



# Why people should run after positive affective experiences, not health benefits

For correspondence:

[silvio.maltagliati@univ-grenoble-alpes.fr](mailto:silvio.maltagliati@univ-grenoble-alpes.fr)  
[boris.cheval@unige.ch](mailto:boris.cheval@unige.ch)

Silvio Maltagliati<sup>1\*</sup>, Philippe Sarrazin<sup>1</sup>, Layan Fessler<sup>1</sup>, Maël Lebreton<sup>2,3,4,†</sup>, Boris Cheval<sup>3,5\*,†</sup>

<sup>1</sup>Univ. Grenoble Alpes, SENS, F-38000 Grenoble, France.

<sup>2</sup>Paris School of Economics, Paris, France.

<sup>3</sup>Swiss Center for Affective Sciences, University of Geneva, Geneva, Switzerland.

<sup>4</sup>Laboratory for Behavioral Neurology and Imaging of Cognition, Department of Fundamental Neurosciences, University of Geneva, Geneva, Switzerland.

<sup>5</sup>Laboratory for the Study of Emotion Elicitation and Expression (E3Lab), Department of Psychology, University of Geneva, Geneva, Switzerland.

<sup>†</sup>Maël Lebreton and Boris Cheval equally contributed to this work and should be considered joint senior authors.

Please cite as: Maltagliati, S., Sarrazin, P., Fessler, L., Lebreton, M., Cheval, B. (2022). Why people should run after positive affective experiences not health benefits. *SportRxiv*.

**Abstract**

Most individuals are now aware of health benefits of physical activity (PA) but remain physically inactive. Mobilizing a multidisciplinary approach at the crossroads between decision-making sciences, we investigate why highlighting the health benefits of PA is unlikely to promote a sustained engagement in PA. Essential features of decision making – effort-discounting, delay-discounting and beliefs distortion – may weaken the subjective value attributed to health benefits, making the latter insufficient to trigger PA behaviors. We develop a decision model demonstrating that health benefits hold a weak subjective value, in comparison with the cost of engaging in PA (e.g., effort) and of our innate attraction toward sedentary alternatives. Instead, focusing on positive affective experiences could counteract the impact of aforementioned features and ultimately favor a regular engagement in PA. Tackling the current pandemic of physical inactivity would therefore require an urgent change in the promotion of PA, so as to make affective experiences central.

**Why people should run after positive affective experiences, not health benefits**

Over time, physical activity (PA) has shifted from being a necessity to being an alternative, such that levels of PA sharply decreased<sup>1</sup>. Today, we are facing a pandemic of physical inactivity<sup>2</sup>, with one death being attributed to insufficient PA every six seconds worldwide<sup>3</sup>. To counteract this trend, a tremendous effort is being made to promote regular PA across the life course. This promotion mainly relies upon the dissemination of knowledge about the health benefits one may expect from accumulating sufficient PA<sup>4</sup>. The success of these campaigns is evident as most people are aware of these health benefits and report the intention to be physically active. One study revealed that ~93% of individuals from an Australian sample declared that PA was very beneficial for their health<sup>5</sup>. Likewise, in a nationwide report, 94% of Canadian adults indicated that they had the intention to be physically active<sup>6</sup>. Yet, despite their awareness about PA benefits and their motivation to engage in PA, about one of two individuals fail to convert their intention into action<sup>7</sup>. This intention-action gap is even observed among individuals who are most in need of PA for their health, such as patients with multimorbidity<sup>8</sup>. For example, about two thirds of patients suffering from chronic respiratory diseases are insufficiently inactive in the six months following a rehabilitation program<sup>9</sup>. As already highlighted<sup>10,11</sup>, these findings challenge the effectiveness of focusing on health benefits to promote PA across the life course. Through this article, we shed light on the reasons underlying this fact by mobilizing a multidisciplinary approach, at the crossroads between decision-making sciences (economics, psychology, neurosciences).

