

Preference for and tolerance of exercise intensity: the mediating role of Vitality in Exercise Habit

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The aim of the current exploratory study was to test the mediation role of subjective vitality in the relation between the intensity-traits and exercise habit, thus helping to understand the role of preference and tolerance in well-being and behavioral outcomes. The sample comprised 299 gym exercisers (39% men) with an average age of 36.4 years (SD = 10.61). In general, the present sample of exercisers manifested a preference and tolerance for moderate intensity exercises/activities. The intensity traits were positively associated with subjective vitality and exercise habit, and vitality partially mediated both models. Globally, the intensity-traits presented small to moderate effects in the tested variables. Both preference and tolerance presented positive associations with vitality and habit in the present study and results depict some preliminary evidence that the intensity-traits related to exercise may be relevant for health club professionals adjust their intervention aiming to promote a better subjective experience and exercise adherence.

KEY WORDS: Habit; Preference; Tolerance; Intensity; Vitality.

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Regular physical activity is a key factor for the prevention and control of non-communicable diseases, such as cardiovascular disease, type 2 diabetes and some types of cancers. It also benefits mental health, including preventing cognitive decline and symptoms of depression and anxiety, and can contribute to maintenance of healthy weight and general well-being (WHO, 2020). Despite the scientific consensus and the benefits mentioned above, sedentary lifestyle and physical inactivity remain prevalent worldwide (EC, 2018; Loyen et al., 2017).

One particularly relevant context of exercise practice is health clubs (IHRSA, 2020). However, despite a particularly relevant role in individual and public health promotion, dropout rates are a major concern. As reported in last decades research, the dropout rates are still high, approaching 75% in the first three months of practice and ~50% after six months (Buckworth, Dishman, O'Connor, & Tomporowski, 2013; Dishman, 2001; Radel et al., 2017; Rand et al., 2020; Sperandei et al., 2016).

Many attempts have been made in order to help address this issue. Particularly, several psychological frameworks have been used with distinct and differentiated outcomes. Mainly, the research developed has been grounded in several cognitivist assumptions that, although with relevance, has not been able to promote over small-to-moderate effects in this particular regard (Ekkekakis et al., 2019; Ekkekakis & Dafermos, 2012; Ekkekakis & Zenko, 2016; Rhodes et al., 2017; Stevens et al., 2020). For that matter, several authors have been suggesting that multitheoretical approaches should be developed aiming to address the dropout and maintenance issues, thus exploring possible direct and indirect effects relevant for this issue (Klos et al., 2020; Kwasnicka et al., 2016; Rhodes et al., 2017).

In recent years the hedonic assumptions related to exercise have been revitalized and new approaches to continuous exercise adherence have been proposed. Generally, the hedonic theory seeks to study the relationship between pleasure and displeasure of a certain behavior, grounded in the premise that individuals are sometimes driven by motivational factors related to the pursuit of pleasure and avoidance of pain (Kahneman, Diener, & Schwarz, 1999; Murphy & Eaves, 2016). In exercise, the evidence seems to support this assumptions, and suggests that more positive affective responses appear to be associated with the quality of subjective experience (Ekkekakis et al., 2011; Evmenenko & Teixeira, 2020; Teixeira et al., 2021), and sustain adherence to practice (Rhodes & Kates, 2015; Williams et al., 2008). Some evidence also suggests that individuals that practice pleasure-based exercise demonstrate stronger intentions to maintain this practice in the future (Rodrigues et al., 2020; Teixeira et al., 2018).

These considerations have supported the suggestion made by some authors that a change is needed in the way general exercise prescription guidelines are proposed and developed. As such, these guidelines (e.g., American College of Sports Medicine) are strongly focused on exercise doses (i.e., frequency, intensity, duration) that are considered safe and effective (Ekkekakis et al., 2011; Ladwig et al., 2017). However, a tripartite rationale has been proposed that was intended to extend the previous framework by considering the importance of the ‘dose’ that participants feel as pleasant and would be willing to repeat in future sessions (Ekkekakis et al., 2011; Ladwig et al., 2017). This is posited to support exercise adherence and avoid dropout when pleasurable and enjoyable experiences are present (Chen et al., 2020; Kwasnicka et al., 2016; Rhodes & Kates, 2015).

