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Corresponding author:

Jovana Vitošević

jovana.vitosevic@vpskp.edu.rs

Author Affiliation:

Department of Business Studies,
Toplica Academy of Applied Studies
(TASS).

A Piece of the Neuroeconomic Puzzle: Effort-Based Decision-Making and Real-World Physical Activity - A Systematic Review

Vitošević, J; Filipović, M; Bogičević, D; Popović, M; Vitošević, B; Ilić, I; Sterkowicz-Przybycień, K; Dobrijević, S; Purenović Ivanović, T.

ADMINISTRATIVE INFORMATION

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INTRODUCTION

Review question / Objective This review synthesises the evidence on the relationship between effort-based decision-making and real-world physical activity, examined bidirectionally: (a) whether effort valuation (effort discounting, effort-cost sensitivity, willingness to expend effort for reward, or neural valuation of physical effort) predicts physical activity; and (b) whether exercise, acute, sustained, or habitual, reshapes effort valuation. Population: humans of any age and health status (healthy and clinical). Exposure: effort-based decision-making. Outcome: real-world or habitual physical activity/exercise behaviour.

Rationale Regular physical activity protects physical and mental health, yet most adults remain insufficiently active. This shortfall is increasingly understood not as a deficit of knowledge but as a problem of decision, in which an immediate, certain cost in physical effort is weighed against

delayed, uncertain rewards. Neuroeconomics frames this valuation, but research on physical activity has focused on delay discounting, while the effort cost most intrinsic to exercise has drawn comparatively little attention. No systematic review has yet synthesised, in both directions, the relationship between effort-based decision-making and real-world physical activity. This review addresses that gap and introduces a two-tier framework distinguishing real/enacted from simulated/hypothetical exercise decisions.

Condition being studied Effort-based decision-making, the neuroeconomic valuation of physical effort, operationalised as effort discounting, effort-cost sensitivity, willingness to expend effort for reward, or neural valuation of effort – and its relationship with habitual, real-world physical activity and exercise behaviour. The domain spans healthy individuals and clinical populations in which effort valuation and physical inactivity are commonly disturbed (e.g., ADHD, Parkinson's disease).

METHODS

Search strategy Databases: Scopus, Web of Science Core Collection, PubMed/MEDLINE, from inception to June 2026. Two concept blocks combined with AND; terms within each joined by OR with truncation. Block 1 (effort-based decision-making): "effort-based decision*", "effort discount*", "effort cost*", "effort expenditure", "effort allocation", "neuroeconomic*". Block 2 (exercise/physical activity): exercise, "physical activity", "physical exercise", "exercise training", "physical fitness", sport*, walking, running, "sedentary behav*". Delay/temporal discounting deliberately excluded as a search construct. Limited to original research articles and reviews, English language. Supplemented by backward and forward citation searching of included studies and key reviews. Full search strings provided as Supplementary Material.

Participant or population Human participants of any age and health status, including both healthy and clinical samples.

Intervention Effort-based decision-making, assessed through behavioural tasks (e.g., Effort-Expenditure for Rewards Task, effort-discounting paradigms) and/or neural and physiological indices.

Comparator Where applicable (e.g., athletes vs non-athletes, clinical vs control, exercise vs sedentary condition). Not required, given inclusion of observational and single-group designs.

Study designs to be included Empirical, peer-reviewed original research using observational (cross-sectional or cohort) or experimental/interventional designs. Excluded: studies lacking an effort-based decision-making construct; abstract laboratory effort proxies with no exercise/physical-activity outcome; animal studies; and non-empirical sources (reviews, theoretical/opinion articles, editorials, commentaries, conference abstracts, book chapters), retained only for background.

Eligibility criteria Two conditions had to be met jointly: (1) a genuine effort-based decision-making construct was measured; and (2) exercise/physical activity was measured or manipulated as the explicit object of the decision, not incidental framing. Studies were eligible in either direction. Studies were classified into Tier 1 (real, enacted exercise, device-measured or validated self-reported activity, or genuine exercise performed as the effort) or Tier 2 (simulated/hypothetical

exercise decisions). English-language only; no date restriction.

Information sources Three multidisciplinary bibliographic databases: Scopus, Web of Science Core Collection, and PubMed/MEDLINE (inception to June 2026). Supplemented by backward and forward citation searching of all included studies and key reviews identified during screening. A public library consortium was searched for full-text retrieval.

