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Evaluación de las respuestas afectivas al ejercicio aeróbico continuo mediante la escala de sentimientos y la escala de activación percibida: una revisión sistemática

Assessing affective responses to continuous aerobic exercise with the feeling scale and the felt arousal scale: A systematic review

Avaliação das respostas afetivas ao exercício aeróbio contínuo com a Feeling Scale e a Felt Arousal Scale: uma revisão sistemática

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RESUMEN

Objetivo: La Feeling Scale (FS) y la Felt Arousal Scale (FAS) son los instrumentos más utilizados para evaluar la valencia afectiva y la activación, respectivamente. Por ello, esta revisión tuvo como objetivo analizar cómo la FS y/o la FAS han sido utilizadas en el ejercicio aeróbico continuo. El foco principal se centró en la aplicación de las escalas, incluyendo el momento, el número y la frecuencia de evaluación. Como objetivo secundario, también se recopiló información relativa al cálculo del tamaño muestral de los estudios, al dominio de intensidad del ejercicio y a la identificación de un rebound afectivo. Método: Esta revisión sistemática se llevó a cabo de acuerdo con las directrices PRISMA. Se realizó una búsqueda exhaustiva de la literatura (última búsqueda en agosto de 2023) en cuatro bases de datos (i.e., PubMed, SPORTDiscus, B-on y PsycINFO) y cuatro repositorios (i.e., clinicaltrials.gov, WHO ICTRP, OSF.io y SportRxiv). En total, cincuenta y tres estudios publicados entre 1995 y 2023 fueron incluidos en el análisis cualitativo. Resultados: Los resultados sugieren que ambas escalas pueden utilizarse en actividades aeróbicas continuas. Las variaciones en los momentos, el número y la frecuencia de las mediciones evidenciaron un alto nivel de heterogeneidad. El dominio de intensidad moderada presentó los valores más elevados de valencia afectiva; además, se observó la presencia de un rebound afectivo en todas las intensidades, detectándose un retraso en este rebound en la mayoría de los dominios. Conclusión: Es necesaria una mejora en la aplicación metodológica y contextual de las escalas para reducir la heterogeneidad y mejorar la interpretación del papel de las respuestas afectivas en la motivación y la adherencia al ejercicio.

Palabras clave: afecto, sentimiento, activación, ejercicio aeróbico, evaluación.

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ABSTRACT

Objective: The feeling scale (FS) and the felt arousal scale (FAS) are the most used instruments to assess affective valence and arousal, respectively. As such, this review aimed to analyze how the FS and/or the FAS have been used in continuous aerobic exercise. The primary focus was on the scales' application, including timing, number, and frequency of assessment. As a secondary focus, information regarding the sample size calculations of the studies, the exercise intensity domain, and the identification of an affective rebound was also collected. Method: This systematic review was conducted in accordance with the PRISMA guidelines. An extensive literature search was conducted (last search, August 2023) across four databases (i.e., PubMed, SPORTDiscus, B-on, and PsycINFO) and four repositories (i.e., clinicaltrials.gov, WHO ICTRP, OSF.io, and SportRxiv). In total, fifty-three studies published between 1995 and 2023 were included in the qualitative analysis. Results: Results suggest that both scales can be used in continuous aerobic activities. Variations in time points, number, and frequency of measurements highlighted a high level of heterogeneity. The moderate intensity domain presented the highest scores on affective valence; additionally, an affective rebound was present in all intensities, and a delay in this rebound was detected in most domains. Conclusion: Improvement of the scales' methodological and contextual application is needed to reduce heterogeneity and enhance the interpretation of the role of affective responses on exercise motivation and adherence.

Keywords: affect, feeling, arousal, aerobic exercise, assessment.

RESUMO

Objetivo: A Feeling Scale (FS) e a Felt Arousal Scale (FAS) são os instrumentos mais utilizados para avaliar a valência afetiva e a ativação, respetivamente. Assim, esta revisão teve como objetivo analisar de que forma a FS e/ou a FAS têm sido utilizadas no exercício aeróbio contínuo. O foco principal incidiu na aplicação das escalas, incluindo o momento, o número e a frequência de avaliação. Como foco secundário, foi também recolhida informação relativa ao cálculo do tamanho da amostra dos estudos, ao domínio de intensidade do exercício e à identificação de um rebound afetivo. Método: Esta revisão sistemática foi conduzida de acordo com as orientações PRISMA. Foi realizada uma pesquisa extensiva da literatura (última pesquisa em agosto de 2023) em quatro bases de dados (i.e., PubMed, SPORTDiscus, B-on e PsycINFO) e quatro repositórios (i.e., clinicaltrials.gov, WHO ICTRP, OSF.io e SportRxiv). No total, cinquenta e três estudos publicados entre 1995 e 2023 foram incluídos na análise qualitativa. Resultados: Os resultados sugerem que ambas as escalas podem ser utilizadas em atividades aeróbias contínuas. As variações nos momentos, no número e na frequência das medições evidenciaram um elevado nível de heterogeneidade. O domínio de intensidade moderada apresentou os valores mais elevados de valência afetiva; adicionalmente, verificou-se a presença de um rebound afetivo em todas as intensidades, tendo sido detetado um atraso neste rebound na maioria dos domínios. Conclusão: É necessária uma melhoria na aplicação metodológica e contextual das escalas para reduzir a heterogeneidade e melhorar a interpretação do papel das respostas afetivas na motivação e adesão ao exercício.

Palavras-chave: afeto, sentimento, ativação, exercício aeróbio, avaliação.

INTRODUCTION

Regular physical activity (PA) and exercise are consistently recognized as essential components of a healthy lifestyle. PA contributes to a wide range of physical and psychological well-being factors (Peña-Muñante et al., 2025; Sánchez-Betancourt et al., 2025), including the promotion of cardiovascular health and positive mood, as well as the alleviation of stress (American College of Sports Medicine, 2022; Warburton, 2006). Known to improve aerobic capacity and contribute to overall physical fitness, aerobic exercise can be defined as a sustained form of PA involving rhythmic movements that engage large muscle groups to increase heart rate and oxygen consumption (Garber et al., 2011; Mersy, 1991; Patel et al., 2017).

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Despite the extensive evidence base demonstrating the vast benefits to be derived from regular PA, most of the world's population does not meet the World Health Organization's minimum recommendations (Santos et al., 2023). For example, 81% of adolescents and 27.5% of adults do not meet the recommendations for aerobic exercise (Bull et al., 2020). A common explanation for these levels of physical inactivity relates to individuals' lack of motivation and/or interest to engage in exercise (European Commission, 2022; Kahn et al., 2002; Standage et al., 2012). Although being a widely studied topic over the last decades, the globally low levels of PA identifies the need for a deeper and different examination of the approaches used for promotion of exercise behaviours (Rodrigues et al., 2023; Yuan et al., 2024; Zarazaga-Peláez et al., 2024).

Understanding the role of affect in exercise motivation

Several theories and frameworks of human behavior have been advanced in attempts to understand what drives people to initiate and maintain exercise behavior. Particularly regarding motivation, several advances were made in the last decades. For example, Self-Determination Theory (SDT; Deci & Ryan, 1985) has been widely studied in the context of physical activity and has demonstrated utility in explaining variability in exercise motivation and adherence (Deci & Ryan, 2008). Other frameworks, such as the Theory of Planned Behavior (TPB; Ajzen, 1991) or Social Cognitive Theory (SCT; Bandura, 1998), have also been used in exercise contexts aiming to comprehend the complexities of individual motivation and adherence. Despite presenting several advancements on the comprehension of the topic, researchers have indicated that these theoretical approaches are heavily underpinned by cognitive and reasoned factors and fail to acknowledge non-conscious regulatory processes that can also dictate future behavior (Addoh et al., 2020; Albarracin et al., 2024; Ekkekakis & Lind, 2006; Ekkekakis & Zenko, 2016; Kolias & Pliafa, 2022; Rebar et al., 2016). Based on the hedonic principle (i.e., people tend to engage in pleasurable activities and avoid the ones that cause displeasure; Andrade et al., 2024; Da Silva et al., 2025; Zhang, 2025), other theories and frameworks such as the Affect and Health Behavior Framework (ABHF; Stevens et al., 2020; Williams & Evans, 2014), the Affective-Reflective Theory (ART; Brand & Ekkekakis, 2018), the Physical Activity Adoption and Maintenance Model (PAAM; Strobach et al., 2020), and the Theory of Effort Minimization in Physical Activity (TEMPA; Cheval & Boisgontier, 2021) have been forwarded in attempts to elucidate PA behaviour. The AHBF, for example, outlines the interconnectedness between core affect (i.e., basic/primary non-reflective, consciously accessible feelings) and health behaviors; it emphasizes the influence of affective experiences on one's attitudes, motivations, and adherence to health-related practices (Addoh et al., 2020; Borges & Souza, 2026; Huang & Wong, 2025; Williams & Evans, 2014).

It also warrants noting that increasing awareness of the use of non-cognitivist models is emerging within exercise guidelines, wherein the affective response has been highlighted as being particularly important (e.g., affect regulation and dual process theory; (ACSM, 2022; p. 455). On this matter, the core affective response characterizes how one feels during exercise and plays a crucial role not only in shaping the individual's experience but also as a determinant of that behavior (Brand & Ekkekakis, 2018; Stevens et al., 2020). This evaluation can only be experienced *in vivo* and thus it should be measured during (or immediately after) the activity (Stevens et al., 2020). However, despite suggestions to capture the affective panorama during exercise (ACSM, 2022), no recommendations have been forwarded regarding *how* to apply the instruments (in comparison, for example, with the method described for measuring somatic symptoms using the Borg RPE scale; see Borg, 1998), at what moments of the session/activity measurement should take place (e.g., *when*; exclusively during the activity? Immediately after?), or *how often* (i.e., what are the adequate intervals for data collection during exercise assessments?) leaving professionals and researchers with a considerable gap in operational knowledge.

Literature indicates that core affect is a construct that encompasses affective valence (i.e., pleasure-displeasure) and activation (i.e., arousal-calmness; (Russell, 1980). The valence dimension is linked to the hedonic part of the experience, and activation represents the level of induced psychological arousal (Ekkekakis, 2003; Williams, 2008). Additionally, the relation between these two dimensions during exercise (as plotted, for example, in the circumplex model of affect), can be used for a better understanding of exercise behavior and adherence, as well as overall well-being (Ekkekakis & Petruzzello, 2002; Kolias & Pliafa, 2022; Rhodes & Kates, 2015; Stevens et al., 2020).

The outcomes of research over the past decades have nonetheless contributed substantially to the interpretation and potential use of affective response in exercise motivation (e.g., Ekkekakis et al., 2011; Ekkekakis & Petruzzello, 2002; Williams & Rhodes, 2023). Numerous studies have investigated how one perceives and responds to several exercise-related activities focusing on affective valence and arousal assessed with the feeling scale (FS; Hardy & Rejeski, 1989) and the felt arousal scale (FAS; Svebak & Murgatroyd, 1985) and significant contributions to the understanding of the relationships between exercise intensity, duration, and affective responses have been realized (e.g., Ekkekakis et al., 2008; Evmenenko & Teixeira, 2022; Kilpatrick et al., 2007; Welch et al., 2007). Although other instruments can be used to assess affective responses (e.g., Activation Deactivation Adjective Check List; Thayer, 1989; Self-Assessment Manikin; Bradley & Lang, 1994; Exercise-induced Feeling inventory; Gauvin & Rejeski, 1993), these scales (i.e., FS and FAS) are the most widely used (Evmenenko & Teixeira, 2022).

Despite their widespread use, the aforementioned methodological limitations related to the instruments contextual application and interpretation have limited understanding of affective responses to exercise (Bastos et al., 2023; Ekkekakis et al., 2023; Evmenenko & Teixeira, 2022; Henriques & Teixeira, 2023; Williams & Rhodes, 2023). Moreover, other considerations can also be made regarding how the scores are obtained (e.g., asked verbally? Presented visually?), the training of professionals/researchers to apply the scales, and the familiarization of the exercisers/research participants with these instruments. As such, all these factors can undermine the collection of sensitive data the scales are attempting to measure (Ekkekakis, 2013; Evmenenko & Teixeira, 2022; Henriques & Teixeira, 2023). The sum of these limitations (i.e., theoretical background heavily grounded on cognitivist assumptions; hedonic-based theory emerging research) preclude systematic interventions targeting core affect in exercise prescription; further, some measurement flaws (e.g., derived from the absence of methodological guidelines) undermine evaluation of treatment efficacy and inhibit wider use as well as the generalizability of study findings.

Current study

Understanding the complex relationship between affective responses and exercise behavior may have important implications for exercise adherence. Therefore, developing evidence-based exercise programs considering the nuances of affective valence and arousal during and post-exercise can lead to more effective public health interventions, as the optimization of how people feel while they exercise can enhance adherence rates (Teixeira et al., 2024; Williams, 2008). At present, there is concern regarding the number (i.e., how many times per session) and timing (i.e., when) of assessments using the FS and the FAS to measure affective valence and arousal, respectively (Evmenenko & Teixeira, 2022). Additionally, other considerations relating to the mode of exercise (e.g., intensity; duration of the session) may influence the interpretation of the instruments' results (Zenko & Ladwig, 2021). Although these concerns have been examined within the exercise contexts of stretching activities (Henriques & Teixeira, 2023), resistance training (Bastos et al., 2023), and high-intensity interval training (Ekkekakis et al., 2023), a gap remains to be explored for studies that have involved continuous aerobic activities.

A systematic review by Ekkekakis and colleagues (Ekkekakis et al., 2011) exploring continuous aerobic exercise in addition to other modes of exercise (e.g., high-intensity short duration) reported some aspects of measurement time points; however, the focus of their study was the relationship between varying exercise intensity and affective responses. A review by Niven and colleagues (Niven et al., 2018) also examined affective responses to high intensity interval exercise, moderate to vigorous continuous training, and vigorous intensity continuous training, but had limited consideration of the range of timing of assessment. Moreover, their study was focused on comparisons of affective response across exercise intensity conditions. In both reviews, although the measurement time-point data was collected, no further analysis or consideration of approaches to measurement was undertaken. In respect of the substantial body of research that has been developed in the time that has elapsed since the review by Ekkekakis and colleagues (Ekkekakis et al., 2011), as well as considering the critical methodological factors relating to a lack of operational recommendations for the scales application and interpretation, a focused review of FS/FAS timing and frequency of measurement in continuous aerobic activities is warranted.

It also merits highlighting that improvements in research design and measurement can advance the exploration of other affective-relevant variables. Particularly in aerobic activities, it is well-known and extensively reported that an improvement in the affective response after exercise termination, commonly designated as affective rebound, is present within all intensities of exercise (Ekkekakis et al., 2011). However, a lack of certainty exists regarding the specific time points to consider when assessing this rebound (Dierkes et al., 2021), as different end-session and/or post-exercise assessment time points could reflect distinct magnitudes of rebound within the same workout. Moreover, elucidating the affective rebound phenomenon may promote understanding of other affect-relevant phenomena, for example end-session affect. As postulated by the "peak and end" rule (Fredrickson, 2000) and later supported in subsequent studies (e.g., Alves et al., 2021; Zenko et al., 2016) and contexts (Alaybek et al., 2022), the effect of the peak (i.e., highest negative and/or highest positive peak affective scores during a session) and end (i.e., final moments proximal to completion) affect associated with an exercise session have been proposed to influence factors underpinning exercise adherence (e.g., remembered affect; Hargreaves & Stych, 2013; enjoyment; Zenko et al., 2016). When aiming to enhance motivation through positive affect regulation, knowing when to capture the session's final affective response (i.e., end affect) and how to organize that training section (i.e., end of fundamental phase; cool-down phase intensity and duration) becomes of paramount importance. Currently, knowledge regarding how exercise intensity, end-session affect, and the affective rebound magnitude can be interpreted in continuous aerobic activities remains elusive.

In consideration of the issues presented, the aim of this systematic review is to analyze how the FS and/or the FAS have been used to assess affective valence and arousal in continuous aerobic exercise. In addressing the primary interest, we will focus on characteristics of the applications of the scales; specifically, the timing, number, and frequency of assessment, as well as both the researchers' and study participants' prior training with the instruments. As a secondary focus, we will review information regarding studies' sample size calculations and exercise intensity, as well as the identification and interpretation of potentially relevant time points associated with affective rebound.

METHOD

This study followed a qualitative systematic review design (Grant & Booth, 2009; Munn et al., 2018), conducted and reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) statement (Page et al., 2021). The review protocol was registered in PROSPERO (CRD42023395919).

Eligibility criteria

The systematic review question was formulated using the PICO framework (Population, Intervention, Comparison, Outcome). Accordingly, the Population of interest comprised apparently healthy adults (≥ 18 years old). The Intervention (or context) was continuous aerobic exercise in non-competitive settings. No specific Comparator was required, therefore, studies without a comparison group or with different exercise conditions (e.g., varying intensity levels) were eligible. The Outcomes of interest were affective valence and arousal, measured by the FS and the FAS, respectively.

The inclusion criteria for this review were: (1) experimental and non-experimental studies; (2) grey literature; (3) written in English; (4) individuals aged ≥ 18 years; (5) use of the feeling scale and/or felt arousal scale applied to continuous aerobic exercise (i.e., a bout of PA performed continuously without resting periods); (6) any expression of intensity; (7) apparently healthy individuals; and (8) physical activity settings using individual or group classes. The exclusion criteria included: (1) evaluations performed in sport/competition contexts; (2) populations with injury; (3) populations with cancer, diabetes, hypertension, or cardiovascular disease; (4) psychological disorder/illness (e.g., clinical depression, bipolarity, Alzheimer); (5) instrument validation studies with no concurrent data; and (6) systematic reviews and meta-analysis. The choosing of apparently healthy individuals and exclusion of specific health or physical conditions pertains to the need to exclude pain or sensory-altering conditions that could influence the pleasure-displeasure response. Moreover, the exclusion of measurements takes during competition events relates to the exclusion of other factor limiting data collection (FS/FAS) and response bias (e.g., competitive anxiety, performance outcomes).

Information sources and search strategy

A comprehensive search of the literature was conducted from February 1, 2023 to August, 2023 on PubMed (host: MEDLINE), SportDISCUS (host: EBSCO), B-on (host: EBSCO), and PsycINFO (host: EBSCO) databases. Also, the following repositories were used: clinicaltrials.gov, WHO ICTRP, OSF.io, and SportRxiv. The last search was conducted on August 30th. It was made using the following terms: “exerciser”, “athlete”, “individual”, “trainee”, “aerobic exercise”, “aerobic training”, “endurance training”, “physical activity, “feeling scale”, “felt arousal scale”. The keywords were separately introduced for research using multiple combinations with the conjunctions “AND” and “OR”, organized according to the PICO search strategy, using the following search expression ((physical AND (exercise OR activity)) AND (feeling scale OR felt arousal scale) AND ((aerobic OR endurance) AND (training OR exercise))). An example of the PubMed query can be found in Appendix 2. Bibliographic references from several related studies were also examined to find potential studies that met the inclusion criteria.

Selection process

Two authors (Filipe Santos and Diogo Teixeira) conducted the article selection process independently, and disagreements were solved by discussion until complete agreement. A third author (Paul Davis) also participated in this discussion when a consensus was not initially found. Eligibility criteria were checked by reviewing all titles and abstracts in Level I study screening, followed by a full-text reading of all publications (Level II) that were not eliminated at the first level. This allowed the opportunity to confirm that eligibility criteria were met, and exclusion criteria were not applicable.