One of the factors that has an important relation with pleasure and enjoyment and aligns with the tripartite rationale is exercise intensity (Ekkekakis et al., 2005, 2011; Ladwig et al., 2017). This important variable in exercise prescription has demonstrated a dose-response relation with pleasure and displeasure in several related studies. In general, increases in exercise intensity are associated with improved pleasure and reduced displeasure. However, the extent to which this intensity starts to reverse the pleasurable sensation has some degree of variability among exercisers (Box & Petruzzello, 2019; Jones et al., 2018; Ladwig et al., 2017). Thus, the ability to individually adjust exercise intensity in order to ensure a pleasurable session may be of particular relevance for exercise professional’s intervention and for supporting behavior maintenance.

For that matter, some research has been conducted in order to assess how exercisers individually relate with exercise intensity. Two intensity-traits have been proposed as capable of addressing this issue, defined as preference (i.e., “A *predisposition to select a particular level of exercise intensity when given the opportunity*”) and tolerance (i.e., “A *trait that influences one’s ability to continue exercising at an imposed level of intensity even when the activity becomes uncomfortable or unpleasant*”) (Ekkekakis et al., 2005). These intensity-traits have been explored in several contexts and present evidence for their usefulness and reliability regarding the role of intensity in several behavioral and psychological outcomes (Ekkekakis et al., 2007, 2008; Hall et al., 2014).

Particularly in the health club context, Teixeira et al. (2021) have reported positive associations between the intensity-traits and exercise frequency, habit, subjective vitality, and psychological well-being, thus suggesting a possibly relevant contribution of these individual traits in health and well-being related variables in this particular setting. As postulated by the hedonic framework, contextual characteristics that could elicit a better plea-

sure/displeasure ratio would be indicative of several positive outcomes (Chen et al., 2020; Stevens et al., 2020). Particularly, regarding exercise adherence in health clubs, a better understanding of how to achieve this purpose is a much-needed topic of exploration aiming to address one of the major public health issues – physical inactivity and sedentary behavior (IHRSA, 2020; Rodrigues et al., 2019; WHO, 2020).

Current Study

The hedonic approach to exercise has been further explored by the Affect and Health Behavior Framework (AHBF; Stevens et al., 2020; Williams & Evans, 2014). This approach postulates that the affective constructs are organized in four dimensions: i) affective response (how one feels associated to physical activity), ii) incidental affect (how one feels throughout the day), iii) affect processing (e.g., remembered affect, affective judgments), and iv) affectively charged motivations (motivational factors). Additionally, the interdependent relations of the dimensions related to physical activity are expected to influence this particular health behavior.

Bearing this in mind, the intensity-dependent affective response in exercise can be considered as a factor to influence the pleasure/displeasure experienced in the session, as for post-exercise affective response (e.g., related to incidental affect) (Calder et al., 2020; Stevens et al., 2020). Additionally, how one feels *during* exercise is also expected to influence remembered affect (affect processing), both through automatic and reflective pathways (Stevens et al., 2020; Williams & Evans, 2014). For that matter, the exploration of how the two intensity-traits could be related to psychological and behavioral factors related to the affective dimensions warrant exploration. Particularly in this study, we hypothesize that preference and tolerance would be positively associated with habit, expressed as an automaticity index for physical activity behavior, thus representing a possible outcome related to affective processing (automatic pathway) (Rhodes & Kates, 2015; Stevens et al., 2020; Weyland et al., 2020). Additionally, we propose that this relation would be mediated by subjective vitality, an indicator of aliveness and energy to the self, reflected in general life situations (Guérin, 2012), that would, albeit indirectly, express how one feels throughout the day (incidental affect).

As reported in literature, habit formation is a relevant variable for exercise maintenance, sustained as influencing health behaviors positively, and is recommended as a key construct for future research in this field (Feil et al., 2021). The association between affect and habit has been previously suggested and may reflect implicit/automatic processes and behaviors that may

be relevant for exercise continuous adherence (Rhodes & Kates, 2015; Weyland et al., 2020). Particularly in the exercise setting, and specifically regarding the intensity-traits, positive associations have been reported between both traits and habit, thus suggesting and supporting previous assumptions (Teixeira et al., 2021).

