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AN ANALYSIS OF THE ASSOCIATIONS BETWEEN BOREDOM, EFFORT VALUE, AND EXERCISE BEHAVIOR

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ABSTRACT

Insufficient physical activity poses significant health risks, making it essential to understand psychological aspects influencing exercise engagement. Here, we examined the relationship between exercise boredom, the perceived value of physical effort, and self-reported exercise behavior. A cross-sectional online study with 351 participants (*M* = 30.58 years, *SD* = 10.82) assessed exercise boredom using the Bored of Sports Scale (BOSS) and the perceived value of physical effort using the Value of Physical Effort Scale (VoPE). Exercise behavior was measured as weekly minutes of sport activity. We found that both exercise boredom and the value of physical effort are relevant for exercise engagement, with the value of physical effort being a stable predictor and closely linked to exercise behavior. Bayesian network analysis further supported this, revealing that value of physical effort and exercise behavior clustered closely together, suggesting a robust relationship. Mediation analyses showed that the relationship between exercise boredom and exercise behavior was mediated by the perceived value of physical effort. Higher boredom levels were associated with a lower perceived value of physical effort, which in turn was positively linked to time spent exercising. The significant indirect effect suggests that boredom contributes to lower exercise engagement partly by reducing the perceived value of physical effort. These findings highlight the importance of addressing exercise boredom and enhancing the perceived value of physical effort to promote sustained physical activity and improve health outcomes.

Keywords: boredom, value of physical effort, exercise behavior, sports.

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According to the World Health Organization, "*nearly 1.8 billion adults (are) at risk of disease from not doing enough physical activity*" (World Health Organization, 2024). This alarming quote highlights that too little physical activity poses a serious threat to personal and public health (Ding et al., 2016, 2017). Thus, despite the tremendous health benefits associated with regular exercise (Kohl et al., 2012), many people struggle to meet physical activity recommendations (Guthold et al., 2018), and to translate their exercise goals into regular behavior (Rhodes & de Bruijn, 2013). Substantial efforts have been undertaken to understand and change this state of affairs (Milkman et al., 2021). In this paper, we will focus on two variables that have not yet been central to understanding peoples' involvement in sports and exercise: The boredom they associate with these activities and the value they ascribe to physical effort in general. We will focus on these variables for several reasons: There is some evidence that people who perceive exercise as boring or are more frequently bored in general tend to exercise less (McCurdy et al., 2022; Wolff, Weich, et al., 2024). In addition, recent studies show that people differ in the value they attribute to physical effort, and people who value physical effort seem to exercise more (Bieleke, Stähler, et al., 2025; Cheval et al., 2024) and experience less boredom during exercise (Martarelli et al., 2023). While these findings suggest that boredom and the perceived value of physical effort matter for sports and exercise behavior, replications are needed to better understand the robustness and the size of these effects. Importantly, boredom influences behavior by signaling a lack of personal value or meaning in an activity (Igou et al., 2024; Pekrun & Goetz, 2024). Therefore, it is conceivable that the value people attribute to physical effort might (partly) explain the connection between finding sports and exercise boring and the amount of time spent exercising. With this contribution, we seek to first replicate the bivariate relationships between sports-specific boredom, the value of physical effort, and sports and exercise behavior. Second, we use network analyses and mediation analyses to explore the relationship between sports-specific boredom, value of physical effort, and self-reported exercise behavior in more detail.

Why do boredom and value of effort matter for sports and exercise behavior?

Clearly, not everyone finds exercise boring and exercise can even be a means to counteract boredom (Brockman et al., 2011). Indeed, many people excitedly perform their sports of choice and some even exhibit signs of exercise addiction (Landolfi, 2013). However, to others exercising feels boring and they even cite boredom as a reason for not exercising (Lawrason et al., 2020; Martin et al., 2008). For example, already in a 1992 study, boredom was among the most highly endorsed reasons not to go jogging (Vitulli & DePace, 1992). Outside the recreational sports context, boredom has also been cited as a reason for not adhering to physical rehabilitation programs (Venegas et al., 2018). Importantly, the degree to which people associate sports and exercise with boredom appears to be a matter of individual differences and these differences are associated with exercise frequency (McCurdy et al., 2022; Wolff, Weich, et al., 2024). For instance, higher scores on the *Bored of Sport Scale* (BOSS), a sport-specific boredom measure, are linked to less self-reported exercise behavior (Bieleke, Wolff, et al., 2025; Wolff, Bieleke,

Stähler, et al., 2021). Interestingly, even among experienced exercisers, higher BOSS scores (indicating greater boredom with exercise) were associated with lower weekly training volume (Bieleke, Wolff, et al., 2025; Weich et al., 2022). Taken together, an emerging body of work underscores boredom's role across a broad range of sports and exercise settings, such as professional sports, physical education classes, clinical contexts and recreational exercise (Wolff, Weich, et al., 2024). This begs the question: why and how can boredom be such an influential sensation?

