	.74	1	7	5.64	1.01
Competence satisfaction	.87	1	7	5.29	1.37
Relatedness satisfaction	.82	1	7	5.80	1.06
Autonomy frustration	.81	1	7	2.03	1.14
Competence frustration	.80	1	6	1.77	1.05
Relatedness frustration	.81	1	7	2.53	1.31
Amotivation	.79	0	4	.24	.61
External regulation	.84	0	4	.33	.69
Introjected avoidance regulation	.70	0	4	1.98	1.07
Introjected approach regulation	.67	0	4	3.31	.68
Identified regulation	.63	0	4	3.45	.61
Integrated regulation	.83	0	4	3.24	.82
Intrinsic motivation	.81	0	4	3.46	.63

Note. M = mean; SD = standard deviation; α = Cronbach's alpha

intrinsic goals presented scores above the scale midpoint, and only one extrinsic goal (i.e., image) depicted the same trend. The highest score shown was health management (M = 6.09). Regarding BPN, needs satisfaction was above scale midpoint, and needs frustration needs were below scale midpoint. As for behavioral regulations, the introjected approach and autonomous regulations and intrinsic motivation depicted scores above the midpoint, and intrinsic motivation had the highest score (M = 3.46). The remaining controlled regulations showed scores below the scale midpoint, in which amotivation depicted the lowest score. The majority of variables under analysis presented good reliability scores (α > 0.70). The introjected approach regulation (α = 0.67) and identified regulation (α = 0.63) can be considered acceptable.

As for the correlational analysis, the results depicted in Table 9 show a consistent pattern of associations aligned with the SDT framework. First, goal content generally presents positive associations with BPN satisfaction and autonomous motivation (identified, integrated, and intrinsic) and negative or non-significant associations with amotivation and external regulation. Positive associations across all goals and introjected regulations (avoidance and approach) also emerged, except for the association between social recognition and introjected approach. An exception to this pattern of association emerged with social recognition motive, depicting positive associations with BPN frustration, amotivation, external regulation, and introjected avoidance.

Regarding the associations between needs and behavioral regulations, the expected theoretical pattern (in general) was observed. First, BPN satisfaction showed negative associations with amotivation and external regulation, and positive associations with introjected regulations and all autonomous forms of behavioral regulations. Second, BPN frustration showed a positive association with amotivation, external regulation, and introjected avoidance, but no significant association with introjected approach was observed. Additionally, negative associations appeared between BPN frustration and autonomous forms of behavioral regulations, particularly with intrinsic motivation.

Lastly, current results support the motivational continuum proposed by SDT, showing that the behavioral regulations closer in the continuum depict positive correlations, and those further correlate less positively or even negatively (i.e., organized pattern of correlations between the different types of regulation; Ryan & Connell, 1989; Howard et al., 2017). Additionally, introjected approach and avoidance appear to be distinct constructs and occupy a space in the motivational continuum that aligns with theoretical assumptions.

Results regarding the CFA and path analysis present further support for criterion validity. First, both models (goals → behavioral regulations measurement model: χ^2/df = 4.77; CFI = 0.917, TLI = 0.909, SRMR = 0.064, RMSEA = 0.067 (CI90% = 0.065, 0.069)]; structural model: χ^2/df = 5.24; CFI = 0.911, TLI = 0.901, SRMR = 0.077, RMSEA = 0.071 (CI90% = 0.067, 0.075)]; basic psychological needs → behavioral regulations measurement model: χ^2/df = 4.45; CFI = 0.921, TLI = 0.915, SRMR = 0.063, RMSEA = 0.063 (CI90% = 0.060, 0.068)]; structural model: χ^2/df = 5.67; CFI = 0.908, TLI = 0.901, SRMR = 0.078, RMSEA = 0.071 (CI90% = 0.065, 0.079)]) presented an adequate fit. Next, path estimates, in general, depict the expected pattern of associations with behavioral relations as sustained by SDT (Tables 10 and 11). Regarding the introjection of approach regulation and adjacent regulations, a similar trend as verified in the bivariate correlation emerges. In particular, estimates indicate a distinction between introjection avoidance and approach when analyzed as outcomes of both types of goals and BPN satisfaction and frustration. As for introjected regulation of approach vs. identified regulation, this distinction appears more pronounced in the BPN frustration model (0.221, $p < .001$ vs. −0.016, $p = .791$, respectively). The remaining paths present similar (BPN satisfaction and intrinsic goals) or inconclusive estimates (extrinsic goals).