Data collection process and data items

As seen in Table 1, the following items were extracted from the included studies: (1) bibliographic information (i.e., authors and year of publication), (2) location (i.e., country of research), (3) study design, (4) sample size, (5) sample characteristics, (6) intervention, (7) measures and measurement frequency, (8) statistical analysis (9) outcomes, and (10) risk of bias. Data extraction was performed by one author using a standardised Excel spreadsheet and was subsequently verified independently by a second author, with any discrepancies resolved by discussion until consensus was reached. A summary of the samples’ characteristics and timings of assessments was created and presented in Table 2, depicting the following items: (1) sample size, (2) sex, (3) location, (4) age, (5) sample size calculations, (6) instruments applied, and (7) timing of application. A comprehensive analysis of the use of the scales and the affective changes after exercise was conducted and presented in Table 3, depicting: (1) author(s), (2) prior training with the instruments, (3) presentation of scales (i.e., material and size), (4) number of assessments, (5) protocol intensity description, (6) intensity domain at the last FS/FAS during exercise/session assessment, (7) which assessment points were potentially relevant for interpretation of affective changes (i.e., from during- to post-exercise assessments), (8) comparison between the last FS/FAS intra-exercise measurement(s) and all post-exercise moments, and (9) post-exercise affective rebound.

Materials and instruments

The two instruments under analysis in this review were the Feeling Scale (FS) and the Felt Arousal Scale (FAS), both grounded in Russell's (1980) circumplex model of affect. The FS (Hardy & Rejeski, 1989) is a single-item, 11-point bipolar measure of affective valence, ranging from −5 ("very bad") to +5 ("very good"), used to assess the pleasure–displeasure dimension of core affect. The FAS (Svebak & Murgatroyd, 1985) is a single-item, 6-point measure of perceived activation, ranging from 1 ("low arousal") to 6 ("high arousal"). Both are widely used in exercise settings due to their brevity and suitability for repeated, real-time assessment during physical activity (Ekkekakis, 2003).

For data management, a standardized data-extraction form was used to chart the variables of interest from each included study (see Table 1). Methodological quality was appraised using design-specific risk-of-bias instruments, the Cochrane Risk of Bias 2 (RoB2) tool for randomized and crossover trials, and the ROBINS-I tool for non-randomized (quasi-experimental) studies, described in detail in the following subsection.

Study risk of bias assessment

To assess the risk of bias in primary studies, the Cochrane Collaboration (Risk of Bias 2) tool was used to evaluate the risk of bias in randomized trials. This tool allows a domain-based assessment in which critical estimates are made separately for: (1) randomization process, (2) deviation from intended interventions, (3) missing outcome data, (4) measurement of outcome, (5) selection of reported results, and (6) overall bias. The judgment for each entry involves assessing the risk of bias as "low risk", "some concern", or "high risk". For crossover trials, an extension of the referred tool was used, and the domains assessed were the same, plus the addition of the "bias arising from period and carryover effects" domain. Additionally, the tool "Risk of Bias in Non-randomized Studies of Interventions (ROBINS-I)" was used to assess the risk of bias in quasi-experimental studies. Using this instrument, a score (i.e., "low risk", "moderate risk", "serious risk", "critical risk", or "no information") was given to each domain (i.e., "confounding", "selection of participants into the study", "classification of interventions", "deviations from intended intervention", "missing data", "measurement of outcomes", and "selection of the reported result"). Two researchers (one author; Filipe Santos) and one external invited researcher Vasco Bastos), both trained in the use of these tools, independently analyzed the included studies, and all disagreements were consensually resolved. If any disagreement persisted, the discrepancies were resolved by a third reviewer (Diogo Teixeira). Of note, we clarify that study design classifications were made according to the definitions proposed by these instruments rather than the ones presented in the studies. The selection of RoB2 and ROBINS-I follows the guidance of the Cochrane Handbook (Higgins et al., 2022). These instruments were selected as the most current and design-appropriate options, jointly covering all included designs (randomized, crossover, and quasi-experimental), thereby ensuring clarity and methodological rigor in the appraisal.

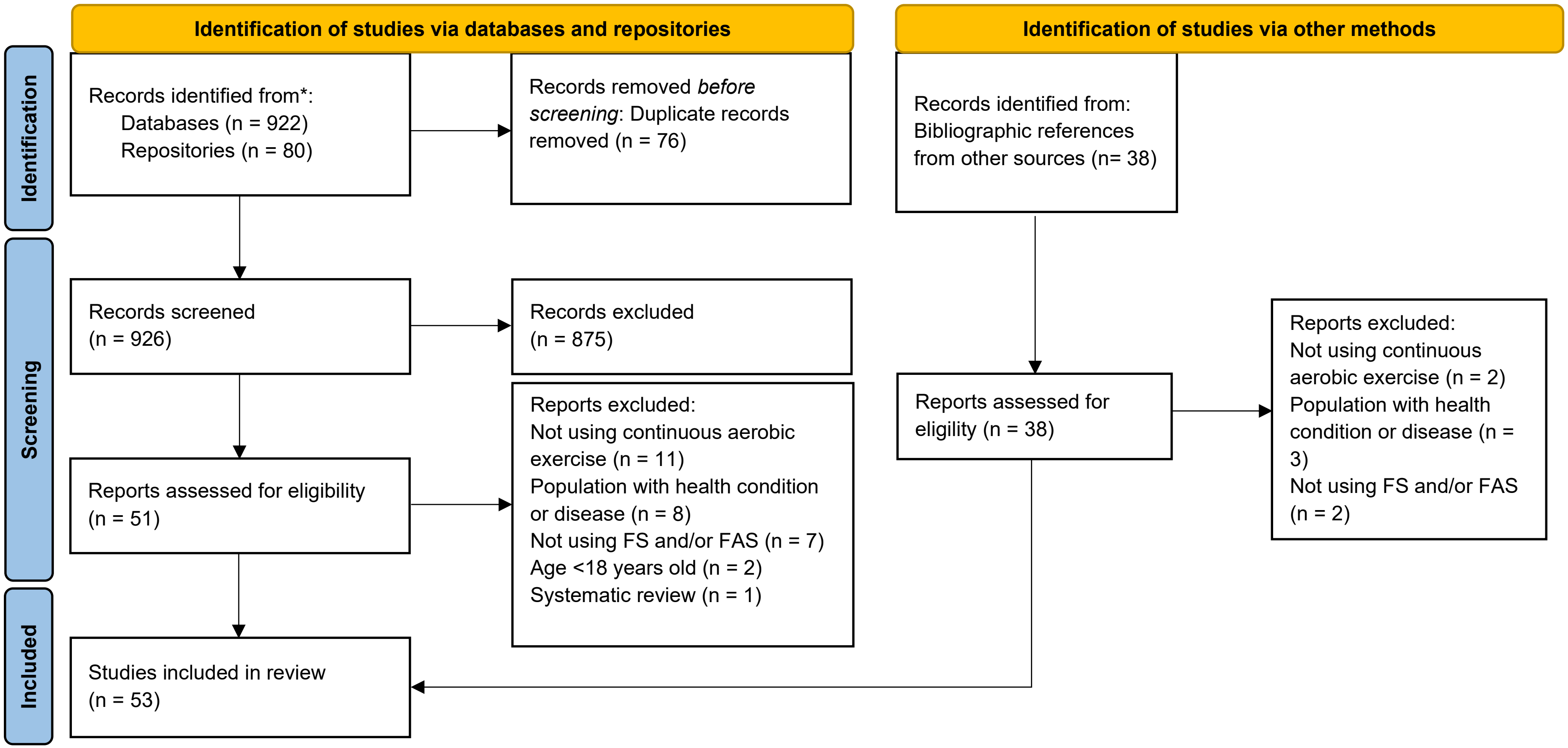
RESULTS

Study selection

As reported in the study's flow chart (Fig 1), a total of 1002 titles were identified from the initial search; whilst some were found from a database search (n = 922) others were found via a search of repositories (n = 80). Through a process of examining bibliographic references and citations from other sources, an additional 38 apparently relevant studies were identified and increased the total number of titles to 1040. After removal of duplicates, 926 titles and abstracts (Level I) and 89 full-text articles (Level II) were screened. Following the full-text review, 13 studies were excluded due to not including continuous aerobic exercise (Acevedo et al., 2003; Alves et al., 2021; da Silva Machado et al., 2019; Evangelista et al., 2017; Farias-Junior et al., 2020; Fessi et al., 2016; Frazão et al., 2016; Haines et al., 2020; Karageorghis et al., 2019; Kucera et al., 2023; Lacharité-Lemieux et al., 2015; B. Oliveira et al., 2022; Silva et al., 2023), an additional 11 studies were excluded because the study population possessed a type of health condition (e.g., obesity, hypertension, depression; Bottoms et al., 2019; Brdareski et al., 2012; Costa et al., 2015; Decker & Ekkekakis, 2017; Freitas et al., 2015; Gerber et al., 2018; Ivanova et al., 2022; Marillier et al., 2022; Moreira et al., 2022; G. Oliveira et al., 2023; Sócrates et al., 2020), nine studies were excluded for not using the FS and/or the FAS (Bratland-Sanda et al., 2022; Edwards & Loprinzi, 2019; Handa et al., 2016; Liu et al., 2023; Nithyanisha et al., 2019; Nogueira et al., 2019; Parfitt et al., 2000; Saanijoki et al., 2015; Wang et al., 2021), two studies were excluded due to the study populations including participants under 18 years of age (Malik et al., 2018; Schneider & Graham, 2009), and one study was excluded because it was a systematic review (Tavares et al., 2021). Consequently, 53 papers were included in the present systematic literature review.

Figure 1

Studies flow chart.



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Study summaries

The 53 empirical studies (published or accepted for publication) that used the FS or FAS in continuous aerobic exercise were evaluated; a synthesis of the data extracted from the studies is presented in alphabetical order in Table 1.

Study characteristics

The composite sample used for this review totaled 1384 apparently healthy individuals, predominantly female (n = 821; 59%). The descriptive data of all 53 papers is presented in Table 1, indicating that all the studies used experimental settings for data collection. Specifically, the studies were quasi-experimental (n = 48), experimental cross-over designs (n = 4), and two randomized control trials. Regarding the exercise protocols applied in the studies, the continuous aerobic exercise sessions were performed in different settings such as walking/running on a treadmill indoors (n = 28), outdoor walking/running (n = 3), indoor vs. outdoor walking/running (n = 4), running on an indoor athletics track (n = 1), and exercise using cycle ergometer (n = 17).

Most of the studies (n = 32) used both scales (i.e., FS and FAS), but 21 of them reported using only the FS. None of the included studies used the FAS independent of the FS.
The presentation of Table 3 is intended to elucidate potentially relevant factors and timing of the assessments for interpretation of changes in affective response. As such, the information extracted depicts the mode of presentation of the scales, the total number of measurements, the protocol intensity description and intensity categorization (Binder et al., 2008), as well as the time point assessments relevant for affective changes which could facilitate identification and interpretation of an affective rebound following exercise. This table includes all studies even though some did not report post-exercise measurements. In those cases, the last three columns present the text "N/A" (not applicable).

Table 1

General descriptive characteristics and outcomes.

Author (s)	Location	Design	Size (%F)	Features (age M±SD)	Intervention	Measures and measurement frequency	Analysis	Outcomes
Ali et al. (2017)	New Zealand	Quasi-experimental	9 (0)	32.7 ± 13.0	4 trials (7 days apart); each trial had two cycling sessions: one 30-min at ~70% peak VO_2 with short sprints + 45 min continuous, the other a 1-h time trial.	FS and FAS measured periodically throughout exercise (every 25% of session completed).	RM ANOVA; Mauchly's test; Huynh-Feldt corrections; post-hoc Student's t-test using Holm-Bonferroni adjustment	No significant differences in affective responses (FS, FAS) between trials.
Alicea et al. (2020)	USA	Quasi-experimental	12 (100)	22.3 ± 1.8	Continuous treadmill exercise (~80% VO_2max) matched in intensity and duration to a prior HIIT session.	FS and FAS measured before exercise, every 2 min during (last 10 s of each interval), and at 2, 5, 10 min post-exercise.	RM ANOVA; Cohen's *d*	No differences in affective responses between continuous and HIIT (similar responses).
Alvarez-Alvarado et al. (2019)	USA	Quasi-experimental	30 (0)	23.1 ± 3.36	Continuous incremental cycling test to exhaustion (starting at low load with frequent increments).	FS and FAS measured every minute during the test, at exhaustion, and 2 and 4 min post-exercise.	RM ANOVA; Geisser-Greenhouse non-sphericity adjustment	Affective responses increased up to the ventilatory threshold (VT) and decreased after surpassing it.
Barnett (2013)	Australia	Quasi-experimental	50 (100)	37.8 ± 18.1	One 20-min continuous cycling session at ~60% VO_2max.	FS and FAS measured immediately before, halfway through, and immediately after exercise.	RM ANOVA	Affective valence and activation (FS, FAS) were higher immediately post-exercise compared to before and mid-exercise.
Batista et al. (2019)	Spain	Quasi-experimental	30 (100)	59.3 ± 6.1	Two 20-min outdoor run/walk sessions (48 h apart): one at self-selected intensity, the other at the same intensity but imposed by protocol.	FS measured before and every 5 min during exercise.	Shapiro-Wilk test; Levene test; RM ANOVA;	The self-selected intensity session elicited higher affective responses compared to the imposed-intensity session.
Bird et al. (2019)	UK	Quasi-experimental	18 (50)	24.17 ± 4.23	One 10-min cycling session at VT under five audiovisual conditions: music; video; music+video; 360° video; 360° video+music.	FS and FAS measured before, every 3 min during, and ~2, 5, 8 min post-exercise (during rest).	RM ANOVA	Affective response was most positive in the 360° video+music condition compared to the other conditions.

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Author (s)	Location	Design	Size (%F)	Features (age M±SD)	Intervention	Measures and measurement frequency	Analysis	Outcomes
Boukabous et al. (2019)	USA	Quasi-experimental	18 (100)	HITT group: 66.0 ± 3.4; MICT group: 64.2 ± 3.7	8-week treadmill programme (3 sessions/week) comparing HIIT vs. MICT. HIIT: 1-min intervals at ~90% HRR with 2-min active recovery; MICT: 45-min continuous at ~55% HRR (with warm-up and cool-down).	FS and FAS measured pre-exercise, immediately post, and at 2 and 5 min into recovery.	Shapiro-Wilk test; RM ANOVA	Affective responses did not differ between high-intensity interval (HIIT) and moderate-intensity continuous (MICT) training.
Brownley et al. (1995)	USA	Quasi-experimental	16 (75)	23.5 ± 4.5	Graded treadmill walk/run: 3 × 10-min stages (low, moderate, high intensity) with music conditions (no, sedative, fast) and trained vs. untrained groups.	FS measured near the end of each stage (~10, 20, 30 min).	RM ANOVA; Tukey post-hoc comparisons	No significant main effect of training status on affect; only a trend for a music × group × intensity interaction was observed (untrained showed more positive affect with fast music).
Cox et al. (2018)	USA	Quasi-experimental	23 (83)	19.26 ± 1.14	Two 10-min walk/run sessions (~65% HRR, 3-min warm-up and 3-min cool-down): one control vs. one with mindfulness (focused attention).	FS measured before, at 4 and 8 min during, and at 3 and 5 min into recovery.	RM MANOVA	Affective response was more positive in the mindfulness condition compared to control.
Cuttell et al. (2016)	UK	Quasi-experimental	8 (0)	24.0 ± 4.0	Five cycle ergometer sessions: 1 incremental test (max power), 1 familiarisation, 3 trials to voluntary exhaustion (with vs. without body cooling).	FS measured every 5 min during exercise and at exhaustion.	RM ANOVA; Friedman ANOVA; Wilcoxon signed-rank tests; paired-samples t-test	Cooling did not change affective response; affect scores declined progressively over time during exercise in all conditions.
Dasilva et al. (2011)	Brazil	Quasi-experimental	34 (50)	23.4 ± 3.0	Two 20-min self-paced walking sessions; environments: treadmill vs. outdoor track.	FS measured every 5 min during exercise.	RM ANOVA	Affective response was more positive during the outdoor track session compared to the treadmill.

Author (s)	Location	Design	Size (%F)	Features (age M±SD)	Intervention	Measures and measurement frequency	Analysis	Outcomes
De Brito Farias et al. (2018)	Brazil	Quasi-experimental	15 (73)	65.4 ± 5.1	Five 30-min walking sessions (5-min warm-up, 20-min walk, 5-min cool-down) in 3 environments: indoor gym ('indoor'), outdoor track ('green'), and beach ('blue').	FS measured every 5 min during exercise.	Shapiro-Wilk test; Friedman test; two-way RM ANOVA;	Affective responses were similar across all three environments (no significant differences across indoor, 'green', or 'blue' settings).
Dierkes et al. (2021)	Germany	Cross-over	40 (72)	27 ± 6	Two continuous cycling sessions: Moderate (~60 min at ~90% LT1) and Vigorous (~50 min between LT1 and LT2, with 10-min warm-up).	FS measured pre-exercise, ~14 and 30 min during, and 5 min post (after cool-down).	Pairwise *post hoc* comparisons; Levene's test	Moderate exercise showed a slight increase in affect from pre to post; vigorous exercise showed a decline during, with an immediate affective "rebound" after stopping.
Dierkes et al. (2023)	Germany	Cross-over	40 (72)	27 ± 6	Three sessions of vigorous-intensity continuous exercise (VICE) on ergometer, each with 10-min warm-up + 50 min vigorous continuous intensity.	FS measured before exercise and every 10 min during the continuous effort.	Intraclass correlation coefficients; within and between person variability Violin plots	Affective responses were more positive when vigorous exercise followed a moderate continuous and interval training programme (MICT–HIIT), compared to other sequences.
Edwards et al. (2018)	USA	Randomized Control Trial	Walking group: 21 (67); Meditating group: 21 (62); Stretching (control) group: 21 (57)	Walking group: 21.24 ± 2.17; Meditating group: 21.29 ± 2.10; Stretching (control) group: 21.52 ± 1.75	Participants in 3 groups (10-min activity): stretching (control); treadmill walking; meditation.	FS and FAS measured pre-activity (all); additionally at 5 min (stretching & walking); and immediately post (all groups).	RM ANOVA; chi-square tests;	Affective valence (FS) increased from pre- to post-activity in all groups (significant in stretching & walking); arousal (FAS) increased overall, significantly only in the walking group.

Author (s)	Location	Design	Size (%F)	Features (age M±SD)	Intervention	Measures and measurement frequency	Analysis	Outcomes
Ekkekakis et al. (2004)	USA	Quasi-experimental	Group A - 30 (43); Group B - 30 (47)	Group A - Female (22.8 ± 3.0), Male (24.4 ± 4.1; Goup B - Female (21.2 ± 2.0), Male (21.5 ± 2.45)	Incremental treadmill run to VT, comparing progression protocols: Group A (rapid increments) vs. Group B (gradual increments).	FS and FAS measured at 1 and 2 min, immediately pre-VT, at VT, 1 and 2 min post-VT, and at final & pre-final exercise moments.	RM ANOVA; Green-house-Geisser correction; Pairwise comparisons; Bonferroni correction	Group A: no significant affect change from start to VT; Group B: significant affect decline over same period. After VT, both groups had similar affective response patterns.
Ekkekakis et al. (2008)	USA	Quasi-experimental	30 (47)	Female (21.21 ± 2.04); Male (21.50 ± 2.45)	Three 15-min treadmill runs: below, at, and above VT (random order).	FS and FAS measured pre-exercise, every 3 min during (last 15 s of each 3-min block), and at 5, 10, 20 min post-exercise.	RM ANOVA	Intensity did not affect improvements in affect from pre- to post-exercise (all positive); however, above-VT exercise caused significant declines in affect during activity.
Ekkekakis et al. (2010)	USA	Quasi-experimental	17 (100)	43.67 ± 4.24	Maximal incremental treadmill test to exhaustion.	FS measured continuously during exercise (frequent assessments until exhaustion).	ANOVA; Correlations	FS scores began to drop at VT and continued declining until exercise cessation (lowest at exhaustion).
Focht (2009)	USA	Quasi-experimental	35 (100)	22.1 ± 1.7	Two 10-min self-paced walks; settings: treadmill vs. outdoor.	FS and FAS measured pre-exercise, at 5 min, immediately post, and 10 min post each session.	RM ANOVA	Affective responses improved in both sessions; however, scores were higher during the outdoor walk compared to the treadmill.
Giles et al. (2018)	USA	Quasi-experimental	24 (63)	25.0 ± 4.3	Three 90-min treadmill runs at ~75–85% HRmax (age-adjusted).	FS and FAS measured pre-exercise, at 30, 60, 90 min during, and immediately post each session.	RM ANOVA; Greenhouse-Geisser corrections; Bonferroni correction; t-tests	Affective response was more positive post-run than pre-run, but did not improve during the prolonged exercise.