**Why health benefits are insufficient to promote PA**

Decision-making is described as a succession of cognitive processes that outputs a choice between different available options, on the basis of their subjective value<sup>12</sup>. Subjective

value aggregates the expected desirability of the different options by weighting their potential benefits and costs, and choices ultimately proceed by maximizing value: individuals select the option that has been assigned the highest subjective value (i.e., higher benefits and lower costs)<sup>13</sup>. In the case of PA, decision-making could involve choosing between an exercise session (e.g., running outside) or an alternative behavior (e.g., watching TV). This situation implies weighing the potential benefits (e.g., “I know that PA will improve my health”) and costs (e.g., “but running involves so much effort”) associated with the PA option against the potential benefits (e.g., “I know that watching my favorite TV show”) and costs (e.g., “but sitting for too long may alter my health on the long run”) of the alternative option. We claim that, because of its low subjective value, if the only reason to action refers to health benefits, it is unlikely that the PA option will be repeatedly chosen over sedentary alternatives. To support our argument, we rely on features stemming from decision-making sciences that have been identified as pivotal in shaping individuals’ choices: *effort-discounting*, *delay-discounting* and *beliefs distortion*<sup>14,15</sup> (Footnote 1).

***Effort-discounting*** corresponds to the decrease in the subjective value assigned to an option as the physical effort required to obtain the reward increases<sup>16</sup>. Effort is often perceived as a cost to avoid and, *ceteris paribus*, options requiring low (vs high) physical effort are generally favored<sup>16,17</sup>. Critically, high levels of physical effort are involved by PA – defined by essence as an increase in energy expenditure beyond its basal level at rest – and health benefits only occur at the expense of an important quantity of physical effort exerted across the life course. Consider someone who engages in the recommended 150 minutes of weekly PA, from one’s twenty years to one’s eighty years (i.e., 60 years). Overall, this person would spend a bit less than a year of their adult life being engaged in PA (i.e., about 325 days, night included). For such a tremendous level of effort, what health gains to expect? If we take the example of

life expectancy, when controlling for confounding risk factors, being physically active would on average increase life expectancy by 0.4 to 4.2 years<sup>18</sup>. Put differently, the physical effort to invest across the life course appears considerable relative to expected health benefits, as referred here to life expectancy. While physical effort stands as a consubstantial characteristic of PA, the general tendency to represent effort as a cost may thus drastically decrease the subjective value assigned to health benefits of PA and, consequently, hinder the engagement in PA.

***Delay-discounting*** refers to the tendency for outcomes that are remote in time to have less subjective value than more immediate rewards<sup>19</sup>. This delay-discounting effect allows to account for the observation that individuals often prefer a smaller reward delivered soon relative to a larger reward delivered at a later stage<sup>20</sup>. Moreover, the time-delayed nature of consequences often go in hand with their intangibility (i.e., rewards which are incapable of being perceived; especially of being handled, touched or felt)<sup>21</sup>, and intangible options are often sharply devalued<sup>22</sup>. Both features (i.e., delay-discounting and intangibility) are likely to weaken the subjective value of alternatives whose consequences only reveal in a distant future<sup>23</sup>. Yet, expected health benefits of PA typically occur on a long-term horizon: engaging in PA is expected to provide positive health consequences (e.g., reduction of risks of all-cause mortality or maintenance of cognitive function) in the next four decades for a 20-year adult. Parallely, health benefits of PA can be seen as intangible (e.g., an improved health in the distant future cannot be easily perceived at the time of PA). Because long-term health benefits are perceived as time-delayed and intangible, the subjective value assigned to health benefits is likely lowered and insufficient to prompt a regular engagement in PA.

***Beliefs distortion*** refer to mechanisms altering the way individuals integrate available information about the current state of the world or they interpret observed events<sup>24</sup>. These biases influence the (re-)structuration of current information and often trigger a propensity to search,

interpret and retain evidence in favor of options that are already favored<sup>25</sup>. This tendency leads to overestimate the likelihood of positive (e.g., living a long and healthy life) events, but to underestimate the likelihood of negative ones (e.g., prematurely dying from a cancer)<sup>26</sup>. It also conduct to focus and restructure available information that confirms own's pre-existing preference and to process opposing information with a "motivated skepticism" (e.g., not trusting a pharmacological test after this test revealed one's pathological condition)<sup>27</sup>. Later on, negative events are often attributed to external reasons rather than to internal ones (e.g., attributing the deterioration of one's health status to genetics rather to a disengagement from health behaviors)<sup>28</sup>. For example, one study showed that on 16 smokers suffering from a lung cancer, only two considered that their illness was directly related to smoking<sup>29</sup>. Following this reasoning, the health benefits of PA could be minimized if the likelihood of a negative event is perceived as weak. Assuming that any other reason for action is hold, a motivated skepticism about health benefits of PA may develop ("I dislike running and, anyway, it will not prevent me from any illness"). In case of a negative event, individuals may finally misattribute the reasons for the occurrence of this outcome. Just as smokers, how many individuals would consider that insufficient PA was the primary cause of their chronic condition? Taken together, the *hard-wired* motivated and biased nature of information-related processes may undermine beliefs about health benefits, so that the subjective value assigned to PA would be weakened and ineffective in triggering a regular engagement in PA behaviors.