To answer this question, it is instructive to look at what boredom is and what it *does*. Boredom is understood to signal that an ongoing activity does not adequately utilize one's resources (Wolff, Bieleke, et al., 2023; Wolff, Radtke, et al., 2024). In turn, if one is feeling bored, this should prompt a search for alternative, more worthwhile things to do (Elpidorou, 2023; Wolff, Radtke, et al., 2024). Consistent with this, a large body of research has shown that people find boredom aversive and try to avoid and escape it (Bieleke et al., 2022), even preferring painful or effortful behavioral alternatives (Wilson et al., 2014; Wu et al., 2023). Prototypical situations that elicit boredom are those that are perceived as either underchallenging (e.g., monotony or repetitiveness), overchallenging (e.g., activities that exceed a persons' capabilities), or meaningless to the person (Igou et al., 2024; Pekrun et al., 2010; Pekrun & Goetz, 2024)Such situations can be found in the sports and exercise context as well. For example, running on a treadmill at a low to moderate intensity might feel boring because the runner does not feel adequately challenged. Likewise, a novice tennis player might become bored (and then probably frustrated) if they repeatedly fail to return the ball over the net and the activity is simply too challenging. Fortunately, in many instances the challenge level can be adjusted rather easily. For example, the runner might choose to up the pace a bit to feel more challenged and the tennis player might decide to practice closer to the net to have a higher chance of returning the ball. By adapting the challenge level (intensity), individuals can reduce feelings of boredom and are more likely to engage in an activity (frequency) and to persist in it (duration) (Danckert & Elpidorou, 2023).

However, challenge is not the only determinant of boredom (Westgate & Wilson, 2018). Even if an activity is appropriately demanding, it may still feel boring if the person does not perceive it as valuable. Within the framework of Self-Determination Theory, lack of intention or motivation (amotivation) can occur when an activity is not perceived as inherently or instrumentally valuable (Ryan & Deci, 2000a, 2000b). What if the runner and the tennis player do not actually value their engagement in these sports and only practice them because a doctor or a coach has urged them to do so? Here, they might experience boredom because the exercises feel meaningless. Consistent with this, team sports athletes perceived ancillary training sessions (such as running) to be more boring than sessions where they could practice their primary sports (Wolff, Bieleke, Martarelli, et al., 2021). The assessment of an activity as valuable or not seems to be critical for boredom to occur and to affect behavior: If a boring activity is not perceived as valuable, then the person is unlikely to be inclined to fight the boredom-induced urge to stop with this activity and do something else (Martarelli et al., 2021). This points towards a key role of value in understanding if and how boredom shapes exercise engagement.

The value people ascribe to an activity is robustly associated with the level of engagement in it

(Pekrun, 2006; Tam et al., 2021; Van Tilburg & Igou, 2012). Research has shown that people differ in how much they value the exertion of physical effort and dedicated scales have been developed to assess these differences (Bieleke, Stähler, et al., 2025; Cheval et al., 2024). As the exertion of physical effort is an integral part of doing sports and exercise, not valuing physical effort might deter people from exercising. Consistent with this, high scores on the *Value of Physical Effort* (VoPE) scale have been associated with more self-reported sports and exercise behavior, higher athletic level, and better grades in physical education classes (Bieleke, Stähler, et al., 2025; Wolff, Stähler, et al., 2023). Likewise, valuing physical effort – measured with the *Physical Effort Scale* (PES) - discriminated between inactive, light, moderate, and vigorously active people (Cheval et al., 2024). In addition to examining the unique relationship between value of physical effort and exercise behavior, one study reported a negative relationship between VoPE and BOSS (Bieleke, Stähler, et al., 2025). Thus, people who find sports and exercise boring tend to not value physical effort (Martarelli et al., 2023). Providing further support for the assumed link between boredom and value, another study found higher VoPE scores to be associated with less self-reported boredom in physical education classes (Wolff, Stähler, et al., 2023). Thus, students who found sports not boring tended to value the exertion of physical effort and reported better grades in physical education classes. In the present study, when we refer to the *value of physical effort*, we specifically mean the extent to which individuals perceive the exertion itself as worthwhile, which is conceptually distinct from the general value of the action as a whole.