Author (s)	Location	Design	Size (%F)	Features (age M±SD)	Intervention	Measures and measurement frequency	Analysis	Outcomes
Gillman & Bryan (2016)	USA	Quasi-experimental	28 (54)	25.1 ± 5.7	One 30-min treadmill run at VT intensity (with experimental manipulation).	FS and FAS measured every 5 min during exercise.	Between-subject factor ANOVA and within-subject factor ANOVA	No significant effect of the experimental condition on affective valence or activation.
Gillman & Bryan (2020)	USA	Quasi-experimental	78 (74)	26.8 ± 6.6	One 30-min treadmill run at VT intensity under different mental focus conditions (mindfulness, distraction, etc.).	FS and FAS measured every 10 min during exercise.	Mixed effects model	Affective responses were more positive under mindfulness and distraction conditions compared to control.
Glen et al. (2017)	Australia	Quasi-experimental	20 (80)	24.2 ± 5.9	Three 15-min sessions on recumbent cycle; conditions: control, virtual track, interactive exergame.	FS measured every 3 min during exercise.	RM ANOVA	Affective responses were more positive during the exergame conditions (virtual track and game) compared to control.
Hall et al. (2002)	USA	Quasi-experimental	30 (43)	23.9 ± 3.6	Incremental treadmill exercise to exhaustion: 2-min stage increments until volitional max.	FS and FAS measured pre-exercise, every min during, immediately post-cool-down, and 10 and 20 min post-exercise.	RM MANOVA	Affect increased significantly from baseline at all post-exercise time points; arousal (FAS) decreased significantly at 10 and 20 min post compared to baseline and immediate post.
Heinrich et al. (2020)	USA	Cross-over	7 (71)	20.6 ± 3.2	One 30-min continuous cycling session at ~50–70% HRmax.	FS and FAS measured pre-exercise (pre-warm-up), at 10, 20, 30 min (end), and after cool-down.	RM MANOVA; Bonferroni post hoc adjustment	Increases in affective responses did not differ between exercise modalities (no modality-specific effect).

Author (s)	Location	Design	Size (%F)	Features (age M±SD)	Intervention	Measures and measurement frequency	Analysis	Outcomes
Hermand et al. (2019)	France	Quasi-experimental	13 (0)	21 ± 4	Four 10-km runs (flat course) at best effort, 4–7 days apart, under varying environmental conditions.	FS measured immediately before and after each 10-km run.	Kolmogorov-Smirnov test; RM ANOVA; Post hoc Student's t-test	Affective responses were lower at the end of the run compared to the start, and were not affected by different conditions.
Hutchinson & Karageorghis (2013)	USA	Quasi-experimental	34 (35)	19.2 ± 4,9	Three 11-min treadmill runs (2-min warm-up, 7-min run at 45%, 65%, 85% HRR, 2-min cool-down) under: motivational music, neutral music, or silence.	FS and FAS measured during running (at 2, 4, 6 min of the main run).	RM ANOVA; RM MANOVA	Affective responses were more positive with motivational music compared to neutral or no music.
Hutchinson et al. (2015)	USA	Quasi-experimental	24 (42)	21.3 ± 13.9	Six 15-min treadmill runs: 3 intensities (10% below, at, 10% above VT) × 3 conditions (music only, music+video, control).	FS and FAS measured pre-exercise, every 5 min during, and immediately post (timing not specified).	RM MANOVA; Greenhouse-Geisser adjustment; Bonferroni-adjusted pairwise-comparisons	Affective responses were more positive in the music+video condition (regardless of intensity) compared to the other conditions.
Jones et al. (2014)	USA	Quasi-experimental	38 (50)	21.1 ± 1.9	Two 10-min cycling sessions (~10% below VT and ~5% above VT, 2-min rest in between) under four conditions: music, video, music+video, control.	FS and FAS measured every 4 min during exercise and 2 min post each session.	MANOVA	Affective responses were more positive during and after exercise with music (alone or music+video) compared to control, irrespective of intensity.
Khcharem et al. (2021)	Tunisia	Quasi-experimental	13 (0)	21.3 ± 0.8	Two 3-km track runs, random order: one after placebo vs. one after caffeine (3 mg/kg), 7 days apart.	FS measured immediately before and after each 3-km run.	Paired t-test; ANOVA	Post-exercise affect decreased in both trials; however, the caffeine trial showed higher affect scores both before and after compared to placebo.
Kilpatrick et al. (2007)	USA	Quasi-experimental	37 (46)	23.9 ± 4.7	One moderate (30 min) and one high-intensity (~24 min, equal work) cycling session on ergometer.	FS and FAS measured pre-exercise, at ~20% intervals during, immediately post (after cool-down), and 15 min post.	RM ANOVA; Green-house-Geisser correction	High intensity led to less positive affective responses (lower pleasure/more discomfort) compared to moderate intensity.

Author (s)	Location	Design	Size (%F)	Features (age M±SD)	Intervention	Measures and measurement frequency	Analysis	Outcomes
Kilpatrick et al., (2015)	USA	Quasi-experimental	24 (50)	24 ± 4	Two 20-min cycling sessions: one ~20% below VT, one at VT (random order).	FS measured pre-exercise, every 4 min during, and at 2 min (end of cool-down) and 10 min post.	RM ANOVA	Affective responses were less positive during heavy exercise near VT than during more moderate intensity.
Niedermeier et al. (2017)	Austria	Cross-over	42 (48)	32.0 ± 3.6	Three conditions (~3 h each): mountain hiking (outdoor), treadmill walking (indoor lab), and sedentary control.	FS and FAS measured pre-activity, at ~65 min, ~135 min (rest), ~175 min, and immediately post each condition.	RM ANOVA	Compared to control, exercise induced significant increases in affect; the improvement was most pronounced in the outdoor hiking condition.
Niven et al. (2018)	Scotland	Quasi-experimental	12 (0)	25 ± 7	Two equal-work cycling sessions: MICE (moderate continuous, 30 min at ~85% VT) vs. HICE (high continuous, ~105% VT with shorter duration for equal work).	FS and FAS measured pre-exercise, post-warm-up, at every 20% of session time, and at 1, 5, 10, 15 min post.	Two-way RM ANOVA	Affective responses during HICE were less positive than during MICE (lower pleasure at higher intensity despite equal work).
Oliveira et al. (2012)	Brazil	Quasi-experimental	24 (50)	27.7 ± 7.6	Two treadmill exercise protocols (random order): one prescribed by VO_2max vs. one by habitual activity level.	FS measured every 5 min during exercise.	Two-way ANOVA	Affective responses were more positive by exercise end in the VO_2max-based protocol compared to the activity-level protocol.
Oliveira et al. (2013)	Brazil	Quasi-experimental	15 (0)	24.0 ± 4.0	Two treadmill sessions (random): HIIT vs. continuous (CT), matched for duration and total work.	FS and FAS measured 10 min pre, after each HIIT bout (and equivalent times during CT), and 5 min post each session.	Shapiro-Wilk test; paired t-test; two-way RM ANOVA;	Greater anaerobic involvement in HIIT led to more negative affective responses (lower valence/higher discomfort) vs. continuous exercise.

Author (s)	Location	Design	Size (%F)	Features (age M±SD)	Intervention	Measures and measurement frequency	Analysis	Outcomes
Oliveira et al. (2015)	Brazil	Quasi-experimental	17 (0)	31.0 ± 7.0	Three cycle ergometer sessions: 1 max incremental test (VO_2max); 1 session self-selected intensity; 1 session imposed at same intensity/duration.	FS and FAS measured 5 min pre, at intervals during, and at 0, 5, 15 min post.	Two-way RM ANOVA; Mauchly's sphericity test; Green-house-Geisser correction; paired t-test	At the same intensity/duration, the self-selected session did not yield better affective responses than the imposed session (no benefit from self-pacing).
Parfitt el al. (2006)	UK	Quasi-experimental	12 (0)	36.5 ± 10.5	20-min treadmill runs at 3 intensities: below lactate threshold, above threshold, and self-selected (random order).	FS and FAS measured pre-exercise, during last ~45 s of each 5-min block, and during last ~45 s of each 10-min block up to 30 min post.	RM ANOVA	During exercise, above-threshold intensity produced more negative affect than below-threshold or self-selected; post-exercise, responses converged with no differences between conditions.
Parfitt et al. (2012)	Australia	Randomized Control Trial	26 (73)	34.3 ± 13.0	8-week intervention: 3 × 30 min/week treadmill at RPE 13 ('somewhat hard'); control group no exercise.	FS measured every 5 min during training sessions (periodic affect checks).	Two-factor RM ANOVA	In maximal tests (pre vs. post intervention), the exercise group had increased affective responses at RPE 13, whereas the control group had a decrease over time.
Pessoa et al. (2022)	Brazil	Quasi-experimental	12 (50)	24.9 ± 3.0	Two 30-min pre-exercise conditions: (1) mental fatigue induction, (2) control (rest), each followed by a 20-min treadmill run at 40–59% HRR (≥2 days apart, counterbalanced).	FS measured immediately before exercise and every 2 min during the 20-min run.	t-test for paired samples; RM ANOVA	Pre-induced mental fatigue resulted in lower average affective responses during the run compared to the control condition.
Qin et al. (2017)	Hong Kong	Quasi-experimental	10 (0)	27.3 ± 1.4	Four 90-min treadmill runs at ~70% VO_2max (1–21 days apart; preceded by VO_2max test & familiarisation), each trial with different supplementation (e.g., CHO+protein vs. control).	FS and FAS measured every 15 min during each 90-min run.	Levene's t-test; RM ANOVA; simple effect analysis with Bonferroni post hoc; Bivariate Pearson' r	Co-ingestion of carbohydrate + protein (α-lactalbumin) improved affective responses during the 90-min run, compared to no supplementation.
Rose & Parfitt (2007)	New Zealand	Quasi-experimental	19 (100)	39.37 ± 10.29	Four 20-min treadmill runs: below lactate threshold, at threshold, above threshold, and self-selected (random order).	FS and FAS measured pre-exercise, at end of each 5-min segment during, immediately post-cool-down, and 10 and 20 min post.	Within-subjects doubly RM ANOVA; Green-house-Geisser correction	Affective responses were less positive during exercise above lactate threshold, and more positive in self-selected and below-threshold conditions.

Author (s)	Location	Design	Size (%F)	Features (age M±SD)	Intervention	Measures and measurement frequency	Analysis	Outcomes
Rose & Parfitt (2008)	New Zealand	Quasi-experimental	17 (100)	44.8 ± 8.9	Eight 30-min treadmill sessions (2/week), intensity guided by affect target: 4 sessions at FS = 3 ('good') and 4 sessions at FS = 1 ('fairly good').	FS measured before and 2 min after each session.	Within-subjects RM ANOVA; Green-house-Geisser correction	When aiming to feel 'good' (FS 3), participants chose lower intensity than when aiming for 'fairly good' (FS 1); both intensities were near the individual VT.
Rose & Parfitt (2012)	UK	Quasi-experimental	32 (100)	45.1 ± 10.1	Two 30-min treadmill sessions: one self-selected intensity vs. one prescribed at VT (random order).	FS and FAS measured pre-exercise, every 5 min during, and at 5 and 10 min post.	Mixed-model RMANOVA	In active women, affective responses were more positive when the self-selected session was done before the prescribed session, suggesting a benefit of initial preference.
Shin et al. (2014)	South Korea	Quasi-experimental	30 (0)	21.4 ± 1.6	One 20-min indoor track run at ~70–75% VO_2max.	FS measured before, every 5 min during, and at 5 and 10 min post-exercise.	Latent curve model analysis	Higher intrinsic motivation was associated with more positive affective responses during exercise.
Slawinska & Davis (2020)	UK	Quasi-experimental	46 (57)	39.64 ± 5.69	Two 20-min treadmill runs: one high intensity (above VT) and one low intensity (below VT), random order.	FS measured immediately before, every 5 min during, immediately after, and at 1, 5, 10, 15 min; 4h, 24h, 48h; 7d, 14d post.	Within-subjects RM ANOVA	Affective responses were more positive in the low-intensity condition vs. high-intensity, and this difference persisted in the immediate post-exercise period.
Stork et al. (2018)	Canada	Quasi-experimental	32 (63)	21.23 ± 3.81	One 45-min continuous cycling session at ~70–75% HRmax.	FS and FAS measured pre-exercise, every 5 min during (up to 40 min and at 42.5 min), immediately post, during cool-down, and at 3, 10, 20 min post.	Chi-squared tests; Friedman's ANOVA; Greenhouse-Geisser and Bonferroni corrections; Pearson's and Spearman's correlation coefficients	Affective responses during exercise ('in-task') predicted the number of subsequent moderate exercise sessions (higher pleasure → greater adherence).
Strohacker et al. (2017)	USA	Quasi-experimental	27 (70)	20.52 ± 4.30	Two 30-min treadmill runs: one imposed moderate (~70–75% HRmax) vs. one self-selected intensity.	FS and FAS measured pre-exercise, at the end of each 5-min block (last 10 s), and at exercise end.	Bivariate correlation; multiple regressions	Individuals' initial 'energy index' correlated with in-exercise affect (higher energy = more positive affect), but was not related to self-selected intensity.

Author (s)	Location	Design	Size (%F)	Features (age M±SD)	Intervention	Measures and measurement frequency	Analysis	Outcomes
Turner & Stevinson (2017)	UK	Quasi-experimental	22 (36)	33.0 ± 8.3	Two 6000-m runs: first 3000 m self-paced, final 3000 m maximal; in two environments: outdoor park ('green') vs. indoor gym.	FS and FAS measured before run, at 3000 m, 6000 m (end), and 10 min post-run.	Friedman two-way analysis of variance; Wilcoxon matched pairs *post hoc* tests; ANOVA	Affective responses decreased (non-significantly) from 3000 to 6000 m, but increased significantly 10 min after; arousal rose steadily from start to finish in both environments.
Tyler & Sunderland (2011)	UK	Quasi-experimental	8 (0)	26.0 ± 2.0	Four treadmill tests at ~70% VO_2max to exhaustion: 2 familiarisation; 2 experimental (with vs. without cooling neck collar).	FS measured every 5 min during exercise and at exhaustion.	Two-way ANOVA	Exhaustion was reached with similar perceived effort, thermal sensation, and affective responses in both collar and no-collar conditions (no differences).
Vazou-Ekkekakis & Ekkekakis (2009)	Greece	Quasi-experimental	19 (100)	21 ± 2	Two 30-min treadmill sessions: one self-selected intensity vs. one imposed (same intensity) (random order).	FS measured pre-exercise and every 5 min during.	ANOVA	Imposing intensity (removing autonomy) led to less positive affect (lower pleasure) compared to the equivalent self-selected session.
Welch et al. (2007)	USA	Quasi-experimental	20 (100)	23.2 ± 4.38	Maximal incremental cycling test to exhaustion (limit of tolerance).	FS and FAS measured pre-exercise, every min during, and at 0, 5, 10, 20 min post.	RM ANOVA	Affective responses improved from baseline by 10 min post-exercise rest; during exercise, affect declined significantly from min 1 to pre-VT, and continued to fall until exhaustion.
Welch et al. (2010)	USA	Quasi-experimental	24 (100)	23.0 ± 4.6	Two 30-min cycling sessions at ~90% VT: one self-paced vs. one imposed (same intensity, random order).	FS measured pre-exercise, every 3 min during, immediately post, and at 4, 9, 14 min post.	RM ANOVA	Affective responses declined during the first half of both conditions; when session duration was unknown, an affective "rebound" was seen at exercise end.

Note. FS = feeling scale; FAS = felt arousal scale; RM ANOVA = repeated measures analysis of variance; W = watt; CT = continuous training; HIIT = high intensity interval training; VT = ventilatory threshold; HRR = heart rate reserve; MICT = moderate intensity continuous training; MICE = moderate intensity continuous exercise; LTP1 = first lactate turning point; LTP2 = second lactate turning point; VICE = vigorous intensity continuous exercise; RM MANOVA = repeated measures multivariate analysis of variance; MANOVA = multivariate analysis of variance; HICE = high intensity continuous exercise; RPE = rate of perceived exertion; HRmax = maximum heart rate.

Risk of bias in studies

Regarding the randomized controlled trials (n=2), the overall risk for both of them was “high risk” due to the randomization process (see Supplementary figure 1). Regarding the four crossover trials included in this review, two were classified as “low risk” and the remaining two were classified as “high risk”, due to possible risk of bias arising from period and carryover effects (see Supplementary figure 2). As for the overall bias in the quasi-experimental studies included, 16 studies were classified as “moderate risk” mostly due to possible bias in the measurement of outcomes (e.g., outcome assessors awareness of intervention status). The overall bias classification for the remaining 31 quasi-experimental studies was “serious risk” for the same reason (i.e., possible bias in the measurement of outcomes; see Supplementary figure 3 for additional information).

Number, frequency, and timing of assessments

In all the studies that used both scales, the FS and FAS were applied at the same time points. Despite this common approach to measurement, significant variability was identified regarding the number of measurements, the frequency, and time points of assessments (see Tables 2 and 3). The number of measurements varied from twice (n = 3), three times (n = 5), four times (n = 6), five times (n = 6), six times (n = 7), seven times (n = 5), eight times (n = 7), 9 times (n = 1), 12 times (n = 1), and 14 times (n = 1). An additional group of studies used a varied number of measurements due to distinct exercise durations (e.g., time to exhaustion; n = 6). The majority of the studies (n = 37) included pre-exercise measurements (e.g., 10-min, 5-min, or immediately before), but others did not (n = 16). There was no apparent uniformity in the way assessment time points during exercise were defined. For example, studies were noted to apply the scales every 1-min (n = 3), every 2-min (n = 3), every 3-min (n = 4), every 4-min (n = 3), every 5-min (n = 18), every 10-min (n = 4), every 15-min (n = 1), and every 30-min (n = 1). Alternative approaches were identified for determining the assessment time points, such as those based on completing a specific percentage of the exercise session such as every 25% of exercise completion (n = 1); every 20% of exercise completion (n = 1); at exercise mid-point (n = 3); at variable intervals (n = 7); and immediately prior to completion of the exercise protocol (n = 11). Some studies (n = 4) only recorded measurements pre- and post-exercise, and others (n = 13) did not apply post-exercise measurements. Finally, the studies that collected post-exercise measurements also showed extensive variability in the timing of the assessments; these included immediately after the protocol ended (n = 28), 1-min after (n = 2), 2-min after (n = 4), 3-min after (n = 1), 4-min after (n = 1), 5-min after (n = 12), 8-min after (n = 1), 10-min after (n = 15), 15-min after (n = 4), 20-min after (n = 6), 30-min after (n = 1), and one study applied the scales 4-hour, 24-hour, 7-days and 14-days following completion of the exercise session. Three studies did not report on the timing of the post-exercise measurement.