When putting the health benefits of PA in perspective with physical effort-discounting, delay-discounting and beliefs distortion, the subjective value assigned to physically active behavioral options is likely weakened. All the more so as some concurrent sedentary behaviors (e.g., watching one's favorite TV show lying down in a sofa) may represent temptations providing effortless-based, immediate and certain consequences. In Box 1, we elaborate a

decision model of these relationships (see also Figure 1) and demonstrate that the sole reliance on health benefits is unlikely to foster the maintenance of a physically active lifestyle. Therefore, and although we fully agree with the need to communicate about the positive health consequences of PA, we argue that additional benefits of PA need to be emphasized.

### **Why positive affective experiences can tip the balance in favor of PA**

We consider that a greater attention should be paid on emphasizing positive affective experiences which can be obtained from PA. While affective mechanisms have been slowly integrated in our understanding of decision-making processes<sup>31</sup>, including in PA,<sup>32–35</sup>, they remain scarcely considered when promoting PA. However, based on the abovementioned features involved in decision-making processes, why does focusing on positive affective experiences could foster a regular PA?

Positive affective experiences can impede the effects of physical effort-discounting by reducing the perceived cost of engaging in PA. For example, feelings of flow – the archetype of positive affective experiences – has been shown to reduce the perception of physical effort<sup>36</sup>. Moreover, autonomous motivation (i.e., practicing PA for its own pleasure or importance), which is related to affective mechanisms, is associated with a lower temptation to reduce effort while exercising<sup>37</sup>. The theory of effort minimization in physical activity (TEMPA) also proposes that positive affective experiences toward PA could help individuals in overcoming their innate attraction toward effort minimization by reducing the perceived effort associated with physically active behaviors<sup>34</sup>.

Regarding delay-discounting, positive affective experiences represent immediate consequences, which can be triggered during and/or directly after PA. Once engaged in PA, multiple sensory signals (e.g., interoceptive and cognitive pathways) are integrated and shape affective experiences<sup>38</sup>. Affective experiences thus become immediately available to

interpretation (e.g., “Am I experiencing pleasure right now?”). On a slightly larger timeframe, being physically active has positive acute effects on mood<sup>39</sup>, perceived energy<sup>40</sup>, or stress<sup>41</sup>. Burgeoning evidence suggests that abovementioned positive consequences could depend upon affective experiences during PA: individuals reporting positive affects while exercising could obtain more positive consequences afterwards (e.g., higher well-being)<sup>42</sup>, an observation that reinforces the necessity to ensure positive affective experiences.

Finally, positive affective experiences have the potential to strengthen beliefs about the benefits of engaging in regular PA. Mechanisms related to beliefs distortion can be described as a double-edge sword in shaping beliefs about PA: they can impede or favor the integration of information about the benefits of PA, depending on whether individuals have developed negative or positive affective experiences toward PA. If PA is only perceived as something unpleasant, individuals may neglect potential benefits of PA, as described above. On the opposite, if PA is something enjoyable, health benefits may gain credit to individuals and thereby trigger PA. In other words, positive affective experiences may favor the engagement in PA, whose health benefits become increasingly credible – though they only represent a backdrop for motivation rather than the unique reason for action.

By conjunctly reducing the perception of effort, providing immediate consequences and strengthening the beliefs about health benefits, positive affective experiences have the potential to increase the subjective value assigned to PA and to consequently foster a regular engagement in related behaviors. In Box 1, we model how including adding positive affects in the equation influences decision-making processes and contributes to tip the balance in favor of PA.