The present study

Sports-specific boredom and the value of physical effort matter for sports and exercise behavior. In addition, as boredom signals that something lacks value, boredom and value are linked on a conceptual level too (Igou et al., 2024; Pekrun, 2006; Van Tilburg & Igou, 2012). However, there is a lack of research that systematically explores the nomological network of sports-specific boredom and the value of physical effort, as well as the potential interplay of these concepts in shaping exercise behavior. As a first step towards addressing this gap, we have conducted a cross-sectional online study where we surveyed participants sports-specific boredom (measured with variant of BOSS), the value they ascribed to physical effort (measured with VoPE), and their self-reported weekly exercise behavior. Our study aims were two-fold. First, we assessed if the negative and positive associations of BOSS and VoPE scores with self-reported weekly exercise behavior are replicable. Second, we systematically explored the conceptual interplay between sport-specific boredom and value of effort with respect to exercise behavior. To do so, we employed a network approach to unpack the relationship between BOSS and VoPE items with each other, as well as with exercise behavior. In addition, we used mediation analyses to assess if the link between BOSS scores and exercise behavior is (partly) mediated by participants VoPE scores. Simply put, we expect that people who associate sports with boredom exercise less, and we investigate if this link is driven by the value they ascribe to the exertion of physical effort. In this analysis, we control for age, gender, and self-control as these variables have been shown to relate to exercise behavior (Althoff et al., 2017; Hagger et al., 2019).

Methods

Transparency and openness

In this section, we report how we determined our sample size, as well as all data exclusions, manipulations, and measures applied in the study. The data, code, and research materials are available at the Open Science Framework (OSF) and can be accessed at https://osf.io/tdcsv. The study was not preregistered.

Participants

We aimed to reach as many participants as possible during the period from April to May 2022 via social media platforms such as Facebook and Instagram (Funder & Ozer, 2019). Eligibility for the study was limited to German-speaking participants who were at least 18 years old. A total of 471 participants completed the questionnaire without receiving any specific incentives. Out of these participants, 129 had missing values and were thus excluded from the analyses. The final sample consisted of 351 participants (53% female) with an average age of 30.58 (*SD* = 10.82). We conducted additional analyses excluding six participants whose z-scores on the dependent variable exceeded 3 (1.7% of the sample). These analyses are available on OSF (https://osf.io/tdcsv) This exclusion led to a small change in the results: the effect of boredom became significant in both the regression and mediation analyses. This change does not affect the conclusions reported in the paper.

Ethical approval was not required for this study, as it involved only questionnaire-based data without interventions, in accordance with institutional regulations. Participation was voluntary, and all participants provided informed consent. The study was conducted in accordance with the Declaration of Helsinki and the ethical guidelines of the German Society for Psychology (DGPs).

Procedure and measures

The study was conducted using the open-source software LimeSurvey (www.limesurvey.org) and questionnaires are available at https://osf.io/tdcsv. The questionnaire also included other variables that are not considered in this publication. It lasted on average 5 minutes. After giving informed consent, participants worked on the items presented below. Finally, participants provided demographic information.

Variables with relevance for our hypotheses

The *experience of boredom* during exercise behavior was assessed using a preliminary 8 item version of the Bored of Sports Scale (BOSS) (Wolff, Bieleke, Stähler, et al., 2021). The scale asks participants to consider their thoughts and feelings when thinking about exercise, imagining themselves in a training session (e.g., working out in a gym). The items measured the levels of boredom experienced in sport contexts (e.g., "My sport sessions are so boring that I find myself mind-wandering"). Responses were given on 5-point Likert scales ranging from 1 (do not agree at all) to 5 (fully agree). The scale demonstrated good internal consistency, with a Cronbach's alpha of 0.822.