Table 2

Summary of Samples' Characteristics, Instruments, Number and Timing of assessments.

Characteristics	Studies (%)	Population (%)
SAMPLE SIZE	53 total	1384 total
<30	35 (66%)	625 (46%)
30-50	15 (28%)	550 (40%)
51-100	3 (6)%)	201 (14%)
>100	0	0
SEX		
Female only	12 (23%)	293 (21%)
Male only	12 (23%)	177 (13%)
Mixed genders	29 (55%)	914 (66%)
LOCATION		
Asia	2 (4%)	40 (3%)
Africa	1 (2%)	13 (1%)
North America	24 (45%)	731 (53%)
South America	6 (11%)	117 (8%)
Oceania	6 (11%)	141 (10%)
Europe	14 (26%)	342 (25%)
MEAN AGE (Years)		
<18	0	0
18 - 25	33 (62%)	809 (59%)
26 - 35	12 (22%)	415 (30%)
35-64	6 (12%)	127 (9%)
≥65	2 (4%)	33 (2%)
SAMPLE SIZE CALCULATION		
Yes	16 (30%)	
No	39 (74%)	
INSTRUMENTS APPLIED		
FS only	21 (40%)	
FAS only	0	
FS & FAS	32 (60%)	
TIMING OF APPLICATION (FS and/or FAS)		
Only pre- and post-exercise	4 (8%)	
Only pre- and during exercise	3 (6%)	
Only during exercise	11 (21%)	
Only during and post-exercise	5 (9%)	
Pre-, during and post-exercise	31 (58%)	
PRE-EXERCISE		
Timing not reported	30	
Immediately before	6	
5-min before	1	
10-min before	1	

Table 2 (*continuation*)

Summary of Samples' Characteristics, Instruments, Number and Timing of assessments.

Characteristics	Studies (%)	Population (%)
DURING EXERCISE		
At variable intervals	7	
At a certain % of exercise completion	3	
At exercise midpoint	3	
Every 1-min	3	
Every 2-min	2	
Every 3-min	4	
Every 4-min	3	
Every 5-min	18	
Every 10-min	4	
Every 15-min	1	
Every 30-min	1	
Immediately before protocol ending	8	
POST-EXERCISE		
Timing not reported	3	
Immediately after protocol ending	16	
1-min after protocol ending	2	
2-min after protocol ending	5	
3-min after protocol ending	1	
4-min after protocol ending	1	
5-min after protocol ending	10	
8-min after protocol ending	1	
10-min after protocol ending	15	
15-min after protocol ending	4	
20-min after protocol ending	6	
30-min after protocol ending	1	
4-hours, 24-hours, 48hr, 7-days, 14-days after protocol ending	1	
Immediately after cool down (variable moments)	11	

Scales presentation and familiarization

Upon attempting to analyze the scales' presentation mode, it was determined that most studies did not report how the scales were presented to the participants (n = 45). Of the studies that documented the way the scales were presented, six used poster-size versions, one used separate laminated A4 size sheets for each of the scales that were printed in a large font, one used laminated copies held in front of the participants (size not reported), and another presented the scales by displaying them on a screen directly in front of the participants. Additionally, 27 of the included studies (i.e., 51%) reported that familiarization sessions or prior training were provided to the participants regarding how to respond to the FS and/or FAS before commencing the study protocol.

Intensity domains and affective response changes from during to post-exercise

In line with the approach by Binder and colleagues (Binder et al., 2008), the studies were categorized by intensity domains and reported as the intensity experienced during the sessions. Most of the studies (n = 34) used more than one intensity domain across their study protocols. Additionally, two studies used very light intensity, nine studies used light intensity, six studies used moderate intensity, and two studies used heavy intensity.

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Regarding the existence of a post-exercise affective rebound, all but four studies that assessed affective responses during- and post-exercise showed an increase in scores on the FS (n = 33). Specifically, the affective rebound was examined via a comparison of the final measurement during exercise and all available measurements recorded after the main phase (i.e., fundamental stage) of the exercise protocol. As noted, only 11 of the included studies reported the inclusion of a cool-down period, and of those, four had a measurement between the main phase ending and the exercise/protocol ending (i.e., FS1 during the cool down; see Table 3). It also warrants reporting the nature of the observed increases associated with the affective rebound (i.e., from a more to a less negative FS score, from a negative to a positive FS score, or from a positive to a more positive FS score). Two studies reported an increase from a more to a less negative FS score, and three studies depicted results with an increase from a negative to a positive FS score. In all the remaining studies (n = 28), the FS scores started positive and went to higher positive FS scores.

For a deeper analysis of the affective rebound, the studies were organized by intensity domain (i.e., VL = very light, L = light, M = moderate, H = heavy – for incremental intensity protocols, only the intensity at the end of exercise/session was considered) to facilitate a better understanding of the affective response changes that occur from during- to post-exercise. Thus, after determining the scale score ranges for each study (i.e., the total range of FS/FAS results observed within each study, not the full scale range), the change between assessment points was expressed as a percentage of that range, and a mean of those percentages was calculated for each intensity domain. For example, in Edwards et al. (2018), the FS increased from 3.52 (last during-exercise measurement) to 4.10 (first post-exercise measurement); given an observed FS range of 3.05 to 4.10 in that study, the percentage change was $(4.10 - 3.52) / (4.10 - 3.05) \times 100 = 55.2\%$. This procedure was applied separately to the FS and the FAS. Focusing on the nearest assessments proximal to the end of the activity, the mean values of affective response changes (↑ = increase in the FS score; ↓ = decrease in the FS score) across the intensity domains are: (1) from during (FS0) to the first post-exercise assessment (FS1) VL = ↑32%, L = ↑29%, M = ↑42%, H = ↑27%; (2) from during (FS0) to the second post-exercise assessment (FS2) VL = ↑21%, L = ↑52%, M = ↑71.5%, H = ↑51%; (3) from the first (FS1) to the second post-exercise assessment (FS2) VL = ↓9%, L = ↑23%, M = ↑29.5%, H = ↑24%; (4) from the second (FS2) to the third post-exercise assessment (FS3) VL = no values to report, L = ↑24%, M = ↑11%, H = ↑5%; (5) due to the scarce values in the following assessment timings, the values were not reported. All results are presented in Supplementary Table 1.

This analysis was also undertaken for the FAS scores and facilitated the examination of changes in arousal (see Supplementary Table 2). Thus, on the assessments most proximal to the end of the activity, the mean values for arousal (↑ = increase in the FAS score; ↓ = decrease in the FAS score) across the domains of intensity are: (1) from during (FAS0) to the first post-exercise assessment (FAS1) VL = ↑2.3%, L = ↓28%, M = ↓33.9%, H = ↓0.8%; (2) from during (FAS0) to the second post-exercise assessment (FAS2) VL = ↓84.2%, L = ↓52.8%, M = ↓56.8%, H = ↓34.8%; (3) from the first (FAS1) to the second post-exercise assessment (FAS2) VL = ↓86.5%, L = ↓24.8%, M = ↓22.9%, H = ↓34%; (4) from the second (FAS2) to the third post-exercise assessment (FAS3) VL = no values to report, L = ↑11%, M = ↓14%, H = ↓16.8%; and (5) due to the scarce values in the following assessments, the values were not reported.

Additionally, in consideration that 65% of the studies presented small sample sizes (< 30 individuals), and only 30% of the total studies reported sample size calculations, cautious interpretation of the results is warranted due to the possibility of type II errors.

Table 3

Scales Presentation, Number of Assessments, Intensity Characterization, and Post-Exercise Affective Rebound.

Author (s)	Prior training	Scales presentation	Number of measurements	Protocol intensity description	Intensity domain (Binder et al., 2008)	Measurements potentially relevant for affective rebound interpretation	Comparison between the last FS and FAS intra-exercise measurement(s) and all post-exercise moments	Post-exercise affective rebound
Ali et al. (2017)	Participants	Not reported	6	1 hour time trial at self-selected intensity (Borg scale 12-16)	Moderate and heavy exercise	15-min before (FS/FAS0) and immediately after protocol ending (FS/FAS1)	**FS:** Placebo rinse - FS0 (-1.7), FS1 (-0.8); Placebo ingestion - FS0 (-1.3), FS1 (-1.7); Carbohydrate rinse - FS0 (-0.9), FS1 (0.2); Carbohydrate ingestion - FS0 (-0.5), FS1 (0.0) / **FAS:** Placebo rinse - FAS0 (3.6), FAS1 (3.9); Placebo ingestion - FAS0 (3.7), FAS1 (4.3); Carbohydrate rinse - FAS0 (3.8), FAS1 (4.2); Carbohydrate ingestion - FAS0 (3.9), FAS1 (4.2)	Yes, immediately after protocol ending for all conditions except placebo ingestion
Alicea et al. (2020)	Participants	Not reported	8	Respiratory compensation point (~80% VO2Max)	Moderate exercise	2-min before (FS/FAS0), 2-min (FS/FAS1) *, 5-min (FS/FAS1)* and 10-min (FS/FAS1)* after protocol ending	FS: FS0 (1.5); FS1 (4.0) / FAS: FAS0 (4.3); FAS1 (3.2) *all post-task measurements were presented as one	Yes, not possible to identify in which measurement
Alvarez-Alvarado et al. (2019)	Participants	Scales displayed on a screen directly in front of the participant	Variable due to distinct exercise durations	1-min stages starting with a 25W output and workload increased progressively every 12-sec until volitional exhaustion	Heavy exercise	2-min before (FS/FAS0) and immediately after main phase (FS/FAS1), 2-min later (cool-down; FS/FAS2) and 4-min (FS/FAS3) after main phase ending	FS: FS0 (-2.7), FS1 (-3.6), FS2 (1.0), FS3 (1.8) / FAS: FAS0 (4.6), FAS1 (5), FAS2 (3.9), FAS3 (3.1)	Yes, in every after main phase ending measurements
Barnett (2013)	Participants	Not reported	3	60% VO2max	Light and moderate exercise	10-min before (FS/FAS0) and immediately after protocol ending (FS/FAS1)	FS: Younger women - FS0 (1.52), FS1 (2.08); Older women - FS0 (2.08), FS1 (3.12) / FAS: Younger women - FAS0 (3.44), FAS1 (3.76); Older women - FAS0 (3.24), FAS1 (3.80)	Yes, for both conditions in the immediately after protocol ending measurement

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Author (s)	Prior training	Scales presentation	Number of measurements	Protocol intensity description	Intensity domain (Binder et al., 2008)	Measurements potentially relevant for affective rebound interpretation	Comparison between the last FS and FAS intra-exercise measurement(s) and all post-exercise moments	Post-exercise affective rebound
Batista et al. (2019)	Participants	Not reported	6	1 session at self-selected intensity and another at imposed intensity but replicating the first (Borg scale ~10)	Light exercise	N/A	N/A	N/A
Bird et al. (2019)	Participants	Not reported	7	At VT	Moderate exercise	1-min before main phase ending (FS/FAS0), 2-min (during cool-down; FS/FAS1), 5-min (immediately after cool-down;FS/FAS2) and 8-min (FS/FAS3) after main phase ending	FS: 360 video + music - FS0 (2.9), FS1 (4.0), FS2 (4.1), FS3 (4.4); 360 video - FS0 (2.8), FS1 (3.6), FS2 (4.1), FS3 (4.3); Music-video - FS0 (2.6), FS1 (3.6), FS2 (4.1), FS3 (4.4); Music - FS0 (2.3), FS1 (3.4), FS2 (4..0), FS3 (4.1); Video - FS0 (2.6), FS1 (3.0), FS2 (3.5), FS3 (4.1); Control - FS0 (2.5), FS1 (3.5), FS2 (3.8), FS3 (4.1) / FAS: 360 video + music - FAS0 (3.6), FAS1 (2.1), FAS2 (1.7), FAS3 (1.3); 360 video - FAS0 (3.4), FAS1 (2.1), FAS2 (1.7), FAS3 (1.4); Music-video - FAS0 (3.3), FAS1 (2.1), FAS2 (1.8), FAS3 (1.3); Music - FAS0 (2.7), FAS1 (2.0), FS2 (1.7), FAS3 (1.5); Video - FAS0 (2.8), FAS1 (1.9), FAS2 (1.7), FAS3 (1.5); Control - FAS0 (2.8), FAS1 (1.9), FAS2 (1.6), FAS3 (1.3)	Yes, for both conditions in every after main phase ending measurements
Boukabous et al. (2019)	Not reported	Not reported	2	55% HRR	Light exercise	N/A	N/A	N/A
Brownley et al. (1995)	Not reported	Not reported	3	RPE (Low - 8.7; Moderate - 11.4; High - 13.8)	Very light, light, moderate and heavy exerciseVL, L, M, H	N/A	N/A	N/A

Author (s)	Prior training	Scales presentation	Number of measurements	Protocol intensity description	Intensity domain (Binder et al., 2008)	Measurements potentially relevant for affective rebound interpretation	Comparison between the last FS and FAS intra-exercise measurement(s) and all post-exercise moments	Post-exercise affective rebound
Cox et al. (2018)	Participants	Not reported	5	65% HRR	Light exercise	2-min before main phase ending (FS0), 3-min later (cool-down; FS1) and 5-min (FS2) after main phase	**FS:** Mindfulness condition - FS0 (1.0), FS1 (2.4), FS2 (3.4); Control condition - FS0 (0.6), FS1 (2.0), FS2 (3.3)	Yes, for all conditions in every main phase ending measurements
Cuttell et al. (2016)	Not reported	Not reported	Variable due to distinct exercise durations	60% of Wmax until volitional exhaustion	Light, moderate and heavy exercise	5-min before (FS0) and immediately after protocol ending (FS1)	**FS:** No cooling - FS0 [-1.0 (-1.8 to -1.0)], FS1 [-4.0 (-4.0 to -2.3)]; Cooling colar - FS0 [-1.0 (-2.0 to -0.3)], FS1 [-4.0 (-4.8 to -3.3)]; Vest cooling - FS0 [-1.0 (-3.0 to -1.0)], FS1 [-4.0 (-5.0 to -1.3)]; Obs: Median (25th to 75th interquartile)	No
Dasilva et al. (2011)	Participants	Not reported	4	Self selected (30-45% HRR)	Very light and light exercise	N/A	N/A	N/A
Farias et al. (2018)	Participants	Not reported	4	RPE OMNI (2.5 - 4)	Light exercise	N/A	N/A	N/A
Dierkes et al. (2021)	Not reported	Poster size version of the scales	4	90% of lactate threshold point LTP1(MICE) and at midpoint between LTP1 and LTP2 (VICE)	Moderate and heavy exercise	8-min before (FS0) and 5-min after main phase ending (immediately after cool-down;FS1)	**FS:** MICE - FS0 (2.9), FS1 (3.1); VICE - FS0 (1.8), FS1 (2.3)	Yes, for both conditions in the immediately after cool-down measurement
Dierkes et al. (2023)	Not reported	Not reported	5	90% of LTP1	Moderate exercise	N/A	N/A	N/A
Edwards et al. (2018)	Not reported	Not reported	3	At a minimum of 4,8 Km/h (Borg scale ~9)	Very light exercise	5-min before (FS/FAS0) and immediately after protocol ending (FS/FAS1)	**FS:** FS0 (3.52), FS1 (4.10) / **FAS:** FS0 (3.10), FS1 (3.20)	Yes, in the after protocol ending measurement

Author (s)	Prior training	Scales presentation	Number of measurements	Protocol intensity description	Intensity domain (Binder et al., 2008)	Measurements potentially relevant for affective rebound interpretation	Comparison between the last FS and FAS intra-exercise measurement(s) and all post-exercise moments	Post-exercise affective rebound
Ekkekakis et al. (2004)	Not reported	Poster size version of the scales	8	Increases in speed every 2-min until volitional exhaustion	Very light, light, moderate and heavy exercise	1-min before (FS/FAS0) and immediately after protocol ending (FS/FAS1)	**FS:** Group A - FS0 (0), FS1 (-1.5); Group B - FS0 (-1.1), FS1 (-2.0) / **FAS:** Group A - FAS0 (4.6), FAS1 (4.8); Group B - FAS0 (4.7), FAS1 (5.0)	No
Ekkekakis et al. (2008)	Not reported	Poster size version of the scales	10	3 sessions: <VT, at VT and >VT	Very light, light, moderate and heavy exercise	Immediately before (FS/FAS0) main phase ending, 5-min later (immediately after cool-down;FS/FAS1) 10-min(FS/FAS2) and 20-min (FS/FAS3) after main phase ending	**FS:** <VT - FS0 (3.0), FS1 (3.9), FS2 (3.5), FS3 (3.5); At VT - FS0 (2.1), FS1 (3.4), FS2 (3.5), FS3 (3.5); >VT - FS0 (0.8), FS1 (3.5), FS2 (3.4), FS3 (3.4) / **FAS:** <VT - FAS0 (3.4), FAS1 (2.2), FAS2 (1.9), FAS3 (1.6); At VT - FAS0 (4.1), FAS1 (2.4), FAS2 (2.0), FAS3 (1.7); >VT - FAS0 (4.5), FAS1 (2.6), FAS2 (1.9), FAS3 (1.7)	Yes, after cool-down (5-min) and 10-min after main phase ending
Ekkekakis et al. (2010)	Participants	Poster size version of the scales	6	Increases in speed or grade until volitional exhaustion	Very light, light, moderate and heavy exercise	1-min after VT (FS/FAS0) and immediately after protocol ending (FS/FAS1)	**FS:** Normal weight - FS0 (2.7), FS1 (1.5); Overweight - FS0 (1.9), FS1 (1.0)	No
Focht (2009)	Not reported	Not reported	4	~60% HRmax	Very light exercise	5-min before (FS/FAS0), immediately after (FS/FAS1) and 10-min (FS/FAS2) after protocol ending	**FS:** Outdoor environment - FS0 (3.67), FS1 (3.86), FS2 (3.49); Laboratory environment - FS0 (2.82), FS1 (3.20), FS2 (3.08) / **FAS:** Outdoor environment - FAS0 (4.54), FAS1 (4.46), FAS2 (3.71); Laboratory environment - FAS0 (4.09), FAS1 (4.17), FAS2 (3.09)	Yes, for all conditions in the immediately after protocol ending measurement

Author (s)	Prior training	Scales presentation	Number of measurements	Protocol intensity description	Intensity domain (Binder et al., 2008)	Measurements potentially relevant for affective rebound interpretation	Comparison between the last FS and FAS intra-exercise measurement(s) and all post-exercise moments	Post-exercise affective rebound
Giles et al. (2018)	Not reported	Not reported	5	75-85% HRmax	Light and moderate exercise	Immediately before main phase ending (FS/FAS0), 5-min later (immediately after cool down; FS/FAS1)	**FS:** No instruction - FS0 (2.96), FS1 (3.63); Cognitive reappraisal instruction - FS0 (2.96), FS1 (3.21); Distraction instruction - FS0 (2.63), FS1 (3.50) / **FAS:** No instruction - FAS0 (3.22), FAS1 (2.39); Cognitive reappraisal instruction - FAS0 (2.74), FAS1 (2.30); Distraction instruction - FAS0 (2.70), FAS1 (2.30)	Yes, for all conditions in the immediately after cool-down measurement
Gillman & Bryan (2016)	Not reported	Not reported	6	70-80% HRmax	Light and moderate exercise	N/A	N/A	N/A
Gillman & Bryan (2020)	Not reported	Not reported	3	Borg scale (9-13)	Light and moderate exercise	N/A	N/A	N/A
Glen et al. (2017)	Participants	Not reported	5	Borg scale (12-13)	Light and moderate exercise	N/A	N/A	N/A
Hall et al. (2002)	Participants	Poster size version of the scales	Variable due to distinct exercise durations	Increases in speed or grade until volitional exhaustion	Very light, light, moderate and heavy exercise	1-min before main phase ending (FS/FAS0), 2-min later (immediately after cool down; FS/FAS1), 10-min (FS/FAS2) and 20-min (FS/FAS3) after main phase ending	**FS:** FS0 (0.07), FS1 (-1.48), FS2 (2.76), FS3 (2.9) / **FAS:** FAS0 (4.65), FAS1 (4.83), FAS2 (3.59), FAS3 (3.10)	Yes, in the 10 and 20-min after main phase ending measurement
Heinrich et al. (2020)	Not reported	Not reported	5	50-70% of estimated maximum heart rate	Very light and light exercise	Immediately before main phase ending (FS/FAS0), 5-min later (immediately after cool down; FS/FAS1)	**FS:** FS0 (2.4), FS1 (2.5) / **FAS:** FAS0 (3.0), FAS1 (2.1)	Yes, in the immediately after cool-down measurement