### **Moving toward the promotion of positive affective experiences toward PA**

In line with previous recommendations<sup>10,11</sup>, the promotion of PA should consequently focus on positive affective experiences. Highlighting that positive affective experiences may



reduce the perception of effort – and can be obtained at the expense of low levels of effort, as exemplified by the slogan “Every move counts”<sup>3</sup> – seems critical in getting past the effects of effort-discounting. To reduce the effects of delay-discounting and belief distortion biases, motivational messages could be reframed on short-term positive affective consequences which can be directly felt (e.g., pleasure) and perceived as more credible by individuals (e.g., reduced stress, perceived energy). In lay terms, when engaging in PA, people should run after positive affective experiences, and may even expect to obtain positive health effects – not the opposite.

Although important, these changes in the promotion of PA will remain vain if they are not accompanied by an effort ensuring that individuals actually develop such positive affective experiences. Regarding the heterogeneity in affects triggered by PA (e.g., from displeasure to pleasure)<sup>43</sup>, improving affective experiences toward PA among the widest population – and especially the most physically inactive ones – may look a wishful thinking. The fact that affective experiences are also (partly) over individuals’ control gives us some reasons to hope. Affective experiences can be manipulated through multiple ways<sup>44</sup>, including external and internal parameters of PA. For external parameters, encouraging to practice PA in pleasant environments (e.g., outdoor green environments) can foster positive affective experiences<sup>45</sup>. Regarding internal parameters, opting for self-selected intensity<sup>46</sup> or manipulating the structure of the session (e.g., ending the session with a lower intensity)<sup>47</sup> can promote positive affective experiences toward PA. In this perspective, practitioners (e.g., physical education teachers, health professionals) are uniquely placed to nurture environments that effectively promote positive affective experiences toward PA. A growing literature is investigating interventional levers and will undoubtedly provide innovative perspectives in fostering positive affective experiences.

## Conclusion

From Morris' pioneering study about the effects of physical inactivity on the health of London bus drivers to best-sellers such as "*Jogging*" from Bill Bowerman or "*Aerobics*" from Kenneth Cooper dating back to the 60's, evidence on the beneficial effects of PA have accumulated and have been disseminated to the general public. Yet, it turns out that exclusively focusing on health benefits is insufficient to favor a sustained engagement in PA across the life course. To explain this ineffectiveness, previous literature mostly highlighted the limited rationality of human decision-making processes<sup>48</sup>. Here, we prosaically explained that expected health benefits require a large amount of effort, are time-delayed and that these health-related beliefs can be distorted by individuals. As evidenced in decision-making sciences, these features may "rationally" undermine the subjective value attributed to health benefits, such that the latter are unlikely to trigger a regular PA across the life course. In contrast, positive affective experiences have the potential to bypass the influence of these features on individuals' decision to engage in PA. As such, we hope that our suggestions will extent the effort undertaken by researchers and practitioners in putting forth the key role of positive affective experiences toward PA.

**Footnotes:**

<sup>1</sup>: The effects of the features on the decision to engage in PA can vary depending on individual (e.g., apathy, hope) or situational factors (scarcity), but their description is beyond the scope of the current article.

### References

1. Pontzer H. Ecological Energetics in Early Homo. *Curr Anthropol*. 2012;53(S6):S346-S358. doi:10.1086/667402
2. Kohl HW, Craig CL, Lambert EV, et al. The pandemic of physical inactivity: Global action for public health. *Lancet*. 2012. doi:10.1016/S0140-6736(12)60898-8
3. Bull FC, Al-Ansari SS, Biddle S, et al. World Health Organization 2020 guidelines on physical activity and sedentary behaviour. *Br J Sports Med*. 2020;54(24):1451-1462. doi:10.1136/bjsports-2020-102955
4. Bauman A, Chau J. The Role of Media in Promoting Physical Activity. *J Phys Act Heal*. 2009;6(s2):S196-S210. doi:10.1123/jpah.6.s2.s196
5. Fredriksson SV, Alley SJ, Rebar AL, Hayman M, Vandelanotte C, Schoeppe S. How are different levels of knowledge about physical activity associated with physical activity behaviour in Australian adults? *PLoS One*. 2018;13(11):e0207003. doi:10.1371/journal.pone.0207003
6. Canadian Fitness and Lifestyle Research Institute. Physical activity monitor: facts and figures.
7. Rhodes RE, de Bruijn G-J. How big is the physical activity intention-behaviour gap? A meta-analysis using the action control framework. *Br J Health Psychol*. 2013;18(2):296-309. doi:10.1111/bjhp.12032
8. Bricca A, Harris LK, Jäger M, Smith SM, Juhl CB, Skou ST. Benefits and harms of exercise therapy in people with multimorbidity: A systematic review and meta-analysis of randomised controlled trials. *Ageing Res Rev*. 2020;63:101166. doi:10.1016/j.arr.2020.101166
9. Saunders TJ, Dechman G, Hernandez P, et al. Distinct Trajectories of Physical Activity