Value of physical effort was assessed with the Value of Physical Effort scale (VoPE) (Bieleke, Stähler, et al., 2025). This scale, which consists of 4 items, measures people's value and

motivation to engage in physical effort (e.g., "I greatly enjoy sports activities that require physical effort"). Responses were given on 7-point Likert scales ranging from 1 (do not agree at all) to 7 (fully agree). The scale demonstrated good internal consistency, with a Cronbach's alpha of 0.836.

To assess *exercise behavior* two items were created, these are the items "How many times a week do you exercise?" and "How many minutes does a sport session last on average?". For the first item, participants could select an integer from a drop-down menu, ranging from 0 to 14. For the second item, they were required to enter an integer. We calculated the sport activity variable (sport activity in minutes per week) by multiplying the number of sport activities per week by the average duration of one activity, following previously established methods for physical activity assessment (Ainsworth et al., 2015).

Control variables

Next to age and gender, also dispositional self-control was assessed with the short version of the Self-Control Scale (SCS-K-D) (Tangney et al., 2004; Bertrams & Dickhäuser, 2009). The scale consists of 13 items (e.g., "I am good at resisting temptations") to be answered on 5-point Likert scales ranging from 1 (do not agree at all) to 5 (fully agree) and measures people's general ability to regulate themselves. The scale demonstrated acceptable internal consistency, with a Cronbach's alpha was 0.791.

Analytical approach

We report descriptive statistics, correlations, regression, and mediation analyses. Descriptive statistics, correlations, and regressions were computed with jamovi version 2.6.2 (The jamovi project, 2024). To test the mediation models, we used R (R Core Team, 2025) with the lavaan package (Rosseel, 2012). Standard errors of the parameters were computed with the bias-corrected bootstrap method (1000 bootstrap repetitions). Additionally, to examine in greater detail how sport-specific boredom, the value of effort, and exercise behavior interact at the item level, we conducted a Bayesian network analysis. In this approach, each questionnaire item is represented as a node, with edges denoting probabilistic dependencies between items. This methodology allows to assess not only the strength of associations but also the uncertainty regarding whether a connection truly exists. This reduces the risk of overinterpreting weak or spurious relationships (Huth et al., 2023). Conditional dependencies among items were estimated with a Gaussian Graphical Model (GGM), which assumes multivariate normality and infers conditional independencies from partial correlations, implemented via the easybgm package (Huth, 2024) in R (R Core Team, 2025) using BDgraph (Mohammadi & Wit, 2019). Default priors were applied, including a Bernoulli prior on edge inclusion with an inclusion probability of 0.5, (implying a uniform prior over graph structures) and a G-Wishart prior on the precision matrix (with degrees of freedom set to the package default of 3 and an identity scale matrix). All other hyperparameters were set to the package defaults. As the analysis was exploratory, the use of default, uninformative priors was considered appropriate. All variables were standardized to ensure comparability across different response formats. Network estimation was performed using 100'000 Markov Chain Monte Carlo (MCMC) iterations, resulting in a posterior distribution over potential network structures that quantifies the

confidence in each possible connection (Huth et al., 2023). This approach provides a probabilistic map of how sport-specific boredom, the perceived value of effort, and exercise behavior are interrelated, accounting for the interdependence among items. The dataset as well as the code for the analyses are shared on OSF at https://osf.io/tdcsv.

Results

Summary statistics of the variables are reported in Table 1. Central tendency measures revealed rather low values of boredom during exercise behavior (*M* = 1.69, *SD* = 0.65), whereas the value of physical effort (*M* = 4.86, *SD* = 1.27), and self-control (*M* = 3.19, *SD* = 0.66) revealed moderate values. On average, participants engaged in exercise behavior for 181.98 minutes per week (i.e., 3 hours) with a range spanning from 0 minutes to 945 minutes, i.e., 15.75 hours; *SD* = 156.11.

	Exercise	Boredom	Value of physical effort	Self-control
Mean	181.980	1.688	4.858	3.194
Standard deviation	156.108	0.650	1.271	0.659
Skewness	1.673	1.081	-0.532	-0.113
Kurtosis	4.162	0.591	-0.187	-0.233

Table 1. N = 351. Means, standard deviations, skewness, and kurtosis for boredom during exercise behavior (BOSS), value of physical effort (VoPE), exercise, as well as self-control are reported. Boredom and self-control were assessed with 5-point Likert scales, whereas value of physical effort was assessed with 7-point Likert scales. Exercise is the reported time spent (in minutes) practicing a sport in one week. Skewness and kurtosis are close to zero, thus suggesting distributions moderately symmetric, i.e., an approximately normal distribution of the data.