Author (s)	Prior training	Scales presentation	Number of measurements	Protocol intensity description	Intensity domain (Binder et al., 2008)	Measurements potentially relevant for affective rebound interpretation	Comparison between the last FS and FAS intra-exercise measurement(s) and all post-exercise moments	Post-exercise affective rebound
Hermand et al. (2019)	Not reported	Not reported	2	Borg scale (15)	Heavy exercise	N/A	N/A	N/A
Hutchinson & Karageorghis (2013)	Not reported	Not reported	3	45%, 65% and 85% HRR	Very light, light and heavy exercise	N/A	N/A	N/A
Hutchinson et al. (2015)	Not reported	Not reported	5	10% below VT and 10% above VT	Moderate and heavy exercise	Immediately before protocol ending (FS/FAS0), post-exercise (timepoint not reported; FS/FAS1)	**FS:** 10% below VT: Music only - FS0 (2.5), FS1 (3.3); Music and video - FS0 (2.8), FS1 (3.8); Control - FS0 (1.9), FS1 (3.7) / 10% above VT: Music only - FS0 (2.2), FS1 (3.2); Music and video - FS0 (2.4), FS1 (3.4); Control - FS0 (0.9), FS1 (2.9) / **FAS:** Values not reported	Yes, for all conditions in the post exercise measurement (time point not reported)
Jones et al. (2014)	Participants	Not reported	6	10% below VT and 5% above VT	Moderate and heavy exercise	2-min before (FS/FAS0) and 2-min after finishing each condition (FS/FAS1)	**FS:** 10% below VT: Music only - FS0 (2.85), FS1 (3.12); Music and video - FS0 (2.91), FS1 (3.18); Video - FS0 (2.06), FS1 (1.88); Control - FS0 (1.38), FS1 (1.56); 5% above VT: Music only - FS0 (1.85), FS1 (1.79); Music and video - FS0 (1.60), FS1 (1.41); Video - FS0 (0.56), FS1 (0.32); Control - FS0 (0.16), FS1 (-0.12) / **FAS:** 10% below VT: Music only - FAS0 (3.97), FAS1 (4.18); Music and video - FAS0 (4.24), FAS1 (4.44); Video - FAS0 (3.32), FAS1 (3.29); Control - FAS0 (2.93), FAS1 (2.94); 5% above VT: Music only - FAS0 (4.21), FAS1 (4.32); Music and video - FAS0 (4.03), FAS1 (4.18); Video - FAS0 (3.41), FAS1 (3.44); Control - FAS0 (3.25), FAS1 (3.03)	Yes, in the 10% below VT condition (except video only) in the 2-min after finishing each condition measurement
Khcharem et al. (2021)	Not reported	Not reported	2	Not reported	N/A	N/A	N/A	N/A

Author (s)	Prior training	Scales presentation	Number of measurements	Protocol intensity description	Intensity domain (Binder et al., 2008)	Measurements potentially relevant for affective rebound interpretation	Comparison between the last FS and FAS intra-exercise measurement(s) and all post-exercise moments	Post-exercise affective rebound
Kilpatrick et al. (2007)	Participants	Not reported	8	1 session of 30-min at 85% of VT and 1 session of 24-min at 105% of VT	Moderate and heavy exercise	Immediately before protocol ending (FS/FAS0), immediately after (FS/FAS1) and 15-min (FS/FAS2) after protocol ending	**FS:** 85% VT - FS0 (1.9), FS1 (2.8), FS2 (2.8); 105% VT - FS0 (0.3), FS1 (2.4), FS2 (2.9) / **FAS:** 85% VT - FAS0 (4.1), FAS1 (3.8), FAS2 (3.1); 105% VT - FAS0 (4.1), FAS1 (3.9), FAS2 (3.3)	Yes, for both conditions in every after protocol ending measurements
Kilpatrick et al. (2015)	Not reported	Not reported	8	20% below VT and at VT	Moderate and heavy exercise	Immediately before main phase ending (FS0), 2-min later (immediately after cool down; FS1) and 10-min (FS2) after main phase ending	**FS:** 20% below VT - FS0 (2.3), FS1 (3.0), FS2 (3.0); At VT - FS0 (0.9), FS1 (2.0), FS2 (2.7);	Yes, for both conditions in every after main phase ending measurements
Niedermeier et al. (2017)	Not reported	Not reported	6	57-63% HRmax	Very light and light exercise	40-min before (FS/FAS0) and immediately after protocol ending (FS/FAS1)	**FS:** Outdoor mountain hiking - FS0 (4.1), FS1 (4.0); Indoor treadmill walking - FS0 (2.2), FS1 (2.7); Sedentary control condition - FS0 (2.5), FS1 (1.8) / **FAS:** Outdoor Mountain hiking - FAS0 (2.8), FAS1 (2.7); Indoor treadmill walking - FAS0 (2.8), FAS1 (2.8); Sedentary control condition - FAS0 (2.1), FAS1 (2.0)	Yes, but only for the treadmill walking condition in the immediately after protocol ending measurement
Niven et al. (2018)	Participants	Laminated copies held in front of the participant	9	1 session of 30-min at 15% below VT and 1 session with variable durations at 5% above VT (matching workload with first session)	Moderate and heavy exercise	Immediately before protocol ending (FS/FAS0), 1-min (FS/FAS1), 5-min (FS/FAS2), 10-min (FS/FAS3) and 15-min (FS/FAS4) after protocol ending	**FS:** 15% below VT - FS0 (2.2), FS1 (2.3), FS2 (3.0), FS3 (3.0), FS4 (3.2); 5% above VT - FS0 (0.7), FS1 (1.0), FS2 (1.4), FS3 (2.1), FS4 (2.3) / **FAS:** 15% below VT - FAS0 (2.9), FAS1 (2.3), FAS2 (1.7), FAS3 (1.6), FAS4 (1.7); 5% above VT - FAS0 (3.8), FAS1 (3.0), FAS2 (2.2), FAS3 (1.9), FAS4 (1.6)	Yes, for both conditions in every post-exercise measurement

Author (s)	Prior training	Scales presentation	Number of measurements	Protocol intensity description	Intensity domain (Binder et al., 2008)	Measurements potentially relevant for affective rebound interpretation	Comparison between the last FS and FAS intra-exercise measurement(s) and all post-exercise moments	Post-exercise affective rebound
Oliveira et al. (2012)	Participants	Not reported	Variable due to distinct exercise durations	60% - 75% HRR	Light and moderate exercise	N/A	N/A	N/A
Oliveira et al. (2013)	Participants	Not reported	7	~72% VO2max	Very light, light, moderate and heavy exercise	Before protocol ending (at different timings; FS/FAS0), and 5-min (FS/FAS1) after protocol ending	**FS:** FS0 (0.80), FS1 (3.60) / **FAS:** FAS0 (4.20), FAS1 (2.47)	Yes, in the after protocol ending measurement
Oliveira et al. (2015)	Participants	Not reported	17	1 session at self-selected intensity and another at imposed intensity but replicating the first (Borg CR100 scale 24-47)	Light exercise	5-min before (FS/FAS0), immediately after (FS/FAS1), 5-min (FS/FAS2) and 15-min (FS/FAS3) after protocol ending	**FS:** Self-selected - FS0 (1.4), FS1 (2.2), FS2 (2.5), FS3 (2.7); Imposed - FS0 (1.5), FS1 (2.3), FS2 (2.4), FS3 (2.8) / **FAS:** Self-selected - FAS0 (4.0), FAS1 (3.5), FAS2 (3.0), FAS3 (2.8); Imposed - FAS0 (4.3), FAS1 (3.2), FAS2 (2.7), FAS3 (2.5)	Yes, for both conditions in every post-exercise measurements
Parfitt el al. (2006)	Participants	Not reported	8	Below-LT (Borg scale ~10), above-LT (Borg scale 13-17) and self-selected (Borg scale 10-13)	Self-selected (light and moderate exercise), Below-LT (light exercise), above-LT (heavy exercise)	Immediately before (FS/FAS0), 10-min (FS/FAS1), 20-min (FS2) and 30-min (FS/FAS3) after protocol ending	**FS:** Self-Selected - FS0(3.9), FS1 (3.8), FS2 (3.6), FS3 (3.7); Below-LT - FS0(3.6), FS1 (3.6), FS2 (3.6), FS3 (3.9); Above-LT - FS0(-0.8), FS1 (3.2), FS2 (3.3), FS3 (3.3) / **FAS:** Self-Selected - FAS0(4.2), FAS1 (3.8), FS2 (3.7), FAS3 (3.5); Below-LT - FAS0 (3.3), FAS1 (3.2), FAS2 (3.1), FAS3 (3.5); Above-LT - FAS0 (3.6), FAS1 (3.7), FAS2 (3.7), FAS3 (3.5)	Yes, for the below-LT condition in the 30-min after protocol ending measurement and for the above-LT condition in the 20-min after protocol ending measurement

Author (s)	Prior training	Scales presentation	Number of measurements	Protocol intensity description	Intensity domain (Binder et al., 2008)	Measurements potentially relevant for affective rebound interpretation	Comparison between the last FS and FAS intra-exercise measurement(s) and all post-exercise moments	Post-exercise affective rebound
Parfitt et al. (2012)	Not reported	Not reported	6	Borg scale (13)	Moderate exercise	N/A	N/A	N/A
Pessoa et al. (2022)	Participants	Not reported	12	40% - 59% HRR	Light exercise	Immediately before protocol ending (FS0), 5-min (FS1) after protocol ending	**FS:** Mental fatigue - FS0 (0.1), FS1 (1.2); Control - FS0 (1.2), FS1 (2.9)	Yes, for both conditions in the 5-min after protocol ending measurement
Qin et al. (2017)	Not reported	Not reported	4	70% VO2max	Moderate exercise	N/A	N/A	N/A
Rose & Parfitt (2007)	Participants	Not reported	8	Self-selected (HRmax 62-72%), below-LT (HRmax 68-70%), at LT (HRmax 79-82%) and above-LT (HRmax 88-91%)	Self-selected (light exercise), below-LT (moderate exercise), at-LT (moderate-heavy exercise) and above-LT (heavy exercise)	Immediately before (FS/FAS0), immediately after (FS/FAS1), 5-min (FS/FAS2) and 10-min (FS/FAS3) after protocol ending	**FS:** Self-Selected - FS0 (2.78), FS1 (3.06), FS2 (3.28), FS3 (3.56); Below-LT - FS0 (2.00), FS1(2.50), FS2 (2.94), FS3 (3.06); At-LT - FS0 (1.28) FS1 (2.11), FS2 (3.11), FS3 (2.94); Above-LT - FS0 (-1.89), FS1 (0.94), FS2 (2.78), FS3 (3.06) / **FAS:** Self-Selected - FAS0 (4.61), FAS1 (3.89), FAS2 (3.89), FAS3 (4.00); Below-LT - FAS0 (4.33), FAS1 (3.44), FAS2 (3.22), FAS3 (3.28); At-LT - FAS0 (4.17), FAS1 (4.11), FAS1 (3.78), FAS2 (3.56); Above-LT - FAS0 (4.17) FAS1 (0.94), FAS2 (2.78), FAS3 (3.06)	Yes, for all conditions in every post-exercise measurements
Rose & Parfitt (2008)	Participants	Not reported	8	Borg scale (10-13)	Very light and light exercise	N/A	N/A	N/A
Rose & Parfitt (2012)	Participants	Not reported	8	Self-selected (~10% above VT) and prescribed (at VT)	Moderate and heavy exercise	Immediately before protocol ending (FS/FAS0), 5-min (FS/FAS1) and 10-min (FS/FAS2) after protocol ending	**FS:** Sedentary: Prescribed - FS0 (2.47), FS1 (3.40), FS2 (3.69); Self-selected - FS0 (2.24), FS1 (3.19), FS2 (3.36); Active: Prescribed - FS0 (2.73), FS1 (3.58), FS2 (4.28); Self-selected - FS0 (3.40), FS1 (4.22), FS2 (4.06) / **FAS:** Sedentary: Prescribed - FS0 (3.78), FS1 (4.13), FS2 (3.71); Self-selected - FS0 (4.12), FS1 (4.31), FS2 (4.08); Active: Prescribed - FS0 (4.00), FS1 (3.75), FS2 (3.36); Self-selected - FS0 (4.11), FS1 (3.75), FS2 (3.36)	Yes, for all conditions in every post-exercise measurements

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Author (s)	Prior training	Scales presentation	Number of measurements	Protocol intensity description	Intensity domain (Binder et al., 2008)	Measurements potentially relevant for affective rebound interpretation	Comparison between the last FS and FAS intra-exercise measurement(s) and all post-exercise moments	Post-exercise affective rebound
Shin et al. (2014)	Not reported	Not reported	7	70-75% VO2max	Moderate exercise	Immediately before protocol ending (FS0), 5-min (FS1) and 10-min (FS2) after protocol ending	**FS:** FS0 (0.53), FS1 (1.60), FS2 (1.80)	Yes, in both after protocol ending measurements
Slawinska & Davis (2020)	Not reported	Not reported	13	low-intensity (below-VT) and high-intensity (above-VT)	Moderate and heavy exercise	Immediately before (FS0), 1-min (FS1), 5-min after (FS2), 15-min (FS3), 4-hr (FS4), 8-hr (FS5), 24-hr (FS6), 48-hr (FS7), 7 days (FS8) and 14 days (FS9) after protocol ending	**FS:** Low intensity - FS0 (3.0), FS1 (3.5), FS2 (3.6), FS3 (3.7), FS4 (3.3), FS5 (2.6), FS6 (2.1), FS7 (2.6), FS8 (2.6), FS9 (2.4); High intensity - FS0 (1.6), FS1 (1.4), FS2 (1.3), FS3 (1.4), FS4 (1.2), FS5 (1.9), FS6 (2.2), FS7 (1.9), FS8 (1.9), FS9 (1.5);	**Low intensity condition:** yes, for the 1-min, 5-min and 15-min after protocol ending measurements; **High intensity condition:** Yes, for the 15-min, 8-hr and 24hr after protocol ending measurements
Stork et al. (2018)	Not reported	Not reported	13	70-75% HRmax	Light exercise	2.5-min before (FS/FAS0), immediately after main phase ending (FS/FAS1), during cool-down (timepoint not reported; FS/FAS2), 3-min later (immediately after cool down; FS3), 10-min (FS/FAS4) and 20-min (FS/FAS5) after main phase ending	**FS:** FS0 (1.1), FS1 (1.2), FS2 (1.9), FS3 (2.3), FS4 (2.5), FS5 (2.7) / **FAS:** FAS0 (3.3), FAS1 (3.2), FAS2 (2.1), FAS3 (1.9), FAS4 (1.3), FAS5 (1.1)	Yes, in every after main phase ending measurements
Strohacker et al. (2017)	Participants	Not reported	7	70-75% of age predicted Hrmax and self-selected	Light exercise	5-min before (FS/FAS0) and immediately after protocol ending (FS/FAS1)	Not reported (FS/FAS scores were only presented as a mean of all measurements)	N/A

Author (s)	Prior training	Scales presentation	Number of measurements	Protocol intensity description	Intensity domain (Binder et al., 2008)	Measurements potentially relevant for affective rebound interpretation	Comparison between the last FS and FAS intra-exercise measurement(s) and all post-exercise moments	Post-exercise affective rebound
Turner & Stevinson (2017)	Participants	Not reported	4	Borg scale ~13 at 3000m, Borg scale ~17 at 6000m	Light, moderate and heavy exercise	At exercise midpoint (3000m; FS/FAS0), immediately after (FS/FAS1) and 10-min after protocol ending (FS/FAS2)	**FS:** Outdoor green - FS0 (1.9), FS1 (1.5), FS2 (3.5); Indoor gym - FS0 (2.5), FS1 (1.3), FS2 (3.0) / **FAS:** Outdoor green - FAS0 (3.5), FAS1 (4.9), FAS2 (3.0); Indoor gym - FAS0 (3.4), FAS1 (4.7), FAS2 (2.8)	Yes, for both conditions in the immediately after protocol ending measurement
Tyler & Sunderland (2011)	Not reported	Not reported	Variable due to distinct exercise durations	~70% VO2max until volitional exhaustion	Light, moderate and heavy exercise	Before (at different timepoints; FS0) and immediately after protocol ending (FS1)	**FS:** Cooling collar - FS0 (1.8), FS1 (-2.6); No collar - FS0 (1.3), (-2.4)	No
Vazou-Ekkekakis & Ekkekakis (2009)	Not reported	Not reported	7	67% HRmax	Light exercise	N/A	N/A	N/A
Welch et al., (2007)	Participants	Poster size version of the scales	Variable due to distinct exercise durations	Increases os 15W every minute maintaining a >50rpm cadence until limit of tolerance is reached	Very light, light, moderate and heavy exercise	Immediately before (FS/FAS0), immediately after (FS/FAS1), 5-min (FS/FAS2), 10-min (FS/FAS3) and 20-min (FS/FAS4) after protocol ending	**FS:** FS0 (-2.05), FS1 (1.79), FS2 (2.25), FS3 (2.68), FS4 (2.79) / **FAS:** FAS0 (4.58), FAS1 (3.29), FAS2 (2.90), FAS3 (2.53), FAS4 (2.42)	Yes, in every after protocol ending measurements
Welch et al. (2010)	Participants	Printed in large font on separate laminated A4 size sheets	14	10% below VT	Light and moderate exercise	3-min before (FS0) and immediatley after main phase (FS1), 4-min later (immediately after cool down; FS2), 9-min (FS3) and 14-min after main phase ending (FS4)	**FS:** Full knowledge of exercise duration - FS0 (0.96), FS1 (1.02), FS2 (2.13), FS3 (not reported), FS4 (2.71); No knowledge of exercise duration - FS0 (0.42), FS1 (0.04), FS2 (1.85), FS3 (not reported), FS4 (2.56)	Yes, in every after main phase ending measurements except the immediately after measurement for the "no knowledge of exercise duration" condition

Note. FS = feeling scale; FS0 = last FS measurement during exercise; FS1 = first post-exercise FS assessment; FS2 = second post-exercise FS assessment; FS3 = third post-exercise FS assessment; FS4 = fourth post-exercise FS assessment; FS5 = fifth post-exercise FS assessment; FS6 = sixth post-exercise FS assessment; FS7 = seventh post-exercise FS assessment; FS8 = eighth post-exercise FS assessment; FS9 = ninth post-exercise FS assessment; W = watts; VT = ventilatory threshold; HRR = heart rate reserve; N/A = not applicable; RPE = rate of perceived exertion; MICE = moderate-intensity continuous exercise; VICE = vigorous intensity continuous exercise; LTP1 = first lactate turning point; LTP2 = second lactate turning point; HRmax = maximum heart rate; LT = lactate threshold.

