Changing behavior towards physical activity and exercise

Edited by: Filipe Rodrigues • Vasco Bastos • Diogo Santos Teixeira • Diogo Monteiro

Polytechnic University of Leiria

Title Changing behavior towards physical activity and exercise

Editors

Filipe Rodrigues

filipe.rodrigues@ipleiria.pt

ORCID: https://orcid.org/0000-0003-1327-8872

Vasco Bastos

vasco.bastos@ulusofona.pt

ORCID: https://orcid.org/0000-0002-9227-8522

Diogo Santos Teixeira

diogo.teixeira@ulusofona.pt

ORCID: https://orcid.org/0000-0003-4587-5903

Diogo Monteiro

diogo.monteiro@ipleiria.pt

ORCID: https://orcid.org/0000-0002-7179-6814

ISBN 978-989-98037-3-2 **Year** 2026 **Edition** Polytechnic University of Leiria

Table of Contents

1. Introduction to socio-cognitive models to explain exercise

Monteiro, D.[1,2], & Rodrigues, F.[1,2]

1 – ESECS – Polytechnic University of Leiria, Campus 1, Rua Dr. João Soares, Apartado 4045, 2411–901 Leiria, Portugal

2 – Research Center in Sports Sciences, Health Sciences and Human Development (CIDESD), Quinta de Prados, 5001-801 Vila Real, Portugal

Rationale

The science underlying behavioral change, particularly in the field of physical activity and health, has become a ubiquitous approach to the adoption of active and healthy lifestyles (Schroé et al., 2020). Generally, behavioral change can be defined as any action a person takes in response to internal or external circumstances regarding a current behavior deemed harmful or risky to health. These actions can be overt (i.e., motor or verbal) and directly measurable, or covert (i.e., non-visible activities, yet involving voluntary muscles) and indirectly measurable. Behaviors are physical events controlled by the brain (Davis et al., 2015). However, it is crucial to acknowledge that behavioral change is non-linear and often cyclical. It is a difficult process, especially concerning physical activity and health, given the existence of numerous barriers impeding physical activity and multiple influences promoting sedentary behavior (Chambliss, 2015).

Individuals' choices regarding the practice of physical activity or the adoption of a pattern of sedentary behaviors (which includes physical inactivity) are influenced by an interplay of personal, health, medical, sociocultural, psychological, motivational, and environmental factors. The dynamics of these aforementioned factors shape each person's goals, preferences, barriers, and,

consequently, habits that invariably affect behavior. Considering the multiple influences on people regarding physical activity behaviors, this is not a static process. Therefore, building behavioral skills is a cornerstone approach in any program aiming to promote a more active and healthier lifestyle over time (Schroé et al., 2020). Nevertheless, exercise and health professionals appear to feel more comfortable prescribing a pre-determined dose-response of exercise to individuals, stating what they should do to improve their health and, in some cases, how to manage symptoms of a specific pathology (Nigg & ACSM, 2013). However, the likelihood of people following a general exercise prescription occurs primarily in subjects who present high motivation/autonomous motivation and only during the period they can easily follow the prescribed plan. When this motivation dissipates or assumes controlling components, or when barriers to the adoption of physical activity or healthy behaviors arise, adherence will decrease, and people will revert to previous behaviors of physical inactivity (Ntoumanis et al., 2020; Rodrigues et al., 2020). Indeed, physical inactivity has established itself as one of the major global burdens, representing a genuine public health problem (Gough et al., 2020) and being, therefore, considered by the World Health Organization (WHO, 2010) as the fourth leading risk factor for global mortality. Subsequently, studies (e.g., Lee et al., 2012) not only confirmed the WHO's (2010) concerns but also reported that physical inactivity was increasing in several countries. This fact led the World Health Assembly (WHA) to approve, in 2018, a new Global Action Plan on Physical Activity 2018-2030, aiming to reduce global levels of physical inactivity in adolescents and adults by 15% by 2030 (WHO, 2018).

In this regard, the WHO published the new guidelines on physical activity and sedentary behavior (Bull et al., 2020) for children, adults, and older adults, also including new specific recommendations for pregnant and postpartum women, as well as for special populations. Generally, Bull et al. (2020) recommend that all adults perform 150–300 minutes of moderate-intensity aerobic physical

activity, or 75–150 minutes of vigorous-intensity physical activity, or an equivalent combination of moderate-to-vigorous intensity per week. Among children and adolescents, an average of 60 minutes per day of moderate-to-vigorous intensity aerobic physical activity should be performed. These new guidelines further recommend muscle-strengthening activities for all age groups, as well as the reduction of sedentary behaviors across the lifespan, although a specific threshold for sedentary behaviors could not be defined. It is worth noting that these guidelines emphasize that replacing sedentary time with physical activity of any intensity (including light intensity) provides health benefits.

Despite these new recommendations being adequately outlined within society's contemporary lifestyle, the most recent global estimates indicate that one in four adults (approximately 28%) and more than three-quarters (over 80%) of adolescents do not meet the recommendations for aerobic physical activity practice (Guthold et al., 2018; Guthold et al., 2020), as stipulated by the WHO (2010). Thus, there is an urgent need to prioritize physical activity promotion services and investment, both in healthcare and other crucial contexts (Bull et al., 2020). Furthermore, these data show no general improvement in physical activity levels over the last two decades (Guthold et al., 2018; Guthold et al., 2020). Indeed, global and national guidelines regarding physical activity are a core factor for broad activity and a consistent political and governance framework in terms of public health action. In this sense, the WHO recommends that all countries establish national guidelines as well as targets for physical activity. To support the population in achieving goals and maintaining physical activity levels, all countries must develop and, above all, implement national policies and programs to create desirable conditions for all age groups to be physically active and, consequently, improve their health. This is supported by vast documentation in the literature stating that physical activity is effective in the treatment of at least 26 chronic diseases (Pedersen & Saltin, 2015).

In Portugal, within the scope of the National Program for the Promotion of Physical Activity (PNPAF), created in 2016 (Order no. 6401/2016), a National Strategy for the Promotion of Physical Activity, Health, and Well-being (ENPAF) was defined (Silva et al., 2016), which operates in synergy with the National Health Plan (Direção-Geral da Saúde, 2015). Including and articulating initiatives for the development and implementation of health-enhancing physical activity promotion policies is one of the key aspects that governmental entities intend to adopt in the coming years. Thus, the promotion and conducting of scientific studies, and the stimulation of research activities, technological development, and dissemination of best practices in the area of physical activity and health appear to be crucial aspects for the years to come. However, accurately assessing the impact of these strategies remains a challenge. Recent analyses highlight significant discrepancies between national reports (e.g., PNPAF) and international data (Eurobarometer), with the latter suggesting that up to 73% of the Portuguese population never engages in exercise. This reality is particularly visible in the fitness sector, which serves as a pragmatic case study for the failure of current retention models. Recent data indicates alarmingly high attrition rates, reaching 75% in 2022, and a member retention rate of only approximately 25%. Furthermore, even among those who maintain their membership, there is a prevalence of "sleepers", individuals who pay for services they do not utilize, and the average attendance frequency often falls below two sessions per week, which is insufficient to meet international health guidelines. These figures (Rodrigues et al., 2024) underscore the gap between the mere availability of exercise facilities and the actual behavioral adoption required for health benefits.

Taken together, it seems evident that there is an urgent need to implement strategies for behavioral change in physical activity and health. It is the responsibility of exercise professionals to create conditions for people to remain involved in the practice of physical activity with a favorable quality of motivation, and for them to understand that the interaction between behavioral change and

physical activity is highly beneficial and important for their health over time, as demonstrated by various studies (e.g., Ntoumanis et al., 2020).

To navigate this complex landscape and address the underlying causes of inactivity, social-cognitive and motivational theories have been increasingly adopted (Rodrigues et al., 2023). These frameworks provide the necessary lens to explore why individuals struggle to engage in sufficient physical activity, moving beyond physical barriers to include psychological and emotional determinants. Indeed, empirical data indicates that "lack of motivation" is a primary determinant for inactivity and dropout. Consequently, understanding variables such as autonomous motivation, perceived benefits, social support, and intentions becomes crucial, as these are significant predictors of exercise adherence. It is through these theoretical perspectives that professionals can better comprehend the mechanisms of behavioral change. Accordingly, the subsequent chapters of this book are dedicated to presenting and explaining the most current and contemporary socio-cognitive theoretical models in the study of behavioral change within the context of physical activity and health. Through an extensive analysis of scientific literature, the objective is to highlight to health professionals the necessity of comprehensive, evidence-based interventions. This approach invites a critical review of the classic prescription of exercise, placing the individual, and their psychological and social context, at the core of applying behavioral change techniques aimed at improving quality of life.

References

Bull, F., Al-Ansari, S., Biddle, S., Borodulin, K., Buman, M., Cardon, G., Carty, C., Chaput, J., Chastin, S., Chou, R., Dempsey, P., DiPietro, L., Ekelund, U., Firth, J., Friedenreich, C., Garcia, L., Gichu, M., Jago, R., Katzmarzyk, P., Lambert, E., … Willumsen, J. (2020). World Health Organization 2020 guidelines on physical activity and sedentary behaviour. *British Journal of Sports Medicine*, *54*(24), 1451-1462. https://doi.org/10.1136/bjsports-2020-102955

Chambliss, H. (2015). Motivating Physical Activity: Skills and Strategies for Behavior Change. In R. R. Watson: *Diet and Exercise in Cystic Fibrosis*. Elsevier. https://doi.org/10.1016/B978-0-12-800051-9.00035-3

Davis, R., Campbell, R., Hildon, Z., Hobbs, L., & Michie, S. (2015). Theories of behaviour and behaviour change across the social and behavioural sciences: a scoping review. *Health Psychology Review*, *9*(3), 323–344. https://doi.org/10.1080/17437199.2014.941722

Direção-Geral da Saúde (2015). *Plano Nacional de Saúde. Revisão e Extensão 2020*. Direção-Geral da Saúde, Ministério da Saúde.

Gough, A., Prior, L., Kee, F., & Hunter, R. (2020). Physical activity and behaviour change: the role of distributed motivation. *Critical Public Health*, *30*(2), 153-165. https://doi.org/10.1080/09581596.2018.1535169

Guthold, R., Stevens, G., Riley, L., & Bull, F. (2018). Worldwide trends in insufficient physical activity from 2001 to 2016: a pooled analysis of 358 population-based surveys with 1·9 million participants. *The Lancet Global Health*, *6*(10), e1077–e1086. https://doi.org/10.1016/S2214-109X(18)30357-7

Guthold, R., Stevens, G., Riley, L., & Bull, F. (2020). Global trends in insufficient physical activity among adolescents: a pooled analysis of 298 population-based surveys with 1·6 million participants. *The Lancet Child & Adolescent Health*, *4*(1), 23-35. https://doi.org/10.1016/S2352-4642(19)30323-2

Lee, I., Shiroma, E., Lobelo, F., Puska, P., Blair, S., Katzmarzyk, P., & Lancet Physical Activity Series Working Group (2012). Effect of physical inactivity on major non-communicable diseases worldwide: an analysis of burden of disease and life expectancy. *The Lancet*, *380*(9838), 219-229. https://doi.org/10.1016/S0140-6736(12)61031-9

Nigg, C., & ACSM (2013). *ACSM's behavioral aspects of physical activity and exercise*. LWW. ISBN: 9781451132113

Ntoumanis, N., Ng, J., Prestwich, A., Quested, E., Hancox, J., Thøgersen-Ntoumani, C., Deci, E., Ryan, R., Lonsdale, C., & Williams, G. (2020). A meta-analysis of

self-determination theory-informed intervention studies in the health domain: effects on motivation, health behavior, physical, and psychological health. *Health Psychology Review*, 1-31. https://doi.org/10.1080/17437199.2020.1718529

Pedersen, B., & Saltin, B. (2015). Exercise as medicine - evidence for prescribing exercise as therapy in 26 different chronic diseases. *Scandinavian Journal of Medicine and Science in Sports*, *25*(3), 1-72. https://doi.org/10.1111/sms.12581

Portuguese Decree nº 6401/2016, de 16 de may. *Republic Diary nº 94/2016*, Serie II.

Rodrigues, F., Monteiro, D., Teixeira, D.S., & Cid, L. (2020). Fitness instructors' role on exercise adherence in Portugal: the importance of need-supportive behaviors and motivational climates. *Motricidade*, *16*(4). https://doi.org/10.6063/motricidade.21120

Rodrigues, F., Figueiredo, N., Jacinto, M., Monteiro, D., & Morouço, P. (2023). Social-cognitive theories to explain physical activity. *Education Sciences, 13*(2), 1–17. https://doi.org/10.3390/educsci13020122

Rodrigues, F., Monteiro, D., Oliveira, C. C., Bastos, V., Pereira, H., & Teixeira, D. (2024). Physical activity, exercise and fitness in Portugal: past, present and future. *Motricidade*, *20*(4), 366-376. https://doi.org/10.6063/motricidade.34836

Schroé, H., Van Dyck, D., De Paepe, A., Poppe, L., Loh, W. W., Verloigne, M., Loeys, T., De Bourdeaudhuij, I., & Crombez, G. (2020). Which behaviour change techniques are effective to promote physical activity and reduce sedentary behaviour in adults: a factorial randomized trial of an e- and m-health intervention. *The International Journal of Behavioral Nutrition and Physical Activity*, *17*(1), 127. https://doi.org/10.1186/s12966-020-01001-x

Silva, P., Graça, P., Mata, F., Arriaga, M., Silva, A. (2016). *Estratégia Nacional para a promoção da atividade física, saúde e bem-estar 2016-2025*. Direção-Geral da Saúde, Ministério da Saúde.

WHO (2018). *Global action plan on physical activity 2018-2030: more active people for a healthier world*. Geneva: World Health Organization. Retrieved from: https://www.who.int/ncds/prevention/physical-activity/global-action-plan-2018-2030/en/

WHO (2010). *Global health observatory data repository*. Geneva: World Health Organization. Retrieved from: http://www.who.int/gho/ncd/risk_factors/physical_activity/en/

2. Rationale of behavior(s)

Rodrigues, F.[1,2], Teixeira, D. S.[3,4], & Monteiro, D.[1,2]

1 – ESECS – Polytechnic University of Leiria, Campus 1, Rua Dr. João Soares, Apartado 4045, 2411–901 Leiria, Portugal

2 – Research Center in Sports Sciences, Health Sciences and Human Development (CIDESD), Quinta de Prados, 5001-801 Vila Real, Portugal

3 – Faculty of Physical Education and Sport – Lusófona University, Campo Grande 376, 1749-024 Lisboa, Portugal

4 – Research Center in Sports, Physical Education, Exercise and Health (CIDEFES), Campo Grande 376, 1749-024 Lisboa, Portugal

Brief historical note

Prior to the publication of *On the Origin of Species* by Charles Darwin (1859), humans, specifically livestock breeders, had already begun to understand that animal behavioral patterns were partially influenced by genetic inheritance and the repetition of behaviors exhibited by other members of the herd. These factors were considered extremely powerful as they facilitated the breeding and maintenance of livestock through the repetition of identical actions. Rather than concern themselves with behavioral differences that might arise in new generations compared to previous ones, the behavioral homeostasis of animals simplified the reproduction process without requiring efforts beyond the customary. This line of reasoning led to the belief that it would be possible to replicate similar processes with human beings, assuming that humans were creatures of habit and that the repetition of certain behaviors would lead to their recurrence in the future without substantial alteration. This simple empirical view inadvertently initiated the study of behavior. However, the investigation of behaviowordr *per se* only emerged in the following century through the

experiments of Pavlov (1927). According to his investigations, behavior occurred, persisted, and changed as a result of classical conditioning. An original stimulus provoked a response. Subsequently, another stimulus was paired with the original one, thereby acquiring the power to elicit the response. In other words, behavior was acquired and altered as a function of external stimuli. The experiment of the salivating dog (i.e., behavior) in response to the sound of a bell (i.e., stimulus), the most globally famous example, thus opened new doors regarding how behavior was studied and manipulated according to human needs.

Although this new method of studying behavior introduced several reflective lines of thought and public interest, the results could not be directly extrapolated to the study of human behavior, as the latter is distinct from that of animals. In summary, applying the results of empirical studies based on animal "behavioral sciences" to humans was fragile and lacked robustness. This is primarily due to the fact that humans possess the capacity for reasoning and critical reflection, an attribute absent in animals. The study of human behavior emerged years after the work of Pavlov and other prominent researchers, through the hands of John Watson (1924). Watson sought to examine human behavior more clearly, emphasizing objective and observable facts, while considering trials conducted on animals as well as mechanistic philosophical models. Years later, Skinner's (1953) studies appeared, introducing operant conditioning and radical behaviorism into the literature. Thanks to the work of these researchers, complemented by psychological studies in various social branches, the first works on human motivation appeared (e.g., Deci & Ryan, 1985; Fishbein & Ajzen, 1975; Maslow, 1954), paving the way for a study of human behavior that considers not only the objective perspective but also the rational and motivational dimensions as determinants of behavior. This raises the question: what is, in fact, *a behavior*?