The correlational analysis revealed significant negative associations between boredom and all other variables. Notably, there was a large negative relationship between the experience of boredom during exercise behavior and the value ascribed to physical effort (r = -0.541, p < .001), and moderate negative relationships between boredom during exercise behavior and exercise behavior (r = -0.329, p < .001), as well as between boredom during exercise behavior and self-control (r = -0.313, p < .001). Furthermore, the value of physical effort correlated positively with exercise behavior (r = 0.478, p < .001), as well as with self-control (r = 0.301, p < .001). Only self-control and exercise behavior did not correlate significantly (r = 0.088, p = .100).

Associations between boredom, value of effort, and exercise behavior

As the correlational analyses showed significant relationships between boredom during exercise and exercise behavior, as well as between the value of physical effort and exercise behavior, we regressed exercise behavior onto both boredom and the value of physical effort. The regression model aimed to determine the relative contribution of boredom and perceived physical effort value in statistically predicting exercise behavior. Specifically, we hypothesized that higher levels of boredom would be linked to less exercise, while higher values of physical effort would be linked to more exercise. The first regression model explained 23.9% of the variance in exercise behavior. In this model, boredom during exercise (b = -23.26, SE = 13.34, 95% *CI*s [-49.50, 2.98], β = -0.097, p = .082) showed a negative but marginally non-significant relationship with exercise behavior. On the other hand, the value of physical effort (b = 52.82, SE = 6.83, 95% *CI*s [39.39, 66.25], β = 0.430, p < .001) was positively and significantly associated with exercise behavior. In

a second step, we added control variables (age, gender, and self-control) to the model. Due to 4 missing values on the gender variable, we computed this analysis with *N* = 347. The second model explained 27.4% of the variance in exercise behavior. In this model, boredom during exercise (*b* = -29.10, *SE* = 13.50, 95% *CI*s [-55.65, -2.54], β = -0.121, *p* = .032) was statistically significant, showing a negative relationship with exercise behavior. The value of physical effort (*b* = 48.86, *SE* = 7.00, 95% *CI*s [35.09, 62.63], β = 0.396, *p* < .001) remained positively associated with exercise behavior, and gender (*b* = 50.15, *SE* = 15.04, 95% *CI*s [20.57, 79.73], β = 0.160, p < .001) was positively related to exercise behavior, indicating that men, on average, exercised more than women. Self-control (*b* = -5.76, *SE* = 11.89, 95% *CI*s [-29.15, 17.63], β = -0.024, *p* = .628) and age (*b* = -1.05, *SE* = 0.68, 95% *CI*s [-2.38, 0.28], β = -0.073, *p* = .120) were not significantly associated with exercise behavior.

The nomological network of boredom, value of effort, and exercise behavior

The network structure visually displays distinct clustering within the value of physical effort and exercise boredom construct, suggesting internal coherence at the item level. Several cross-construct associations are observed. Items measuring the value of physical effort are positively associated with exercise frequency and exercise duration and negatively connected to specific boredom items. Notably, exercise boredom exhibits dependencies with the value of physical effort, while exercise behavior is linked to the value of physical effort but not directly to exercise boredom (Figure 1).