7. Discussion

The purpose of this second study was to investigate the relationship between SDT constructs, namely goal content, BPN satisfaction and frustration, and behavioral regulations, considering both sides of introjected regulation (avoidance and approach) in a sample of exercisers. Results showed significant associations as theoretically expected and will be discussed according to existing literature. Study II presented additional evidence for the relevance of measuring introjected approach in the exercise context. In a sample composed mainly of long-term exercisers, results depicted higher scores of autonomous regulations and lower scores of amotivation, external, and introjected avoidance regulations. The introjected approach regulation presented a mean score higher than introjected avoidance regulation, and close to the remaining autonomous regulations. This seems to be in line with SDT assumptions regarding more relevant contributions to exercise continuous adherence as people regulate their behavior gradually through a more autonomous and less controlled way in the long term of exercise practice (Rodrigues, Macedo, et al., 2020; Teixeira et al., 2012).

The correlational pattern supported the proposed hypothesis that introjected approach would define a closer transitional line between the controlled (i.e., introjected avoidance) and autonomous motivations (i.e., the least autonomous of all, the identified regulation). When comparing both introjection subscales, the introjected approach regulation showed the following results: i) higher associations with all intrinsic goals and absence of association with social recognition (i.e., extrinsic motive); ii) stronger relationship with BPN satisfaction and absence of associations with BPN frustration; and iii) although both introjected regulations presented positive associations with autonomous regulations, introjected approach depicted stronger associations and, contrarily to introjected avoidance, negative associations with amotivation and external regulation. As for the structural models and path analysis developed, some support emerges for the space occupied by the introjected regulation of approach in the SDT continuum. Again, both introjection facets presented relevant differences in path estimates, thus suggesting their distinctiveness. However, these differences are less expressive when comparing introjected regulation of approach and identified regulation, particularly on the 'bright side' of SDT variables. This may suggest an approximation of this new factor to the autonomous regulations (i.e., the identified regulation), but also clarifies the controlling expression of the factor, which is present by the 'dark side' of motivation (i.e., BPN frustration and possibly extrinsic goal contents) (Rodrigues, Teixeira, et al., 2020). Nonetheless, this adds to the previous work of Assor et al. (2009), where through regression analysis of these three adjacent regulations with adaptive and maladaptive outcomes, they showed that introjected regulation of approach presented neutral (i.e., non-significant) associations, thus putting it in the middle of the positive and negative effects of the introjected regulation of avoidance

Table 9
Correlational analysis across goal content, basic psychological needs, and behavioral regulations.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1. Social affiliation	1																
2. Image	.212***	1															
3. Health management	.197***	.437***	1														
4. Social recognition	.505***	.268***	.081	1													
5. Skills development	.361***	.362***	.585***	.197***	1												
6. Autonomy satisfaction	.220***	.299***	.431***	.002	.437***	1											
7. Competence satisfaction	.291***	.118*	.264***	.152**	.185***	.400***	1										
8. Relatedness satisfaction	.190***	.282***	.445***	.047	.387***	.759***	.419***	1									
9. Autonomy frustration	.047	.073	−.092	.271***	−.058	−.327***	−.085	−.268***	1								
10. Competence frustration	.084	.022	−.162**	.283***	−.052	−.220***	−.194***	−.254***	.604***	1							
11. Relatedness frustration	.097*	.117*	−.042	.254***	.049	−.275***	−.091	−.395***	.555***	.622***	1						
12. Amotivation	.063	−.065	−.202***	.257***	−.142**	−.149**	−.132**	−.183***	.442***	.575***	.362***	1					
13. External regulation	.075	−.104*	−.228***	.277***	−.103*	−.227***	−.167**	−.246***	.516***	.521***	.330***	.770***	1				
14. Introjected avoidance	.222***	.263***	.220***	.240***	.226***	.148**	.194***	.154**	.247***	.265***	.239***	.121*	.118*	1			
15. Introjected approach	.241***	.368***	.504***	.089	.455***	.437***	.308***	.474***	−.021	−.025	.089	−.132**	−.184***	.436***	1		
16. Identified regulation	.237***	.310***	.540***	.043	.429***	.555***	.358***	.480***	−.193***	−.190***	−.079	−.223***	−.282***	.362***	.643***	1	
17. Integrated regulation	.320***	.212***	.355***	.197***	.504***	.566***	.263***	.409***	−.141**	−.078	−.068	−.159**	−.089	.333***	.499***	.598***	1
18. Intrinsic motivation	.300***	.275***	.485***	.021	.467***	.613***	.297***	.545***	−.255***	−.184***	−.133**	−.267***	−.256***	.274***	.592***	.683***	.705***