Regarding subjective vitality, it has been defined as a psychological sense of aliveness, energy and enthusiasm, reflecting a positive feeling of having energy to the self (Guérin, 2012; Ryan & Frederick, 1997). This construct has been positively associated with general health indicators, well-being, and moderate intensity physical activity, and suggestions for further research aiming to explore distinct mechanisms (e.g., as a mediator) of vitality interaction with physical activity relevant variables have been presented (Guérin, 2012; Wendel-Vos et al., 2004).

Given the previously mentioned studies, how one feels throughout the day (incidental to physical activity) may be an important factor related to affect processing. Although subjective vitality is not in essence a core affect based variable, it is a commonly accepted relevant variable for well-being (for a review, see Guérin, 2012), aligned with individual desire to live a values-oriented life and to meet aspirations, and therefore adds to a general subjective feeling of happiness, which reflects daily life feelings (Stevens et al., 2020). Empirical evidence for the intensity-traits and vitality relation have emerged in Teixeira et al. (2021) study, where preference and tolerance presented positive associations with vitality. Moreover, Faria et al. (2020) have demonstrated that vitality is a significant predictor of habit, thus supporting the previously hypothesized association.

Thus, the present exploratory study aimed to test the mediation role of subjective vitality in the relation between the intensity-traits and exercise habit. We postulate that i) preference and tolerance will be positively associated to subjective vitality and exercise habit, as suggested previously in similar contexts (Teixeira et al., 2021), and that ii) subjective vitality, a general indicator of feeling alive and with energy available to the self, will mediate the intensity-traits and habit association (Faria et al., 2020).

Present study may thus add to the existing literature insights about the intensity-traits relation with other well-being and behavioral constructs in health club exercisers. As suggested previously, the hedonic approach to exercise and the intensity-traits characterization and comprehension is an emerging field of exploration that has potentially relevant applications in this context and may help professionals supporting their interventions aimed at promoting continuous adherence.

Methods

PARTICIPANTS

The sample comprised a total of 299 gym exercisers (39% men and 61% women) with an average age of 36.4 years ($SD = 10.61$) that participated in a larger ongoing study related with exercise sustainability in health clubs. These participants were involved in individual (e.g., exercise room; personal training) and group fitness activities (e.g., aerobics, hydrogymnastics) in several gyms and health clubs. They were mostly experienced exercisers (training experience: 3-6 months = 7.5%; 6-12 months = 6.8%; > 12 months 85.7%) with an average weekly exercise frequency of 4.25 workouts ($SD = 1.74$). To participate in the present study, exercisers had to be 18 years old, and have at least a 3-month regular exercise practice (minimum of 1 weekly exercise workout).

PROCEDURES

For the sample constitution, an invitation to complete an online battery of sociodemographic and psychometric questionnaires was distributed through social media and mailing lists. Data were collected anonymously through Google Forms from anyone willing to participate. After reading out a letter of explanation, a signed informed consent was provided prior to completing the questionnaires. The time of completion was approximately 10 to 15 minutes for all data collection methods. To comply with the informed consent, the online questionnaire had an initial part to indicate if the participants wanted to continue or not. If the answers were negative, the questionnaire would end there. All the procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee (FEFD/ULHT) and with the 1964 Helsinki declaration and its later amendments and comparable ethical standards. Responses were screened to assess eligibility to participate in the study.

INSTRUMENTS

Preference for and Tolerance of the Intensity of Exercise Questionnaire — Portuguese version (PRETIE-Q-PT; Teixeira et al., 2021). To assess preference and tolerance in exercise settings, the PRETIE-Q-PT was used, which comprises 10 items representing two scales (five items per scale) that correspond to the intensity-preference (e.g., “*I’d rather go slow during my workout, even if that means taking more time*”) and intensity-tolerance (e.g., “*When my muscles start to hurt during exercise, I tend to slow down a little*”) traits. The stem asks respondents what best describes what they believe and how they feel when exercising, and the answers are given on a 5-point bipolar Likert scale, ranging from 1 (“Totally disagree”) to 5 (“Totally agree”). Present instrument has been tested in the health club’s context and presented good psychometric properties. Present samples subscale’s reliability was assessed with Cronbach’s alpha and was deemed acceptable (.76 for preference and .71 for tolerance).