Conceptualization

Behavior can be defined as the aggregate of actions performed by organisms or systems in response to the environment in which they are situated or to themselves (Gardner, 2015; Kwasnicka et al., 2016). That is, any action, whether conscious, unconscious, voluntary, or involuntary, can be considered a behavior: a response to a situation created by the organism itself or by the environment (e.g., social, cultural, environmental). In this sense, human behavior can be partially influenced by thoughts or emotions, revealing determinants of behavior such as individual values, attitudes, norms, and beliefs (Fishbein & Ajzen, 2009).

This conceptualization appears to be the broadest and generalized, considering that a behavior may or may not involve energy expenditure. In other words, physical activity, for instance, is a manifestation of behavior, but not all behavior is considered physical activity. While physical activity encompasses movement resulting in energy expenditure equal to or greater than 1.5 metabolic equivalents of task (METs), according to the American College of Sports Medicine (ACSM, 2021), behavior can be performed mentally in structure with other behaviors. For example, watching television is a behavior. However, in terms of caloric expenditure, it is substantially trivial (clearly below 1.5 METs) compared to brisk walking on an incline, which is, in itself, also a behavior.

However, applying this general conceptualization to exercise requires a nuanced understanding of its specific nature. Unlike many other health behaviors (e.g., taking medication or brushing teeth), exercise behavior is unique because it often involves immediate costs (e.g., physical effort, fatigue, time displacement) in exchange for delayed rewards (e.g., long-term health, weight management). Consequently, exercise behavior cannot be viewed solely as a mechanical output. It is a dynamic process that competes with other highly reinforcing sedentary behaviors in daily life. This competition suggests that the adoption of exercise behavior is not merely about initiating an action but persisting against a backdrop

of varying biological and environmental cues that often favor energy conservation.

Therefore, behavior can be classified as any activity a human being can perform, such as painting, driving, brushing teeth, preparing lessons, or exercising the body. Although behavior is, to a certain extent, determined by a set of factors well-described in the literature, such as self-determined motivation (Ryan & Deci, 2017), attitudes (Fishbein & Ajzen, 2009), or habit (Gardner, 2015), there is inter- and intra-individual variability among behavioral determinants. That is, not all individuals respond in the same way to the same stimulus, leaving room for sociodemographic factors (e.g., sex, age, past experiences) that may influence behavior in response to the stimulus.

Measurement of exercise behavior

It is important to note that the method by which behavior is measured must be considered. This can be done objectively or subjectively. When referring to objectively assessed behavior, we allude to behaviors that can be measured using validated devices. For example, if we wish to measure the number of steps a person takes during a walk, we can utilize pedometers or accelerometers. Conversely, if we intend to assess behavior subjectively, we can do so, for instance, by asking how many times the individual consumed fruit in the previous week. Another method of assessing behavior is through a questionnaire, such as the International Physical Activity Questionnaire (IPAQ), validated by Craig et al. (2003), which evaluates physical activity performed in the last seven days.

The way behavior is measured and evaluated depends on the researcher's or professional's objective, as well as available resources. However, significant differences exist. On one hand, objective behavior measurement implies, in most cases, costs for acquiring measurement equipment (e.g., pedometers, heart rate monitors), which may prove to be an obstacle. Furthermore, even objective measurement is not devoid of behavioral influence. The mere presence of a

monitoring device can alter the subject's behavior, a phenomenon often referred to as reactivity or the Hawthorne effect (Adair, 1984), leading to a temporary increase in physical activity that may not reflect typical patterns. On the other hand, subjective measurement presents some bias, insofar as the mental image of the behavior performed may not correspond to the reality of the event (Urda et al., 2017). For example, asking an individual how many times they practiced exercise, in a structured and planned manner, during the past month may imply a value distorted from reality, due to social desirability bias, the interpretation of the question (e.g., "does physical activity count?"), or recall error by the person in question.

There seems to be a generalized line of thought that human behavior is goal-directed (Ajzen, 1985). Without wishing to convey a reductive message, human behavior can be better described as the execution of plans that are structured to varying degrees. For example, before engaging in exercise, a person packs their sports bag, schedules the best time to go to the gym, arranges to go with a friend, and travels via personal or public transport. Most, if not all, of these actions (i.e., behaviors) will have been projected in advance. Their execution occurs as each action is completed and leads to the next. Thus, while actions are largely determined by the intentions the individual holds, it is crucial to recognize that intention alone may not always translate into sustained behavior, particularly in the complex context of exercise.

References

Adair, J. G. (1984). The Hawthorne effect: A reconsideration of the methodological artifact. *Journal of Applied Psychology, 69*(2), 334–345. https://doi.org/10.1037/0021-9010.69.2.334

Ajzen, I. (1985). From Intentions to Actions: A Theory of Planned Behavior. In J. Kuhl & J. Beckmann (Eds.), *Action Control*. SSSP Springer Series in Social Psychology. Springer. https://doi.org/10.1007/978-3-642-69746-3_2

American College of Sports Medicine (2021). *ACSM's Guidelines for Exercise Testing and Prescription* (11th edition). Wolters Kluwer. ISBN: 9781975150181

Craig, C. L., Marshall, A. L., Sjöström, M., Bauman, A. E., Booth, M. L., Ainsworth, B. E., Pratt, M., Ekelund, U., Yngve, A., Sallis, J. F., & Oja, P. (2003). International physical activity questionnaire: 12-country reliability and validity. *Medicine and Science in Sports and Exercise*, *35*(8), 1381-1395. https://doi.org/10.1249/01.MSS.0000078924.61453.FB

Darwin, C. (1859). *On the Origin of Species*. John Murray.

Deci, E. L., & Ryan, R. M. (1985). *Intrinsic motivation and self-determination in human behavior*. Plenum Press.

Fishbein, M., & Ajzen, I. (2009). *Predicting and Changing Behavior: The Reasoned Action Approach*. Psychology Press. https://doi.org/10.4324/9780203838020

Fishbein, M., & Ajzen, I. (1975). *Belief, attitude, intention and behavior: An introduction to theory and research*. Addison-Wesley.

Gardner, B. (2015). A review and analysis of the use of 'habit' in understanding, predicting and influencing health-related behavior. *Health Psychology Review*, *9*(3), 277-295. https://doi.org/10.1080/17437199.2013.876238

Kwasnicka, D., Dombrowski, S. U., White, M., & Sniehotta, F. F. (2016). Theoretical explanations for maintenance of behavior change: a systematic review of behavior theories. *Health Psychology Review*, *10*(3), 277-296. https://doi.org/10.1080/17437199.2016.1151372

Maslow, A. H. (1954). *Motivation and Personality*. Harper & Brothers. ISBN: 9780060419875

Pavlov, I. P. (1927). *Conditioned reflexes: an investigation of the physiological activity of the cerebral cortex*. Oxford University Press.

Ryan, R. M., & Deci, E. L. (2017). *Self-determination theory: Basic psychological needs in motivation, development, and wellness*. The Guilford Press. https://doi.org/10.1521/978.14625/28806

Skinner, B. F. (1953). *The Science of Human Behavior*. Free Press. ISBN: 9780029290408

Urda, J. L., Larouere, B., Verba, S. D., & Lynn, J. S. (2017). Comparison of subjective and objective measures of office workers' sedentary time. *Preventive Medicine Reports*, *8*, 163-168. https://doi.org/10.1016/j.pmedr.2017.10.004

Watson, J. B. (1924). *Behaviorism*. People's Institute. ISBN: 9780393005240

3. Intentions as a proxy for exercise behavior

Rodrigues, F.[1,2], Bastos, V.[3,4], Antunes, R.[1,2], & Monteiro, D.[1,2]

1 – ESECS – Polytechnic University of Leiria, Campus 1, Rua Dr. João Soares, Apartado 4045, 2411–901 Leiria, Portugal

2 – Research Center in Sports Sciences, Health Sciences and Human Development (CIDESD), Quinta de Prados, 5001-801 Vila Real, Portugal

3 – Faculty of Physical Education and Sport – Lusófona University, Campo Grande 376, 1749-024 Lisboa, Portugal

4 – Research Center in Sports, Physical Education, Exercise and Health (CIDEFES), Campo Grande 376, 1749-024 Lisboa, Portugal

Conceptualization

If we observe behavior from a purely physical standpoint, it is possible to draw an analogy with Newton's third law: for every action, there is a reaction. Applying this principle to the social sciences, behavior typically occurs in response to a stimulus. While this appears straightforward from an observational perspective, human behavior itself is fundamentally determined by the intentions the individual holds to act in accordance with, or in response to, that stimulus. Succinctly defined, intention is a cognitive state or mental action that immediately precedes behavior. However, contemporary literature refines this definition by distinguishing between "decisional intention" (the binary decision to perform a behavior, e.g., "I will exercise") and "intention strength" (the degree of commitment to enact that decision). The construction of intention reflects the plans individuals formulate to perform, or not perform, a specific behavior (Fishbein & Ajzen, 1975). Consequently, people generally act according to their intentions. For an individual to engage in a behavior, in most instances, they require the prior intent to do so. From a pragmatic perspective, every voluntary

behavior performed by an individual undergoes a deliberate mental planning process; as such, the strength of the intention to adopt a certain behavior is reflected in the likelihood of that behavior occurring.

The intention-behavior gap

Theoretical and empirical evidence clearly demonstrates that, generally, the stronger the intention to perform a behavior, the greater the probability that this behavior will be enacted in the future (Ajzen, 1991). Specifically, the literature is consensual in defining intention as the most proximal antecedent predictor of behavior. Nevertheless, the predictive validity of intention is far from perfect, and recent evidence suggests the disparity is wider than previously thought. This phenomenon is described in the literature as the intention-behavior gap. This gap elucidates that intention, while necessary, often possesses limited explanatory power regarding the final behavior. Recent graphical reviews indicate that while the presence of intention is almost always necessary to achieve physical activity (only ~4% of people engage in physical activity without prior intention), the probability of following through with that intention is ostensibly a "flip of the coin" (Rhodes & Brennan, 2025). Approximately 48% of individuals who hold positive intentions to be active fail to translate those intentions into action, categorizing them as "unsuccessful intenders" (Rhodes & Brennan, 2025).

This reality is starkly evident in the Portuguese fitness sector, which serves as a pragmatic laboratory for observing this gap (Rodrigues et al., 2024). Analytical studies indicate that the variance explained by intention is significantly lower when moving from cross-sectional designs to longitudinal reality. For instance, Rodrigues et al. (2024) highlight that despite high volumes of new memberships (intentions), the fitness sector faces an alarming annual attrition rate that reached 75% in 2022. Furthermore, the phenomenon of "sleepers", individuals who maintain active, paying memberships but do not attend the facility, exemplifies a persistent intention-behavior gap, where the financial

commitment (intention) does not translate into physical participation (i.e., behavior) (Rodrigues et al., 2024).

Understanding this gap requires moving beyond a static view of human psychology. As proposed by Jekauc et al. (2025), the gap is not merely a fixed trait but a multidimensional difference between an individual's intended behavior and their subsequent observed behavior (IBG = I - B). This difference is highly dynamic and fluctuates based on factors such as:

- Temporal Stability: Intentions are not concrete statutes; they are fluid and subject to decay. The longer the time lag between the formation of the intention (e.g., signing up for a gym in January) and the opportunity to act, the less predictive the intention becomes (Jekauc et al., 2025).
- Contextual factors: The "strength" of an intention measured in a calm environment (e.g., at home) often crumbles when faced with the immediate barriers of daily life (e.g., work stress, bad weather), creating within-person variability (Jekauc et al., 2025).

Therefore, while society appears to recognize physical activity as a necessary behavior (possessing the "intention to" act), this mental image frequently fails to transcend the cognitive domain. It is, therefore, imperative to distinguish between the intention to initiate a behavior and the intention to maintain it over time. Since nearly half of all "intenders" fail to act (Rhodes & Brennan, 2025), relying solely on increasing a person's intention is an insufficient strategy for behavior change. This suggests that other mechanisms, beyond rational planning and conscious intent, must be at play in regulating human behavior. In the following chapters, we will explore the determinants that lie beyond intention.

References

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, *50*(2), 179-211. https://doi.org/10.1016/0749-5978(91)90020-T

Fishbein, M., & Ajzen, I. (1975). *Belief, Attitude, Intention, and Behavior: An Introduction to Theory and Research*. Addison-Wesley.

Jekauc, D., Voelkle, M. C., Giurgiu, M., & Nigg, C. R. (2025). Unveiling the multidimensional nature of the intention-behavior gap: Dynamics of intentions and behaviors. *European Journal of Health Psychology*, *32*(1), 34-50. https://doi.org/10.1027/2512-8442/a000162

Rhodes, R. E., & Brennan, C. (2025). Closing the gap between physical activity intentions and sustained behavior: An overview of evidence. *Exercise, Sport & Movement*, *4*(1). http://dx.doi.org/10.1249/ESM.0000000000000059

Rodrigues, F., Monteiro, D., Oliveira, C. C., Bastos, V., Pereira, H., & Teixeira, D. (2024). Physical activity, exercise and fitness in Portugal: past, present and future. *Motricidade*, *20*(4), 366-376. https://doi.org/10.6063/motricidade.34836

4. Transtheoretical Model

Monteiro, D.[1,2], Jacinto, M.[1,2], Teixeira, D. S.[3,4]

1 – ESECS – Polytechnic University of Leiria, Campus 1, Rua Dr. João Soares, Apartado 4045, 2411–901 Leiria, Portugal

2 – Research Center in Sports Sciences, Health Sciences and Human Development (CIDESD), Quinta de Prados, 5001-801 Vila Real, Portugal

3 – Faculty of Physical Education and Sport – Lusófona University, Campo Grande 376, 1749-024 Lisboa, Portugal

4 – Research Center in Sports, Physical Education, Exercise and Health (CIDEFES), Campo Grande 376, 1749-024 Lisboa, Portugal

Conceptualization

Before delving specifically into the conceptualization of determinants explaining behavior and the intention to perform it, it is essential to understand how behavior was (and continues to be) evaluated as a function of its state or stage. Although the study of human behavior is not novel, various theoretical models have evolved according to contemporary evidence based on the theoretical assumptions of prior studies. According to several authors (e.g., Prochaska & Velicer, 1997), changing people's behaviors is extremely difficult, particularly when these behaviors have been established for a long time. Thus, behavioral change emerges over time rather than in a single moment. The Transtheoretical Model (Prochaska & DiClemente, 1982) posits that an individual's progress in a given behavior depends on a series of stages of change. However, this process can be cyclical rather than linear, as some individuals do not succeed in their initial efforts to change behavior, and not all behaviors necessarily pass linearly through all stages before becoming habitual.

The Transtheoretical Model describes the process through which behavioral change is induced and how it can subsequently be maintained over time. This model offers an integrative perspective on the structure of intentional behavioral change and can be assessed according to stages of change. Prochaska and colleagues, following various studies (1982, 1983, 1984), delineated the existence of five stages through which behavioral change unfolds over time. Indeed, contrary to what was previously assumed, Prochaska and DiClemente (1983, 1984) revolutionized behavioral change theories by considering behavior as a process rather than a rigid event. This paradigm shift led researchers to deepen the study of behavior, focusing on the time a behavior takes to transition to another state. According to Prochaska and Norcross (2001), each stage represents not only a period of time but also a set of distinct tasks required for movement to the next stage.

Precontemplation. In this stage, individuals do not intend to act in the foreseeable future, usually measured as the next six months. People may be in this stage because they are uninformed or under-informed about the consequences of their behavior, or they may have tried to change a number of times and became demoralized about their ability to change (Prochaska & Velicer, 1997). In the context of exercise, these individuals tend to avoid reading, talking, or thinking about their high-risk behaviors (e.g., sedentary lifestyle). They often characterize their resistance to change as a lack of motivation or discipline, whereas, in reality, they are simply not ready. Examples of a person in the precontemplation stage include:

- "*I have no intention of starting an exercise program in the next six months.*"
- "*Exercise is not for me; I don't have time.*"
- "*I feel fine as I am; my health is not a concern right now.*"

Contemplation. This is the stage where individuals intend to change in the next six months. They are more aware of the pros of changing but are also acutely aware of the cons. This balance between costs and benefits can produce profound ambivalence and cause what is frequently termed "chronic contemplation" or behavioral procrastination (Prochaska & Velicer, 1997). The analysis of costs versus benefits regarding behavioral change can cause the individual to remain stuck in a mental limbo for an indeterminate period. Examples of a person in the contemplation stage include:

- Searching for the benefits of physical activity but remaining sedentary.
- Weighing the pros vs. cons of joining a gym.
- Acknowledging that reducing sedentary time could bring health benefits but feeling the effort might be too high.

Preparation. In this stage, individuals intend to act in the immediate future, usually measured as the next month. Typically, these individuals have already taken some significant steps in the past year, albeit without success, but possess a deliberate intention to change their current state. It is in this phase that "windows of opportunity" for behavioral change arise, where professional intervention is pivotal. Individuals in this stage seek information through various available means (e.g., media, social networks) for strategies that can assist behavioral change in an achievable and appropriate manner (Prochaska & DiClemente, 1982). There is a commitment to change and, often, the implementation of small changes. Examples of a person in the preparation stage include:

- Having already scheduled a consultation with a physician to evaluate health indicators for exercise readiness.
- Having a specific plan of action to start physical activity (e.g., "*I will start walking next Monday*.").