Main outcome(s) Real-world or habitual physical activity and exercise behaviour, captured through device-based measurement, validated self-report, athletic training status, or exercise performed as the effortful action itself.

Additional outcome(s) Direction of the effort-activity relationship; neural and physiological correlates of effort valuation; and the ecological tier of the evidence (Tier 1 vs Tier 2).

Data management All records were imported into a reference manager and de-duplicated. Screening and full-text assessment were performed independently by three groups of reviewers, with disagreements resolved by discussion. Data were extracted using a piloted, standardised form; discrepancies were reconciled through discussion. Excluded full-text records were logged with their primary reason. The selection process is reported in a PRISMA 2020 flow diagram.

Quality assessment / Risk of bias analysis Methodological quality was appraised using the Mixed Methods Appraisal Tool (MMAT), version 2018 (Hong et al., 2018), chosen because included studies span randomised, non-randomised, quantitative descriptive, and mixed-methods designs. Following two screening questions, each study was rated against the five criteria specific to its design category (yes/no/can't tell). Per developer guidance, ratings are reported per criterion and not summed. Each study was appraised independently by all reviewers; disagreements resolved by discussion. Quality informed synthesis but was not an exclusion threshold.

Strategy of data synthesis A structured narrative synthesis was undertaken, given heterogeneity across populations, effort paradigms, and activity measures (precluding meta-analysis). Findings were organised along two intersecting dimensions: by ecological tier (real/enacted vs simulated/hypothetical) and by direction of the relationship (effort valuation predicting activity vs exercise

reshaping effort valuation). Within these, studies were grouped by effort construct and activity measure. Ecological validity of effort paradigms was carried through as a cross-cutting theme.

Subgroup analysis By effort construct; by nature of the activity measure (device-based, self-report, training status, enacted); by ecological tier; and by population (healthy vs clinical).

Sensitivity analysis Given the small number of eligible studies and substantial heterogeneity, no quantitative sensitivity analysis was planned. The robustness of the synthesis was instead examined narratively by considering the influence of study design (e.g., cross-sectional vs longitudinal/experimental) and methodological quality on the overall pattern of findings.

Language restriction Yes. Only English-language records were included.

Country(ies) involved Serbia; Poland.

Other relevant information This review introduces a novel bidirectional and two-tier framework, distinguishing real/enacted exercise (Tier 1) from simulated/hypothetical exercise decisions (Tier 2), allowing the ecological reach of the evidence to be examined directly. Reporting follows PRISMA 2020.

Keywords effort-based decision-making; effort discounting; physical activity; exercise behavior; neuroeconomics; subjective value; motivation.

Dissemination plans The findings will be disseminated through publication in a peer-reviewed scientific journal and may be presented at relevant scientific conferences.

Contributions of each author

Author 1 - Jovana Vitošević - Conceptualization; methodology; formal analysis; investigation; writing - original draft preparation; visualization; project administration.

Email: jovana.vitosevic@vpskp.edu.rs

Author 2 - Milica Filipović - Methodology; validation; formal analysis; investigation; data curation; writing - review and editing; project administration.

Email: milica.bojovic@pr.ac.rs

Author 3 - Damijan Bogičević - Validation; investigation; data curation; writing - review and editing.

Email: damljanbogicevic@yahoo.com

Author 4 - Validation; investigation; data curation; writing - review and editing. - Validation;

investigation; data curation; writing - review and editing.

Email: milos.popovic@pr.ac.rs

Author 5 - Biljana Vitošević - Investigation; writing - review and editing.

Email: biljana.vitosevic@pr.ac.rs

Author 6 - Igor Ilić - Investigation; data curation; writing - review and editing.

Email: igor.ilic@pr.ac.rs

Author 7 - Katarzyna Sterkowicz-Przybycień - Investigation; writing - review and editing.

Email: katarzyna.sterkowicz@awf.krakow.pl

Author 8 - Slobodanka Dobrijević - Writing - review and editing; visualization.

Email: slobodanka.dobrijevic@fsfv.bg.ac.rs

Author 9 - Tijana Purenović-Ivanović - Conceptualization; methodology; validation; writing - review and editing; supervision.

Email: tijanapurenovic@gmail.com