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Is the light at the end of the tunnel bright? Associations between preference and tolerance of the intensity, basic psychological needs and behaviour in exercise context

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ABSTRACT

In recent years, sedentary behaviour and physical inactivity have seen an evident increase. Many individuals who embark on an exercise regimen end up leaving it within the first three to six months, often citing barriers such as a lack of time or motivation. Research shows that the pleasure and enjoyment derived from exercise play a crucial role in preventing people from giving up. This suggests that theories related to the emotional aspects of exercise, including an individual's exercise intensity preference and tolerance, should be integrated into broader motivation theories such as Self-Determination Theory (SDT). This chapter aims to provide a theoretical framework for these theories, emphasised by empirical evidence and proposes potential avenues for future research.
KEYWORDS: preference; tolerance; psychological needs; physical exercise; behaviour.

INTRODUCTION

Behaviour can be defined as a set of actions taken in the context in which the individual is inserted, with intrinsic (e.g. emotions) or extrinsic (e.g. built environment) characteristics (Gardner, 2015). Physical exercise (PE) can be considered a healthy behaviour, as researchers have shown benefits at both a physical and psychological level (Bull et al., 2020; Pedersen & Saltin, 2015; Warburton & Bredin, 2017; Westcott, 2012; Wu et al., 2023). However, behavioral change (e.g. exercise) is a challenging and timeless process, particularly concerning PE, due to the existence of numerous barriers (e.g., lack of time, lack of motivation, and discomfort associated with exercise) (Bowles et al., 2002; Herazo-Beltrán et al., 2017; Koh et al., 2022) and factors that tend to favor sedentary behavior (e.g., excessive use of mobile phones and watching television for long periods) (Chambliss, 2015; Martins et al., 2021; Mohammed et al., 2020).

The recommended exercise guidelines are well-documented in the literature, advocating for individuals to engage in 150–300 minutes of moderate aerobic exercise or 75-150 minutes of vigorous aerobic exercise per week, along with at least two resistance training sessions for added health benefits (Bull et al., 2020).

However, researchers from the World Health Organisation (WHO) project that if the prevalence of physical inactivity remains unchanged by 2030, there will be approximately 500 million new cases of serious non-communicable diseases (NCDs) worldwide, including type 2 diabetes, cancer, and depression (Santos et al., 2023). These escalating new disease cases can strain the economy by necessitating healthcare and medications to treat these conditions. The lack of physical exercise in Portugal is estimated to cost the state an average of more than 1,500 million euros annually. According to the Eurobarometer (2022), 73% of the population (73 out

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of every 100 respondents) report that they do not or rarely engage in physical exercise or sport, surpassing the European Union average of 45%.

Thus, of all the spaces or ways to exercise, gyms seem to be relevant contexts for manifesting this behaviour (Eurobarometer, 2022; International Health, Racquet and Sportsclub Association, 2020). In light of all these permissions, several empirical studies (Monteiro et al., 2018; Neipp et al., 2015; Pfeffer & Alfermann, 2008; Puente & Anshel, 2010; Rodrigues et al., 2019; Teixeira et al., 2021b) have attempted to explore the relationship between behavior maintenance/adoption and various theories/models (e.g., Self-Determination Theory: Deci & Ryan, 1985; Transtheoretical Model: Prochaska & Velicer, 1997; Theory of Planned Behaviour: Ajzen, 1985) to provide solutions to the various stakeholders in the field of sports science, particularly in physical exercise and health (Klos et al., 2020; Marques et al., 2022; Rhodes & Sui, 2021).

THEORIES CONCEPTUALIZATION

Self determination theory

The Self-Determination Theory (SDT), developed by Deci and Ryan (1985), is a comprehensive theory exploring human motivation regulation. It comprises six interconnected sub-theories that organise essential aspects of motivation regulation (Ryan & Deci, 2000). According to the creators of SDT, individuals exert control over their actions by aligning them with their values, achieving autonomy when their decision-making is guided by their interests, preferences, and desires (Rodrigues et al., 2023a).