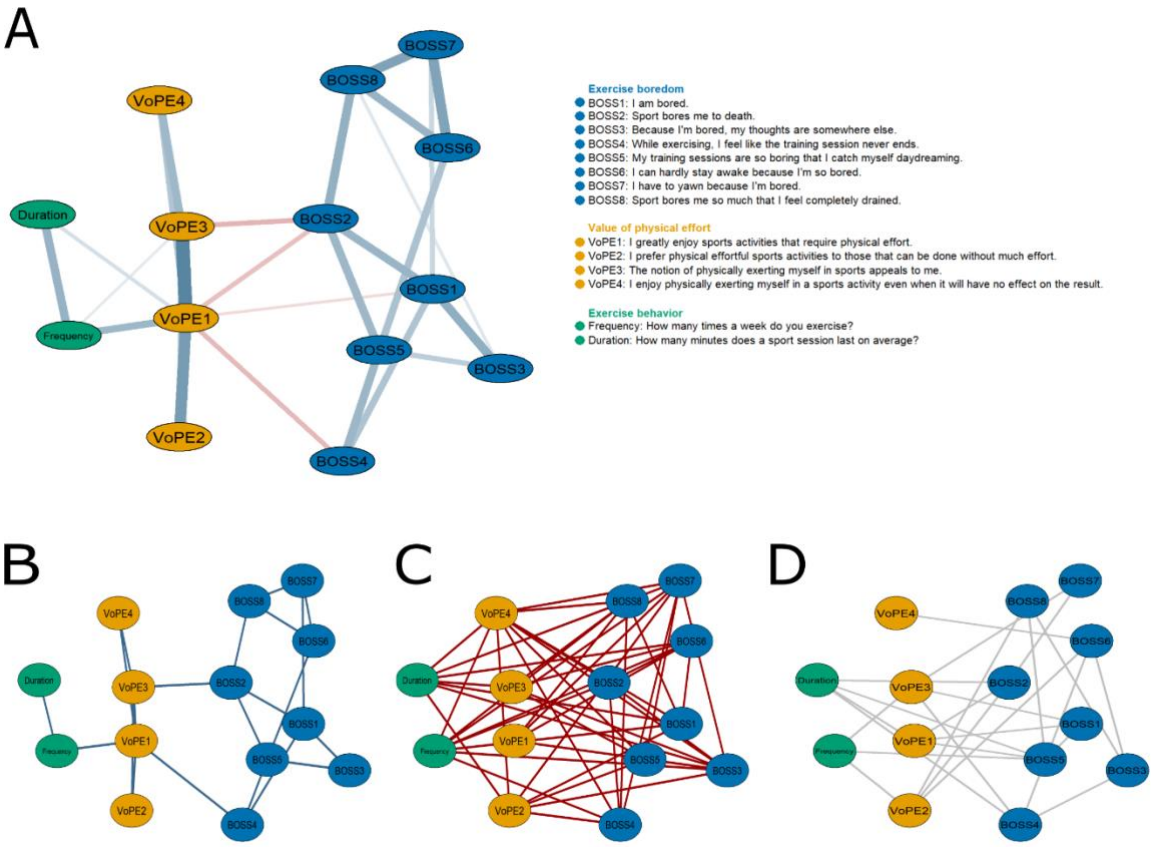

Figure 1. Results of Bayesian network analyses for exercise boredom, value of physical effort, and exercise behavior. Blue nodes represent the 8

items measuring exercise boredom, red nodes indicate 4 items assessing the value of physical effort, and green nodes represent exercise behavior (exercise frequency per week and exercise duration per session). The use of three colors reflects a theory-driven, top-down differentiation. **A)** Edges represent conditional dependencies between items, with edge thickness indicating the strength of the relationship and edge color reflecting the direction. Blue edges indicate positive associations, red edges indicate negative associations. Visual analysis reveals clusters corresponding to the constructs, supporting internal coherence within each construct. Items measuring the value of physical effort are negatively linked to exercise boredom items. No direct connections are observed between exercise boredom and exercise behavior. **B)** Edge inclusion plot: blue lines represent item pairs with strong evidence for conditional dependency ($BF_{10} \geq 10$) **C)** Edge exclusion plot: red lines indicate item pairs with evidence for conditional independence ($BF_{10} \leq 0.1$). **D)** Inconclusive evidence plot: grey lines represent item pairs for which the data provides inconclusive evidence ($0.1 < BF_{10} < 10$) regarding the presence or absence of a conditional dependency.

Is the association between boredom and exercise behavior driven by value of effort?