- Among Patients with COPD During and After Pulmonary Rehabilitation. *J Chronic Obstr Pulm Dis*. 2015;12(5):539-545. doi:10.3109/15412555.2014.995286
10. Ekkekakis P. People have feelings! Exercise psychology in paradigmatic transition. *Curr Opin Psychol*. 2017;16:84-88.
  11. Segar ML, Richardson CR. Prescribing Pleasure and Meaning. *Am J Prev Med*. 2014;47(6):838-841. doi:10.1016/j.amepre.2014.07.001
  12. Rangel A, Camerer C, Montague PR. A framework for studying the neurobiology of value-based decision making. *Nat Rev Neurosci*. 2008;9(7):545-556. doi:10.1038/nrn2357
  13. Rangel A, Hare T. Neural computations associated with goal-directed choice. *Curr Opin Neurobiol*. 2010;20(2):262-270. doi:10.1016/j.conb.2010.03.001
  14. Floresco SB, Onge JR St., Ghods-Sharifi S, Winstanley CA. Cortico-limbic-striatal circuits subserving different forms of cost-benefit decision making. *Cogn Affect Behav Neurosci*. 2008;8(4):375-389. doi:10.3758/cabn.8.4.375
  15. Basten U, Biele G, Heekeren HR, Fiebach CJ. How the brain integrates costs and benefits during decision making. *Proc Natl Acad Sci*. 2010;107(50):21767-21772. doi:10.1073/pnas.0908104107
  16. Prévost C, Pessiglione M, Météreau E, Cléry-Melin M-L, Dreher J-C. Separate valuation subsystems for delay and effort decision costs. *J Neurosci*. 2010;30(42):14080-14090.
  17. Hagura N, Haggard P, Diedrichsen J. Perceptual decisions are biased by the cost to act. *Elife*. 2017;6. doi:10.7554/elife.18422
  18. Reimers CD, Knapp G, Reimers AK. Does Physical Activity Increase Life Expectancy? A Review of the Literature. *J Aging Res*. 2012;2012:1-9.

doi:10.1155/2012/243958

19. Ainslie G. Specious reward: A behavioral theory of impulsiveness and impulse control. *Psychol Bull.* 1975;82(4):463-496. doi:10.1037/h0076860
20. Rachlin H, Raineri A, Cross D. Subjective probability and delay. *J Exp Anal Behav.* 1991;55(2):233-244. doi:10.1901/jeab.1991.55-233
21. Rick S, Loewenstein G. Intangibility in intertemporal choice. *Philos Trans R Soc B Biol Sci.* 2008;363(1511):3813-3824. doi:10.1098/rstb.2008.0150
22. Lebreton M, Bertoux M, Boutet C, et al. A critical role for the hippocampus in the valuation of imagined outcomes. *PLoS Biol.* 2013;11(10). doi:10.1371/JOURNAL.pbio.1001684
23. Blackburn M, Mason L, Hoeksma M, Zandstra EH, El-Deredy W. Delay discounting as emotional processing: An electrophysiological study. *Cogn Emot.* 2012;26(8):1459-1474. doi:10.1080/02699931.2012.673478
24. Sharot T, Kanai R, Marston D, Korn CW, Rees G, Dolan RJ. Selectively altering belief formation in the human brain. *Proc Natl Acad Sci.* 2012;109(42):17058-17062. doi:10.1073/pnas.1205828109
25. Brownstein AL. Biased predecision processing. *Psychol Bull.* 2003;129(4):545-568. doi:10.1037/0033-2909.129.4.545
26. Weinstein ND. Unrealistic optimism about future life events. *J Pers Soc Psychol.* 1980;39(5):806-820. doi:10.1037/0022-3514.39.5.806
27. Ditto PH, Lopez DF. Motivated skepticism: Use of differential decision criteria for preferred and nonpreferred conclusions. *J Pers Soc Psychol.* 1992;63(4):568-584. doi:10.1037/0022-3514.63.4.568
28. Miller DT, Ross M. Self-serving biases in the attribution of causality: Fact or fiction?