Note. $^*p < .05$; $^{**}p < .01$; $^{***}p < .001$

and identified regulation. Given that the present study did not collect any variables to be tested as outcomes/dependent variables of behavioral regulations, the extent of the possible influences of the now added facet of introjection in this context, given its hybrid behavior between the controlled and autonomous motivational space, remains to be explored.

All in all, the results seem to support a differentiated space for the assessment of introjection regulations and provide support to the existing literature (Assor et al., 2009; Gagné et al., 2015; Howard et al., 2017; Rodrigues, Teixeira, et al., 2020) explaining the need to differentiate introjected regulations as a means to provide a clear image of the whys individuals engage in regular exercise. Given all know relations between goal content, BPN, and behavioral regulations and their respective impact on well-being (Antunes et al., 2017), health (Teixeira et al., 2012), and exercise adherence (Rodrigues, Teixeira, et al., 2020), understanding this double side of introjection may be of relevance for interventions and warrants future attention.

8. General discussion

The current work presented two studies that aimed to psychometrically and contextually evaluate a subscale to assess the introjected approach regulation in exercise settings. In addition, it also prosed to explore theoretically sound associations grounded in SDT, considering goal content, BPN satisfaction and frustration, and behavioral regulations. Study I presented evidence that introjected regulation can be assessed by contemplating the avoidance and approach facets, and that adding the latter subscale to the preexisting factorial structure of the BREQ did not affect the content validity of the questionnaire. This was further supported by reliability, convergent and discriminant validity testing, thus ensuring that the three items proposed to the introjected approach subscale were relevant for the construct, adding evidence to the multidimensionality of the BREQ-4 Portuguese version. Thus, Study II tested the newly proposed factorial structure in an independent sample to analyze its associations with two theoretically proposed antecedents of behavioral regulations, goal content, and BPN satisfaction and frustration.

Considering the extent of SDT testing and know relations in the exercise context (Ntoumanis et al., 2018; Rodrigues et al., 2018; Teixeira et al., 2012), and the theoretical proposal for introjected approach regulation (Assor et al., 2009) in the self-determined motivational continuum (Gagné et al., 2015; Howard et al., 2017), results supported the hypothesis of a less controlling role of introjected approach. This was then supported by the goal content and BPN satisfaction and frustration correlational pattern and subsequent path analysis. If as proposed, the introjected approach was less controlling than introjected avoidance, the correlational pattern of the approach facet should display stronger associations with intrinsic goals, BPN satisfaction, and autonomous regulations, but not as relevant as identified regulation, given the controlled vs. autonomous nature of each motivational force. This was clearly detected in the current results and aligns with the simplex structure of the SDT and the preliminary work of Assor et al. (2009) regarding identified regulation role when compared to introjected approach regulation, and preliminary evidence in the exercise context (e.g., Rodrigues, Macedo, et al., 2020; Rodrigues, Teixeira, et al., 2020).

However, Assor et al. (2009) results indicated that in athletes the introjected approach "*was not associated with improved performance or well-being*" (p. 494), although small positive regression effects on engagement and positive affect were detected in their work. Our results may speculate otherwise. The positive associations between intrinsic goals, BPN satisfaction (and absence of association with BPN frustration), and introjected approach may present some contribution to exercise adherence, given that the sample of long-term exercisers had a high mean score for this regulation. Additionally, the path analysis results suggest that this facet of regulation (i.e., approach) may behave in some situations (although not always, particularly with BPN frustration)

Table 10
Path estimates among latent variables (intrinsic and extrinsic goals).