- Buying fitness equipment to train at home or visiting a gym to ask about prices.

Action. In this stage, people have made specific overt modifications in their lifestyles within the past six months. In the action phase, individuals modify their behavior, experiences, and environment to overcome their current behavior. Indeed, action involves the most visible behavioral changes and requires a considerable commitment to time and energy. Changes made in the action phase tend to be more visible and receive greater social recognition (Prochaska & Norcross, 2001). Individuals are classified in the action stage if they have successfully altered their problematic behavior for a period of one day to six months (Prochaska & Norcross, 2001). However, it should be noted that the six-month period serves as a reference, not an exact limit. Examples of a person in the action stage include:

- Exercising regularly and maintaining frequency stably.
- Choosing to use stairs instead of the elevator consistently.
- Replacing sedentary leisure time with active hobbies (e.g., walking, gardening).
- Maintained consistent gym attendance over the past three months.

Maintenance. This is the stage where people work to prevent relapse and consolidate the gains attained during the action (Prochaska et al., 1992). The criterion for an individual to be considered in this stage consists of being able to remain free from the problematic behavior and consistently engage in the new, incompatible behavior for more than six months (Prochaska & DiClemente, 1982). In this phase, individuals work to prevent relapse but do not apply change processes as frequently as those in the action stage. They are less tempted to relapse and more confident that they can maintain their changes. Examples of a person in the maintenance stage include:

- Going to a fitness center to exercise twice a week consistently for over a year.
- Effortlessly avoiding personal car use and opting to cycle to work.
- Belonging to an outdoor activity group for at least six months, participating regularly in events.

These are the five main stages described in the Transtheoretical Model. Placed in a logical sequence, behavior change initiates in the Precontemplation phase, moves to Contemplation, followed by Preparation, Action, and consequently, Maintenance. However, evidence highlights a sixth stage that generally assumes the terminal phase of behavioral change.

Termination. This is the stage in which individuals have completed the change process and no longer have to work hard to prevent relapse. It refers to the person's total confidence in maintaining the new behavior across all high-risk situations, accompanied by zero temptation to relapse (Prochaska & Norcross, 2001). Regardless of whether the individual is depressed, bored, anxious, lonely, or stressed, they are confident they will not return to their old problematic habits as a way of coping (Prochaska & Velicer, 1997). When an individual remains in this phase for five years, they tend to maintain the new behavior regularly throughout their life, almost as a personality trait. In this phase, the probability of returning to the old behavior is nearly null. However, in the context of exercise, most researchers prefer to focus on "Maintenance" as the ultimate goal, since exercise requires continuous effort and "Termination" is theoretically rare for lifestyle behaviors (unlike for addictions).

Processes of change

Beyond the stages of change, the Transtheoretical Model addresses and describes the processes of change. To progress through the stages, people apply

cognitive, affective, and evaluative processes (Prochaska & Norcross, 2001; Prochaska & Velicer, 1997). In total, ten processes of change have been identified, with some being more relevant to a specific stage of change than others (Prochaska et al., 2008). These processes result in strategies that help the individual make and, importantly, maintain lasting changes. The first five described below are part of experiential (cognitive/affective) processes, while the remaining are behavioral processes.

- **Consciousness Raising**: Increasing information about the self and the problem. The individual intentionally assumes behavioral change as a pivotal aspect of their life.
- **Dramatic Relief**: Experiencing and expressing feelings about one's problems and solutions. This involves an emotional arousal regarding the healthy behavior, whether through a positive or negative stimulus.
- **Self-Reevaluation**: Assessing how one feels and thinks about oneself with respect to a problem. The new behavior becomes part of the individual's identity (i.e., "this is who I am").
- **Environmental Reevaluation**: Assessing how the presence or absence of a personal habit affects one's social environment. It involves realizing how the risky behavior (e.g., inactivity) affects others and how changing it could have a positive effect.
- **Social Liberation**: Increasing alternatives for non-problem behaviors available in society. Noticing contextual opportunities that show society supports the healthy behavior.
- **Self-Liberation**: Believing in one's ability to change and making commitments to act. The person assumes the commitment to behavioral change based on the belief that it is possible to achieve the healthy behavior.

- **Helping Relationships**: Finding people who are supportive of the change. It is fundamental for the individual to associate with a group capable of assisting in behavioral change.
- **Counter-Conditioning**: Substituting alternatives for the problem behavior. There is an emphasis on replacing thoughts or actions of risky behaviors with healthy ones (e.g., taking a walk instead of watching TV when stressed).
- **Reinforcement Management**: Rewarding the healthy behavior and reducing the rewards that come from the risky behavior.
- **Stimulus Control**: Avoiding stimuli that trigger the problem behavior and using cues that support the healthy one. This involves restructuring the environment to have resources that support the healthy behavior (e.g., putting running shoes by the door).

Measurement of stages of change

Questionnaires have been the most current method to evaluate the stage of behavior change. To date, this appears to be the most adjusted approach, as questioning the individual directly about the stage they "think" they are in can lead to error and inhibit the researcher's or health professional's ability to accurately define the stage, potentially creating response bias. Therefore, validated questionnaires, preferably adapted for the specific population, are used so that professionals can apply behavioral change strategies and tools according to the individual's actual stage. An example of a validated questionnaire is presented in study of Zamarripa et al. (2018), which measures the stage of behavioral change, including scoring and item coding for correct assessment.

Application of the model in physical activity

The stages of change provide a significant challenge for the development of interventions. Although the Transtheoretical Model was initially presented as an integrative and comprehensive model of behavioral change in smokers (i.e.,

smoking cessation), the model rapidly expanded its scope, including investigations and applications in a wide range of other health behaviors, including physical activity and exercise (e.g., Centis et al., 2013; Marcus & Simkin, 1994; Zamarripa et al., 2018).

In the case of integrating physical activity into an individual's daily life or changing harmful behaviors to healthy ones, Self-Efficacy (described as the sense of adequacy, efficiency, and competence to face challenges) and Decisional Balance (the notion that decision-making can be thought of as a conflict between two factors, pros and cons, that influence motivation for a given behavior) have come to be recognized as essential factors in the behavioral change process (Biddle & Nigg, 2000; Prochaska & Norcross, 2001; Prochaska & Velicer, 1997).

This theoretical model thus integrates elements of Bandura's (1982) Self-Efficacy Theory. This behavioral determinant reflects the degree of confidence an individual has in maintaining the change to the desired behavior (i.e., new behavior) in situations that may trigger relapses. Self-efficacy is also measured by the degree to which the individual feels tempted to return to the problematic behavior (i.e., old behavior) in high-risk situations. In the Precontemplation and Contemplation stages, the temptation to engage in the problematic behavior (e.g., remaining sedentary) is much greater than the self-efficacy to abstain from it. As individuals move from Preparation to Action, the disparity between feelings of self-efficacy and temptation decreases, and behavior change is achieved. Relapse generally occurs in situations where feelings of temptation overcome the individual's sense of self-efficacy to maintain the new behavior change.

Regarding Decisional Balance, the Transtheoretical Model includes the conceptualization of Janis and Mann (1977), where behavioral change can occur through the comparison between the advantages (pros) and disadvantages (cons) of assuming the new behavior. In other words, people weigh their decisions, evaluating the costs and benefits of choices they may make in the future. As the individual progresses through the stages of change, the balance of decisions

shifts critically. When an individual is in the Precontemplation stage, the cons regarding change outweigh the pros in favor of behavioral change, favoring the continuity of the current behavior. In the Contemplation stage, the pros and cons tend to carry equal weight, leaving the individual ambivalent regarding change. However, the cons often continue to weigh slightly more in the balance, as the person does not yet feel capable of initiating the new behavior. Nevertheless, if the balance tips towards the pros, many individuals move to the Preparation or even the Action stage. As individuals enter the Maintenance stage, and to decrease the risk of relapsing, the pros in favor of maintaining the behavior change must outweigh the cons regarding change that drive a return to the old behavior.

Interventions promoting physical activity and health aimed at reaching individuals in the Contemplation stage should be directed towards reflection regarding the benefits that behavioral change (e.g., initiating a physical activity program) could bring to these individuals' lives. Examples include decreasing the likelihood of acquiring certain chronic diseases, improving mood, reducing stress, and increasing energy levels (e.g., perception of vitality).

Individuals in the Precontemplation stage tend to consider the "cons" regarding behavioral change much more frequently, demonstrating reluctance regarding the consequences that may arise, such as less time with family or muscle soreness in response to training. In these instances, it is indicated to offer alternatives that counter-argue the individual's point of view without entering into conflict. Suggestions might include practicing physical activity with family members, proposing pleasurable activities with intensities adjusted to the individual's fitness level, and demonstrating that physical activities do not need to be vigorous to produce physical and mental benefits (Marcus & Lewis, 2003).

Interventions for individuals in the Contemplation stage need to be efficiently stimulated to increase the likelihood of individuals initiating physical activity practice. Individuals in this stage, like those in precontemplation, are still

in internal conflict about the pros and cons, with a slight tendency towards the cons. Health professionals should offer specific information on how to start practicing some physical activity and how this behavior can be integrated into daily life. In this phase, professionals play a fundamental role, as these individuals should be encouraged to find a physical activity that fits their needs and is pleasurable, and to seek the best practice schedule so they can include it in their daily timeline without conflicting with other activities. After defining these issues, it is important to outline realistic goals, as difficult and unattainable goals often cause great frustration and can provoke abandonment of practice, whereas achievable and completed objectives can promote continuous practice. It is suggested that individuals in this stage seek social support from family members and close acquaintances, a factor that can assist in maintaining physical activity practice (Marcus & Lewis, 2003).

For individuals in the Preparation stage, some interventions utilized in the previous phase can be used, such as goal setting and seeking social support from family members. However, the main objectives in this phase consist of encouraging individuals to start physical activity practice in a structured way, attempting to overcome barriers that currently prevent this behavior from becoming routine. For example, people who practice outdoor activities may cease practice during periods of cold, rain, or intense heat. To avoid the cessation of this behavior, professionals should guide individuals in seeking other viable options, such as exercising at home using a plan adapted to their physical condition, trying a class at a fitness operator, or looking for indoor facilities available for non-formal sports practice (e.g., tennis court, futsal field).

In the Action stage, individuals must be stimulated to avoid relapse. Since the action phase is sensitive to the abandonment of the new behavior, professionals must act so that the pros of the new behavior prevail over the previous behavior. To this end, it is important to identify risk factors that may lead individuals to such a situation. Factors such as vacations and illnesses are

common, and in these cases, strategies must be applied that support the adoption of the new behavior. For example, advising the individual to try exercising in the hotel gym or going for walks while on vacation.

For individuals in the Maintenance stage, the healthy lifestyle professional should stimulate the individual to follow the goals they have outlined. In this phase, it is important that the new behavior becomes a habit, that is, it becomes a behavior that does not require mental effort, is automatic, and is an implicit process (e.g., non-conscious, unthought). This is a calmer follow-up phase, as the probability of relapse is low, provided certain factors remain relatively stable: a) the context in which the behavior is performed; b) the consistency with which it is done; c) the degree of demand on the individual to perform the behavior; d) the intention to maintain this behavior in the future.

There are some final considerations regarding the Transtheoretical Model and the process of behavioral change. According to Biddle and Nigg (2000), behavioral change rarely occurs on the first attempt. It is expected that individuals seeking a behavioral change in their lifestyle will suffer a relapse to previous stages. However, it is in these relapses that individuals absorb knowledge and try to change again (e.g., using other strategies, new ways to change the old behavior), increasing the chances of success. Additionally, this model does not present or describe the specific determinants of behavior (e.g., motivation types), explaining only the stage in which it is found (Nigg et al., 2011). Another limitation of the Transtheoretical Model involves its classification of behavior change into a series of five distinct stages, as opposed to being understood as a continuous process. Considering that a large part of the existing literature results from cross-sectional empirical studies, assessing behavior in all its stages becomes almost impossible. Furthermore, to have a general picture of behavioral change, the adoption of physical activity would have to be evaluated over a minimum period of one year so that all phases could be measured and considered. To overcome these concerns, it is essential to define the underlying mechanisms for behavioral

change, apply theoretical models that explain behavior, and understand how science-based interventions can be useful in promoting physical activity and health.

References

Bandura, A. (1982). Self-efficacy mechanism in human agency. *American Psychologist*, *37*(2), 122-147. https://doi.org/10.1037/0003-066X.37.2.122

Biddle, S., & Nigg, C. (2000). Theories of exercise behavior. *International Journal of Sport Psychology*, *31*(2), 290-304

Centis, E., Moscatiello, S., Bugianesi, E., Bellentani, S., Fracanzani, A., Calugi, S., Petta, S., Dalle Grave, R., & Marchesini, G. (2013). Stage of change and motivation to healthier lifestyle in non-alcoholic fatty liver disease. *Journal of Hepatology*, *58*(4), 771-777. https://doi.org/10.1016/j.jhep.2012.11.031

Janis, I., & Mann, L. (1977). *Decision-making: A psychological analysis of conflict, choice, and commitment*. The Free Press.

Marcus, B., & Simkin, L. (1994). The transtheoretical model: applications to exercise behavior. *Medicine and Science in Sports and Exercise*, *26*(11), 1400-1404.

Marcus, B. H., & Lewis, B. A. (2003). Physical activity and the stages of change. In *President's Council on Physical Fitness and Sports Research Digest* (pp. 1-8). Washington, DC: The President's Council on Physical Fitness and Sports. http://www.fitness.gov/Reading_Room/Digests/march2003digest.pdf

Nigg, C., Geller, K., Motl, R., Horwath, C., Wertin, K., & Dishman, R. (2011). A Research Agenda to Examine the Efficacy and Relevance of the Transtheoretical Model for Physical Activity Behavior. *Psychology of Sport and Exercise*, *12*(1), 7-12. https://doi.org/10.1016/j.psychsport.2010.04.004

Prochaska, J., Butterworth, S., Redding, C., Burden, V., Perrin, N., Leo, M., Flaherty-Robb, M., & Prochaska, J. M. (2008). Initial efficacy of MI, TTM tailoring and HRI's with multiple behaviors for employee health promotion. *Preventive Medicine*, *46*(3), 226-231. https://doi.org/10.1016/j.ypmed.2007.11.007

Prochaska, J., & Norcross, J. (2001). Stages of change. *Psychotherapy: Theory, Research, Practice, Training*, *38*(4), 443-448. https://doi.org/10.1037/0033-3204.38.4.443

Prochaska, J., & Velicer, W. (1997). The transtheoretical model of health behavior change. *American Journal of Health Promotion*, *12*(1), 38-48. https://doi.org/10.4278/0890-1171-12.1.38

Prochaska, J., DiClemente, C., & Norcross, J. (1992). In search of how people change. Applications to addictive behaviors. *The American Psychologist*, *47*(9), 1102-1114. https://doi.org/10.1037//0003-066x.47.9.1102

Prochaska, J., & DiClemente, C. (1984). *The transtheoretical approach: crossing traditional boundaries of therapy*. Homewood, IL: Dow Jones-Irwin. ISBN: 087094438X

Prochaska, J., & DiClemente, C. (1983). Stages and processes of self-change of smoking: Toward an integrative model of change. *Journal of Consulting and Clinical Psychology*, *51*(3), 390-395. https://doi.org/10.1037/0022-006X.51.3.390

Prochaska, J. O., & DiClemente, C. C. (1982). Transtheoretical therapy: Toward a more integrative model of change. *Psychotherapy: Theory, Research and Practice*, *19*(3), 276-288. https://doi.org/10.1037/h0088437

Zamarripa, J., Castillo, I., Baños, R., Delgado, M., & Álvarez, O. (2018). Motivational Regulations Across the Stages of Change for Exercise in the General Population of Monterrey (Mexico). *Frontiers in Psychology*, *9*, 2368. https://doi.org/10.3389/fpsyg.2018.02368

5. Theory of Reasoned Action / Planned behavior

Rodrigues, F.[1,2], Jacinto, M.[1,2], Couto, N. [2,5], Teixeira, D. S.[3,4], & Monteiro, D.[1,2]

1 – ESECS – Polytechnic University of Leiria, Campus 1, Rua Dr. João Soares, Apartado 4045, 2411–901 Leiria, Portugal

2 – Research Center in Sports Sciences, Health Sciences and Human Development (CIDESD), Quinta de Prados, 5001-801 Vila Real, Portugal

3 – Faculty of Physical Education and Sport – Lusófona University, Campo Grande 376, 1749-024 Lisboa, Portugal

4 – Research Center in Sports, Physical Education, Exercise and Health (CIDEFES), Campo Grande 376, 1749-024 Lisboa, Portugal

5 – Sports Science School of Rio Maior - Polytechnic Institute of Santarém, Av. Dr. Mário Soares 110, 2040-413 Rio Maior

Conceptualization

According to Fishbein and Ajzen (1975), people make rational decisions about their behavior based on information and beliefs regarding that behavior and its consequences. Thus, the major question arises: what do people expect, and what value do they place on the outcome when performing the behavior?