Subjective Vitality Scale — Portuguese Scale (SVS; Moutão et al., 2013). This 6-item scale assesses subjective vitality, a state of felling alive and with energy, reflecting a general subjective experience of psychological enthusiasm and inspiration (e.g., “I feel strong and powerful”) (Ryan & Frederick, 1997). Responses are given using a 7-point bipolar Likert scale, ranging from 1 (“Totally disagree”) to 7 (“Totally agree”). The score is calculated by averaging the values from each item. The Moutão et al. (2013) version has been translated and tested in a sample of Portuguese exercisers, presenting good psychometric properties, and the original English scale has been used extensively in physical activity-related studies demon-

strating adequate reliability (e.g., Guérin, 2012). The SVS reflected good internal consistency in the current study (Cronbach $\alpha = .88$).

Self-Report Behavioral Automaticity Index (SRBAI; Rodrigues et al., 2021). The SRBAI is a 4-item unidimensional scale developed to assess behavioral habit development. The statement “*Practicing exercise / physical activity is something that...*” preceded the four items (e.g., “*I do without having to consciously remember*”), and participants rated how true each statement was for them on a 7-point bipolar Likert scale, ranging from 1 (“Totally disagree”) to 7 (“Totally agree”). This scale has been used previously in this context (Teixeira et al., 2021), and in current study sample demonstrated good reliability through Cronbach’s alpha test (.89).

DATA ANALYSIS

Descriptive statistics, including mean, standard deviation as well as bivariate correlations were calculated for the variables studied. Statistical analysis assumptions were tested following usual procedures and Hayes (2018) recommended approaches (e.g., through scatterplots). The level of significance was defined at $p < .05$. For indirect effect analysis, PROCESS macro v.3.4.1 for SPSS was used and Hayes (2018) indications were followed. For single mediator testing, model 4 was selected. This model allows the estimation of the direct effect between the independent (intensity-traits) and depended variables (habit), while estimating the indirect effects through the proposed mediator (subjective vitality). For study purposes, the intensity-traits were tested in separate models. As suggested by Hayes (2018), the decision to use more than one independent variable in mediation models should be based according with the variables correlation scores (higher scores may provide suppressing effects), and theoretical implications. Thus, considering the present study correlation score of the intensity-traits ($r = .578, p < .001$), and the exploratory nature of the study, preference and tolerance will be tested in separate models. A bootstrap with 5000 samples will be used, and the confidence interval (95%) estimate calculated as suggested by MacKinnon et al. (2004). Significant indirect effects will be considered if 95% of the confidence interval do not include zero (Hayes, 2018).

Results

Preliminary testing showed no relevant issues with linearity, normality or homoscedasticity. Descriptive and correlation analysis results are depicted in Table 1. As seen, present sample of exercisers demonstrated a preference and tolerance for moderate exercise intensities (Preference: $M = 18.24, SD = 4.11$; Tolerance: $M = 16.98, SD = 4.21$). In subjective vitality and habit, exercisers presented scores above the scales middle-points ($M = 5.41, SD = 1.09$; $M = 4.48, SD = 1.19$, respectively). The correlation analysis presented positive and significant associations among all variables (all $p < .05$).

Regarding mediation analysis, Figure 1 depicts the direct and indirect effects of the tested models. In model 1a, the direct effect ($\beta = .14 [.06, .29]$) and indirect total effect ($\beta = .04 [.01, .08]$) were significant, indicating a partial mediation. Both indirect effects through mediator were also significant. In model 1b, the same trend of results emerge and the association depicts a

TABLE I
Descriptive and correlation analysis of studied variables.