DISCUSSION

The present systematic review aimed to analyze extant research literature that has used the FS and/or the FAS to assess affective valence and arousal constructs in continuous aerobic exercise. As the most widely undertaken and prescribed mode of exercise, continuous aerobic exercise is the preferred form of regular PA for millions of individuals globally (Ipsos, 2021; Statista Research Department, 2024; P. J. Teixeira et al., 2019). The collective results arising from the examination of the final 53 studies included in the review suggest a high heterogeneity of the frequency and timing of assessment. The protocols with moderate intensity presented the highest affective valence scores; affective rebounds were detected in all intensities, although they were of greater magnitude and more extended over a longer time in higher intensities. The global picture of the results suggests that the FS and FAS can be used with relative ease to capture the affective panorama during continuous aerobic exercise. However, several discrepancies beyond those that can be attributed to studies' protocols/sessions/training heterogeneity, reflect the need for cautious interpretations and the potential development of methodological guidelines for effective use of the scales.

Number, frequency, and timing of assessments

The number, frequency, and timing of assessments varied considerably across studies. The study of affective responses in exercise is a contemporary field of study; although the topic has garnered increasing interest among researchers, it is somewhat expected that methods of best research practice and uptake of methodological recommendations lag in this emerging topic area (Evmenenko & Teixeira, 2022). Limitations in research design and methodology have previously been highlighted in resistance training (Bastos et al., 2023), flexibility (Henriques & Teixeira, 2023), and some high-intensity exercise modes of practice (Ekkekakis et al., 2023), where similar heterogeneity and undefined methodology in the use of both scales were noted.

In the results of the present review, notable trends appeared that may suggest recent advancements in the measurement of affective responses (e.g., assessments considering the *in vivo* nature of core affect). For example, the timing of the assessments in more than half of the studies (58) included the collection of data pre-, during-, and post-exercise. As such, the common pitfall of prior studies, where only pre- to post-exercise assessments were completed and fluctuations of affect during exercise were obscured, is now less cause for concern (Backhouse et al., 2007). This improvement in methodology can support future research designs as it is now recognized that affective responses during exercise are acknowledged to be influential for motivational and behavioral outcomes associated with exercise (Backhouse et al., 2007; Rhodes & Kates, 2015; Teixeira et al., 2024; Williams, 2008).

Also noted is the trend to assess the affective response *immediately* after exercise/protocol termination, and for five- and 10-min post-exercise. This may reflect two distinct but relevant considerations. First, it is not always possible due to the nature of the activity to assess the FS/FAS during exercise (e.g., safety reasons); thus, measurements immediately after exercise termination may be the soonest opportunity to record data reflecting *in vivo* core affect. The use of five- and 10-min post-exercise assessments may reflect the intention to measure the affective consequence of the session; this is relevant when aiming to investigate the possible implications on other affect related outcomes (e.g., affective rebound). It warrants noting, however, that using the FS in a given period of time post-session does not account for a measure of affective recall (or remembered pleasure). Considerations regarding the specificity of each instrument are paramount for proper assessment and understanding of distinct but related affect constructs (Ekkekakis, 2013).

It also appears that an increasing body of research is aiming to produce a panorama of affective responses to exercise. Most studies comprising this review collected data across several time points (the most common approach to sampling was every 5 min). However, it is to be noted that the frequency of measurement varied dramatically across the reviewed studies (i.e., every 1-min to every 30-min). This variability in assessment may elicit some concerns given that responses can be influenced by temporal proximity (i.e., carry-over effect) as well as become a burden to participants required to complete excessive measurements (Zenko & Ladwig, 2021). Alternatively, assessments separated by substantial periods of time (e.g., 10 min apart) may also present a methodological limitation by failing to detect fluctuations in affect that may have gone unnoticed between the sampling intervals.

The variation in the number of data collection points across the studies is also of note, on average approximately six measurements were recorded per study. The number of measurements appeared to be determined by each study's aims and characteristics of the protocol (e.g., duration of the exercise session, warm-up, cool-down). However, numerous assessments are not always needed (e.g., one assessment in the fundamental stage of resistance training in advanced trainers is recommended; (Bastos et al., 2022)) or offer greater insight (Bastos et al., 2022; Hasselhorn et al., 2022). When aiming to understand affective fluctuations, perhaps choosing an adequate frequency to collect this data would be more relevant than to consider the number of assessments per session/exercise.

For the reasons discussed, caution is advised when interpreting these collective results. That said, a comprehensive collection of the most widely used timings, number of assessments, and frequency of scale application in continuous aerobic exercise is provided, and implications for future assessment and methodological advancements can now be contemplated when constructing research designs.

Scales presentation and familiarization

In summarizing the data of the reviewed studies, it is apparent that most studies did not report how the scales were presented and administered to participants. Perceptual instruments, like the FS and FAS, can be influenced by the conditions and methods of application (Haile et al., 2015). Therefore, to ensure the validity and reliability of an instrument, consideration of how the scale is to be used in practice is paramount during both the creation (i.e., time point) and application of the measure. Existing recommendations outline that the scales should be presented and explained both visually and orally (Haile et al., 2015; Hardy & Rejeski, 1989). Moreover, because the scales' scores can be plotted in the circumplex model of affect, suggestions to present them horizontally (FS) and vertically (FAS) have been forwarded (Ekkekakis, 2013; Evmenenko & Teixeira, 2022). On a final note, training with participants should be undertaken to ensure comprehension and accurate use of the instruments prior to data collection (Evmenenko & Teixeira, 2022; Haile et al., 2015). Most of the studies comprising this review did not report the method of application ($n = 47$), and about half of the studies did not indicate the inclusion of a familiarization session or prior training with the scales. Although absence of information is not necessarily an indication of absence of assessment rigor, these results are in line with limitations identified in previous reviews of the use of these scales (Bastos et al., 2023; Evmenenko & Teixeira, 2022; Henriques & Teixeira, 2023). When comparing with the application procedures and recommendations of the Borg scales (Borg, 1998), probably one of the most used perceptual scales in exercise science, the contrast between the absence of procedural indications of the FS and FAS and the detail presented for the Borg scales is considerable (Bok et al., 2022; N. Williams, 2017). As such, there is extensive scope for improvement to ensure proper methodological and operational recommendations for the use of the FS and FAS, despite no studies revealing limitations in the applicability or use of the scales.

Intensity domains and affective response changes from during to post-exercise

The categorization of the studies by intensity domains (i.e., very light, light, moderate, and heavy) aimed to clarify the importance of considering the timing of assessments in relation to the intensity of the exercise when interpreting the results. There are known relationships between exercise intensity and affective responses (Ekkekakis et al., 2020). Although there can be some individual variability, the predominant trend is an increase in the affective response until the occurrence of ventilatory threshold (beginning of the heavy domain), upon which a tendency to experience a decrease in pleasurable feelings starts to emerge (Ekkekakis et al., 2008, 2011). The results of the present review lend support to this previous evidence, as the affective responses registered were on average higher at intensities in the moderate domain (Ekkekakis et al., 2004, 2008, 2020).

Another relevant result pertains to the changes detected between the last measurement performed during exercise/protocol and the subsequent measures (i.e., affective rebound). As noted in the results, an improvement in the affective response after the exercise/protocol termination was present in most of the studies and across all intensities; this aligns with the findings of Ekkekakis and colleagues (Ekkekakis et al., 2011) for aerobic exercise, where more than 95% of participants presented a more positive affective response following the activity. The magnitude of this change varied across the intensity domains and the elapsed time between the last during-exercise measure and the post-exercise measures. Generally, the first and second post-measures depicted the greatest amplitude of change (when compared to the last during-exercise measure), with a diminishing effect as time after the exercise termination elapsed. It warrants highlighting that the affective rebound showed prolonged effects. Results showed that the largest increase in the FS scores and the largest decrease in the FAS scores occurred between the last during-exercise measurement and the first post-exercise measurement for all intensity domains. The only exception was for the FAS in the heavy domain, were the highest change occurred with some delay between the first and second post-session time points.

Collectively, these results indicate that the highest affective rebound scores are present in the moderate and heavy intensity domains, with a gradual improvement throughout he immediate the post-session minutes. These results may have implications for health promotion and exercise adherence interventions, given the theoretical implications of an individual's affect at the end of a session on exercise adherence, as postulated by the peak and end rule (Fredrickson, 2000; Hargreaves & Stych, 2013). Specifically, multiple studies have presented preliminary evidence suggesting that the recall of exercise-related affect and enjoyment, noted predictors of exercise adherence, may be dependent on the affect experienced at the end of the exercise session (Bastos et al., 2025; Stevens et al., 2020; Zenko et al., 2016). Therefore, a more nuanced understanding of the oscillation of affect during and following continuous aerobic exercise in relation to exercise intensity domains and their influence on affective rebound may constitute an exciting area of research that aims to promote individuals' motivation and adherence to exercise. Moreover, this can guide the consideration of future research efforts and organization of the exercise session, where the end of the session (e.g., cool-down) could be restructured aiming to support an affect regulation by providing a positive end-session affective response.

Operational recommendations to the application of the FS and FAS in continuous aerobic activities

This review highlights the need to understand how, when, and how often core affect assessment should be undertaken to ensure sound methodological and interpretable data. Based on our results in combination with existing theoretical support, and until additional studies present support to the enrichment of this topic, we suggest some methodological guidelines. Regarding *how*, prior training of the scales for the administrator and receiver is an important condition to assure a correct understanding and reporting of the constructs. Additionally, the results of the review support the proposal to visually present the scales horizontally (FS) and vertically (FAS; Ekkekakis, 2013; Evmenenko & Teixeira, 2022). As for *when*, current results show a considerable disparity on timing assessments. However, the majority of the studies collected data before, during, and after the exercise bouts; we suggest that this is the most appropriate methodology to follow (Backhouse et al., 2007). This could capture a baseline measurement, in-session fluctuations, and post-exercise affective consequences of the exercise (although focused on how one is feeling at that moment). As noted, the post-exercise assessments can vary in proximity to the end of the fundamental phase of the training, as well as the immediacy of the session's termination (i.e., immediately after cool-down) and some minutes post-session (e.g., recovery). Current results do not allow the proposal of clear guidelines on this matter, but both an immediate post-session and a short interval post-session assessment (e.g., 1-min after cool-down; 2-min after a session without a cool-down phase) could support insightful inquiry of these specific moments until further understanding of this topic is established. Finally, regarding *how often* there is a need to define an assessment frequency that captures affective fluctuations without performing excessive measurements (i.e., burdening the participant) or diminish data quality (e.g., carry-on effects). In practical fitness settings, professionals can integrate these brief FS/FAS assessments by leveraging natural transition points (e.g., water breaks or short rest intervals since the ratings are collected immediately after stopping) and, in fully continuous sessions where no pauses occur, by displaying the scale visually (e.g., a wall-mounted or projected FS/FAS chart) and using a subtle, pre-agreed cue that allows participants to self-report without interrupting movement, for instance, signaling their rating with their fingers in time with the activity. Thanks to the scales' simplicity and minimal cognitive burden, these check-ins can be carried out discreetly, preserving the technical flow, pedagogical rhythm, and musical structure of a continuous aerobic session. The results of this review tend to suggest that intervals of 5 minutes could be useful in protocols/bouts lasting over 10 minutes. However, this frequency can be adjusted in accordance with shorter or longer periods given that several training variables can impact affective responses; as such, a more refined understanding of affective fluctuations during exercise is needed. Moreover, the frequency of assessment may also be dependent on the exerciser's familiarity and adaptation to the proposed activity. Assessment frequency should be higher in the first sessions of a new exercise regimen and may be reduced in future and continuous repetitions of the sessions (e.g., throughout the mesocycle).

Study limitations and future directions

In addition to the methodological considerations noted across the studies comprising the present review, there are additional limitations relating to the parameters used in this study that warrant highlighting to assist in accurate interpretation of the findings as well as to guide future research. First, only studies of continuous aerobic exercise were considered in the inclusion criteria which may be viewed as both a limitation and an opportunity for future study. Specifically, the evaluation of methodological approaches in continuous aerobic exercise (i.e., the frequency and timing of assessments) can be extended to examine other modes of non-continuous exercise at alternative intensities (e.g., sprint interval training). On another note, the extensive heterogeneity of methodologies across the studies, in combination with the absence of clear guidelines detailing appropriate measurement technique in the administration of the scales, can create doubt in the interpretability and comparison of results across studies. Although there were evident trends in results across studies, future research would be well served by establishing systematic approaches to detailing how, when, and how often assessment of affect must be undertaken. Gaining consensus on methods of best practice in continuous aerobic activities, the most common and habitual mode of exercise, could advance both research and practice in the use of exercise prescription to promote physical and mental health outcomes.

It is important to emphasise that the overall risk of bias in the included studies, classified predominantly as "serious" or "moderate" due to methodological limitations such as lack of blinding, needs particular caution in the interpretation and extrapolation of our findings. This high risk of bias reduces the certainty of the conclusions regarding affective changes and underscores that the results should not be generalised without reservation. As such, this systematic review should be viewed as a preliminary mapping of the field and future research employing more rigorous and standardised methodologies is essential to strengthen the evidence base and allow for more confident conclusions.

One note must also be presented regarding the intensity domains criteria used. As reported, we used Binder and colleagues' (Binder et al., 2008) thresholds and physiological markers to determine the sessions/exercises intensity domain, which are aligned with previous guidelines (e.g., Stork et al., 2018). In each of the 53 studies distinct markers were used based on the indication of the respective protocol. Because of this, there is the possibility that some misclassification could exist when using the studies' sample mean scores, the existence of a single marker (e.g., RPE), the adequacy of some of the indicators (e.g., % max HR), and the experience intensity. As such, some intensities may slightly deviate from the determined classifications. Finally, considering that VT is a known marker for the identification of the expected transition from pleasure to displeasure experienced during exercise, methods that are not so precise in determining the proximity of this marker may obscure the correct association between the experienced affect and the exercise intensity.

Finally, in this review, the period after the main phase/fundamental stage, regardless of the existence of a cool-down phase, was considered as post-exercise/protocol. Although only 8 studies reported the inclusion of a cool-down phase, in these cases the FS/FAS calculations and interpretations reflect a stage of transition (vs. an abrupt stop of the main phase and cessation of PA). When attempting to interpret differences between the last intra main phase measurement (which was derived from varying durations from the respective phase end) and the post main phase assessments, some could reflect higher or lower magnitudes of change due to these characteristics of the exercise session. As such, the calculation of changes in affect must be viewed with caution and are best suited to highlight the direction and magnitude of change within the study, rather than comparisons between studies where it may be tempting to propose effects that are extrapolatable for similar situations, intensities, and contexts. For that purpose, a line of research focusing on assessments taken at different timings and intensities of exercise sessions, in relation to protocols with or without cool-down periods, is required to advance knowledge of the influence of session end-affect on motivation and adherence to exercise.

CONCLUSION

The results of the present review suggest that the FS and the FAS are contextually appropriate for use in continuous aerobic activities and elucidate affective responses across multiple modes of PA. However, in review of the variability of application of the scales in the extant research literature, future research can benefit from methodological guidelines that outline considerations for effective use of the scales yet afford flexibility across the wide range of research undertaken to examine affective responses within diverse modes of exercise and research protocols. Findings reported across more than 50 studies indicate that generally the scores reflecting the most positive affective response were observed in exercise/protocols completed at a moderate intensity. Further, clear indication of the existence of affective rebound was present within all intensities of exercise, albeit they were more pronounced in the moderate and heavy intensity domains. Additionally, a prolonged affective rebound was observed in the light, moderate, and heavy domains in the minutes following exercise sessions. This observation can be used to guide future study of the role of exercise intensity in interventions aiming to improve exercise adherence and motivation.

The mounting evidence regarding these instruments' applicability within diverse exercise settings and modes appears to confirm their adequacy for advancing understanding of the affective panorama an individual experiences before, during, and following exercise. Guidelines for the application of these scales in continuous aerobic activities are presented for consideration to enhance scientific rigor and advance applied efforts directed towards health promotion. The next steps for the progression of affective response measurement relates to the creation, definition, and consensus of methodological guidelines for the instruments' application and interpretation across a greater diversity of exercise conditions, thus supporting related research targeting motivation for physical activity and sustainable engagement in health behaviors.

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Author's contribution

All authors contributed to the study's conception and design. The idea of this systematic review belongs to Diogo Teixeira. The literature search, data analysis, and draft were performed by Filipe Santos, Paul Davis, and Diogo Teixeira and the final critical revision was made by Filipe Santos, Paul Davis, and Diogo Teixeira.

Declaration of interest statement

No potential conflict of interest was reported by the author(s).

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Supplementary Table 1. FS comparison values (last during exercise vs. all post-exercise assessments)

Author (s)	Intensity domain at the end of the session	FS range	FS0 ⇢ FS1	FS1 ⇢ FS2	FS2 ⇢ FS3	FS3 ⇢ FS4	FS4 ⇢ FS5	FS5 ⇢ FS6	FS6 ⇢ FS7	FS7 ⇢ FS8	FS8 ⇢ FS9
Edwards et al. (2018)	Very light exercise	(3.05 to 4.10 = 1.05)	(+0.58 = ↑55 %)								
Focht (2009)	Very light exercise	**Outdoor environment** (2.54 to 3.86 = 1.32); **Laboratory environment** (2.02 to 3.20 = 1.18)	**Outdoor environment** (+0.19 = ↑14%); **Laboratory environment** (+0.38 = ↑32%)	**Outdoor environment** (-0.37 = ↓28%); **Laboratory environment** (-0.12 = ↓10%)							
		FS range	**FS0 ⇢ FS1**	**FS1 ⇢ FS2**	**FS2 ⇢ FS3**	**FS3 ⇢ FS4**	**FS4 ⇢ FS5**	**FS5 ⇢ FS6**	**FS6 ⇢ FS7**	**FS7 ⇢ FS8**	**FS8 ⇢ FS9**
Mean values for affective response changes in very light intensity exercise		**1.18**	**↑ 32%**	**↓ 9%**							
Cox et al. (2018)	Light exercise	**Mindfulness condition** (1.0 to 3.4 = 2.4); **Control condition** (0.6 to 3.3 = 2.7)	**Mindfulness condition** (+1.4 = - ↑58%); **Control condition** (+1.4 = ↑51%)	**Mindfulness condition** (+1.0 = - ↑42%); **Control condition** (+1.3 = - ↑48%)							
Heinrich et al. (2020)	Light exercise	(1.8 to 2.5 = 0.7)	(+0.1 = ↑14%)								

Author (s)	Intensity domain at the end of the session	FS range	FS0 ⇢ FS1	FS1 ⇢ FS2	FS2 ⇢ FS3	FS3 ⇢ FS4	FS4 ⇢ FS5	FS5 ⇢ FS6	FS6 ⇢ FS7	FS7 ⇢ FS8	FS8 ⇢ FS9
Niedermeier et al. (2017)	Light exercise	**Outdoor mountain hiking** (2.7 to 4.1 = 1.4); **Indoor treadmill walking** (1.4 to 2.7 = 1.4); **Sedentary control condition** (1.7 to 2.5 = 0.8)	**Outdoor mountain hiking** (-0.1 = ↓7%); **Indoor treadmill walking** (+0.5 = ↑36%); **Sedentary control condition** (-0.7 = ↓88%)								
Oliveira et al. (2015)	Light exercise	**Self-selected** (1.4 to 2.7 = 1.3); **Imposed** (1.5 to 2.8 = 1.3)	**Self-selected** (+0.8 = ↑62%); **Imposed** (+0.8 = ↑62%)	**Self-selected** (+0.3 = ↑23%); **Imposed** (+0.1 = ↑8%)	**Self-selected** (+0.2 = ↑15%); **Imposed** (+0.4 = ↑31%)						
Parfitt et al. (2006)	Light exercise	(3.3 to 4.2 = 0.9)	**Below-LT** (0.0)	**Below-LT** (0.0)	**Below-LT** (+0.3 = ↑33%)						
Pessoa et al. (2022)	Light exercise	**Mental fatigue** (0.0 to 3.3 = 3.3); **Control** (1.2 to 3.5 = 2.3)	**Mental fatigue** (+1.1 = 33↑%); **Control** (+1.7 = ↑74%)								
Rose & Parfitt (2007)	Light exercise	(2.39 to 3.56 = 1.17)	**Self-Selected** (+0.28 = ↑24%)	**Self-Selected** (+0.22 = ↑18%)	**Self-Selected** (+0.28 = ↑24%)						
Stork et al.	Light	(1.0 to 2.7 =	(+0.1 = ↑6%)	(+0.7 = ↑41%)	(+0.4 =						