The Theory of Reasoned Action was proposed in 1975 by Fishbein and Ajzen with the aim of analyzing and understanding what determines the performance of a behavior. The Theory of Reasoned Action and the Theory of Planned Behavior, and in its most recent culmination, the Reasoned Action Approach, are among the most influential theoretical models in predicting and understanding intentional behavior. According to the Theory of Reasoned Action, people will perform behavior based on their attitudes, subjective norms, and pre-existing intentions. The model posits that most socially relevant behaviors (including health behaviors) are under the individual's volitional control and that

a person's intention to perform a behavior is both the immediate determinant and the single best predictor of that behavior (Armitage & Conner 2001; Fishbein & Ajzen, 2010). Thus, if people evaluate the suggested behavior as positive (attitude) and think others want them to perform the behavior (subjective norms), this will result in higher intention levels, thereby increasing the probability that the behavior will be enacted (Ajzen, 1991).

Attitudes represent favorable or unfavorable feelings regarding the behavior. In other words, attitudes represent the construction of a positive or negative evaluation. People weigh positive beliefs (e.g., "exercising is good for health") against negative beliefs (e.g., "I will feel sore tomorrow after exercising") and generally evaluate the consequences in the short term. For example, a person who believes that performing a certain behavior will lead to predominantly positive personal consequences will have a more favorable attitude towards the behavior. Specifically, attitude is considered a function of the sum of the person's salient behavioral beliefs regarding the outcome of the action, with each belief weighted by the evaluation of that outcome.

Subjective norms represent the pressures generated by the importance attributed to others (e.g., peers, friends, family) and are a function of the perception of this importance (Fishbein & Ajzen, 1975). Thus, the expectations of significant others perceived by the individual performing the behavior can lead to the performance or non-performance of that behavior. The individual evaluates what consequences might arise from enacting the behavior (e.g., "If I start exercising, my friends will respect me more"). When an individual thinks that significant others approve of a behavior and feels it is important to act in accordance with others' beliefs, favorable subjective norms regarding the behavior are developed. A person who believes that significant peers think they should perform the behavior will perceive social pressure to do so. Specifically, the subjective norm is considered a function of the person's salient normative

beliefs regarding each person in their close circle, with each belief weighted by their motivation to comply with the referent (Ajzen, 1991).

The central construct of the Theory of Reasoned Action is intention, a motivational construct considered the most proximal determinant of behavior (Fishbein & Ajzen, 1975). Intention reflects the extent to which it is likely that an individual plans to do and invests effort in seeking a certain behavior (e.g., "I intend to start a physical activity program next week/month/year"). It is a function of the attitudes and subjective norms the person holds regarding a behavior. To simplify interpretation, the more favorable the attitudes and subjective norms are towards a behavior, the stronger the individual's intention to perform the behavior will be.

Regarding the mental construction of behavior, Ajzen (1987) states that most behaviors lie on a continuum between easy and difficult. Behaviors designated as easy are those presenting few control problems (e.g., taking a walk, window shopping, drinking a glass of water), while those designated as difficult require special resources or capabilities (e.g., overcoming sedentarism, quitting smoking). Thus, although this theoretical model explained rational and intentional behaviors within the individual's control, it presented several limitations highlighted by researchers in various social and behavioral fields.

First, many behaviors cannot simply be performed by volition alone; they require skills, opportunities, resources, or cooperation for their execution (Fishbein, 2008). For example, attending a gym is virtually impossible if one lacks financial resources or transportation, and outdoor running may be impractical in unsafe neighborhoods or extreme weather conditions. Second, people who tend to have a weak perception of efficacy or ability regarding their behavior (e.g., "I am not capable of running") also tend to present low levels of intention. Third, this theoretical model assumes that people only make systematic and rational decisions based on normative evaluations of behavior, ignoring impulsive

motives (e.g., automatic habitual behaviors). Finally, this theoretical model assumes behavior is somewhat fixed and immutable.

In response to existing criticism and limitations of the theoretical model, Ajzen (1985) evolved the Theory of Reasoned Action into the Theory of Planned Behavior as a means to account for behaviors not under the individual's complete control. The Theory of Planned Behavior focuses not only on the cognitive determinants of intention (i.e., attitudes and subjective norms) but also on the person's Perceived Behavioral Control (PBC). Perceived behavioral control refers to the perceived ease or difficulty of performing the behavior and is considered a reflection of past experience as well as anticipated obstacles (Ajzen, 1991). It is easy to see that this factor can substantially improve the model's general applicability, as many behaviors require specific skills or external resources. Therefore, behavioral performance can be facilitated or hindered according to how the person utilizes material resources, opportunities, and/or capabilities (e.g., being able to exercise three times a week).

It is assumed that perceived control has a direct influence on intention. For desirable and easily executable behaviors, when greater control is perceived, it is understood that this should determine stronger intentions (Ajzen, 1985). Perceived behavioral control can also have a direct predictive effect on behavior through two different mechanisms. First, holding intention constant, an individual with greater perceived control over the behavior tends to exert more effort and persist longer than an individual with less perceived control. Second, people may have accurate perceptions of the amount of control they have over their behavior. If the individual perceives they have the capabilities to perform the behavior, intentions cease to exert the sole predominant effect. In summary, beyond the indirect effect that perceived control has on behavior via intention, the Theory of Planned Behavior suggests a direct effect of perceived control, which reflects the extent to which perceived control accurately approximates actual control over behavioral performance (Ajzen, 1991).

The reasoned action approach

This is the most current iteration of the Theory of Reasoned Action and the Theory of Planned Behavior, incorporating key points from each conceptual framework (Fishbein & Ajzen, 2010). It considers behavior as a consequence of intention, which in turn is subject to dichotomous assumptions of attitude, subjective norms, and perceived control. Beliefs play an essential role in cognitive determinants, resulting from personal, sociodemographic, and informational factors.

Attitudes have been bifurcated into instrumental aspects, that is, the person's evaluation of anticipated positive or negative consequences (e.g., "Will using the stairs instead of the elevator be beneficial for me?"), and experiential aspects, meaning the perception of positive or negative experiences (e.g., "How did I feel the last time I exercised until exhaustion?"). This differentiation is particularly pertinent in the context of physical activity. Empirical evidence (Spink et al., 2012) suggests that while instrumental attitudes (e.g., health benefits) may be sufficient to initiate an intention, it is the experiential attitudes (e.g., enjoyment, satisfaction, affective response) that are often stronger predictors of exercise maintenance. If an individual values the health outcome but despises the process of exercising (negative experiential attitude), the stability of the intention is compromised over time.

According to the Reasoned Action Approach (Fishbein & Ajzen, 2010), subjective norms can be divided into descriptive norms, defined by the perception that others are performing the behavior (e.g., "My friends regularly go for walks, so I should too"), and injunctive norms, the perception of what should be done based on pressures imposed or suggested by peers (e.g., "My doctor says I must lose weight").

The construct of perceived behavioral control, according to this more contemporary approach, is deconstructed into capacity, that is, the perception of

being able to perform the behavior (e.g., "I can walk for half an hour every day"), and autonomy, meaning the perception the person has regarding control over the behavior (e.g., "I engage in physical activity because I choose the modality and schedule myself").

Measurement of constructs adjacent to the theoretical model

According to electronic records and scientific evidence, there is no single formal questionnaire that universally evaluates attitudes, subjective norms, perceived control, and intention across all contexts. However, Ajzen (2013) has provided recommendations on constructing questionnaires to assess these factors, allowing researchers and professionals to estimate behavioral determinants. Before initiating any type of investigation, the behavior of interest must be clearly defined in terms of its Target, Action, Context, and Time (TACT) elements. For example, we can define physical activity behavior as follows: "Training for at least half an hour (Time), three times a week (Time/Frequency) at a fitness center (Context) to improve fitness (Action/Target)".

Secondly, the target population must be considered. The population should be well-defined to avoid potential interpretation bias of the questionnaire items. In the example mentioned above, only individuals enrolled in a gym or health club would be included in the study population. Next, items comprising each factor for measuring the constructs are formulated and subsequently analyzed. A seven-point bipolar scale is typically employed in these questionnaires. Three to four items are formulated to measure each construct within the theoretical model. Participants are asked to circle the number that best describes their personal opinions. It should also be noted that items are formulated to be exactly compatible with the behavioral criterion and to be self-referenced. An example of constructing a possible questionnaire can be seen here https://people.umass.edu/aizen/pdf/tpb.measurement.pdf.

Application in the context of physical activity and exercise

These theoretical models have been applied in various intervention areas promoting healthy behaviors, specifically physical activity practice (Blanchard et al., 2003; Bozionelos & Bennett, 1999; Davies et al., 2010; Hagger et al., 2002; Spink et al., 2012; Stolte et al., 2017). Interventions based on the Theory of Planned Behavior, or even the Reasoned Action Approach aimed at behavioral change, can be designed focusing on just one or more determinants: attitudes, subjective norms, or perceived control. Alterations in these factors should promote changes in intentions towards the behavior, providing adequate control over it.

Given that subjective norms, attitudes, and perceived control are based on a set of beliefs, interventions must modify these beliefs as a means to ultimately achieve the performance of the new behavior. Determinants with the greatest explanatory power for healthy behavior (e.g., physical activity) are explained by intention and perceived control (Godin & Kok, 1996). Intention remains the most proximal determinant, except when the behavior is not under the individual's full volitional control. That is, the motivation leading the individual to perform the behavior does not always require high levels of intention when this behavior is already within the individual's domain. Thus, in individuals who have been practicing physical activity regularly and consistently for some months (see the Transtheoretical Model for interpretation), intentions may not generate the behavior as much as the control the person already possesses, making them feel capable of performing it with a high degree of efficacy.

One way to influence behavioral determinants has been through the use of Behavior Change Techniques described by Michie and Johnston (2012). BCTs are strategies that help an individual change their behavior to promote better health (e.g., setting goals, removing sedentary cues from home, or packing a sports bag the night before). These techniques have been used in intervention studies aimed at influencing attitudes, subjective norms, perceived control, and

intentions in various healthy behaviors (Senkowski et al., 2019). For example, Antikainen et al. (2010) applied several BCTs to manipulate beliefs about behavior and perceived control. The techniques included: instruction on how to perform the behavior (participants received educational materials on physical activity benefits and basic principles); reliable and science-based information (a qualified technician demonstrated various exercises); and information leaflets on social and environmental consequences. The results of Antikainen et al.'s (2010) study demonstrated significant differences post-intervention, indicating that participants increased their beliefs regarding the behavior, with a significant influence on physical activity practice.

The likelihood of the message communicated by professionals creating favorable attitudes about the product or service depends on the users' attitudes toward the message. Thus, clear, pragmatic messages appreciated by users lead to positive evaluations. However, it is necessary to understand the person's motivations for wanting to change behavior and its impact on the individual, social, and ecological levels.

The presentation of instrumental aspects of attitudes (e.g., "*Will starting to exercise be beneficial for me?*") is a pivotal aspect that health professionals must address. Decisional balance can be an effective tool, as it prompts the individual to reflect on current behavior and the benefits of change, leading them to change. Furthermore, experiential aspects lead the individual to perceive negative experiences (e.g., "The last time I remained sedentary for a whole weekend, I felt lethargic and moody."). In this way, professionals can influence beliefs, reinforcing the negative aspects of current behavior and how change could improve the person's quality of life (e.g., "Do you remember the last time you climbed two flights of stairs and had immense difficulty breathing? do you think introducing physical activity into your daily life could reverse this situation?"). The professional must place the power of behavior on the individual, leading them to critical and

constructive reflection on current behavior and how the new behavior could improve their quality of life.

An individual's subjective norms about behavior can be (and are) influenced by social norms. That is, the individual's perception of the value significant others place on the behavior. Thus, pressure and control to adhere to a new behavior by significant others can, a priori, determine failure. For example, if the individual believes their partner wants them to stay physically active by imposing mandatory daily long walks, their subjective norms for exercise will be low, negatively influencing their intentions. On the other hand, a communicative approach, presenting the benefits of physical activity and performing the behavior together as a "motivator," could be a more efficient strategy for increasing intentions. Research specifically examining these constructs, such as the work by Spink et al. (2012), suggests that descriptive norms often have a more robust influence on physical activity intentions than injunctive norms in certain settings. This implies that observing peers actively engaging in exercise (social modeling) may generate a stronger behavioral impulse than merely receiving verbal encouragement or pressure to be active. Thus, beliefs about descriptive norms (e.g., "My friends exercise moderately, so I should too") and injunctive norms (e.g., "My coach says I need to improve my fitness to enhance my quality of life") are determinants of intention quality.

However, like the Transtheoretical Model, the Theory of Planned Behavior presents limitations that must be considered. First, sociodemographic factors and personality traits appear to influence the cognitive variables determining intention. However, these are not explicitly considered in the model's core structure. Furthermore, this theoretical model assumes that all actions and behaviors have a rational basis, largely excluding the hypothesis of unconscious influences on the performance of a given behavior (Sheeran et al., 2013). This theoretical model does not consider past behavior as a direct determinant of future behavior (Ajzen, 2002), despite it presenting significant effects, often

superior to intention, especially in health-related behaviors where habit formation is key (Hagger et al., 2018). The intention-behavior gap, as previously mentioned, is substantial, indicating that not all intention translates into behavior. In fact, results under ceteris paribus conditions suggest that individuals are more likely to engage in behaviors they like less if they feel capable of doing them, casting doubt on whether rational intention is the sole driver. Critically, the theory operates on the assumption that behavior is driven by conscious deliberation. However, repeated behaviors like physical activity can eventually become automatic responses to environmental cues, bypassing the cognitive deliberation of intention. Hagger et al. (2018) emphasize that past behavior often predicts future behavior directly, independent of intention and perceived control, reflecting the force of habit. Similarly, Stolte et al. (2017) highlight that for older adults, rigid habits can moderate the relationship between the theory of planned behavior constructs and behavior change. When a behavior becomes habitual, the predictive power of intention weakens, as the individual acts out of automaticity rather than reasoned decision-making. This suggests that the theory of planned behavior is highly effective for the *adoption* phase of exercise but may be less comprehensive for explaining long-term *maintenance* where automatic processes dominate.

References

Ajzen, I. (2013). *Theory of Planned Behavior Questionnaire*. Measurement Instrument Database for the Social Science. Retrieved from www.midss.ie

Ajzen, I. (2002). Residual effects of past on later behavior: Habituation and reasoned action perspectives. *Personality and Social Psychology Review*, *6*(2), 107-122. https://doi.org/10.1207/S15327957PSPR0602_02

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, *50*(2), 179-211. https://doi.org/10.1016/0749-5978(91)90020-T

Ajzen, I. (1987). Attitudes, traits, and actions: Dispositional prediction of behavior in personality and social psychology. In L. Berkowitz (Ed.), *Advances in experimental social psychology* (Vol. 20, pp. 1-63). Academic Press. https://doi.org/10.1016/S0065-2601(08)60411-6

Ajzen, I. (1985). From Intentions to Actions: A Theory of Planned Behavior. In J. Kuhl & J. Beckmann (Eds.), *Action Control: From Cognition to Behavior* (pp. 11-39). Springer-Verlag. https://doi.org/10.1007/978-3-642-69746-3_2

Antikainen, I., Ellis, R., Kosma, M., Allen, P., Cherry, K., Monroe, P., & Wood, R. (2010). Examining change in theory-based physical activity beliefs of culturally diverse older adults. *Journal of Applied Gerontology*, *29*(4), 507-517. https://doi.org/10.1177/0733464809341469

Armitage, C., & Conner, M. (2001). Efficacy of the Theory of Planned Behavior: a meta-analytic review. *The British Journal of Social Psychology*, *40*(4), 471-499. https://doi.org/10.1348/014466601164939

Blanchard, C., Courneya, K., Rodgers, W., Fraser, S., Murray, T., Daub, B., & Black, B. (2003). Is the theory of planned behavior a useful framework for understanding exercise adherence during phase II cardiac rehabilitation? *Journal of Cardiopulmonary Rehabilitation*, *23*(1), 29-39. https://doi.org/10.1097/00008483-200301000-00007

Bozionelos, G., & Bennett, P. (1999). The theory of planned behavior as predictor of exercise: the moderating influence of beliefs and personality variables. *Journal of Health Psychology*, *4*(4), 517-529. https://doi.org/10.1177/135910539900400406

Davies, C., Mummery, W., & Steele, R. (2010). The relationship between personality, theory of planned behavior and physical activity in individuals with type II diabetes. *British Journal of Sports Medicine*, *44*(13), 979-984. https://doi.org/10.1136/bjsm.2008.050930

Fishbein, M. (2008). A reasoned action approach to health promotion. *Medical Decision Making*, *28*(6), 834-844. https://doi.org/10.1177/0272989X08326092

Fishbein, M., & Ajzen, I. (2010). *Predicting and changing behavior: The Reasoned Action Approach*. Psychology Press.

Fishbein, M., & Ajzen, I. (1975). *Belief, Attitude, Intention, and Behavior: An Introduction to Theory and Research*. Addison-Wesley.