Direct Path	B	CI95%		*p*
Intrinsic Goals → Amotivation	−.389	−.538	−.240	<.001
Intrinsic Goals → External Regulation	−.385	−.532	−.237	<.001
Intrinsic Goals → Introjected Regulation of Avoidance	.237	.112	.363	<.001
Intrinsic Goals → Introjected Regulation of Approach	.766	.673	.860	<.001
Intrinsic Goals → Identified Regulation	.732	.621	.843	<.001
Intrinsic Goals → Integrated Regulation	.510	.390	.631	<.001
Intrinsic Goals → Intrinsic Motivation	.721	.613	.829	<.001
Extrinsic Goals → Amotivation	.400	.266	.534	<.001
Extrinsic Goals → External Regulation	.420	.279	.561	<.001
Extrinsic Goals → Introjected Regulation of Avoidance	.292	.145	.440	<.001
Extrinsic Goals → Introjected Regulation of Approach	−.060	−.176	.057	.399
Extrinsic Goals → Identified Regulation	−.039	−.153	.075	.573
Extrinsic Goals → Integrated Regulation	.166	.058	.274	.012
Extrinsic Goals → Intrinsic Motivation	−.076	−.200	.049	.316

Table 11
Path estimates among latent variables (basic psychological needs satisfaction and frustration).

Direct Path	B	CI95%		*p*
BPN Satisfaction → Amotivation	.100	−.011	.211	.139
BPN Satisfaction → External Regulation	−.012	−.128	.105	.867
BPN Satisfaction → Introjected Regulation of Avoidance	.440	.333	.547	<.001
BPN Satisfaction → Introjected Regulation of Approach	.762	.659	.865	<.001
BPN Satisfaction → Identified Regulation	.719	.631	.806	<.001
BPN Satisfaction → Integrated Regulation	.680	.591	.768	<.001
BPN Satisfaction → Intrinsic Motivation	.808	.726	.890	<.001
BPN Frustration → Amotivation	.759	.634	.884	<.001
BPN Frustration → External Regulation	.672	.540	.804	<.001
BPN Frustration → Introjected Regulation of Avoidance	.521	.433	.609	<.001
BPN Frustration → Introjected Regulation of Approach	.221	.104	.338	<.001
BPN Frustration → Identified Regulation	−.016	−.117	.085	.791
BPN Frustration → Integrated Regulation	.140	.055	.225	.006
BPN Frustration → Intrinsic Motivation	.082	−.006	.169	.126

in proximity of the identified regulation, and thus possibly relevant for autonomously regulated outcomes.

Albeit not clear due to this study methodology and variables collected, some attention may be warranted in the future for the role of introjected approach regulation on variables usually dependent on autonomous motivations, as suggested by Howard et al. (2017). This assumption is supported by previous work (Rodrigues, Macedo, et al., 2020), showing that exercisers might have had interpretation issues of introjected regulation in the past, since previous applications of the BREQ (specifically BREQ-3) did not differentiate these dual facets of introjected regulation. Thus, this new version of BREQ could fill the existing gap in the literature, helping researchers and practitioners to assess differentiated forms of introjected regulation as a means to understand the internalization process from extrinsic to intrinsic motivation, as purposed by organismic integration theory within the SDT framework (Deci & Ryan, 1985; Ryan & Deci, 2017). Although less controlling in nature, we posit that the introjected approach regulation will not depict the same magnitude for exercise adherence and well-being indicators when compared with autonomous motivation but may still be worthy of attention for an adequate understanding of motives and motivations in exercisers, and some evidence does support these assumptions (Assor et al., 2009; Howard et al., 2017). Considering that some maladaptive outcomes are expected with this regulation, because seeking social approval or self-worth may be perceived as stressful and unpleasant (Deci & Ryan, 1995), some caution is warranted in exercisers with this profile. In health clubs, striving for image adequacy or image-based social approval (e.g., thus feeling worthy of belonging) is a usual motive (Deelen et al., 2018; Halliwell et al., 2007; Rodrigues et al., 2022), even in the elderly (Antunes et al., 2017). When looking at all associations with BPN and behavioral regulations, image presents the strongest association with introjected approach, which may reflect a path for self-worth achievement in this context. The impact of these associations with well/ill-being variables remains partially unclear at this point.