The affective responses to physical exercise are associated with one micro-theory: the Basic Psychological Needs Theory (BPNT). According to BPNT, needs are innate and universal to all human beings, regardless of race, gender, and cultural background (Chen et al., 2015; Deci & Ryan, 2002; Ryan & Deci, 2017). It directly correlates with motivation (Bartholomew et al., 2011; Ng et al., 2013; Rodrigues et al., 2019; Teixeira et al., 2018) and mediates between social factors and the regulation of motivation (Deci & Ryan, 1985; Ntoumanis, 2005; Rocchi & Pelletier, 2018). BPNT delineates three fundamental psychological needs that are distinct yet interconnected and interdependent: autonomy, competence, and relatedness. When autonomy is fulfilled, individuals regulate their behaviour by freely engaging with the environment (Ryan & Deci, 2000). Competence satisfaction is evident when individuals master and improve new skills (Chen et al., 2015). Lastly, the ability to form emotional connections and affective interactions with others reflects relatedness satisfaction (Vansteenkiste & Ryan, 2013).

It is essential to consider the frustration of needs, which occurs when an individual realises that their surrounding environment does not align with their objectives (Chen et al., 2015; Vansteenkiste et al., 2020). According to Vansteenkiste et al. (2020), autonomy frustration refers to the feeling of pressure imposed by the context, guiding us in undesirable directions. Competence frustration refers to the feeling of ineffectiveness or impotence in carrying out tasks, and relatedness frustration is defined as a feeling of exclusion and loneliness in the context. The author highlights that BPN can be influenced by other psychological characteristics and personality traits (preference and tolerance) and that further studies should aim to better understand these potential interactions.

Affectivism: One of the main components in the adoption of physical activity behaviour

In recent decades, the approach of hedonism to the context of physical exercise has been exponential, especially with the emergence of studies in which the pleasure of performing physical exercise can promote sustainable increases (Ekkekakis & Dafermos, 2012; Rhodes & Kates, 2015; Williams et al., 2008). According to Lee et al. (2016), when we consider the affective response to exercise as a potential predictor and mediator (for the mediating role of the affective response in determining physical exercise, see Chen et al., 2020) in the adoption of future behavior, rather than an isolated outcome (e.g., effects of physical exercise on reducing anxiety-depressive symptoms), it is essential to take into account the central affective valence (pleasure vs. displeasure), a term embedded in the hedonic theory (Higgins, 1997), characterised by the states in which a person feels good or bad, including the affective responses of pleasure and displeasure, as well as moods and emotions. However, the nature and intensity may vary over time (Ekkekakis, 2013, p. 38).

Several theoretical constructs have been developed to determine the effect on the adherence and maintenance of physical exercise (Rhodes & Kates, 2015). One of these that advocates affect as a predictor of physical exercise maintenance is the affect and health behaviour framework (AHBF) (Williams & Evans, 2014). This theoretical framework suggests that affect (e.g., central affect, emotions, and mood) and all affective products (e.g., affect-related cognition) are highly relevant to the determinants of physical exercise (Marques et al., 2022). According to Stevens et al. (2020), affective constructs are organised in the AHBF into four

categories: i) affective response (e.g., how one feels in reaction to physical exercise behavior); ii) casual affect (e.g., the individual's sensations throughout the day, excluding those related to behavior); iii) affective processing (e.g., affective associations, implicit attitudes, memorised affect, anticipated affective response and affective judgments); iv) motivationally charged affective states (e.g. intrinsic motivation, fear, and hedonic motivation). According to Marques et al. (2022), the AHBF holds that the development and maintenance of health behaviour (e.g., physical exercise) result from a dynamic and continuous balance of affective factors, in which previous positive affective responses can trigger automatic and reflexive affect processing pathways. After the conceptualisation of AHBF, Lee et al. (2016) hypothesised an approach based on an evolutionary functional perspective, in which the exercise prescription will have to tend towards exercises in which the perception of usefulness and intensity trigger positive affective responses, which, in themselves, will increase adherence to exercise. This exercise-affect-adherence pathway is driven by the systematic review with meta-analysis by Chen et al. (2020), which concludes that interventions in the field of physical exercise should consider variables that promote positive affect, which can provide positive effects on exercisers, particularly in terms of increasing levels of physical exercise.