Godin, G., & Kok, G. (1996). The theory of planned behavior: a review of its applications to health-related behaviors. *American Journal of Health Promotion*, *11*(2), 87-98. https://doi.org/10.4278/0890-1171-11.2.87

Hagger, M., Polet, J., & Lintunen, T. (2018). The reasoned action approach applied to health behavior: Role of past behavior and tests of some key moderators using meta-analytic structural equation modeling. *Social Science and Medicine*, *213*, 85-94. https://doi.org/10.1016/j.socscimed.2018.07.038

Hagger, M., Chatzisarantis, N., & Biddle, S. (2002). A meta-analytic review of the theories of reasoned action and planned behavior in physical activity: Predictive validity and the contribution of additional variables. *Journal of Sport and Exercise Psychology*, *24*(1), 3-32. https://doi.org/10.1123/jsep.24.1.3

Michie, S., & Johnston, M. (2012). Theories and techniques of behavior change: Developing a cumulative science of behavior change. *Health Psychology Review*, *6*(1), 1-6. https://doi.org/10.1080/17437199.2012.654964

Senkowski, V., Gannon, C., & Branscum, P. (2019). Behavior Change Techniques Used in Theory of Planned Behavior Physical Activity Interventions Among Older Adults: A Systematic Review. *Journal of Aging and Physical Activity*, *27*(5), 746-754. https://doi.org/10.1123/japa.2018-0103

Sheeran, P., Gollwitzer, P., & Bargh, J. (2013). Nonconscious processes and health. *Health Psychology*, *32*(5), 460-473. https://doi.org/10.1037/a0029203

Spink, K., Wilson, K., & Bostick, J. (2012). Theory of planned behavior and intention to exercise: effects of setting. *American Journal of Health Behavior*, *36*(2), 254-264. https://doi.org/10.5993/AJHB.36.2.10

Stolte, E., Hopman-Rock, M., Aartsen, M., van Tilburg, T., & Chorus, A. (2017). The Theory of Planned Behavior and Physical Activity Change: Outcomes of the Aging Well and Healthily Intervention Program for Older Adults. *Journal of Aging and Physical Activity*, *25*(3), 438-445. https://doi.org/10.1123/japa.2016-0182

6. Theory of Habit

Rodrigues, F.[1,2], Teixeira, D. S.[3,4], Mendes, P.[5,6], Antunes, R.[1,2], Bastos, V.[3,4]

1 – ESECS – Polytechnic University of Leiria, Campus 1, Rua Dr. João Soares, Apartado 4045, 2411–901 Leiria, Portugal

2 – Research Center in Sports Sciences, Health Sciences and Human Development (CIDESD), Quinta de Prados, 5001-801 Vila Real, Portugal

3 – Faculty of Physical Education and Sport – Lusófona University, Campo Grande 376, 1749-024 Lisboa, Portugal

4 – Research Center in Sports, Physical Education, Exercise and Health (CIDEFES), Campo Grande 376, 1749-024 Lisboa, Portugal

5 – Department of Sport and Well-being, Polytechnic Institute of Castelo Branco, Castelo Branco, Portugal

6 – Sport, Physical Activity, and Health Research & Innovation Center (SPRINT), Santarém, Portugal

Conceptualization

Many public health challenges are rooted in behavior. Even small changes in daily behavior can yield considerable benefits, provided the individual is capable of conscious reflection regarding their health. However, while many people successfully adopt new healthy behaviors, they often fail to maintain them in the long term. This paradox has sparked interest in the concept of habit and in attempting to understand how it predicts behavior. Habit is defined as a behavior repeated without intention or with little need for intentional resources (Gardner, 2015). Consequently, it is performed regularly in a natural and spontaneous manner (Gardner, 2020). As a behavior, initially directed toward a specific goal, becomes habitual, control over that behavior is transferred from a reflective and rational processing system, which elicits behavior relatively slowly based on the

individual's intention and motivation, to an impulsive system, often grounded in Dual Process Theories, which elicits behavior quickly and efficiently based on the context in which it occurs (Gardner & Rebar, 2019). Habit can also be defined as a set of learned sequences of actions that have become automatic in response to specific contexts (Verplanken & Aarts, 1999). However, frequently performed behaviors do not automatically become habits (Gardner, 2015). Furthermore, knowing only the cues (e.g., contextual key moments such as having a sports bag in the car) that trigger the behavior merely indicates what might be performed. Knowing only the behavior and its frequency may lead to assumptions of habit, but these characteristics do not provide information regarding the timeframe in which the behavior was performed. For a behavior to become habitual (shifting from less intentional to more habitual), several criteria proposed by Gardner (2020) must be considered.

Repetition. This refers to the frequency with which the behavior is performed. It seems evident that one can hardly assume a behavior is habitual in a person's daily life if it is not repeated with some regularity. However, we cannot assume that the higher the frequency of the behavior, the greater the likelihood of that behavior becoming habitual. This fine line between frequency and habit depends on other mechanisms, described below.

Consistency. While repetition describes the number of times the behavior is performed, consistency defines the stability with which the behavior is executed. It is substantially different to engage in physical activity three times a week on a fixed schedule (e.g., Mondays, Wednesdays, and Fridays at the same time) versus practicing twice a week on a completely random schedule without a defined pattern. We do not wish to imply that consistency must be rigid for the behavior to assume a habitual dimension. The literature merely states that for us to label a behavior as a habit, it must be performed under stable conditions, particularly in

the initial periods (Gardner et al., 2012). Thus, if the behavior is performed under stable conditions (e.g., the practice of exercise in the same location), with a stable schedule and under the same conditions, this behavior may become habitual. Repeating the behavior in the same context reinforces the mental associations between the context and the behavior (Wood & Rünger, 2016; Verplanken & Wood, 2006).

Complexity. In summary, behaviors that are less physically and mentally demanding (e.g., drinking a glass of water in the morning) have a higher probability of becoming habitual compared to complex behaviors (e.g., going for a walk or engaging in structured exercise). This is related not only to the behavior itself but to all the cues that trigger the realization of the behavior. While drinking a glass of water implies fetching the glass, filling it with water, and drinking, going for a walk implies: changing clothes, planning the route, warming up, among others, a concept often referred to as "behavioral friction". Thus, simpler behaviors appear to be closer to becoming habitual compared to more complex behaviors (Gardner, 2015).

Cues. As previously mentioned, cues are key moments that trigger or lead the individual to act in accordance with their intentions. For example, washing hands automatically (action) after using the bathroom (contextual cue) or fastening the seatbelt (action) after entering the car (contextual cue). Indeed, the literature consistently shows that mere repetition of a simple action in a consistent context leads, through associative learning, to the action being activated upon subsequent exposure to those contextual cues, that is, habit formation (Gardner et al., 2012). Once the initiation of the action is "transferred" to contextual or external cues, the dependence on conscious attention or motivational processes is reduced (Lally et al., 2011). Often, people fail to maintain behavior changes because they lose motivation; however, if they created habits for new behaviors,

they should, in theory, continue to perform them despite the loss of motivation (Gardner, 2015; Rebar et al., 2014). Therefore, habitual behaviors tend to persist even after conscious motivation or interest dissipates. Habitual behaviors are also cognitively efficient because the automaticity of actions frees up mental resources for other tasks. In short, the transfer from intentional to habitual resources facilitates the human capacity to invest previously unavailable resources into other behaviors or actions.

Measurement of habit

As there was initially no validated instrument for measuring habit, Verplanken and Orbell (2003) created and validated the Self-Report Habit Index (SRHI). This is a 12-item instrument that incorporates the assessment of automaticity (e.g., "Practicing exercise is something I do without thinking"), behavioral frequency (e.g., "Eating a piece of fruit with meals is something I have been doing for a long time"), and self-identity awareness (e.g., "Using the stairs instead of the elevator is something that is part of me"). The SRHI demonstrated high test-retest reliability and adequate internal consistency (alpha coefficients > 0.90) when applied to measure various habitual behaviors, such as eating sweets, listening to music, and watching TV series.

As the measurement of habit was taking its first steps, this instrument served as the "Gold Standard" for nearly a decade (Gardner et al., 2011; Orbell & Verplanken, 2015). However, Gardner et al. (2011) redefined habit assessment, arguing that identity is not necessarily a component of habit. Some habitual behaviors may not be associated with a sense of self-identity; they may simply be simple intentional behaviors that are not intended to be an expression of the self (e.g., drinking a glass of water). As stated by Gardner et al. (2012), self-identity predicts intentions, but not behaviors. In contrast, habit predicts behavior but does not predict intentions. As previously mentioned, habit does not play a moderating role in the intention-behavior association according to pre-

established criteria. Gardner et al. (2012), after systematically analyzing the SRHI and soliciting the collaboration of seven experts in applied psychology to classify the extent to which each SRHI item met the definitions of habit, concluded that only four items of the SRHI actually measured habit formation (specifically, automaticity). These four items were then used to create the Self-Reported Behavior Automaticity Index (SRBAI) as a valid measure for assessing habit. In the same work, Gardner et al. (2012) showed that the SRBAI presented acceptable internal consistency (alpha coefficients above 0.80), demonstrating that habit development showed a positive and significant correlation with various behaviors (i.e., commuting by car versus bicycle). These authors concluded that the SRBAI was, compared to the SRHI, conceptually more precise and more parsimonious in the evaluation of behavioral habit, as it isolates the "active ingredient" of habit automaticity, removing the confounding variables of frequency and identity. For building a measure of habit please see guidelines provided by Gardner et al. (2012).

Habit, physical activity, and exercise

Hagger (2018) explained that the repeated performance of a specific behavior over a period of time can lead to the development of a habitual behavior, even in complex activities such as physical activity. This conceptualization highlights the notion that the repetition of physical activity practice can increase the likelihood of the behavior becoming automatic. A recent study conducted by Rodrigues et al. (2021) with exercisers in fitness centers, aligning with findings from Kaushal and Rhodes (2015), evidenced significant associations between exercise experience, frequency, and habit. These associations support previous evidence (Verplanken & Orbell, 2003), suggesting that habit strength may be associated with behavioral frequency (Gardner, 2020), in this case, related to the frequency with which an exerciser visits the fitness center. Nevertheless, the results support the distinction between past behavior

(i.e., exercise experience) and habit, since past behavior may or may not include the development of a habitual behavior (Gardner, 2015; Gardner et al., 2011). However, the performance of exercise depends on how an individual has repeated the behavior in the past (Rodrigues et al., 2020), and therefore, the associations between experience and frequency found in this study support this assumption.

For a healthy behavior to become habitual, it must be performed repeatedly in the presence of the same contextual cues (Lally et al., 2010). Therefore, one must consider post-initiation variables that can sustain behavior maintenance over time (Lally et al., 2013). Whether a behavior that has been performed a small number of times transitions to being repeated largely depends on whether people continue to want to perform the new behavior after its inception; this is likely dependent on the goals the person had initially proposed and on motivational issues. In the early stages of long-term behavior change, goal-directed actions that stimulate negative affect are typically discontinued, while those that give rise to positive emotions can reinforce commitment (Lally et al., 2013) reinforcing the role of intrinsic rewards in the habit loop.

There is no concrete theoretical model regarding habit formation, simply because the concept of habit is still in its infancy. Furthermore, there is no consensus regarding the approximate time it takes for an intentional behavior to transition into a more habitual behavior. The intention-habit-behavior link is very fragile, and assuming a behavior is entirely a habit, without recourse to a rational link, can be misleading. No matter how much behavior may be assumed to be habitual, there exists, even if only in a residual portion, an intention to perform the behavior. Another important aspect lies in the complexity of behaviors and the resources required for them to be repeated. For example, for physical activity to become habitual, we must consider the person's capabilities (e.g., physical fitness), resources (e.g., gym, bike path, appropriate space), ecological surroundings (e.g., family tasks), and professional responsibilities, among others. Thus, habit formation, based on physical activity as the behavior in question,

varies substantially. Consequently, it is not possible to outline a more conservative timeframe to create more effective interventions in habit formation. Current literature addresses this complexity by distinguishing between "Habitual Instigation", automatically deciding to go to the gym, and "Habitual Execution", the workout itself. For complex behaviors like exercise, habit often assists the instigation, but intention is still required for execution.

References

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*(2), 179-211. https://doi.org/10.1016/0749-5978(91)90020-T

Gardner, B. (2015). A review and analysis of the use of 'habit' in understanding, predicting and influencing health-related behavior. *Health Psychology Review, 9*(3), 277-295. https://doi.org/10.1080/17437199.2013.876238

Gardner, B. (2020). Habit as automaticity, not frequency. *European Health Psychologist, 14*(2), 32-36.

Gardner, B., & Rebar, A. (2019). Habit Formation and Behavior Change. *Oxford Bibliographies Online*. https://doi.org/10.1093/OBO/9780199828340-0232

Gardner, B., Bruijn, G., & Lally, P. (2011). A systematic review and meta-analysis of applications of the Self-Report Habit Index to nutrition and physical activity behaviors. *Annals of Behavioral Medicine, 42*(2), 174-187. https://doi.org/10.1007/s12160-011-9282-0

Gardner, B., Corbridge, S., & McGowan, L. (2015). Do habits always override intentions? Pitting unhealthy snacking habits against snack-avoidance intentions. *BMC Psychology, 3*(1), 8. https://doi.org/10.1186/s40359-015-0065-4

Gardner, B., Lally, P., & Wardle, J. (2012). Making health habitual: the psychology of "habit-formation" and general practice. *British Journal of General Practice, 62*(605), 664-666. https://doi.org/10.3399/bjgp12X659466

Hagger, M. (2018). Habit and physical activity: Theoretical advances, practical implications, and agenda for future research. *Psychology of Sport and Exercise, 42*, 118-129. https://doi.org/10.1016/j.psychsport.2018.12.007

Kaushal, N., & Rhodes, R. (2015). Exercise habit formation in new gym members: a longitudinal study. *Journal of Behavioral Medicine, 38*(4), 652-663. https://doi.org/10.1007/s10865-015-9640-7

Lally, P., & Gardner, B. (2013). Promoting habit formation. *Health Psychology Review, 7*(1), 137-158. https://doi.org/10.1080/17437199.2011.603640

Lally, P., van Jaarsveld, C., Potts, H., & Wardle, J. (2010). How are habits formed: Modelling habit formation in the real world. *European Journal of Social Psychology, 40*, 998-1009. https://doi.org/10.1002/ejsp.674

Lally, P., Wardle, J., & Gardner, B. (2011). Experiences of habit formation: a qualitative study. *Psychology, Health and Medicine, 16*(4), 484-489. https://doi.org/10.1080/13548506.2011.555774

Orbell, S., & Verplanken, B. (2015). The strength of habit. *Health Psychology Review, 9*(3), 311-317. https://doi.org/10.1080/17437199.2014.992031

Rebar, A., Elavsky, S., Maher, J., Doerksen, S., & Conroy, D. (2014). Habits predict physical activity on days when intentions are weak. *Journal of Sport and Exercise Psychology, 36*(2), 157-165. https://doi.org/10.1123/jsep.2013-0173

Rodrigues, F., Forte, P., Teixeira, D., Cid, L., Travassos, B., & Monteiro, D. (2021). A avaliação do hábito em praticantes de exercício físico: Testando a validade do Self-Report Behavioral Automaticity Index. *Motricidade, 17*(1).

Rodrigues, F., Teixeira, D., Neiva, H., Cid, L., & Monteiro, D. (2020). The bright and dark sides of motivation as predictors of enjoyment, intention, and exercise persistence. *Scandinavian Journal of Medicine and Science in Sports, 30*(4), 787-800. https://doi.org/10.1111/sms.13617

Verplanken, B., & Aarts, H. (1999). Habit, Attitude, and Planned Behavior: Is Habit an Empty Construct or an Interesting Case of Goal-directed Automaticity?

European Review of Social Psychology, 10(1), 101-134. https://doi.org/10.1080/14792779943000035

Verplanken, B., & Orbell, S. (2003). Reflections on Past Behavior: A Self-Report Index of Habit Strength. *Journal of Applied Social Psychology, 33*(6), 1313-1330. https://doi.org/10.1111/j.1559-1816.2003.tb01951.x

Verplanken, B., & Wood, W. (2006). Interventions to Break and Create Consumer Habits. *Journal of Public Policy and Marketing, 25*(1), 90-103. https://doi.org/10.1509/jppm.25.1.90

Wood, W., & Rünger, D. (2016). Psychology of Habit. *Annual Review of Psychology, 67*, 289-314. https://doi.org/10.1146/annurev-psych-122414-033417

7. Self-Determination Theory

Monteiro, D.[1,2], Teixeira, D. S.[3,4], Couto, N.[2,5], & Rodrigues, F.[1,2]

1 – ESECS – Polytechnic University of Leiria, Campus 1, Rua Dr. João Soares, Apartado 4045, 2411–901 Leiria, Portugal

2 – Research Center in Sports Sciences, Health Sciences and Human Development (CIDESD), Quinta de Prados, 5001-801 Vila Real, Portugal

3 – Faculty of Physical Education and Sport – Lusófona University, Campo Grande 376, 1749-024 Lisboa, Portugal

4 – Research Center in Sports, Physical Education, Exercise and Health (CIDEFES), Campo Grande 376, 1749-024 Lisboa, Portugal

5 – Sports Science School of Rio Maior - Polytechnic Institute of Santarém, Av. Dr. Mário Soares 110, 2040-413 Rio Maior

Conceptualization

Motivation plays a pivotal role in the exertion of effort and the realization of any type of behavior. The very definition of the term implies that motivation energizes behavior, acting as a genuine engine for achievement (Weinberg & Gould, 2007); it is defined as the process by which goal-directed activities are initiated and sustained. Thus, we can conceptualize motivation as behavioral energy that dictates the performance or non-performance of a behavior. In the specific context of physical activity, understanding this energetic direction is crucial for distinguishing between sedentary lifestyles and active participation, as well as for predicting adherence to exercise protocols.