Based on our regression analyses and network analyses, as well as the theoretical premise that boredom signals a lack of value, we hypothesized that boredom reduces the perceived value of physical effort, which in turn may lead to disengagement from exercise. Therefore, we conducted a mediation analysis with boredom as the predictor, the value of physical effort as the mediator, and exercise behavior as the outcome variable. Given the cross-sectional nature of the data, alternative causal orderings (e.g., value predicting boredom) cannot be ruled out. While the direct effect of boredom on time spent exercising was marginally non-significant (*b* = -23.262, *SE* = 12.468, 95% *CI*s [-48.707, 2.401], β = -0.097, *p* = .062), all other paths turned out to be significant. Notably, individual differences in the experience of boredom during exercise were significantly related to the value ascribed to physical effort (*b* = -1.057, *SE* = 0.098, 95% *CI*s [-1.244, -0.866], β = -0.541, *p* < .001), accounting for 29.2% of variance in this variable. Interestingly, the indirect effect (*b* = -55.802, *SE* = 8.890, 95% *CI*s [-76.201, -39.506], β = -0.233, *p* < .001), and the total effect (*b* = -79.063, *SE* = 10.789, 95% *CI*s [-102.200, -59.191], β = -0.329, *p* < .001) of boredom on time spent exercising were significant. Additionally, the effect of the value ascribed to physical effort on time spent exercising was significant (*b* = 52.817, *SE* = 7.253, 95% *CI*s [38.625, 67.977], β = 0.430, *p* < .001). The model explained 23.9% of variance in exercise behavior. In essence, this analysis highlights how boredom's statistical impact is mediated by the value attributed to physical effort in predicting time spent exercising.

In a second step, we added the control variables (age, gender, and self-control) to the model. Estimated coefficients are reported on OSF under Analyses (https://osf.io/tdcsv). Adding the control variables did not impact the significance of the effects, apart from the direct effect, which now turned out to be significant (*b* = -29.095, *SE* = 12.838, 95% *CI*s [-53.290, -1.714], β = -0.121, *p* = .023). The indirect (*b* = -46.822, *SE* = 8.619, 95% *CI*s [-66.769, -32.791], β = -0.195, *p* < .001) and total effect (*b* = -75.917, *SE* = 11.577, 95% *CI*s [-101.006, -53.840], β = -0.316, *p* < .001) of boredom on time spent practicing a sport remained significant. The model explained 10.3% of the variance in the experience of boredom during exercise behavior, 33.9% in the value ascribed to physical effort, and 27.4% in the time spent exercising.

Discussion

Our study explored the interplay between exercise boredom, the value of physical effort, and exercise behavior. We found exercise boredom and the value of physical effort matter in the context of sports and exercise. This replicates findings from prior research (Bieleke, Stähler, et

al., 2025; Cheval et al., 2024; Wolff, Bieleke, Stähler, et al., 2021). Bivariate correlations revealed significant relationships between boredom, the value of physical effort, and exercise behavior. However, when we moved to multiple regression models, the relevance of boredom as a predictor of exercise behavior diminished while the value ascribed to physical effort remained a stable and robust predictor. Consistent with this, Bayesian network analyses further illustrated that exercise behavior, and the value of physical effort were strongly connected within the same cluster of variables, suggesting a close relationship between the two. This raised an important question: Is the association between boredom and exercise behavior a direct one, or is it driven by other variables?

Given the results of the regression and network analyses, we hypothesized that boredom's link to exercise behavior might be mediated by the value a person attributes to physical effort. This is based on the theoretical premise that boredom signals a lack of value and that the available resources might be better spent engaging in something else (Elpidorou, 2023; Gomez-Ramirez & Costa, 2017; Wolff, Radtke, et al., 2024): If an activity (like exercise) requires physical effort but the exertion of effort is not seen as valuable, individuals could be less likely to engage in it. Consistent with this, the mediation analysis revealed a significant indirect effect of boredom on exercise behavior via the value of physical effort. Specifically, exercise boredom was associated with a reduced value of physical effort, which in turn was linked to less time spent exercising.

Our results align with different theoretical approaches that conceptualize boredom and value as interconnected aspects in goal-directed behavior (Pekrun, 2006; Tam et al., 2021). However, it is important to note that previous theoretical models have theorized different causal chains among these variables. For example, the control-value theory (CVT; (Pekrun et al., 2010)) suggests that both engagement and value, as well as their interaction, predict boredom (a theory, whose predictions have been tested and supported in a sport context, (Martarelli et al., 2023)). while the boredom feedback model (BFM; (Tam et al., 2021)) theorizes that value impacts engagement, which then influences boredom. This indicates that the causal link between these variables in the context of sports and exercise needs to be unpacked by further research. As our study used a cross-sectional correlational design, we are unable to elucidate these causal relationships with our data. Keeping these open questions in mind, we believe that considering both exercise boredom and the value ascribed to physical effort in relation to exercise behavior is crucial. This is not only important from a theoretical point of view, which calls for further research, but also from an applied perspective, as understanding these dynamics could help develop interventions to enhance exercise engagement.