Thus, the affective-reflexive theory of physical inactivity and exercise (ART) emerged, building on a foundation of previous theoretical constructs. ART is a theory that glorifies the importance of automatic positive and negative associations for subsequent physical inactivity or exercise, suggesting that automatic evaluation (type 1 processing, characterised by being fast and automatic in the sense that it requires minimal cognitive resources) is the basis for the emergence of more complex affective and cognitive processes (type 2 processing, characterised as a slower and more reflective process taking on a more controlled form of reasoning) (Brand & Ekkekakis, 2018). Therefore, an impulse action and action plans can occur independently of each other, i.e., the processing can be concordant (e.g., the impulse of the practitioner to pack the training bag now and the intention to go to the gym to train following hospital advice) or discrepant (e.g., an impulse to keep watching a series while the intention was to get dressed and do some physical exercise). According to Brand and Ekkekakis (2018), ART differs from other psychological theories in three ways: 1) the role of affect and automaticity; 2) it is a psychological account of exercise, explicitly linked to what we know about pleasurable and displeasure experiences that occur during exercise; 3) it explains why individuals sometimes tend to maintain their current state of physical inactivity, postulating that core affective valence can strongly influence deliberative reasoning about engagement and effort in exercise, suggesting that it can have a direct and immediate impact on behavior through behavioral impulses.

Considering the vast universe of services available in gyms and health clubs, promoting a pleasurable exercise experience can be challenging for the exercise technician because there is a multiverse of possible intra-individual responses, creating an obligation to try to control the multiple affective responses through reliable indicators. The affective response must be assessed through the intensity of the exercise, and these responses must be measured by exercise instructors during or immediately after the exercise. This tends to change with increasing intensity, and continuous exercise that exceeds the ventilatory threshold decreases enjoyment (Ekkekakis et al., 2004, 2008, 2011). In addition, appropriate responses to the individual's characteristics during a training experience can theoretically impact casual affect, affect processing, and motivationally charge affective states (Stevens et al., 2020; Teixeira et al., 2021b).

Identifying how the exerciser will respond to the intensity of the exercise can be favourable to adjusting the affective response and providing a more individualised intervention. To measure the intensity of exercise and the affective response, Ekkekakis et al. (2005) proposed the use of intensity traits (Preference and Tolerance), variables that, from a conceptual point of view, are orthogonal and have been studied in various contexts, namely: ventilatory threshold tests (Ekkekakis et al., 2005; 2006; 2007; Smith et al., 2015); physical tests (Hall et al., 2014); strength training (Andrade et al., 2022; Bastos et al., 2022; Cavarretta et al., 2019) and recently applied to stretching exercises (Henriques et al., 2023). Exercise intensity preference is described as the "predisposition to select a particular level of exercise intensity when given the opportunity," and tolerance is "a trait that influences the ability to continue exercising at an imposed level of intensity beyond the point at which the activity becomes uncomfortable or unpleasant" (Ekkekakis, 2013, p. 354). When these two orthogonal variables are aligned with exercise intensity, it seems that positive associations are established with exercise adherence and other variables (e.g., motivation and vitality) (Faria et al., 2021; Teixeira & Palmeira, 2016; Teixeira et al., 2021a).