Although motivation has been considered the primary cause of individuals' thoughts, feelings, and actions in various theoretical models (e.g., evolutionary theory, psychoanalytic theory, physiological psychology), this is not entirely accurate within the psychology of motivation. According to contemporary

evidence (Gollwitzer & Oettingen, 2015), motivation is merely one cause among others explaining behavior and its essence, consisting of the study of personality, feelings, and actions conducive to behavioral analysis.

For instance, when an individual feels hunger, behavior is stimulated (e.g., finding and consuming food), which is fundamental to correcting the disequilibrium caused by the organism's needs. There is a physical motivation driving the individual to take action to address a physiological necessity. However, an individual does not always seek food to remedy physiological deficits. The commonly termed "psychological hunger," however archaic it may seem, does not stem from a physiological need but rather from a reference to an emotional desire that must be assuaged through food intake. Thus, motivation arises not as a physical necessity, but as an emotional response (e.g., stress, anxiety, among others) leading the individual to consume a snack or other food items.

Numerous motivational theories have been proposed to explain human motivation. While each elucidates specific aspects of motivation, they necessarily neglect others. The diversity of motivational theories creates confusion because most share areas of conceptual overlap and disagreement, and many employ an idiosyncratic vocabulary, using different words for the same concept and the same word for different concepts. Although this can be bewildering, each contemporary theory contributes a unique perspective, providing potentially novel insights and distinct implications for practice and future research, particularly those most involved in behavioral change regarding physical activity and health.

Self-Determination Theory, developed by Deci and Ryan (1985) and studied extensively since (Ryan & Deci, 2000; 2017; 2020), posits that human beings have a natural tendency to act in accordance with their motivational state within a given context. This theoretical model focuses on surrounding contextual factors, personality factors, as well as the causes and consequences of self-determined behavior. In other words, SDT analyzes and explains how motivational

determinants, such as interpersonal behaviors and contextual factors, may be responsible for positive outcomes or negative consequences at emotional, cognitive, and, principally, behavioral levels (Ryan & Deci, 2017).

This theoretical macro-model assumes intrinsic motivation as the prototype of self-determined behavior, wherein individual participation occurs voluntarily, without any type of reward or external pressure. This type of motivation is intrinsically related to feelings of pleasure and enjoyment inherent in the performance of the behavior itself (Ryan & Deci, 2017). That is, the individual explores the environment in which they are situated, manipulates available instruments and tools, and performs a certain behavior with the sole objective of achieving a sense of personal satisfaction. Consequently, when an individual experiences pleasure during or after performing a certain behavior (e.g., physical activity, watching a movie at the cinema), it is expected that they will repeat this behavior in the future (Deci & Ryan, 1985).

According to this theoretical model, the quality (see following section) of motivation is not directly dependent on contextual (e.g., place of residence) and/or social factors (e.g., interpersonal behaviors of peers) but is mediated by the satisfaction of "universal nutrients," innate to all human beings, which are responsible for personal growth and development (Ryan & Deci, 2017). Per the assumptions of this model, there are three basic psychological needs, innate in all humans regardless of race, ethnicity, gender, age, or other sociodemographic factors, the satisfaction of which represents a universal experience of physical and psychological well-being (Ryan & Deci, 2000). The degree of satisfaction of the psychological need for autonomy (i.e., the subject's capacity to regulate their own actions), competence (i.e., the subject's efficacy in interacting with the environment), and relatedness (i.e., the subject's capacity to seek and develop connections and interpersonal relationships) will determine the quality of motivation and, consequently, the commitment to performing the behavior. In the realm of exercise, this implies that environments supporting a client’s choice

(autonomy), fostering skill mastery (competence), and promoting social inclusion (relatedness) are more likely to result in sustained physical activity. Self-Determination Theory is a macro-theory incorporating six mini-theories, each interconnected:

Organismic Integration Theory. It is perhaps the most contemporary and robust, it addresses the various manifestations of motivation, qualitatively deconstructing extrinsic motivation and explaining how internalization processes can assist in integrating behavior as self-determined (Howard et al., 2017; Ryan & Deci, 2017). This is particularly relevant for understanding how individuals transition from exercising due to medical pressure to exercising for personal value.

Basic Psychological Needs Theory. It conceptualizes the existence of three basic psychological needs (i.e., autonomy, competence, and relatedness) and how these are fundamental structures in the internalization and integration of behavior. These components play a key role in promoting positive emotional and behavioral outcomes (Deci et al., 2017).

Cognitive Evaluation Theory. Proposes a viable theoretical framework to explain the detrimental effects of performance-contingent rewards on intrinsic motivation and how social and contextual factors can promote or inhibit this type of motivation (Deci & Ryan, 1985).

Causality Orientations Theory. Premised on the cause of actions, positing that individuals differ in their interpretation of the cause of their behavior, interpreting it as originating from within themselves, from others, or from external events (Deci & Ryan, 1985).

Goal Contents Theory. Focuses on different types of motives and aspirations, based on the intrinsic nature (e.g., personal growth, physical and mental health) or extrinsic nature (e.g., money, image, social recognition) of the individual (Ryan & Deci, 2017). It is noteworthy that motives should not be viewed as synonymous with motivations, as intrinsic and extrinsic motives can play a predictive role in the quality of motivation.

Relationships Motivation Theory. The most recent mini model, it postulates that the basic psychological need for relatedness is what mobilizes individuals in search of lasting relationships. However, not all relationships are of high quality or satisfy the basic psychological need for relatedness. Even in affectionate connections or relationships between peers, only those in which both experience autonomy and provide autonomy support to the other profoundly satisfy the basic psychological need for relatedness (Deci & Ryan, 2014).

Each of these mini theories systematizes key aspects of Self-Determination Theory. However, although each mini theory plays its role in explaining self-determined behavior (Vansteenkiste et al., 2010), only the models most utilized in research concerning behavioral change in physical activity and health will be addressed.

Organismic Integration Theory

Contrary to antiquated theoretical assumptions regarding the dichotomy of extrinsic and intrinsic motivation, Self-Determination Theory revolutionized the field by presenting motivation as a motivational continuum, varying the quality of motivation based on the degree of self-determination. Thus, motivation can manifest through six forms, ranging from more self-determined to less self-determined forms, divided from a macro perspective into intrinsic motivation, extrinsic motivation, and amotivation (Deci & Ryan, 1985).

Intrinsic motivation represents the most self-determined manifestation of motivation. As previously mentioned, individuals who perform a certain behavior regulated by intrinsic motivation experience pleasure, enjoyment, a sense of exploration, and other sensations inherent to the behavior itself (Ryan & Deci, 2017). Intrinsically motivated persons do not seek to obtain rewards through the execution of their behavior. Its execution is purely an expression of the person and their identity. The experience of the behavior is enriching, and thus there is a fondness or passion for its performance. Children playing in a park are a prime example regarding intrinsic motivation. A child explores the corners of the house, gardens, green spaces, or the beach, with toys or other objects, without a notion of time or possible consequences. The child plays for pure pleasure. When the behavior ceases to be interesting or stimulating, the child disconnects from that behavior and moves on to another, without jeopardizing the child's motivation to play and explore. For an adult athlete, this might manifest as the sheer joy of the movement itself, such as the sensation of running or the rhythmic flow of swimming, regardless of training metrics. Thus, intrinsic motivation leads the person to self-determine to perform a certain behavior as long as it remains stimulating for the individual.

Proceeding along the motivational continuum toward less self-determined regulations, extrinsic motivation arises, characterizing situations in which behavior is performed with the intent of obtaining specific benefits other than the pleasure and enjoyment derived from its execution. Throughout the motivational continuum, there are different forms of regulating extrinsic motivation. The most self-determined form is termed integrated regulation. In this type of regulation, the subject integrates the behavior volitionally, as there exists a high degree of congruence with their values and needs (Ryan & Deci, 2017). However, they perform the behavior to obtain adjacent benefits (e.g., practicing physical activity because they intend to improve their physical condition). In this type of regulation, there is a certain harmony with the person's other daily activities,

creating a sense of congruence. The person performing a behavior under integrated regulation is at the most self-determined point of extrinsic motivation. Here, physical activity is no longer just a behavior but a central part of the individual's identity (e.g., "*I am a cyclist*" rather than "*I ride a bike*").

Next appears identified regulation, wherein the subject recognizes the importance of the behavior and acts motivated by the appreciation of the results and benefits of participating in that behavior (Deci & Ryan, 2000), although they may not enjoy performing it or even consider it interesting (e.g., a person attends a group class because they identify with the environment inherent to fitness). Often confused with integrated regulation (Howard et al., 2020a; 2020b; 2017), this regulation defines how the person identifies with and personally values the behavior. Unlike integrated regulation, where the behavior is involved in daily activities in full harmony, in identified regulation, the person consciously accepts the behavior and, thus, experiences a relatively high degree of willingness or volition to act. In a clinical exercise setting, this is often seen when a patient adheres strictly to a rehabilitation protocol not because it is enjoyable, but because they value the recovery of their mobility.

On a less self-determined slope, yet still integrated within extrinsic regulations, introjected regulation is conceptualized by internal pressures, namely feelings of guilt and anxiety, which lead to the performance of the behavior (Ryan & Deci, 2000). In these cases, the individual accepts the reason for performing the behavior but does not identify with it, nor do they internalize it (e.g., a person forces themselves to lose weight because they feel they should do so). The source of motivation based on introjected regulation for a behavior is guilt, worry, or shame. Thus, introjected regulation inspires the individual to perform a behavior not because they want to, but because they fear that by not doing so, they might jeopardize their representation among peers (i.e., a sense of social obligation). This is frequently observed in fitness culture, where individuals may exercise

primarily to avoid body shaming or to seek validation through physical appearance.

Much research based on Self-Determination Theory has considered introjected regulation as a single factor (Howard et al., 2017; Ryan & Deci, 2017). However, a deeper analysis of the concept of introjected regulation raises a possible differentiation between an approach introjected component and an avoidance introjected component (Assor et al., 2009). The avoidance component refers to the individual's attempts to meet introjection standards as a way to avoid feelings of guilt, shame, or embarrassment (e.g., "*I feel guilty when I don't exercise*"). On the other hand, the approach component is conceptualized by the individual's attempts to meet standards to feel worthy and proud of themselves (e.g., "*I diet so that other people are impressed with me*"). This approach-avoidance differentiation based on Self-Determination Theory was initially studied by Assor et al. (2009), as these researchers clearly explained that existing instruments evaluating introjected regulation are largely oriented toward avoidance. Nevertheless, one cannot discard the possibility that the negative effects of avoidance introjected motivation are equated to the effects of approach introjected regulation, with the latter being partially comparable to identified regulation (Assor et al., 2009). That is, the approach component may have positive effects that are confronted with identified regulation regarding positive behavioral or emotional outcomes (e.g., well-being).

Finally, at the extreme of extrinsic regulations lies external regulation, considered the most controlled form within the less self-determined regulations. In this regulation, the subject performs the behavior to satisfy external demands, sometimes related to obtaining rewards (e.g., the individual quits smoking because the doctor forced them to; the athlete practices sports as a means to achieve prizes and monetary resources). This regulation is the most controlled of all because the maintenance of motivation, and consequently of behavior, depends on the continuous presence of monitoring and external reinforcements

(Deci & Ryan, 1985). In competitive sports, this might involve playing solely to avoid a fine or to secure a contract bonus, with no personal desire to compete.

Amotivation appears at the extreme of the motivational continuum and represents the least self-determined form of motivation. In this case, there is an absence of regulation or lack of intention to perform a certain behavior, whereby the behavior is performed without intention or proactive thought (e.g., the person no longer practices physical activity or does not know why they will continue to do so in the future). The individual no longer perceives importance in their actions, accompanied by a feeling of incompetence and loss of control (Ryan & Deci, 2017). This absence of regulation or lack of intention to act regarding a specific behavior indicates that the probability of dropout is high and that its resumption may be compromised unless there is support from the context for change (Ryan & Deci, 2000). This state often precedes dropout, characterizing individuals who feel that no amount of effort will yield the desired physiological results.

There is substantial evidence grouping the six regulations into two macro dimensions designated as autonomous motivation and controlled motivation (Ryan & Deci, 2017; 2000), including within the context of structured physical activity (Teixeira et al., 2012; Rodrigues et al., 2018). Autonomous regulation assumes that the performance of the behavior occurs due to the positive values inherent to the behavior, while the person integrates the behavior into their daily life; it encompasses identified regulation, integrated regulation, and intrinsic motivation, that is, the three most self-determined forms of motivation present in the motivational continuum. This autonomous motivation is defined as engagement in a behavior because it is perceived as consistent with intrinsic goals or outcomes and emanates from the individual's identity. Individuals who engage in behaviors according to autonomous motivation have a sense of choice, interest, and satisfaction and, as a consequence, tend to persist in the behavior in question. Fundamentally, individuals acting out of autonomous motivation are

more prone to initiate and persist in a behavior without any external reinforcement and/or imposed contingency (Hagger et al., 2014).

Controlled motivation assumes that the performance of the behavior is adjacent to coercive or self-imposed assumptions and encompasses introjected regulation, external regulation, and amotivation, that is, the three less self-determined forms present in the motivational continuum. Individuals who engage in a certain behavior in a controlled manner feel a sense of obligation and pressure and tend to persist with the behavior only as long as the external or self-imposed contingency is present (Ryan & Deci, 2000). If the stimulus is removed, the action is likely to be abandoned. Individuals acting based on controlled motivation are, therefore, less prone to being self-determined in the long term. Crucially for exercise professionals, distinguishing between these broad categories is more practical for predicting long-term adherence than analyzing each micro-regulation individually.

Organismic Integration Theory indicates that an individual can regulate their behavior according to the type of regulation adjacent to the motivational continuum, but that this situation is not finite and static (Ryan & Deci, 2017). The distinction between more and less self-determined regulations is a core characteristic of Organismic Integration Theory (Ryan & Connell, 1989), in which the process by which controlled regulations are internalized into self-determination is described, as well as the impact that the various regulations have on the individual's behavior (Howard et al., 2017). The more internalized a regulation or value attributed by the individual, the more autonomous the behavior will be experienced (Ryan & Connell, 1989). Regarding the process of internalization, it is social contexts that enhance or prevent the internalization of behavior. That is, what leads people to resist, partially adopt, or deeply internalize values, goals, or belief systems. Thus, the coach or therapist’s role shifts from merely prescribing exercise to facilitating an environment that nurtures this internalization process. The type of regulation a person adopts regarding a

behavior is determined according to the satisfaction or frustration of three basic psychological needs, subsequently addressed in the mini theory of the same designation.

Basic Psychological Need Theory

As previously mentioned, autonomy, competence, and relatedness are relevant to human behavior regardless of gender, ethnicity, or cultural repertoire, even considering that the means for their satisfaction may differ, and explain the regulation of motivation (Deci & Ryan, 2008). Whether in elite sports or recreational fitness, these needs form the bedrock of sustained engagement.

The need for autonomy is defined by the individual's capacity to regulate their own actions. The individual acts in accordance with the behavior because the goal is valued by the individual themselves. It is coherent with the person's deepest internal values and aims for nothing beyond the realization of the behavior itself. Behavior is considered autonomous when interests, preferences, and volition guide the decision-making process regarding whether or not to participate in a particular activity.

Autonomy should not be confused with the concept of independence (Chirkov et al., 2003; Ryan & Deci, 2017). Self-Determination Theory makes a critical distinction between being autonomous and being independent. According to this theoretical model, a person feels autonomous when their behavior is experienced as voluntarily enacted and when they assume full responsibility for their actions and the values expressed by them. People are, therefore, more autonomous when they act according to their integrated interests or values and desires (Chirkov et al., 2003).

Dependence is defined in terms of individual reliance: a person is dependent if they rely on others to obtain goods or guidance. Given this definition, people can rationally choose to rely on others, thus being autonomously dependent, or they can thoughtfully choose not to be dependent, thus being autonomously independent. Similarly, individuals may also feel

controlled or pressured to depend on the leadership or guidance of others (e.g., authoritarian pressure from medical care) or, in certain circumstances, the introjected voice that they must be benevolent (Deci & Ryan, 2012). As such, the opposite of autonomy is not dependence or interdependence, but rather being controlled or feeling the frustration of the basic psychological need for autonomy, as will be addressed subsequently. This implies being pressured to think, feel, or behave in specific ways, whether through coercion or manipulation. In a coaching context, this means that an athlete can follow a strict training plan autonomously if they fully endorse the rationale behind it, rather than feeling coerced by the coach.