Our findings provide new insights into how boredom and the value of physical effort relate to sports and exercise behavior. They suggest that very basic experiences - like boredom and the perceived value of physical effort - covary with how active people are. Addressing these fundamental aspects could help individuals become more engaged in physical activity. Unlike the challenge of an exercise, which can be adjusted (e.g., by increasing or decreasing intensity), the value people attribute to effort tends to be relatively robust against change (Lin et al., 2024). People may modify the difficulty of their workouts, but if they do not perceive any inherent value in the activity itself, they are less likely to engage in it consistently. This makes value central to understanding why some individuals find sports and exercise more rewarding than others and

why they continue to engage in these activities despite potential boredom (Bieleke, Wolff, et al., 2025).

Finally, how can we change the value of physical effort? How can we shift from perceiving effort as costly and aversive to viewing it as beneficial? Previous research has shown that boredom levels tend to be lower when individuals train in a team setting or with a coach (Martarelli et al., 2023). These findings point to possible interventions, such as social support or group exercise, as ways to alter the perceived value of exercise and reduce boredom. Additionally, research has identified gamification strategies—such as fitness apps, point systems, badges, challenges, or competitions—as effective ways to enhance engagement (Kim et al., 2023). By introducing game-like elements, such interventions can make physical activity more enjoyable, provide immediate feedback, and create a sense of achievement, which can shift motivation toward a more intrinsic orientation (Li et al., 2024). For example, exergames (video games that require physical activity) have been found to reduce perceived effort, enhance enjoyment, and increase engagement in physical activity (Alhirsan et al., 2023; McDonough et al., 2018; Rubio-Arias et al., 2024). Similarly, (public) monitoring of goal progress (Harkin et al., 2016) and social incentives (Patel et al., 2017) can increase engagement. Techniques such as the "foot-in-the-door" approach (i.e., starting with small, achievable tasks) may further enhance adherence (Freedman & Fraser, 1966). Finally, shifting the focus from extrinsic goals (e.g., burning calories) to intrinsic ones (e.g., improving skills) may help sustain long-term exercise engagement (Ryan & Deci, 2000a, 2000b; Sebire et al., 2009; Vansteenkiste et al., 2004).

While our study provides insights into the relationship between boredom, the value of physical effort, and exercise behavior, several limitations should be acknowledged. First, our study employed a cross-sectional design, which limits our ability to draw causal conclusions. Although our mediation analysis suggests a possible indirect effect of boredom on exercise behavior through the value of physical effort, the relationships between these variables are likely bidirectional. Future longitudinal or experimental studies are needed to clarify causality. Second, we operationalized physical effort as frequency and duration of sport activity, however, in the context of boredom research, it might also be important to operationalize physical effort in terms of intensity. More generally, we relied on self-report measures, which are subject to biases such as social desirability (Adams et al., 2005) and retrospective recall errors (Fransson et al., 2008). Participants' perceptions of their own boredom, the value they assign to physical effort, and their exercise behavior may not always accurately reflect their actual experiences. Objective measures of physical activity (e.g., accelerometers) and momentary assessments of boredom could strengthen future research. Third, our sample consisted of a general population recruited through convenience sampling during a very specific period (post-COVID), which may limit the generalizability of our findings to other populations and to contexts. The sample was for example not stratified based on fitness level or sporting background, aspects that could moderate the observed effects. Future studies should aim for more representative sampling or focus on specific subgroups (e.g., athletes vs. sedentary individuals) to examine potential differences. Despite these limitations, our findings highlight the importance of considering both boredom and the value of physical effort when studying exercise behavior. Addressing these aspects could inform both theoretical models of goal-directed behavior and practical interventions aimed at

increasing physical activity.

Conclusion

Here, we showed that exercise behavior is associated with exercise boredom and the value ascribed to physical effort. Our results further suggest that the value of physical effort mediates the relationship between exercise boredom and exercise engagement, indicating that exercise boredom may be associated with lower physical activity in part due to a reduced value placed on physical effort. These findings highlight the value of physical effort and exercise boredom as two relevant psychological factors that covary with lower levels of physical activity. Future research should aim to clarify causal relationships among these variables, which could provide valuable insights into the motivational mechanisms associated with exercise behavior. Understanding and addressing these factors may inform effective interventions to promote physical activity and reduce health risks associated with sedentary lifestyles.

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