8.1. Limitations

Given the limited works exploring this double facet of introjection, comparisons and implications are difficult to establish and thus reflect a limitation on results interpretation. Further studies must be made with this subscale, specifically targeting usual and relevant outcomes in exercise settings such as exercise adherence, enjoyment, and well/ill-being, as for age, body mass index, and other relevant context-related variables. Still, on a matter of general limitations for the current study framing, orientations from the SDT regarding introjection theoretical division and assessment are lacking, an issue already highlighted by Assor et al. (2009). For example, given the distinctiveness of the two subscales, what will be the next steps for introjection assessment? A concern can be made regarding the use of a single factor that encompasses both facets of introjection. This has already been partially explored by Gagné et al. (2015). In their work, a balance was created between avoidance and approach items for the introjected regulation (two items each; four in total), which provided evidence for a first-order factor. However, this global/balanced factor could raise some issues, considering that the distinct and possibly relevant associations from both facets are "diluted", thus resulting in construct information losses, and possible reliability issues within this factor[1] (Howard et al., 2017). Additionally, how should a controlled regulation factor be studied? Given that most of the existing studies rely on avoidance assessment, how should introjection be explored in future studies, particularly in the exercise context? All these questions warrant future attention and research endeavors aiming to better understand and refine the motivational continuum assessment and, lastly, to help people improve their health and well-being.

The present study also put in evidence that additional studies are needed to confirm the psychometric properties of the model (seven-factor/28 items), especially in other languages. According to Vlachopoulos et al. (2013), SDT is a good example of a theory that has been developed considering cross-cultural applicability. This means that SDT constructs are universal in their importance and their effects (Ryan & Deci, 2017). This assumption has been highlighted in SDT cross-cultural related studies (Cid et al., 2016; Gagné et al., 2015; Vlachopoulos et al., 2013). However, future studies are encouraged to examine the universality of constructs underlying BREQ-4, across different countries and cultures. This is important to establish the relevance of the instrument taking into account aspects related to factors and concepts specific to a given culture (emic concepts), as well as aspects related to factors and concepts that are universal to all cultures (etic concepts) (Cid et al., 2022; Geisinger & McCormick, 2012).

Still on the matter of psychometric future evaluations, exploring the associations between independent factors of exercise goals and BPN may be of value. Although the use of composite factors (e.g., BPN satisfaction; intrinsic goals) is a relevant and usual approach for model testing, more detailed information could be obtained when exploring each factor independently, particularly when aiming to further understand this new

[1] As a post-hoc analysis for this study, the global introjected regulation factor (the six items used concerning avoidance and approach) was tested. Results depicted some negative factorial weights and an inadequate model adjustment.

facet of introjection. For that, sample size precautions must be considered if complex models are to be tested.

On a final note, it is important to recognize that physical exercise can be developed in several contexts. Although this study has focused on one of the largest and more relevant contexts of practice, further efforts should be made to test this instrument's psychometric properties in other settings, thus adding to the understanding of BREQ-4 properties and its usefulness.

9. Conclusion

Present results add to the scarcity of the literature on this topic several outcomes: i) a retest of BREQ-3 Portuguese version factorial structure and item refinement which provided additional evidence of validity and reliability; ii) a translation and adaptation for the exercise context of an introjected approach subscale; iii) the first test of a new version of BREQ (i.e., BREQ-4 Portuguese version) with a correlated seven-factor structure grounded in SDT, which provided good psychometric properties; iv) and a path analysis of several SDT related constructs with the newly proposed subscale in a specific exercise context. All in all, this work presents preliminary evidence for an introjected approach regulation subscale that can be used in exercise settings for a better understanding of the motivational quality of exercise practice.

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Declaration of competing interest

The authors have no conflicts of interest.

Data availability

Data will be made available on request.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.psychsport.2022.102286.

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