- Psychol Bull.* 1975;82(2):213-225. doi:10.1037/h0076486
29. Salander P. Attributions of lung cancer: my own illness is hardly caused by smoking. *Psychooncology.* 2007;16(6):587-592. doi:10.1002/pon.1121
30. Fox CR, Poldrack RA. Prospect Theory and the Brain. In: *Neuroeconomics*. Elsevier; 2014:533-567. doi:10.1016/B978-0-12-416008-8.00042-5
31. Dukes D, Abrams K, Adolphs R, et al. The rise of affectivism. *Nat Hum Behav.* 2021;5(7):816-820. doi:10.1038/s41562-021-01130-8
32. Brand R, Ekkekakis P. Affective–Reflective Theory of physical inactivity and exercise: Foundations and preliminary evidence. *Ger J Exerc Sport Res.* 2018;48(1):48-58. doi:10.1007/s12662-017-0477-9
33. Conroy DE, Berry TR. Automatic Affective Evaluations of Physical Activity: *Exerc Sport Sci Rev.* 2017;45(4):230-237. doi:10.1249/JES.000000000000120
34. Cheval B, Boisgontier MP. The Theory of Effort Minimization in Physical Activity. *Exerc Sport Sci Rev.* 2021;49(3):168-178. doi:10.1249/JES.000000000000252
35. Williams DM, Bohlen LC. Motivation for exercise: Reflective desire versus hedonic dread. In: *APA Handbook of Sport and Exercise Psychology, Volume 2: Exercise Psychology (Vol. 2)*. Washington: American Psychological Association; 2019:363-385. doi:10.1037/0000124-019
36. Swann C, Jackman PC, Schweickle MJ, Vella SA. Optimal experiences in exercise: A qualitative investigation of flow and clutch states. *Psychol Sport Exerc.* 2019;40:87-98. doi:10.1016/j.psychsport.2018.09.007
37. Taylor IM, Smith K, Hunte R. Motivational processes during physical endurance tasks. *Scand J Med Sci Sports.* 2020;30(9):1769-1776. doi:10.1111/sms.13739
38. Ekkekakis P. The Dual-Mode Theory of affective responses to exercise in

- metatheoretical context: II. Bodiless heads, ethereal cognitive schemata, and other improbable dualistic creatures, exercising. *Int Rev Sport Exerc Psychol.* 2009;2(2):139-160. doi:10.1080/17509840902829323
39. Liao Y, Shonkoff ET, Dunton GF. The Acute Relationships Between Affect, Physical Feeling States, and Physical Activity in Daily Life: A Review of Current Evidence. *Front Psychol.* 2015;6. doi:10.3389/fpsyg.2015.01975
40. Reed J, Ones DS. The effect of acute aerobic exercise on positive activated affect: A meta-analysis. *Psychol Sport Exerc.* 2006;7(5):477-514. doi:10.1016/j.psychsport.2005.11.003
41. Ensari I, Greenlee TA, Motl RW, Petruzzello SJ. Meta-analysis of acute exercise effects on state anxiety: an update of randomized controlled trials over the past 25 years. *Depress Anxiety.* 2015;32(8):624-634. doi:10.1002/da.22370
42. White RL, Parker PD, Lubans DR, et al. Domain-specific physical activity and affective wellbeing among adolescents: an observational study of the moderating roles of autonomous and controlled motivation. *Int J Behav Nutr Phys Act.* 2018;15(1):87. doi:10.1186/s12966-018-0722-0
43. Ekkekakis P, Parfitt G, Petruzzello SJ. The pleasure and displeasure people feel when they exercise at different intensities. *Sport Med.* 2011;41(8):641-671.
44. Bourke M, Hilland TA, Craike M. Variance in the valenced response during moderate-to-vigorous physical activity: a review of cognitive and contextual mechanisms. *Int Rev Sport Exerc Psychol.* 2021;14(1):154-185. doi:10.1080/1750984X.2020.1780626
45. Lahart I, Darcy P, Gidlow C, Calogiuri G. The Effects of Green Exercise on Physical and Mental Wellbeing: A Systematic Review. *Int J Environ Res Public Health.* 2019;16(8):1352. doi:10.3390/ijerph16081352