	M	SD			
Age	36.40	10.61			
Frequency	4.25	1.74			
Preference	18.24	4.11	Preference	Tolerance	Vitality
Tolerance	16.98	4.21	-	-	-
Subjective Vitality	5.41	1.09	.578***	.135*	.161**
Habit	4.25	1.74	.172**	.185***	.339***

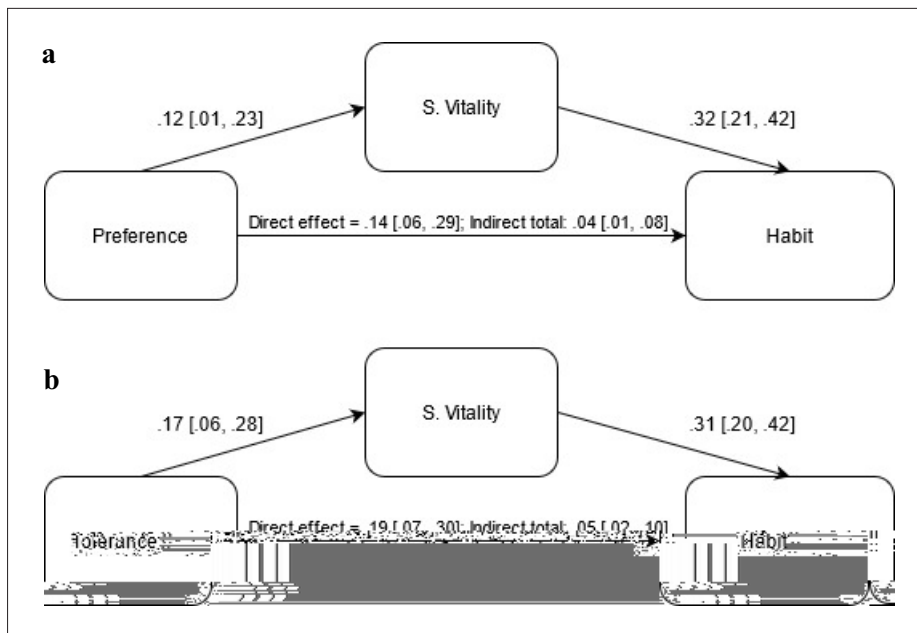


Fig. 1a and 1b - Analysis of subjective vitality as a mediator between preference/tolerance and exercise habit.

partial mediation. The direct effect ($\beta = .19 [.07, .30]$) and indirect total effect ($\beta = .05 [.02, .10]$) presented positive and significant effects. Both indirect effects associated with the mediators were significant. In both models, subjective vitality presented the higher regression scores.

Discussion

The aim of the current exploratory study was to test the mediation role of subjective vitality in the relation between the intensity-traits and exercise habit, thus helping to understand the role of preference and tolerance in well-being and behavioral outcomes. In general, the present sample of exercisers demonstrated preference and tolerance for moderate intensity exercises/activities. The intensity traits were positively associated with subjective vitality and exercise habit, and vitality partially mediated both models that tested the preference and tolerance association with habit. Globally, the intensity-traits present small-to-moderate effects in the tested variables.

Hedonic assumptions to exercise adherence have gained visibility as recent research has brought new evidence for its use and implications. Given the global health burden of sedentary behavior and physical inactivity (Stamatikis et al., 2019), and considering that health clubs are one of the most relevant contexts of exercise practice (EC, 2018; IHRSA, 2020), the exploration of new lines of research aimed to help initiate and sustain exercise practice is warranted (Ekkekakis et al., 2019; Kwasnicka et al., 2016).

The results of the current study present some preliminary evidence that the intensity-traits related to exercise may be relevant for health club professionals adjust their intervention aiming to promote a better subjective experience. As posited, both preference and tolerance presented positive associations with vitality and habit. This has been previously reported in the only known study that addressed these variables, at this point, in this exercise context (Teixeira et al., 2021), suggesting that distinct positive outcomes are, to some extent, dependent on these traits. Additionally, the results of present study reinforce that health club exercisers tend to prefer and better tolerate moderate intensities, thus adding relevant information that may be considered when promoting physical activity counseling or exercise prescription aiming to promote a pleasurable experience.

Regarding the proposed mediation role of vitality, analysis partially supported the presented hypothesis. Grounded in AHBF, it was defined that vitality and habit could be indirect consequences of a theoretically proposed interaction between affective constructs (affective response in exercise > incidental affect > affect processing) (Stevens et al., 2020; Williams & Evans, 2014). In fact, significant regressions among constructs present preliminary support for these assumptions. However, vitality depicted a partial mediation with small regression scores, thus suggesting that other mechanisms and variables may be relevant in the intensity-traits > habit relation. As suggested, how one feels throughout the day may be a relevant determinant of physical activity, particularly when paired with affect processing related to previous exercise experiences and affectively charged motivation. The latter affective

dimensions are theorized to be dependent on pleasure/displeasure one feels during exercise, and therefore may be related to the intensity-traits and how they are addressed in exercise.