Competence is another psychological need conceptualized within the self-determination macro-model. Competence is defined as efficacy in the interaction with the context in which the person is situated. Competence refers to the capacity to deal with context-related challenges in order to achieve greater personal growth and development (Ryan & Deci, 2017). The need for competence is reflected in the individual's desire to exercise their capacities, seek to master challenges at an optimal level, and obtain positive feedback. For a novice at the gym, this need is satisfied not by lifting the heaviest weight, but by mastering proper form and perceiving incremental progress.

Last but not least, relatedness is the basic psychological need defined as the individual's capacity to seek and develop connections and interpersonal relationships with peers in the context where they are situated (Deci & Ryan, 1985). It also represents the feeling of personal bond, emotion, and care for others. This suggests that relatedness, the need to feel connected to others, is centrally important for the internalization of behavior (Ryan & Deci, 2000). This explains the high retention rates often observed in group exercise classes (e.g., CrossFit, Zumba), where the social component acts as a powerful glue for adherence.

The three basic psychological needs are conceptually distinct yet highly correlated and interdependent. Thus, the satisfaction of each reinforces and strengthens the others, and it is the satisfaction of all three that promotes personal development and well-being (Deci & Ryan, 2008). Contextual and social factors that promote competence support during a behavior increase the sense of competence (Ryan & Deci, 2017); however, the sense of competence alone is insufficient to promote an increase in more self-determined motivation. It is fundamental that it be accompanied by a sense of autonomy, that is, the situation should not stifle the sense of individual freedom, and the subject also needs to feel accompanied by and connected to peers in the context through cooperation, where affective relationships are developed and created between individuals that can facilitate the achievement of goals. A highly skilled athlete who feels competent but socially isolated or controlled by an authoritarian regime is likely to experience burnout despite their high performance level.

The descriptions previously provided regarding basic psychological needs were outlined from the perspective of satisfaction. That is, when the three basic psychological needs are satisfied, the individual tends to regulate their behavior in more self-determined ways (i.e., integrated regulation, identified regulation, and intrinsic motivation). The literature is abundant in supporting this assertion (Ryan & Deci, 2017; 2000), specifically indicating that the satisfaction of the needs for autonomy, competence, and relatedness is fundamental in the internalization and integration of behavior. However, there is evidence that autonomy, competence, and relatedness can be frustrated, according to the characteristics of the social and contextual environment which can undermine or control the development of these needs (Vansteenkiste & Ryan, 2013). This distinction is vital for health professionals: it is not enough to simply 'add' positive support; one must also actively remove 'toxic' controlling behaviors (Teixeira et al., 2018).

Autonomy frustration is characterized when the individual has no control over their own actions (Ryan & Deci, 2017). The individual feels compelled to act

in accordance with values imposed by the context in which they are situated. Thus, any behavior is performed according to standards that are neither voluntary nor guided by the person, such as a personal trainer who ignores client feedback or insists on a 'my way or the highway' approach.

Competence frustration involves feelings of failure and doubts regarding one's own efficacy in the behavior in question. That is, competence frustration occurs when an individual feels incapable of operating correctly, with a feeling of guilt and failure (Chen et al., 2015), often seen when exercise tasks are set far above the individual's current functional capacity.

Relatedness frustration refers to feelings of disconnection, loneliness, and social exclusion. The individual feels they are being excluded from the social group or "tribe" to which they would like to belong (Vansteenkiste & Ryan, 2013), such as being picked last for a team or actively ignored by gym staff.

When autonomy, competence, and relatedness are frustrated, behavior tends to be regulated by less self-determined forces (i.e., amotivation, external regulation, and introjected regulation). Thus, behavior tends not to be internalized but rather controlled by external or self-imposed forces on the individual.

It is noteworthy that low levels of basic psychological need satisfaction are not indicative of high levels of frustration of autonomy, competence, and relatedness (Vansteenkiste & Ryan, 2013), and that their implications manifest with different intensity and duration. Thus, low need satisfaction does not necessarily involve need frustration but need frustration may be related to low need satisfaction from a perspective of orthogonal determinants of motivation (Vansteenkiste & Ryan, 2013). Indeed, low need satisfaction will have its negative effects over time, but active need frustration will accelerate this process. Evidence demonstrates that environments promoting support for basic psychological needs do not explain low levels of need frustration and vice versa (Ryan & Deci, 2017). That is, it is the context in which the individual is inserted that can actively

provide high levels of need satisfaction or frustration, depending on the individual's perception (Bidee et al., 2016). In practical terms, a neutral gym environment might result in low satisfaction (apathy), whereas a critical or shaming environment results in active frustration (aversion), leading to much faster dropout rates.

Cognitive Evaluation Theory

This theoretical mini theory posits that events external to the individual can promote or undermine intrinsic motivation (Ryan & Deci, 2000). Cognitive Evaluation Theory (CET) specifically addresses the effects of the social context on intrinsic motivation, and how rewards, interpersonal controls, and imposed pressures can undermine intrinsic motivation and interest in the behavior itself. In other words, the absence of controlling pressure, the presentation of choices and optimal developmental challenges, and interpersonal warmth can promote intrinsic motivation. Conversely, normative evaluations, controlled supervision, the presentation of extremely easy or difficult tasks, and cold, distant behaviors can undermine this type of motivation. This mini model addresses how the person cognitively evaluates all contextual factors that may influence the regulation of motivation, assuming that contextual determinants can promote the prototype of self-determined motivation: intrinsic motivation (Deci & Ryan, 1985; Ryan & Deci, 2017).

Primarily, this model emerged from the study of autonomy support, determined by the context, and how this supportive behavior promoted the satisfaction of the psychological needs for autonomy, competence, and relatedness, which are consequently linked to intrinsic motivation (Deci & Ryan, 1985). Autonomy support represents the perception the individual holds regarding peers, authority figures, family members, or other representative elements in the context in which they are situated. This interpersonal behavior encompasses the possibility of choice the individual has ("*Do you prefer to do*

exercise A or exercise B?"), communication centered on the person rather than imposed ("*What do you want/would like to do?*"), and addressing the obstacles the person faces and the motives that might shift their current perspective.

When exercise professionals are capable of placing themselves in the user's position, they are more able to effectively assist in behavioral change and the long-term integration of healthy behavior (Ryan & Deci, 2017). Autonomy-supportive behaviors also consider the encouragement of self-initiated new behaviors ("*Congratulations on quitting smoking autonomously*"). When people are supported in their own initiatives and actions, this reinforcement substantially increases the internalization of the behavior (Ryan & Deci, 2000). When the individual is led to behave in a certain way or perform certain tasks, it is fundamental that they perceive the motives and that the arguments are presented clearly so that the individual does what is intended. In a physical training context, this means explaining the physiological "why" behind a specific set of intervals, rather than simply commanding "run faster". The use of rewards can be a form of support, provided the individual is aware of the outcome and the arguments are valid for them to desire the reward. Otherwise, if the reward is used as a behavioral regulator, it may backfire.

Competence support refers to the design of activities wherein mastery is a dominant experience. That is, the person feels that the social context is creating conditions for skill improvement that are demanding and challenging, yet within a pattern of continuous progress. For example, the prescription of a exercise program must meet the person's needs, as well as their physical and mental capacities, with an emphasis on progress so that the person feels challenged to evolve, preferably always in an optimal manner. This is the "Goldilocks principle" of exercise prescription: not too hard to cause failure/injury, not too easy to cause boredom, but 'just right' to foster flow. Competence support also considers positive and specific feedback ("*Today you improved your squat technique immensely.*") rather than normative and ambiguous feedback ("*Today your*

training performance was weak compared to other clients here at the gym."). Finally, praise should be considered in supportive behaviors, principally when the behavior was initiated by the individual ("*It has been two weeks since you got drunk, thanks to your decision to stop letting yourself go to extremes. Congratulations!*") rather than praise for behaviors instilled by the context.

Relatedness support indicates respectful and clear communication so that the individual feels valued and significant. Perception of empathy, attention, and connection are key pieces ("*I feel that my coworkers support my diet*"). When the individual perceives that the social context (e.g., friends, coaches, peers) provides a sense of affective connection, also called a "tribe," where there is mutual concern within the social sphere, they perceive that the context is promoting the satisfaction of the psychological need for relatedness. In group fitness classes, this is often the "secret sauce", the shared struggle and camaraderie that transforms a workout into a social event. Behaviors of relatedness support also include experiences of inclusion and care ("*My coach likes me*") which are equally determinant factors of relatedness satisfaction. Note that we refer to the perception the individual has of the context ("*I feel that my coach likes me*"), which is substantially different from how the individual perceives the context ("*I like my coach*"). People feel more autonomously motivated when the "motivator" is someone who cares about them (Ryan & Deci, 2020b). Sometimes, simple empathetic presence is sufficient for the person to feel connected.

On the other hand, frustration behaviors are linked to how basic psychological needs are thwarted (Vansteenkiste & Ryan, 2013). The perception of autonomy-thwarting behaviors is defined by factors that undermine autonomy, such as controlling and externally imposed behaviors ("*You have to do this exercise because I tell you to!*"), viewing the context rather than the person ("*I think you have to lose weight because you are very heavy!*"), and the use of controlling rewards ("If you do what I tell you, you will win a fantastic prize!"). This type of behavior should not be seen merely as the opposite of autonomy support,

but rather as coercive and manipulative behavior regarding the person's own autonomy. The person feels controlled by external forces without an orientation toward a more autonomous regulation. This is often seen in "cookie-cutter" diet plans handed out without regard for the client's lifestyle or preferences.

Competence-thwarting behaviors encompass normative feedback focused on normative contingencies ("*You are gaining weight and are already heavier than the other clients I have*"). This type of behavior indicates challenges or actions that go beyond the person's physical and psychological capacities, leading to a sensation of inefficacy regarding the context, often due to the insensitivity of the social context in adapting to the individual rather than vice versa ("*My coach said I should run for an hour without stopping, but I have never run in my life*"). Behaviors of this genre point out failures and incompetence and promote inadequate adaptation, leading the individual to question their own competencies. Consequently, it is theoretically expected that these types of behaviors lead to the frustration of the psychological need for competence.

Finally, relatedness-thwarting behaviors are those in which the individual perceives that the context is actively frustrating the basic psychological need for relatedness. Cold, negligent, distant, and apathetic behaviors ("*My nutritionist does not worry about me, nor is interested in knowing my reality*") are examples of relatedness frustration behaviors. Since a human being is a biosocial being, it is expected that connections between people, in various contexts, be as interactive and communicative as possible within a framework of mutual respect and valorization. However, in these types of behaviors, the social context (e.g., coaches, nutritionists, doctors) ignores and devalues social interactions, assuming impassive, careless, and sloppy behaviors. A classic example is a personal trainer checking their phone while their client performs a set, signaling a complete lack of care and engagement.

When people perceive behaviors supporting autonomy, competence, and relatedness, they tend to feel that their basic psychological needs are being

satisfied. Conversely, when they perceive that the social context is undermining or frustrating the three basic psychological needs, they tend to feel the frustration of autonomy, competence, and relatedness (Vansteenkiste & Ryan, 2013). It is important to highlight that need-supportive behaviors are not, per se, the basic psychological needs. Interpersonal behaviors, whether supportive or thwarting, are determinant factors in how basic psychological needs may be satisfied or frustrated (Ryan & Deci, 2017). Thus, it is strongly advised that physical activity and health professionals promote and assume behaviors supportive of users' basic psychological needs as a means of promoting the satisfaction of autonomy, competence, and relatedness. It is also recommended that these professionals reduce or avoid frustration behaviors, knowing that, theoretically, they will be promoting the frustration of basic psychological needs.

Goal Content Theory

This theory was developed to understand how the content of a goal or motive can lead to differentiated outcomes that affect behavioral enactment (Deci & Ryan, 2000). Indeed, some motives that individuals pursue are more likely to promote well-being than other goals (Schmuck et al., 2000). At this stage, it is important to emphasize that motives and motivation are two completely disparate concepts (Ryan & Deci, 2017), yet they are intimately linked by Self-Determination Theory. In an effort to differentiate goal contents (i.e., motives) from behavioral regulations (i.e., motivation), Deci and Ryan (2000) proposed that a motive is conceptually "what" a person hopes to obtain as a function of participating in a certain behavior (e.g., "*I exercise to improve my health*"). On the other hand, the regulation of motivation focuses on "why" the person commits to performing the behavior (e.g., "*I do it because the doctor told me to*"). Goal Contents Theory conceptually distinguishes between intrinsic motives and extrinsic motives. This distinction is paramount because the pursuit of intrinsic goals is typically associated with greater psychological need satisfaction, whereas

the focus on extrinsic goals can distract from these needs, leading to a phenomenon often described in the literature as the "dark side of the American Dream" (Kasser & Ryan, 1993), where the attainment of material success does not yield the expected increase in happiness.

Intrinsic motives are those that generate satisfaction in the work or context where one operates, aiming for the development of personal interests, values, and potentials, and are naturally satisfying to perform. Health, skill improvement, enjoyment, pleasure, or vitality are examples of intrinsic motives. These motives are internally oriented, thus being actively sought for personal development (Sebire et al., 2008). It is crucial to note that within the exercise domain, "health" can function as a double-edged sword. When health is viewed as functional (e.g., "being able to play with my grandchildren" or "maintaining mobility"), it aligns with intrinsic goals. However, when "health" is used as a proxy for appearance management (e.g., "looking healthy" to fit a societal standard), it often functions closer to an extrinsic motive, displaying weaker associations with well-being (Sebire et al., 2008).

Although intrinsic motives are related to intrinsic motivation and autonomous motivation (Ryan & Deci, 2017), they are distinct. For example, an individual may act altruistically, a goal defined as intrinsic, solely to impress a family member or friend, a behavioral regulation inserted within extrinsic motivation. Thus, intrinsic motives, despite being more associated with intrinsic motivation and autonomous motivation, can equally orient motivation toward extrinsic regulations (Sheldon et al., 2004).

Extrinsic motives, on the other hand, are those possessing an extrinsic nature, being oriented "outward" from the individual, and are therefore sought for external contingencies (Deci & Ryan, 2000). Money, fame, social recognition, and competition are examples of extrinsic motives that lead the individual to orient their motivation through extrinsic regulations (e.g., external and introjected). The focus on image and social recognition, often exacerbated by

social media usage in fitness contexts, leads to a constant process of upward social comparison, which is detrimental to self-esteem. These goals often impede the satisfaction of autonomy, competence, and relatedness, which consequently harms well-being (Kasser & Ryan, 1996) and the individual's personal development (Ryan & Deci, 2017). Furthermore, research indicates that extrinsic goal pursuit is often associated with a "conditional self-worth," where an individual's value is contingent upon their latest success or failure, creating a fragile psychological foundation for long-term adherence (Vansteenkiste et al., 2010).

Putting the pieces together: Associations between mini theories

There is theoretical and empirical evidence describing a causal sequence between the motivational determinants described in the mini-theories and emotional, cognitive, and behavioral responses (Ryan & Deci, 2017). Succinctly, the social environment in which the individual is inserted (Cognitive Evaluation Theory) or the motives for performing a certain behavior (Goal Contents Theory) may determine the degree of satisfaction or frustration of basic psychological needs (Basic Psychological Needs Theory), which in turn will determine the type of motivational regulation (Organismic Integration Theory) that the person adopts regarding the behavior (Ryan & Deci, 2017; Vallerand, 1997).

This motivational sequence was first proposed by Vallerand (1997) and revised by Vallerand & Ratelle (2002), incorporating the main elements of the mini-theories adjacent to Self-Determination Theory, designated as the Hierarchical Model of Intrinsic and Extrinsic Motivation (HMIEM). This model advocates that the regulation of motivation is a consequence of social or personality determinants, mediated by basic psychological needs. In turn, the way the individual regulates their behavior will yield respective cognitive, affective, and behavioral consequences, which can be defined at three levels: global (personality), contextual (distinct human activity), and situational (state).

At a vertical level, these three different levels vary from stable (at the top) to momentary or state elements (at the bottom), that is, from the global to the contextual and, fundamentally, the situational level. The global level is the most general and refers to a person's personality or usual mode of operational functioning (Vallerand & Lalande, 2011). Motivation at this level assumes the form of broad dispositions to engage in activities in a typically intrinsic or extrinsic manner. This can be considered the level of trait motivation. Next in the hierarchy is the contextual level. This level represents specific life contexts, such as interpersonal relationships with peers in a professional context or the specific domain of sport and exercise. This level accounts for the probability that individuals may develop motivational orientations that differ across various contexts. For example, an individual may engage in leisure activities in a more intrinsic way yet participate in work-related activities through extrinsic motivation. This explains why a highly disciplined athlete (high autonomous motivation in the sport context) might be completely amotivated regarding their academic studies (low motivation in the education context). Therefore, it is important to take into consideration the type of activity in which the person engages to refine possible associations between motivation and behavior (Vallerand, 1997). Finally, the situational level is the most specific and refers to the "here and now" of motivation. It is the motivational state an individual experiences when engaging in a specific behavior at a given moment, such as someone taking a walk through the forest with intrinsic motivation on a Sunday morning. Crucially, Vallerand proposes a "recursive effect," where repeated positive situational experiences can, over time, influence and alter motivation at the contextual level (bottom-up effect).