EMPIRICAL EVIDENCE

Various empirical studies have demonstrated the interactions between personality traits and behavioural consequences. In the validation study of the PRETIE-Q-PT scale

(Teixeira et al., 2021a) the variables that compose personality traits were positively and significantly associated with frequency (Pref: $r = 0.134$, $p < .05$; Tol: $r = 0.229$, $p < .001$), with habit (Pref: $r = 0.176$, $p < .001$; Tol: $r = 0.185$, $p < .001$), vitality (Pref: $r = 0.119$, $p < .05$; Tol: $r = 0.166$, $p < .01$) and well-being (Pref: $r = 0.146$, $p < .01$; Tol: $r = 0.167$, $p < .01$). In the study by Rodrigues et al. (2023c), aimed at investigating the psychometric nature of the PRETIE-Q-PT in physical exercise, it was reported that the greater the perception of preference and tolerance to intensity, the greater the perception of enjoyment, intention, and frequency of exercise.

By testing the moderation effect of personality traits between enjoyment and habit, intention and frequency, the results proved to be in line with the theoretical hypotheses (i.e. when the exerciser's perception of their preference and tolerance of exercise intensity are aligned, they tend to exercise more, develop higher levels of exercise habit and have a greater intention to continue exercising) (Teixeira et al., 2022).

In a study conducted by Faria et al. (2021) both traits correlated positively and significantly with vitality (Pref: $r = 0.135$, $p < .05$; Tol: $r = 0.161$, $p < .01$) and habit (Pref: $r = 0.172$, $p < .01$; Tol: $r = 0.185$, $p < .001$), in which vitality partially mediated both models associating personality traits with habit. Consequently, a study by Marques et al. (2022) also highlights the associations established between intensity traits and behavioral consequences: frequency (Pref: $r = 0.100$, $p < .05$; Tol: $r = 0.230$, $p < .001$), habit (Pref: $r = 0.111$, $p < .05$; Tol: $r = 0.204$, $p < .001$) and subjective vitality (Pref: $r = 0.090$, $p < .05$; Tol: $r = 0.167$, $p < .001$). In this study, four groups were created based on the agreement/disagreement of the intensity traits (methodology suggested by Teixeira et al., 2021a), verifying that when they are in agreement with the current intensity of the training, they present more relevant scores for the consequences.

Based on these associations, the mediating role of BPNs between intensity traits and different behavioural consequences was tested. It is a very pertinent question, but it's still a susceptible topic to discuss due to the few studies available in the literature that address these issues (3 articles at the time of writing this chapter).

From a conceptual point of view, it is hypothesized that the concordance of intensity traits will promote the satisfaction of BPN (Teixeira et al., 2021b). In this way, adjusting the intensity of exercise (through autonomous adjustment or an intensity interval) can promote the ability to choose behavior and control the activity, thus facilitating the need for autonomy. Concerning the need for competence, autonomous intensity adjustment can develop real competence and mastery with the individual's level of aptitude, ability, and interest. Finally, if exercise is prescribed and supervised according to the practitioner's intensity traits, this can reflect the professional's concern, relevance, and emotional support for the exerciser (Teixeira et al., 2021b).

This innovative approach began with research conducted by Teixeira et al. (2021b) analyzing the mediating role of BPN in the relationship between preference and tolerance for intensity and enjoyment. The results of this study showed a negative association between intensity traits and the global needs frustration (Pref: $r = -0.26$, $p < .001$; Tol: $r = -0.16$, $p < .05$), autonomy frustration (Pref: $r = -0.26$, $p < .001$; Tol: $r = -0.21$, $p < .01$), competence frustration (Pref: $r = -0.22$, $p < .01$; Tol: $r = -0.19$, $p < .05$) and a positive association between tolerance and competence satisfaction ($r = 0.16$, $p < .05$). Through the mediation model (Pref Model: Direct Effect ($\beta = 0.32$ [0.12, 0.52]), Indirect Effect ($\beta = 0.20$ [0.01, 0.41]), it was possible to see that when there is a deviation from the usual dynamics of the training patterns, the practitioner tends to have less fun, particularly when this deviation is caused by an increase in the professional's control behaviors.