Author (s)	Intensity domain at the end of the session	FS range	FS0 ⇢ FS1	FS1 ⇢ FS2	FS2 ⇢ FS3	FS3 ⇢ FS4	FS4 ⇢ FS5	FS5 ⇢ FS6	FS6 ⇢ FS7	FS7 ⇢ FS8	FS8 ⇢ FS9
(2018)	exercise	1.7)			↑24%)						
		FS range	**FS0 ⇢ FS1**	**FS1 ⇢ FS2**	**FS2 ⇢ FS3**	**FS3 ⇢ FS4**	**FS4 ⇢ FS5**	**FS5 ⇢ FS6**	**FS6 ⇢ FS7**	**FS7 ⇢ FS8**	**FS8 ⇢ FS9**
Mean values for affective response changes in light intensity exercise		**1,4**	**↑29%**	**↑ 23%**	**↑ 24%**						
Alicea et al. (2020)	Moderate exercise	(1.5 to 4.0 = 2.5)	(+2.5 = ↑100%)								
Barnett (2013)	Moderate exercise	**Younger women** (-0.35 to 4.34 = 4.69); **Older women** (0.31 to 4.71 = 5.02)	**Younger women** (+0.56 = ↑12%); **Older women** (+1.04 = ↑21%)								
Bird et al. (2019)	Moderate exercise	**360 video + music** (2.9 to 4.4 = 1.5); **360 video** (2.8 to 4.3 = 1.5); **Music-video** (2.6 to 4.4 = 1.8); **Music** (2.3 to 4.1 = 1.8) **Video** (2.6 to 4.2 = 1.6); **Control** (2.5 to 4.3 = 1.8)	**360 video + music** (+1.1 = ↑73%); **360 video** (+0.8 = ↑53%); **Music-video** (+1.0 = ↑56%); **Music** (+1.1 = ↑ 61%) **Video** (+0.4 = ↑25%); **Control** (+1.0 = ↑56%)	**360 video + music** (+0.1 = ↑7%); **360 video** (+0.5 = -↑33%); **Music-video** (+0.5 = ↑-28%); **Music** (+0.6 = ↑33%) **Video** (+0.5 = 31%); **Control** (+0.3 = ↑17%)	**360 video + music** (+0.3 = ↑20%); **360 video** (+0.2 = ↑13%); **Music-video** (+0.3 = -↑17%); **Music** (+0.1 = ↑6%) **Video** (+0.6 = ↑38%); **Control** (+0.3 =						

Author (s)	Intensity domain at the end of the session	FS range	FS0 ⇢ FS1	FS1 ⇢ FS2	FS2 ⇢ FS3	FS3 ⇢ FS4	FS4 ⇢ FS5	FS5 ⇢ FS6	FS6 ⇢ FS7	FS7 ⇢ FS8	FS8 ⇢ FS9
					↑17%)						
Dierkes et al. (2021)	Moderate exercise	(-0.12 to 4.46 = 4.58)	**MICE** - (+0.2 = - ↑4%)								
Giles et al. (2018)	Moderate exercise	**No instruction** (2.33 to 3.63 = 1.30); **Cognitive reappraisal instruction** (1.92 to 3.21 = 1.29); **Distraction instruction** (2.13 to 3.50 = 1.37)	**No instruction** (+0.67 = ↑52%); **Cognitive reappraisal instruction** (+0.25 = ↑19%); **Distraction instruction** (+0.87 = ↑64%)								
Kilpatrick et al. (2015)	Moderate exercise	**20% below VT** (2.3 to 3.0 = 0.7)	**20% below VT** (+0.7 = ↑100%)	**20% below VT** (0.0)							
Niven et al. (2018)	Moderate exercise	**15% below VT** (2.1 to 3.3 = 1.2)	**15% below VT** (+0.1 = ↑8%)	**15% below VT** (+0.7 = ↑58%)	**15% below VT** (0.0)	**15% below VT** (+0.2 = ↑17%)					
Parfitt el al. (2006)	Moderate exercise	(2.7 to 3.8 = 1.1)	**Self-Selected** (-0.1 = ↓9%)	**Self-Selected** (-0.2 = ↓18%)	**Self-Selected** (+0.1 = ↑9%)						
Rose & Parfitt (2007)	Moderate exercise	(1.0 to 2.94 = 1.94)	**At-LT** (+0.83 = ↑43%)	**At-LT** (+1.00 = ↑52%)	**At-LT** (-0.17 = ↓9%)						

Author (s)	Intensity domain at the end of the session	FS range	FS0 ⇢ FS1	FS1 ⇢ FS2	FS2 ⇢ FS3	FS3 ⇢ FS4	FS4 ⇢ FS5	FS5 ⇢ FS6	FS6 ⇢ FS7	FS7 ⇢ FS8	FS8 ⇢ FS9
Shin et al. (2014)	Moderate exercise	(-0.73 to 1.80 = 2.53	(+1.07 = ↑42%)	(+0.20 = ↑8%)							
Slawinska & Davis (2020)	Moderate exercise	(2.1 to 3.7 = 1.6)	(+0.5 = ↑31%)	(+0.1 = ↑6%)	(+0.1 = ↑6%)	(-0.4 = ↓25%)	(-0.7 = ↓44%)	(-0.5 = ↓31%)	(+0.5 = ↑31%)	(0.0)	
Welch et al. (2010)	Moderate exercise	**Full knowledge of exercise duration** (0.94 to 2.71 = 1.77); **No knowledge of exercise duration** (0.04 to 2.56 = 2.52)	**Full knowledge of exercise duration** (+0.06 = ↑3%); **No knowledge of exercise duration** (-0.38 = ↓15%)	**Full knowledge of exercise duration** (+1.11 = ↑63%); **No knowledge of exercise duration** (+1.81 = ↑72%)							
		FS range	**FS0 ⇢ FS1**	**FS1 ⇢ FS2**	**FS2 ⇢ FS3**	**FS3 ⇢ FS4**	**FS4 ⇢ FS5**	**FS5 ⇢ FS6**	**FS6 ⇢ FS7**	**FS7 ⇢ FS8**	**FS8 ⇢ FS9**
Mean values for affective response changes in moderate intensity exercise		**1.77**	**↑ 42%**	**↑ 29.5%**	**↑ 11%**	**↓ 4%**	↓44%	**↓31%**	↓31%	**0**	
Ali et al. (2017)	Heavy exercise	**Placebo rinse** (-1.9 to 0.1 = 2.0); **Placebo ingestion** (-1.8 to 0.2 = 2.0); **Carbohydrate rinse** (-0.8 to 1.1 = 1.9); **Carbohydrate ingestion** (-0.8 to 0.3 =1.1)	**Placebo rinse** (+0.9 = ↑45%); **Placebo ingestion** (-0.4 = ↓20%); **Carbohydrate rinse** (+0.3 = ↑27%); **Carbohydrate ingestion** (+0.5 = **-** ↑26%)								

Author (s)	Intensity domain at the end of the session	FS range	FS0 ⇢ FS1	FS1 ⇢ FS2	FS2 ⇢ FS3	FS3 ⇢ FS4	FS4 ⇢ FS5	FS5 ⇢ FS6	FS6 ⇢ FS7	FS7 ⇢ FS8	FS8 ⇢ FS9
Alvarez-Alvarado et al. (2019)	Heavy exercise	(-3.6 to 2.7 = 6.3)	(-0.9 = ↓14%)	(+4.6 = ↑73%)	(+0.8 = ↑13%)						
Dierkes et al. (2021)	Heavy exercise	(-0.12 to 4.46 = 4.58)	**VICE** - (+0.4 = ↑9%)								
Ekkekakis et al. (2004)	Heavy exercise	**Group A** - (-1.5 to 2.2 = 3.7); **Group B** - (-2.0 to 3.1 = 5.1)	**Group A** - (-1.5 = ↓41%); **Group B** - (-0.9 = ↓18%)								
Ekkekakis et al. (2008)	Heavy exercise	**>VT** (0.6 to 3.5 = 2.9)	**>VT** (+2.7 = ↑93%)	**>VT** (-0.1 = ↓3%)	**>VT** (0.0)						
Ekkekakis et al. (2010)	Heavy exercise	**Normal weight** (1.5 to 2.9 = 1.4); **Overweight** (1.0 to 3.0 = 2.0)	**Normal weight** (-1.2 = ↓86%); **Overweight** (-0.9 = ↓45%)								
Hall et al. (2002)	Heavy exercise	(-1.48 to 2.90 = 4.38)	(-1.55 = ↓35%)	(+4.24 = ↑97%)	(+0.14 = ↑3%)						

Author (s)	Intensity domain at the end of the session	FS range	FS0 ⇢ FS1	FS1 ⇢ FS2	FS2 ⇢ FS3	FS3 ⇢ FS4	FS4 ⇢ FS5	FS5 ⇢ FS6	FS6 ⇢ FS7	FS7 ⇢ FS8	FS8 ⇢ FS9
Hutchinson et al. (2015)	Heavy exercise	**10% above VT: Music only** (2.2 to 3.2 = 1.0) **Music and video** (2.3 to 3.4 = 1.1); **Control** (0.9 to 2.9 = 2.0)	**10% above VT: Music only** (+1.0 = ↑100%); **Music and video** (+1.0 = ↑90%); **Control** (+2.0 = ↑100%)								
Jones et al. (2014)	Heavy exercise	**Available data does not allow to calculate the range**									
Kilpatrick et al. (2007)	Heavy exercise	**105% VT** (0.0 to 2.9 = 2.9)	**105% VT** (+2.1 = -↑72%)	**105% VT** (+0.5 = -↑17%)							
Kilpatrick et al. (2015)	Heavy exercise	**At VT** (0.9 to 2.7 = 1.8)	**At VT** (+1.1 = ↑61%)	**At VT** (+0.7 = ↑39%)							
Niven et al. (2018)	Heavy exercise	**5% above VT** (0.7 to 2.4 = 1.7)	**5% above VT** (+0.3 = ↑18%)	**5% above VT** (+0.4 = ↑24%)	**5% above VT** (+0.7 = -↑41%)	**5% above VT** (+0.2 = -↑12%)					
Oliveira et al. (2013)	Heavy exercise	(0.8 to 3.6 = 2.8)	(+2.8 = ↑100%)								
Parfitt el al. (2006)	Heavy exercise	(-0.8 to 3.3 = 4.1)	**Above-LT** (+4.0 = ↑98%)	**Above-LT** (+1.0 = ↑24%)	**Above-LT** (0.0)						

Author (s)	Intensity domain at the end of the session	FS range	FS0 ⇢ FS1	FS1 ⇢ FS2	FS2 ⇢ FS3	FS3 ⇢ FS4	FS4 ⇢ FS5	FS5 ⇢ FS6	FS6 ⇢ FS7	FS7 ⇢ FS8	FS8 ⇢ FS9
Rose & Parfitt (2007)	Heavy exercise	(-1.89 to 3.06 = 4.95)	**Above-LT** (+2.83 = ↑57%)	**Above-LT** (+1.84 = ↑37%)	**Above-LT** (+0.28 = ↑6%)						
Rose & Parfitt (2012)	Heavy exercise	**Sedentary: Self-selected** (2.06 to 3.36 = 1.30); **Active: Self-selected** (2.94 to 4.22 = 1.28)	**Sedentary: Self-selected** (+0.95 = - ↑73%); **Active: Self-selected** (+0.82 = ↑64%)	**Sedentary: Self-selected** (+0.17 = - ↑13%); **Active: Self-selected** (-0.16 = ↓13%)							
Slawinska & Davis (2020)	Heavy exercise	(1.1 to 2.3 = 1.2)	(-0.2 = ↓17%)	(-0.1 = ↓8%)	(-0.1 = ↓8%)	(-0.2 = ↓17%)	(+0.7 = ↑58%)	(+0.3 = ↑25%)	(-0.3 = ↓25%)	(0.0)	(-0.4 = ↓33%)
Turner & Stevinson (2017)	Heavy exercise	**Outdoor green** (1.5 to 3.5 = 2.0); **Indoor gym** (1.3 to 3.0 = 1.7)	**Outdoor green** (-0.4 = ↓20%); **Indoor gym** (-1.2 = ↓71%)	**Outdoor green** (+2.0 = ↑100%); **Indoor gym** (+1.7 = ↑100%)							
Tyler & Sunderland (2011)	Heavy exercise	**Cooling collar** (-2.6 to 3.0 = 5.6); **No collar** (-2.4 to 3.5 = 5.9)	**Cooling collar** (-3.4 = ↓60%); **No collar** (-3.7 = ↓63%)								
Welch et al. (2007)	Heavy exercise	(-2.05 to 2.79 = 4.84)	(+3.84 = 79%)	(+0.46 = ↑10%)	(+0.43 = ↑9%)	(+0.11 = ↑2%)					
		FS range	**FS0 ⇢ FS1**	**FS1 ⇢ FS2**	**FS2 ⇢ FS3**	**FS3 ⇢ FS4**	**FS4 ⇢ FS5**	**FS5 ⇢ FS6**	**FS6 ⇢ FS7**	**FS7 ⇢ FS8**	**FS8 ⇢ FS9**
Mean values for affective response changes in heavy		**2.00**	**↑ 27%**	**↑ 24%**	**↑ 5%**	**↑ 2%**	**↑ 58%**	**↑ 25%**	**↓ 25%**	**0%**	**↓ 33%**

Author (s)	Intensity domain at the end of the session	FS range	FS0 ⇢ FS1	FS1 ⇢ FS2	FS2 ⇢ FS3	FS3 ⇢ FS4	FS4 ⇢ FS5	FS5 ⇢ FS6	FS6 ⇢ FS7	FS7 ⇢ FS8	FS8 ⇢ FS9
intensity exercise											

Note. FS = feeling scale; FS0 = last FS measurement during exercise; FS1 = first post-exercise FS assessment; FS2 = second post-exercise FS assessment; FS3 = third post-exercise FS assessment; FS4 = fourth post-exercise FS assessment; FS5 = fifth post-exercise FS assessment; FS6 = sixth post-exercise FS assessment; FS7 = seventh post-exercise FS assessment; FS8 = eighth post-exercise FS assessment; FS9 = ninth post-exercise FS assessment; VT = ventilatory threshold; MICE = moderate intensity continuous exercise; VICE = vigorous intensity continuous exercise; LT = lactate threshold.

Supplementary Table 2. FAS comparison values (last during exercise vs. all post-exercise assessments)

Author (s)	Intensity domain at the end of the session	FAS range	FAS0 ⇢ FAS1	FAS1 ⇢ FAS2	FAS2 ⇢ FAS3	FAS3 ⇢ FAS4	FSA4 ⇢ FS5
Edwards et al. (2018)	Very light exercise	(1.90 to 3.20 = 1.30)	(+0.10 = ↑8%)				
Focht (2009)	Very light exercise	**Outdoor environment** (3.51 to 4.54 = 1.03); **Laboratory environment** (3.09 to 4.17 = 1.08)	**Outdoor environment** (-0.08 = ↓8%); **Laboratory environment** (+0.08 = ↑7%)	**Outdoor environment** (-0.75 = ↓73%); **Laboratory environment** (-1.08 = ↓100%)			
		FAS range	**FAS0 ⇢ FAS1**	**FAS1 ⇢ FAS2**	**FAS2 ⇢ FAS3**	**FAS3 ⇢ FAS4**	**FAS4 ⇢ FAS5**
Mean values for perceived activation changes in very light intensity exercise		**1.1**	**↑2.3%**	**↓ 86.5%**			
Heinrich et al. (2020)	Light exercise	(1.6 to 3.0 = 1.4)	(-0.9 = ↓64%)				

Author (s)	Intensity domain at the end of the session	FAS range	FAS0 ⇢ FAS1	FAS1 ⇢ FAS2	FAS2 ⇢ FAS3	FAS3 ⇢ FAS4	FSA4 ⇢ FS5
Niedermeier et al. (2017)	Light exercise	**Outdoor mountain hiking** (2.5 to 3.2 = 0.7); **Indoor treadmill walking** (2.8 to 3.1 = 0.3); **Sedentary control condition** (1.9 to 2.5 = 0.6)	**Outdoor mountain hiking** (-0.1 = ↓14%); **Indoor treadmill walking** (0.0); **Sedentary control condition** (-0.1 = ↓17%)				
Oliveira et al. (2015)	Light exercise	**Self-selected** (2.2 to 4.0 = 1.8); **Imposed** (2.4 to 4.3 = 1.9)	**Self-selected** (0.5 = ↓28%); **Imposed** (-1.1 = ↓58%)	**Self-selected** (-0.5 = ↓28%); **Imposed** (-0.5 = ↓26%)	**Self-selected** (-0.2 = ↓11%); **Imposed** (-0.2 = ↓11%)		
Parfitt et al. (2006)	Light exercise	(2.9 to 3.4 = 0.5)	**Below-LT (**-0.1 = ↓20%**)**	**Below-LT (**-0.1 = ↓20%**)**	**Below-LT (**+0.4 = ↑80%**)**		
Rose & Parfitt (2007)	Light exercise	(3.22 to 4.78 = 1.56)	**Self-Selected** (-0.72 = ↓46%)	**Self-Selected** (0.0)	**Self-Selected** (+0.11 = ↑7%)		
Stork et al. (2018)	Light exercise	(1.1 to 3.3 = 2.2)	(-0.1 = ↓5%)	(-1.1 = ↓50%)	(-0.2 = ↓10%)	(-0.6 = ↓27%)	(-0.3 = ↓14%)
		FAS range	**FAS0 ⇢ FAS1**	**FAS1 ⇢ FAS2**	**FAS2 ⇢ FAS3**	**FAS3 ⇢ FAS4**	**FAS4 ⇢ FAS5**
Mean values for perceived activation changes in light intensity exercise		**1.2**	**↓ 28%**	**↓ 24.8%**	**↑ 11%**	**↓ 27%**	**↓ 14%**
Alicea et al. (2020)	Moderate exercise	(2.4 to 4.3 = 1.9)	(-1.1 = ↓58%)				
Barnett (2013)	Moderate exercise	**Younger woman** (3.00 to 3.76 = 0.76); **Older women** (3.16 to 3.80 = 0.64)	**Younger women** (+0.32 = ↑42%); **Older women** (+0.56 = ↑88%)				