46. Williams DM, Dunsiger S, Emerson JA, Gwaltney CJ, Monti PM, Miranda R. Self-Paced Exercise, Affective Response, and Exercise Adherence: A Preliminary Investigation Using Ecological Momentary Assessment. *J Sport Exerc Psychol*. 2016;38(3):282-291. doi:10.1123/jsep.2015-0232
47. Zenko Z, Ekkekakis P, Ariely D. Can You Have Your Vigorous Exercise and Enjoy It Too? Ramping Intensity Down Increases Postexercise, Remembered, and Forecasted Pleasure. *J Sport Exerc Psychol*. 2016;38(2):149-159. doi:10.1123/jsep.2015-0286
48. Zenko Z, Ekkekakis P, Kavetsos G. Changing minds: Bounded rationality and heuristic processes in exercise-related judgments and choices. *Sport Exerc Perform Psychol*. 2016;5(4):337-351. doi:10.1037/spy0000069

**Box 1.****Modelling the effects of health benefits and of positive affective experiences on the decision to engage in physical activity (PA).**

Imagine a situation in which two alternatives are available: a PA alternative (e.g., running) and a sedentary one (e.g., watching TV) (see Figure 1). The chosen option is expected to be the one which has been assigned the highest subjective value (SV). The SV assigned to engaging in a behavior  $x$  can be calculated as the sum over all possible states of the world resulting from this behavior ( $s_i$ ; e.g., being in a good health) of the products of the probabilities of occurrence of this state ( $p(s_i)$ ; distorted by a probability distortion function  $w$ ) and the value ( $V$ ) assigned to this state (see<sup>30</sup> for an introduction to similar decision models):

$$SV(x) = \sum_{s_i \in x} w(p(s_i)) \times V(s_i)$$

Assuming that obtaining health benefits of PA is the unique reason to action, the probabilities of being in a bad health ( $p_{\text{risk}}$ ) or in a good health ( $1-p_{\text{risk}}$ ) in the future (delay  $d$ ) are first estimated, with a good and a bad health being future states which respectively holds delay-discounted and intangible values ( $V_d^+$  and  $V_d^-$ ). If and only if it is estimated that being in bad health in the future is probable, the benefits of PA on health are then considered: investing in being active can restore a good health in the future ( $p_{\text{benefit}}$ ), but it may also be insufficient to prevent developing bad health ( $1 - p_{\text{benefit}}$ ). Here, all these probabilistic estimations are affected by beliefs distortion biases (e.g., low odds of being in a bad health in the future, motivated skepticism about the benefits of PA on health). When including the costs of PA ( $c$ ) – which are

related, but do not restrict to physical effort (e.g., time, pain) – in the equation, the subjective value of PA can be calculated as follows:

$$SV(PA) = -c + (1 - p_{risk})V_d^+ + p_{risk}[p_{benefit}V_d^+ + (1 - p_{benefit})V_d^-]$$

Following the same reasoning regarding sedentary alternatives, the equation includes another term for the value  $V$  assigned to the related outcome (e.g., the pleasure to watch a TV show):

$$SV(SED) = V_{Sed} + (1 - p_{risk})V_d^+ + p_{risk}V_d^-$$

When calculating the net difference in subjective values assigned to PA and sedentary alternatives, we obtain:

$$SV(PA) - SV(SED) = -c - V_{Sed} + p_{risk}[p_{benefit}V_d^+ + (1 - p_{benefit})V_d^- - V_d^-]$$

$$SV(PA) - SV(SED) = -c - V_{Sed} + p_{risk}p_{benefit}[V_d^+ - V_d^-]$$

In this last equation, the net difference in SV between PA and sedentary behaviors is mainly dependent on the cost of engaging in PA (e.g., cost of effort) and on the value assigned to sedentary alternatives. In contrast, the health benefits are only accounted by a multiplicative term, conditional to several parameters that are subject to delay-discounting effects and beliefs distortions biases (e.g., risk of being in a bad health in the future). When health benefits are the unique reason for action, they weakly influence decision-making processes between PA and

sedentary alternatives. In such situation, we can easily understand why people tend to opt for watching TV, rather than running.