Considering the previous evidence, Rodrigues et al. (2023b) aimed to study the relationships between intensity traits, competence satisfaction/frustration (see original study to understand the theoretical conceptualization leading to this decision by the group of researchers), and intention to exercise. In this study, intensity traits correlated positively and significantly with competence satisfaction (Pref: $r = 0.27$, $p < .01$; Tol: $r = 0.20$, $p < .05$) and negatively and significantly with competence frustration (Pref: $r = -0.36$, $p < .01$; Tol: $r = -0.31$, $p < .01$). Through the mediation models, preference for intensity indirectly effected intention ($\beta = 0.11$, 90%CI 0.03–0.21), with competence satisfaction being a significant mediator. At the same time, there were no indirect effects between tolerance and intention, through the mediation of need for competence ($\beta = 0.05$, 90%CI -0.01–0.14).

Finally, Teixeira et al. (2024) proposed studying the associations between intensity preference agreement, BPN satisfaction/frustration, enjoyment, intention, and frequency of exercise. In this study, sex was considered as a moderating variable. The results of the associations were in line with previous studies, except for the association between preference agreement and exercise frequency, which was not significant. There were positive associations between preference agreement and need satisfaction (autonomy: $\beta = 0.35$, [0.28, 0.42]; competence: $\beta = 0.21$, [0.14, 0.28]; and relatedness: $\beta = 0.13$, [0.02, 0. 23]) and negative associations with need frustration (autonomy frustration: $\beta = -0.32$, [-0.42, -0.22]; competence frustration: $\beta = -0.22$, [-0.31, -0.12]; and relatedness frustration: $\beta = -0.11$, [-0.19, -0.03]). Of the three

models tested, only two had significant direct effects (Model A: preference agreement- enjoyment; β = 0.26, [0.12, 0.39]); Model B: preference agreement -intention; β = 0.35, [0.19, 0.51]). In model A, sex had significant interactions with preference agreement (β = -0.38, [-0.59, -0.17]) and autonomy satisfaction (β = 0.41, [0.06, 0.76]) and in model B only with preference agreement (β = 0.28, [0.03, 0.53]).

LITERATURE LIMITATIONS AND FUTURE RESEARCH

There are limitations in the available scientific literature that address affective issues combined with psychosocial issues. Of the three studies that analyze the associations between trait intensity, BPN, and behavioral consequences, all are cross-sectional studies. This type of study does not allow us to visualize the interaction of variables over time, making it impossible to formulate causal relationships. In this sense, future studies could adopt a longitudinal study design in which the variables are measured over a certain period or in different periods.

Socio-demographic factors are important, simply because intra-individual and inter-individual response variability can be a determining factor. Given the above, age is a potential moderator variable that should be analyzed in future studies for the simple reason that all the studies consider healthy individuals over the age of 18 in their sample. Regarding how the agreement has been analyzed, more approaches should be tested (e.g. creation of groups concerning the dictomic response of intensity alignment about the practitioner's preference and tolerance) with BPN as a mediator of behavioral consequences.

In conclusion, this interaction between affective issues and SDT should be carried out in other cultures and in different contexts related to physical exercise, to explore the potential influences of culture and context on the relationships established between constructs. After understanding the variables in different cultures and contexts, the introduction of motivation regulation could be a step to consider understanding how regulating intensity according to preferences and their tolerances can lead to more intrinsic regulation (or not).

CONCLUSIONS

The interaction between intensity traits and BPN shows promising results so that professionals can improve their exercise prescription following the tripartite model. In this way, developing interactions that promote the satisfaction of needs through the regulation of exercise intensity can promote feelings of pleasure, thus increasing the intention to practise and, consequently, increasing the frequency of physical exercise. The exerciser should be the centre of all interventions, leading them to increase their levels of exercise through feelings of pleasure. Further studies should be carried out using other methodologies to assess the concordance of intensity traits, considering sociodemographic factors (e.g. gender and age) and correlating these variables with SDT (e.g. BPN and Motivation Regulation) to understand their interaction with behavioural consequences.

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