However, in the present study, no control was exercised regarding how exercisers perceived that their current exercise regimen was aligned with the intensity-traits. In the study by Teixeira et al. (2021), a sample of health club exercisers showed differences when the training intensity was in agreement with preference and tolerance when compared with groups where this was not met, suggesting that meeting these traits in the activities performed was related with better affective, behavioral and cognitive outcomes. This could, hypothetically, justify the magnitude of the scores obtained in the present study and should be addressed in future related research. Moreover, vitality was used as an indirect and related construct of incidental affect. As posited by Stevens et al. (2020), incidental affect constructs related to physical activity should be related to core affect, specifically affectively charged states as moods and emotions. Thus, subjective vitality as measured and defined in present study may not, although being a relevant construct of well-being, fully reflect the affective responses intended and experienced in individual's general life.

The present results may reflect an emerging hypothesis that what professionals do in their exercise prescription and supervision related to the in-session affective response, may have a broader effect on exercise adherence than previously expected. This may change the way exercise must be seen in health clubs, particularly regarding the promotion of pleasurable experiences. As reported previously, the dropout rates in the first 6 months in health clubs are considerably high, and some evidence suggests that this is in part related with poor professional follow-up procedures in earlier attendance behaviors (Rand et al., 2020). As such, it may be wondered how much of these members were lost due to poor management of the pleasure/displeasure relation, thus possibly influencing short (affective processing aiming to the automaticity of the behavior) and medium-term (affectively charged motivation) exercise behavior. If these assumptions are to be supported by future studies, as the results of the present study tend to indirectly suggest, a new concern may be raised related to poor follow-up procedures as well as pleasure and enjoyment promotion disregard/discontent, because not only will they not add to the intended positive exercise experience related to adherence, but, conversely, may reinforce barriers for future exercise engagement.

Limitations and future directions

The present study presented some initial exploration of a possible role of the preference for and tolerance of exercise intensity in health club exercis-

ers. Although preliminary, several suggestions and hypothesis tend to align with theoretical frameworks and may represent a future line of research aiming to address pleasurable experiences in these settings. As a relevant necessity, future endeavors should aim to address AHBF dimensions more closely as proposed by the framework authors (e.g., core affect), allowing a more comprehensive approach for the dimensions interaction in relation with exercise. Additionally, several other correlates may be relevant for further understanding of how the intensity-traits may be related with the AHBF (e.g., exercise frequency, well-being), and possible causal links should be explored. As for the intensity-traits, the level of agreement/disagreement between the training intensity and individual traits should reflect the theoretically proposed improvement of the pleasure/displeasure relation. This level of agreement should depict distinct affective consequences and their influence in relevant outcomes should be tested.

In conclusion, preference and tolerance presented positive associations with subjective vitality and habit to perform exercise. Vitality partially mediated the relation between both intensity-traits and habit. In general, results suggest that the intensity-traits may reflect a relevant aspect to explore by professionals aiming to promote pleasurable experiences. Results tend to align with AHBF framework, but further research is warranted to adequately extend and explore more directly these

Authors' contributions

DST, JF, AJA, AE and PM developed the design, collect and analysed the data. JF and DST wrote the manuscript. DM, FR, LC and AE reviewed and critiqued the manuscript. All authors approved the final version of the manuscript.

CRedit authorship contribution statement

João Faria: Conceptualization, Methodology, Formal analysis, Investigation, Writing – original draft. **Ana J. Andrade:** Conceptualization, Visualization, Writing – review & editing. **Anastasiia Evmenenko:** Conceptualization, Visualization, Writing – review & editing. **Diogo Monteiro:** Methodology, Formal analysis. **Filipe Rodrigues:** Visualization, Writing – review & editing. **Paulo Marques:** Conceptualization, Visualization. **Luís Cid:** Writing – review & editing. **Diogo S. Teixeira:** Conceptualization, Methodology, Investigation, Formal analysis, Writing – original draft, Supervision, Project administration.

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