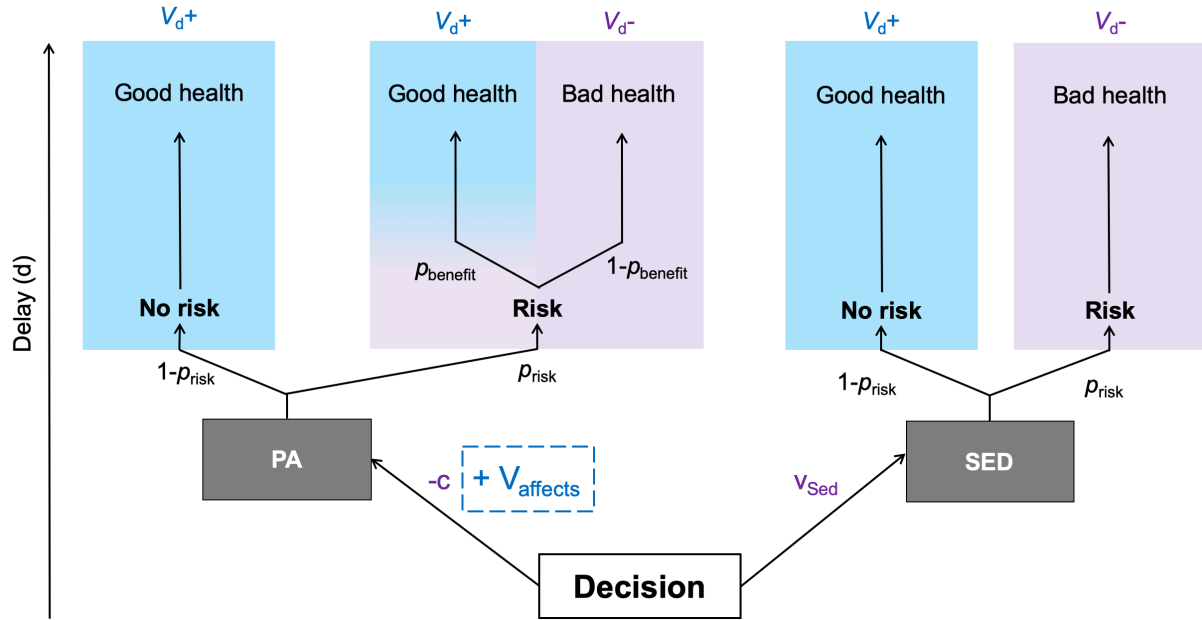
Now, say that positive affects are also expected to be obtained from engaging in PA, with a value  $V_{affects}$ . The equation becomes:

$$SV(PA) - SV(SED) = V_{affects} - V_{sed} - c + p_{risk}p_{benefit}[V_d^+ - V_d^-]$$

The balance between PA and sedentary alternatives is reweighted because another valued outcome is added in the equation: positive affects which can be expected from engaging in PA. Please also note that, as explained in the main text, positive affects can reduce the perceived cost of PA and are likely to strengthen beliefs about the positive health benefits expected from PA. Overall, they increase the overall SV of PA, over sedentary alternatives, which ultimately pushes individuals to run, rather than to watch TV.

**Figure 1.**

Illustration of the decision model between physical activity and sedentary alternatives.



*Note.* PA: Physical activity; SED: sedentary alternatives. This figure highlights that, when health benefits are the unique reason to action, costs of PA and the subjective value assigned to sedentary alternatives ( $V_{Sed}$ ) are the main drivers of decision-making processes. In contrast, the subjective value assigned to health benefits is likely having little effect on decision-making processes, as it is conditional to multiple parameters (i.e., value assigned to a good ( $V_d^+$ ) and a bad health ( $V_d^-$ ) in a delay  $d$ , risk of being in a bad health in a delay  $d$  ( $p_{risk}$ ), and benefits of PA ( $p_{benefit}$ )). However, when considering positive affects as an additional reason for action ( $V_{affects}$ ), the balance between PA and sedentary alternatives is likely reweighted.