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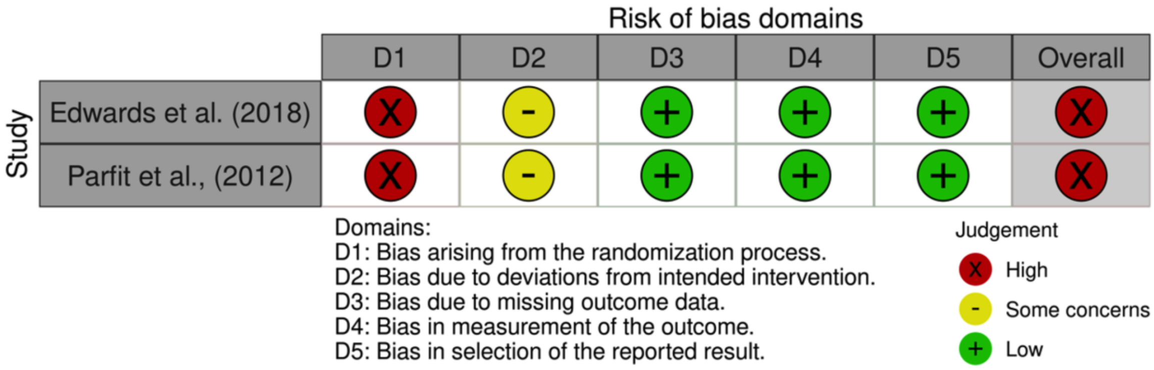
Author (s)	Intensity domain at the end of the session	FAS range	FAS0 ⇢ FAS1	FAS1 ⇢ FAS2	FAS2 ⇢ FAS3	FAS3 ⇢ FAS4	FSA4 ⇢ FS5
Bird et al. (2019)	Moderate exercise	**360 video + music** (1.3 to 3.6 = 2.3); **360 video** (1.4 to 3.4 = 2.0); **Music-video** (1.3 to 3.3 = 2.0); **Music** (1.5 to 2.8 = 1.3) **Video** (1.5 to 2.8 = 1.3); **Control** (1.3 to 2.8 = 1.5)	**360 video + music** (-1.5 = ↓65%); **360 video** (-1.3 = ↓65%); **Music-video** (-1.2 = ↓60%); **Music** (-0.7 = ↓54%) **Video** (-0.9 = ↓69%); **Control** (-0.9 = ↓60%)	**360 video + music** (-0.4 = ↓17%); **360 video** (-0.4 = ↓20%); **Music-video** (-0.3 = ↓15%); **Music** (-0.3 = ↓23%) **Video** (-0.2 = ↓15%); **Control** (-0.3 = ↓20%)	**360 video + music** (-0.4 = ↓17%); **360 video** (-0.3 = ↓15%); **Music-video** (-0.5 = ↓25%); **Music** (-0.2 = ↓15%) **Video** (-0.2 = ↓15%); **Control** (-0.3 = ↓20%)		
Giles et al. (2018)	Moderate exercise	**No instruction** (1.91 to 3.22 = 1.31); **Cognitive reappraisal instruction** (1.48 to 2.78 = 1.30); **Distraction instruction** (1.65 to 2.87 = 1.22)	**No instruction** (-0.83 = ↓63%); **Cognitive reappraisal instruction** (-0.44 = ↓34%); **Distraction instruction** (-0.40 = ↓33%)				
Kilpatrick et al. (2007)	Moderate exercise	**85% VT** (3.1 to 4.1 = 1.0)	**85% VT** (-0.3 = ↓30%)	**85% VT** (-0.7 = ↓70%)			
Niven et al. (2018)	Moderate exercise	**15% below VT** (1.6 to 3.0 = 1.4)	**15% below VT** (-0.6 = ↓43%)	**15% below VT** (-0.6 = ↓43%)	**15% below VT** (-0.1 = ↓7%)	**15% below VT** (+0.1 = ↑7%)	
Parfitt el al. (2006)	Moderate exercise	(3.4 to 4.3 = 0.9)	**Self-Selected** (-0.3 = ↓33%)	**Self-Selected** (-0.1 = ↓11%)	**Self-Selected** (-0.2 = ↓22%)		
Rose & Parfitt (2007)	Moderate exercise	(2.94 to 4.33 = 1.39)	**Below-LT** (-0.89 = ↓64%)	**Below-LT** (-0.22 = ↓16%)	**Below-LT** (+0.06 = ↑4%)		

Author (s)	Intensity domain at the end of the session	FAS range	FAS0 ⇢ FAS1	FAS1 ⇢ FAS2	FAS2 ⇢ FAS3	FAS3 ⇢ FAS4	FSA4 ⇢ FS5
Rose & Parfitt (2012)	Moderate exercise	**Sedentary: Prescribed** (2.95 to 4.13 = 1.18); **Active: Prescribed** (3.36 to 4.00 = 0.64)	**Sedentary: Prescribed** (+0.35 = ↑30%); **Active: Prescribed** (-0.25 = ↓39%)	**Sedentary: Prescribed** (+0.42 = ↑36%); **Active: Prescribed** (-0.39 = ↓61%)			
		FAS range	**FAS0 ⇢ FAS1**	**FAS1 ⇢ FAS2**	**FAS2 ⇢ FAS3**	**FAS3 ⇢ FAS4**	**FAS4 ⇢ FAS5**
Mean values for perceived activation changes in moderate intensity exercise		**1.3**	**↓33.9%**	**↓22.9%**	**↓14%**	↑7%	
Ali et al. (2017)	Heavy exercise	**Placebo rinse** (2.8 to 3.9 = 1.1); **Placebo ingestion** (2.5 to 4.3 = 1.8); **Carbohydrate rinse** (2.8 to 4.2 = 1.4); **Carbohydrate ingestion** (2.9 to 4.2 = 1.3)	**Placebo rinse** (+0.3 = ↑27%); **Placebo ingestion** (+0.6 = ↑55%); **Carbohydrate rinse** (+0.4 = ↑36%); **Carbohydrate ingestion** (+0.3 = ↑27%)				
Alvarez-Alvarado et al. (2019)	Heavy exercise	(1.4 to 5 = 3.6)	(+0.4 = ↑11%)	(-1.1 = ↓31%)	(-0.8 = ↓22%)		
Ekkekakis et al. (2004)	Heavy exercise	**Group A** - (2.7 to 4.6 = 1.9); **Group B** - (2.3 to 5.0 = 2.7)	**Group A** - (+0.2 = ↑11%); **Group B** - (+0.3 = ↑16%)				
Ekkekakis et al. (2008)	Heavy exercise	(1.8 to 4.4 = 2.6)	(-1.9 = ↓73%)	(-0.7 = ↓27%)	(-0.2 = ↓8%)		
Hall et al. (2002)	Heavy exercise	(2.14 to 4.83 = 2.69)	(+0.18 = ↑7%)	(-1.24 = ↓46%)	(-0.49 = ↓18%)		
Kilpatrick et al. (2007)	Heavy exercise	**105% VT** (3.0 to 4.1 = 1.1)	**105% VT** (-0.2 = ↓18%)	**105% VT** (-0.6 = ↓55%)			

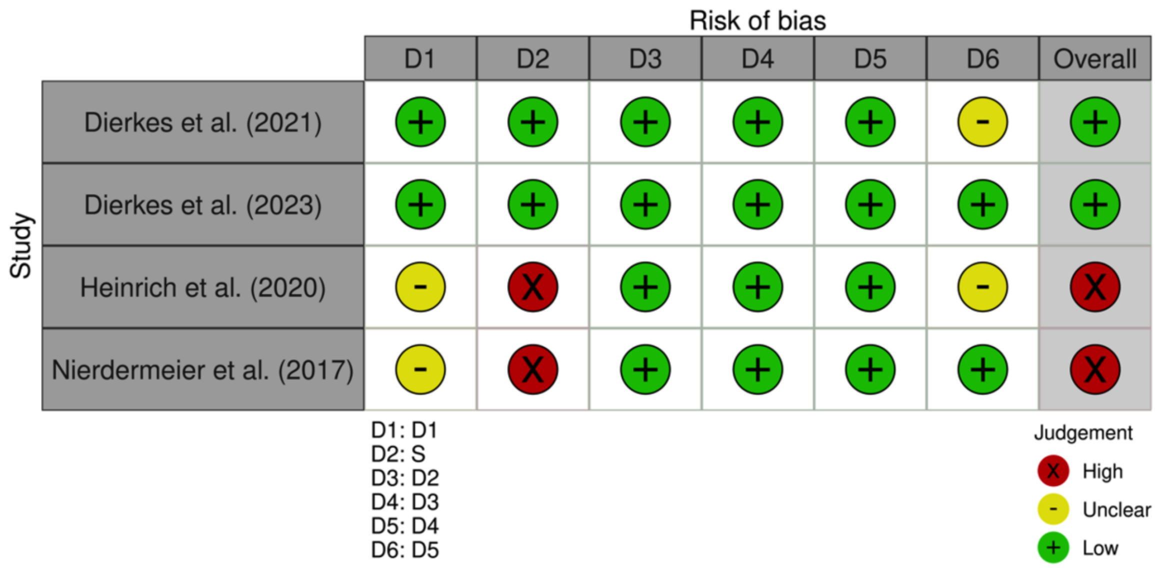
Author (s)	Intensity domain at the end of the session	FAS range	FAS0 ⇢ FAS1	FAS1 ⇢ FAS2	FAS2 ⇢ FAS3	FAS3 ⇢ FAS4	FSA4 ⇢ FS5
Niven et al. (2018)	Heavy exercise	**5% above VT** (1.6 to 4.0 = 2.4)	**5% above VT** (-0.8 = ↓33%)	**5% above VT** (-0.8 = ↓33%)	**5% above VT** (-0.3 = ↓13%)	**5% above VT** (-0.3 = ↓13%)	
Oliveira et al. (2013)	Heavy exercise	(2.47 to 4.20 = 1.73)	(-1.73 = ↓100%)				
Parfitt el al. (2006)	Heavy exercise	(2.9 to 3.7 = 0.8)	**Above-LT** (+0.1 = ↑13%)	**Above-LT** (0.0)	**Above-LT** (-0.2 = ↓25%)		
Rose & Parfitt (2012)	Heavy exercise	**Sedentary: Self-selected** (2.83 to 4.31 = 1.48); **Active: Self-selected** (3.00 to 4.11 = 1.11)	**Sedentary: Self-selected** (+0.19 = ↑13%); **Active: Self-selected** (-0.36 = ↓32%)	**Sedentary: Self-selected** (-0.23 = ↓16%); **Active: Self-selected** (-0.39 = ↓35%)			
Turner & Stevinson (2017)	Heavy exercise	**Outdoor green** (2.1 to 4.9 = 2.8); **Indoor gym** (2.2 to 4.7 = 2.5)	**Outdoor green** (+1.4 = ↑50%); **Indoor gym** (+1.3 = ↑52%)	**Outdoor green** (-1.9 = ↓68%); **Indoor gym** (-0.19 = ↓8%)			
Welch et al. (2007)	Heavy exercise	(2.05 to 4.58 = 2.53)	(-1.29 = ↓51%)	(-1.39 = ↓55%)	(-0.37 = ↓15%)	(-0.11 = ↓4%)	
		FAS range	**FAS0 ⇢ FAS1**	**FAS1 ⇢ FAS2**	**FAS2 ⇢ FAS3**	**FAS3 ⇢ FAS4**	**FAS4 ⇢ FAS5**
Mean values for perceived activation changes in heavy intensity exercise		**1.97**	**↓ 0.8%**	**↓ 34%**	**↓ 16.8%**	**↓ 8.5%**	

Note. FAS = feeling scale; FAS0 = last FAS measurement during exercise; FAS1 = first post-exercise FAS assessment; FAS2 = second post-exercise FAS assessment; FAS3 = third post-exercise FAS assessment; FAS4 = fourth post-exercise FAS assessment; FAS5 = fifth post-exercise FAS assessment; VT = ventilatory threshold; LT = lactate threshold.

Supplementary Figure 1. Risk of bias assessment of the included randomized controlled trials

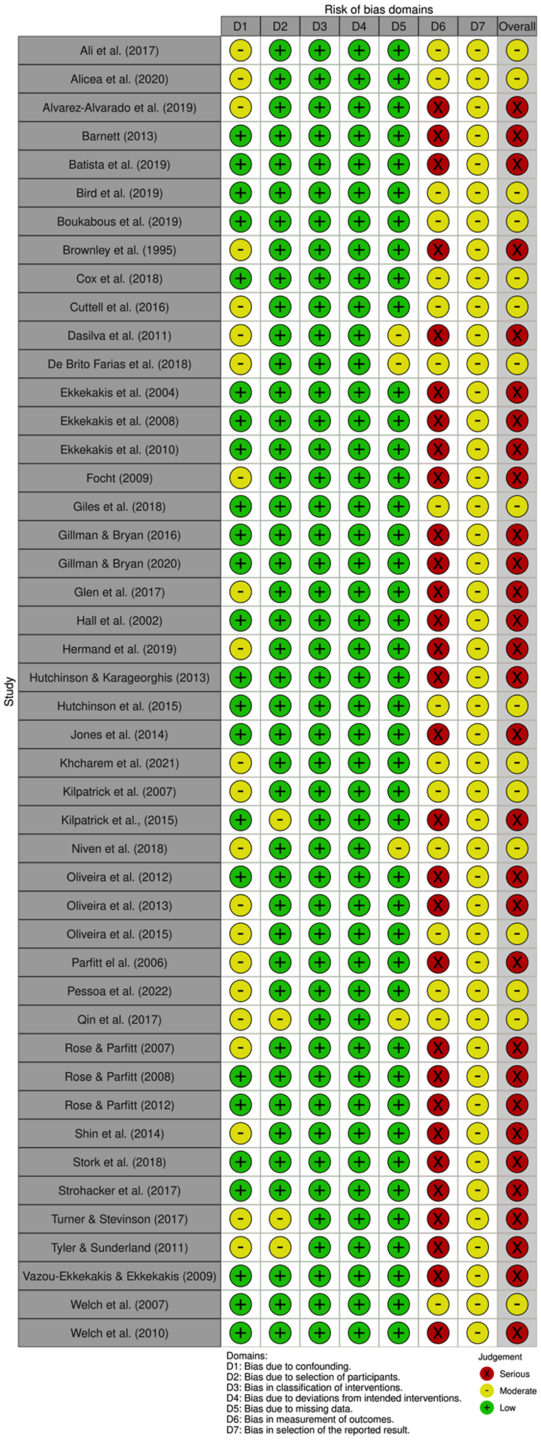


Supplementary Figure 2. Risk of bias assessment of the included randomized crossover trials



Assessing affective responses to continuous aerobic exercise with the feeling scale and the felt arousal scale: A systematic review

Supplementary Figure 3. Risk of Bias assessment of the included quasi-experimental studies



Sociedad Iberoamericana de Psicología del Deporte

Appendix 1. PRISMA 2020 Checklist

Section and Topic	Item #	Checklist item	Location where item is reported
TITLE			
Title	1	Identify the report as a systematic review.	Page 1
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	Page 2-4
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	Pages 5-8
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	Page 8
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	Page 8
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	Page 8-9
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	Page 8-9; full strategy in Appendix 6 (Page 67)
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	Page 9
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	Page 9-10
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	Page 9-10; Table 1
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	Page 9-10; Table 1
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	Page 10
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	Not applicable

Section and Topic	Item #	Checklist item	Location where item is reported
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	Not applicable
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	Not applicable
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	Pages 9-10
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	Not applicable
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	Not applicable
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	Not applicable
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	Not applicable
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	Not applicable
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	Page 10-13 (flow chart, Fig 1, Page 10)
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	Page 10-13 (flow chart, Fig 1, Page 10)
Study characteristics	17	Cite each included study and present its characteristics.	Page 13-27; Table 1
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	Page 28; Supplementary Figures 1-3
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	Pages 113-43; Tables 1, 3, 4
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	Not applicable
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision	Not applicable

Section and Topic	Item #	Checklist item	Location where item is reported
		(e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	Not applicable
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	Not applicable
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	Not applicable
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	Not applicable
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	Pages 44-47
	23b	Discuss any limitations of the evidence included in the review.	Pages 44-47
	23c	Discuss any limitations of the review processes used.	Pages 44-47
	23d	Discuss implications of the results for practice, policy, and future research.	Pages 44-47
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	Page 8 (PROSPERO, CRD42023395919)
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	PROSPERO, publicly accessible
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	No ammendments
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	Page 49 (Funding Declaration)
Competing interests	26	Declare any competing interests of review authors.	Page 49 (Declaration of interest)
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	Not applicable

Appendix 2. Sample MEDLINE search strategy

Description	Search terms
Limit: humans only and language	((humans[Filter]) AND (english[Filter]))
Limit: Adult: 18+ years	((18+ years [Filter])
Physical:	"physical examination"[MeSH Terms] OR ("physical"[All Fields] AND "examination"[All Fields]) OR "physical examination"[All Fields] OR "physical"[All Fields] OR "physically"[All Fields] OR "physicals"[All Fields]
Exercise:	"exercise"[MeSH Terms] OR "exercise"[All Fields] OR "exercises"[All Fields] OR "exercise therapy"[MeSH Terms] OR ("exercise"[All Fields] AND "therapy"[All Fields]) OR "exercise therapy"[All Fields] OR "exercise's"[All Fields] OR "exercised"[All Fields] OR "exerciser"[All Fields] OR "exercisers"[All Fields] OR "exercising"[All Fields]
Activity:	"activable"[All Fields] OR "activate"[All Fields] OR "activated"[All Fields] OR "activates"[All Fields] OR "activating"[All Fields] OR "activation"[All Fields] OR "activations"[All Fields] OR "activator"[All Fields] OR "activator's"[All Fields] OR "activators"[All Fields] OR "active"[All Fields] OR "actived"[All Fields] OR "actively"[All Fields] OR "actives"[All Fields] OR "activities"[All Fields] OR "activity's"[All Fields] OR "activitys"[All Fields] OR "motor activity"[MeSH Terms] OR ("motor"[All Fields] AND "activity"[All Fields]) OR "motor activity"[All Fields] OR "activity"[All Fields]
Feeling:	"emotions"[MeSH Terms] OR "emotions"[All Fields] OR "feeling"[All Fields] OR "feelings"[All Fields] OR "feels"[All Fields]
Scale:	"scale's"[All Fields] OR "scaled"[All Fields] OR "scaling"[All Fields] OR "scalings"[All Fields] OR "weights and measures"[MeSH Terms] OR ("weights"[All Fields] AND "measures"[All Fields]) OR "weights and measures"[All Fields] OR "scale"[All Fields] OR "scales"[All Fields]
Arousal:	"arousability"[All Fields] OR "arousable"[All Fields] OR "arousal"[MeSH Terms] OR "arousal"[All Fields] OR "arousals"[All Fields] OR "arousal's"[All Fields] OR "arouse"[All Fields] OR "arouses"[All Fields] OR "wakefulness"[MeSH Terms] OR "wakefulness"[All Fields] OR "aroused"[All Fields] OR "arousing"[All Fields]
Scale:	"scale's"[All Fields] OR "scaled"[All Fields] OR "scaling"[All Fields] OR "scalings"[All Fields] OR "weights and measures"[MeSH Terms] OR ("weights"[All Fields] AND "measures"[All Fields]) OR "weights and measures"[All Fields] OR "scale"[All Fields] OR "scales"[All Fields]
Aerobic:	"aerobic"[All Fields] OR "aerobically"[All Fields] OR "bacteria, aerobic"[MeSH Terms] OR ("bacteria"[All Fields] AND "aerobic"[All Fields]) OR "aerobic bacteria"[All Fields] OR "aerobe"[All Fields] OR "aerobes"[All Fields] OR "exercise"[MeSH Terms] OR "exercise"[All Fields] OR "aerobics"[All Fields]
Endurance:	"endurance"[All Fields] OR "endurances"[All Fields]
Training:	"education"[Subheading] OR "education"[All Fields] OR "training"[All Fields] OR "education"[MeSH Terms] OR "train"[All Fields] OR "train's"[All Fields] OR "trained"[All Fields] OR "training's"[All Fields] OR "trainings"[All Fields] OR "trains"[All Fields]

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