In horizontal terms, motivation (autonomous vs. controlled; intrinsic vs. extrinsic) arises as a consequence of how basic psychological needs are satisfied or frustrated, with these being the consequence of contextual factors and/or personality traits of the individual themselves (Ryan & Deci, 2017). In other words,

the perception of interpersonal behaviors of others (e.g., coaches, health professionals, fitness instructors) will determine how the individual feels the satisfaction or frustration of their basic psychological needs (Ryan & Deci, 2017; Vansteenkiste & Ryan, 2013). Thus, the characteristics of the social context can support the development of these basic psychological needs. Conversely, agents acting in controlling environments can equally influence and directly control the thoughts, feelings, and behaviors of the people with whom they interact, potentially resorting to external tactics of pressure, manipulation, and the induction of guilt and shame via the frustration of basic psychological needs (Vansteenkiste & Ryan, 2013).

In a practical example, the exerciser who perceives the fitness instructor as a supportive figure, demonstrating competence, support, and positive feedback, is closer to satisfying their basic psychological needs (Ntoumanis et al., 2017; Rodrigues et al., 2020, Teixeira et al., 2022). On the other hand, an exerciser who perceives interpersonal behaviors of frustration or obstruction, that is, who identifies negligent behaviors on the part of the fitness instructor, is the target of negative feedback, or feels imposed pressure, may be experiencing the frustration of autonomy, competence, and relatedness (Costa et al., 2015; Rodrigues et al., 2019). This often manifests in "controlling coaching styles," where the coach uses exercise as punishment (e.g., "*drop and give me 20 push-ups!*"), effectively weaponizing the activity against the athlete's psychological needs. In this sense, Ryan and Deci (2017) propose that, theoretically and empirically, supportive and thwarting interpersonal behaviors have a significant association with the satisfaction and frustration of basic psychological needs, respectively.

The next part of the motivational sequence explains how the satisfaction and/or frustration of basic psychological needs affects behavioral regulation. Vansteenkiste & Ryan (2013) propose a positive and significant relationship between basic psychological need satisfaction and autonomous motivation (i.e., the person identifies with and integrates the behavior as part of themselves), a

motivation composed of identified regulation, integrated regulation, and intrinsic motivation. Conversely, it is expected that the frustration of autonomy, competence, and relatedness has a positive and significant effect on the regulation of controlled motivation (i.e., the person engages in the behavior due to internal and external pressures or in search of external rewards), a motivation composed of introjected and external regulation, and, in certain instances, amotivation (Ryan & Deci, 2017). This compensatory mechanism suggests that when internal needs are unmet, individuals shift their focus to external indicators of worth (e.g., appearance, rankings) to fill the psychological void. Empirical studies in the context of physical activity and health have supported this evidence, equally reinforcing a negative association between basic psychological need satisfaction and controlled motivation, and between the frustration of autonomy, competence, and relatedness and autonomous motivation (e.g., Costa et al., 2015; Ng et al., 2013; Rodrigues et al., 2020).

The final part of the motivational sequence proposed by Vallerand (1997), considering the motivational determinants described by Ryan and Deci (2017) based on Self-Determination Theory, explains how the regulation of motivation is associated with cognitive, emotional, and behavioral responses. The literature indicates that autonomous motivation has a positive and significant relationship with emotional responses, such as enjoyment of structured and regular physical activity practice (Rodrigues et al., 2018), positive affect (Teixeira et al., 2018), and subjective vitality (Ryan & Deci, 2017). Furthermore, empirical evidence suggests a positive correlation between autonomous motivation and the intention to maintain the behavior in the future (Ntoumanis et al., 2017; Teixeira et al., 2012) and adherence to physical activity (Rodrigues et al., 2020; Silva et al., 2011). Autonomous motivation also explains various healthy behaviors such as dietary patterns, seatbelt use, and fruit and vegetable consumption, among others, as described by various studies (Gillison et al., 2019; Hagger et al., 2014; Williams et al., 2002). Conversely, the literature (Ryan & Deci, 2017; Vansteenkiste & Ryan,

2013) demonstrates that controlled motivation is positively associated with emotional aspects such as negative affect (Teixeira et al., 2018). Controlled motivation is also significantly associated with low levels of intention to practice physical activity (Rodrigues et al., 2019; Teixeira et al., 2012) and a higher risk of behavioral dropout (Rodrigues et al., 2020; Silva et al., 2011). Regarding healthy behaviors, controlled motivation tends to have a detrimental effect, presenting itself as positively related to risk behaviors such as tobacco and alcohol consumption, sedentary behaviors, or the risk of transmission of sexually transmitted infections, among others (Hagger et al., 2014). It is critical to understand that while controlled motivation can produce short-term behavioral bursts (e.g., rapid weight loss for a wedding), it rarely supports the psychological resilience required for long-term lifestyle maintenance.

Measurement of motivational determinants

Given that this theoretical model is one of the most contemporary and generalist frameworks used in the analysis of motivational determinants of behavior (Ryan & Deci, 2020a), there are numerous validated instruments that assess contextual factors, the satisfaction and frustration of basic psychological needs, as well as the regulation of motivation according to the motivational continuum (Ryan & Deci, 2017). It would be redundant to expose all validated questionnaires here, as there is a platform where all questionnaires validated and accepted by the Self-Determination Theory community are available at https://selfdeterminationtheory.org/. Furthermore, in cases where questionnaires are not appended to the respective validation studies, authors typically grant access to the instruments upon a formal request for academic or professional use.

For facilitation and interpretation, some examples are provided within this book for the assessment of contextual factors (i.e., interpersonal behaviors), the satisfaction and frustration of basic psychological needs, and the regulation of motivation. These represent three questionnaires validated for the physical

activity exerciser population. These are robust instruments that have been submitted to recent factorial and reliability tests, thus demonstrating a high degree of validity for theoretical and empirical application.

Practical implications in the context of physical activity and exercise

Considering the importance presented in these studies, particularly regarding the effect of supportive interpersonal behaviors as indicators of basic psychological need satisfaction, autonomous motivation, and consequently adherence to exercise practice, it is crucial that exercise professionals consider the needs of the exerciser rather than their own needs. According to results obtained in various studies (Ng et al., 2013; Rodrigues et al., 2020; Silva et al., 2011), it appears fundamental that physical activity professionals view the prescription of exercise not only as a tool for improving the person's physical condition but also as an activity that is in harmony with what the exerciser wants and seeks.

As evidenced in previous studies (Rodrigues et al., 2019; Vansteenkiste & Ryan, 2013), the imposition of controlling behaviors or normative evaluations represents a null or even negative association with physical activity, which in turn may be responsible for dropout from exercise practice or the abandonment of active lifestyles. Specifically, it is recommended that physical activity professionals focus on responding to the goals and problems presented by exercisers, rather than investing time and resources in commercial growth and/or external rewards. Indeed, the results of various empirical studies (e.g., Chen et al., 2018; Patrick & Williams, 2012; Rodrigues et al., 2021) support the assertion that the exerciser-professional relationship is one of the key factors for adherence to physical activity.

Thus, it seems evident to us that the way individuals perceive interpersonal behaviors will have a significant impact on how they regulate their behavior; that is, the promotion of more autonomous forms of behavior will depend on contextual support. The lack of social integration and monitoring, the use of

purely commercial approaches, and the focus on merely "consumer" components and their "lifecycle" reveals a lack of knowledge about the structure by which the human being is governed: respectable and honest connections. The quantity of physical activity practice seems to be dependent on the quality of the approaches made by exercise professionals, who in turn insert themselves as a variable in the equation of behavioral sustainability.

It is noteworthy that the social context is not the only variable explaining the adoption of physical activity by the individual, as evidenced in the literature (Ryan & Deci, 2017). However, its analysis and understanding seem of extreme importance so that efficient interventions can be created to enable exercise professionals to contribute with better interpersonal practices. Physical activity professionals should focus on promoting a set of moderately demanding and challenging activities that enable the development of exercisers' physical capacities, keeping in mind their personal goals and needs.

Physical activity planning should be assigned individually, and individuals should be given the opportunity to actively participate in defining short-term goals regarding the training program, ensuring these are challenging but at the same time realistic (e.g., asking the exerciser how long they want to be able to run without resting, and by when this goal should be achieved). In parallel, exercise professionals should equally encourage the active involvement of exercisers in their progress, allowing them to choose which exercises to perform, giving them the freedom to propose new challenges, and instill in them the autonomy to be responsible for their own progress, without jeopardizing the primordial structure of the training program, safety, and the exerciser's health. This co-creation process shifts the dynamic from a dictatorship to a partnership. Exercisers should have the opportunity to choose the exercises they wish to complete within the standards established by the professional, being given the possibility to monitor and evaluate their own physical performances (e.g., asking the exerciser how they felt doing the squat with more load or at a slower

execution speed). In sum, professionals should assist individuals in incorporating exercise into their daily lives so that they can feel and experience its benefits as a way to improve their quality of life over time. These professionals must guide and monitor the person's growth process and response to their needs, as a way to contribute to a healthy, sustainable, and lasting relationship.

Although Self-Determination Theory presents relevant scientific advances for the context of physical activity, it is fundamental to understand existing limitations and critiques. First, looking at the motivational continuum, it makes sense to distinguish between extrinsic and intrinsic motivation. However, this distinction should not be seen as a fixed "A or B" distinction. Suffice it to say that an individual can be intrinsically motivated in a certain behavior, for example, practicing a specific sport (e.g., football), and extrinsically motivated in another exercise behavior, such as gym-based conditioning. Thus, the same individual can be simultaneously intrinsically and extrinsically motivated in two behaviors theoretically beneficial for their physical condition. Furthermore, an individual can regulate their behavior externally (e.g., "*I exercise because my partner tells me to do so*") and equally in an identified manner (e.g., "*I exercise because it improves my running capacity*"). The process of internalization and integration indicates the evolution from less self-determined to more self-determined behavior (Ryan & Deci, 2020b; 2017). Thus, the way the individual regulates their behavior is in a constant process of alteration. And if we consider the vertical levels of motivation according to Vallerand (1997), general levels can influence contextual and situational ones, something that the physical activity professional cannot always manipulate. This constant progression/regression of motivation sometimes implies a demanding evaluation by the professional so that they can apply the best tools (e.g., Behavior Change Techniques; Michie et al., 2013) for the maintenance of exercise behavior. Second, motivational theoretical models explain approximately 25-30% of behavior (Ekkekakis & Dafermos, 2012), which leaves a margin of 70-75% of variance that is explained by other determinants.

Thus, motivational factors are not the variables with the greatest explanatory power of behavior, indicating the existence of other variables that must be considered during behavioral analysis. Indeed, there is evidence that other models (e.g., the Dual-Mode Theory of Affect, which posits that above the ventilatory threshold, physiological cues override cognitive motivational factors; Ekkekakis, 2003) or the Circumplex Model of Affect (Russell, 1980) may better explain behavior, particularly in the case of physical activity intensity (Ekkekakis, 2008). However, regarding sustained adherence, Self-Determination Theory appears to be a robust model regarding the explanatory power of social context determinants (Gillison et al., 2019).

Third, a large part of the studies that have used Self-Determination Theory as a theoretical framework has resorted to a cross-sectional design, thus lacking inferential evidence. A recent meta-analysis (Ntoumanis et al., 2020) considered only intervention studies, in which only seventy-three studies met the inclusion criteria. Although the authors found evidence demonstrating some efficacy of interventions based on Self-Determination Theory in improving physical activity indices, the authors point to a gap in further intervention studies, mainly aiming at the manipulation of contextual variables, as these are the determinants of the motivational sequence that explains emotional, cognitive, and behavioral outcomes.

References

Assor, A., Vansteenkiste, M., & Kaplan, A. (2009). Identified versus introjected approach and introjected avoidance motivations in school and in sports: The limited benefits of self-worth strivings. *Journal of Educational Psychology, 101*(2), 482-497. https://doi.org/10.1037/a0014236

Bidee, J., Vantilborgh, T., Pepermans, R., Griep, Y., & Hofmans, J. (2016). Temporal dynamics of need satisfaction and need frustration. Two sides of the same

coin? *European Journal of Work and Organizational Psychology, 25*(6), 900-913. https://doi.org/10.1080/1359432X.2016.1176021

Chen, B., Vansteenkiste, M., Beyers, W., Boone, L., Deci, E. L., Van der Kaap-Deeder, J., Duriez, B., Lens, W., Matos, L., Mouratidis, A., Ryan, R., Sheldon, K., Soenens, B., Van Petegem, S., & Verstuyf, J. (2015). Basic psychological need satisfaction, need frustration, and need strength across four cultures. *Motivation and Emotion, 39*(2), 216-236. https://doi.org/10.1007/s11031-014-9450-1

Chen, M., Chang, R., Tsai, H., & Hou, Y. (2018). Effects of perceived autonomy support and basic need satisfaction on quality of life in hemodialysis patients. *Quality of Life Research, 27*(3), 765-773. https://doi.org/10.1007/s11136-017-1714-2

Chirkov, V., Ryan, R., Kim, Y., & Kaplan, U. (2003). Differentiating autonomy from individualism and independence: a self-determination theory perspective on internalization of cultural orientations and well-being. *Journal of Personality and Social Psychology, 84*(1), 97-110. https://doi.org/10.1037/0022-3514.84.1.97

Costa, S., Ntoumanis, N., & Bartholomew, K. (2015). Predicting the brighter and darker sides of interpersonal relationships: Does psychological need thwarting matter? *Motivation and Emotion, 39*(1), 11-24. https://doi.org/10.1007/s11031-014-9427-0

Deci, E. L., & Ryan, R. M. (1985). *Intrinsic motivation and self-determination in human behavior*. Plenum. https://doi.org/10.1007/978-1-4899-2271-7

Deci, E. L., & Ryan, R. M. (2000). The "what" and "why" of goal pursuits: human needs and the self-determination of behavior. *Psychological Inquiry, 11*, 227-268. http://dx.doi.org/10.1207/S15327965PLI1104_01

Deci, E. L., & Ryan, R. M. (2008). Self-determination theory: A macrotheory of human motivation, development, and health. *Canadian Psychology, 49*(3), 182-185. https://doi.org/10.1037/a0012801

Deci, E. L., & Ryan, R. M. (2012). Self-determination theory in health care and its relations to motivational interviewing: a few comments. *The International Journal of Behavioral Nutrition and Physical Activity, 9*, 24. https://doi.org/10.1186/1479-5868-9-24

Deci, E. L., & Ryan, R. M. (2014). Autonomy and Need Satisfaction in Close Relationships: Relationships Motivation Theory. In: N. Weinstein (Ed.), *Human Motivation and Interpersonal Relationships*. Springer. https://doi.org/10.1007/978-94-017-8542-6_3

Deci, E. L., Olafsen, A., & Ryan, R. M. (2017). Self-determination theory in work organizations: The state of a science. *Annual Review of Organizational Psychology and Organizational Behavior, 4*, 19-43. https://doi.org/10.1146/annurev-orgpsych-032516-113108

Ekkekakis P. (2003). Pleasure and displeasure from the body: Perspectives from exercise. *Cognition & Emotion, 17*(2), 213–239. https://doi.org/10.1080/02699930302292

Ekkekakis, P. (2008). Affect circumplex redux: The discussion on its utility as a measurement framework in exercise psychology continues. *International Review of Sport and Exercise Psychology, 1*(2), 139-159. https://doi.org/10.1080/17509840802287200

Ekkekakis, P., & Dafermos, M. (2012). Exercise is a many-splendored thing, but for some it does not feel so splendid: Staging a resurgence of hedonistic ideas in the quest to understand exercise behavior. In E. O. Acevedo (Ed.), *The Oxford handbook of exercise psychology* (pp. 295–333). Oxford University Press. https://doi.org/10.1093/oxfordhb/9780195394313.013.0016

Gillison, F., Rouse, P., Standage, M., Sebire, S., & Ryan, R. M. (2019). A meta-analysis of techniques to promote motivation for health behavior change from a self-determination theory perspective. *Health Psychology Review, 13*(1), 110-130. https://doi.org/10.1080/17437199.2018.1534071

Gollwitzer, P., & Oettingen, G. (2015). Motivation: History of the Concept. In J. D. Wright (Ed.), *International Encyclopedia of the Social & Behavioral Sciences* (2nd ed., pp. 936–939). Elsevier.

Hagger, M., Hardcastle, S., Chater, A., Mallett, C., Pal, S., & Chatzisarantis, N. (2014). Autonomous and controlled motivational regulations for multiple health-related behaviors: between- and within-participants analyses. *Health Psychology and Behavioral Medicine, 2*(1), 565-601. https://doi.org/10.1080/21642850.2014.912945

Howard, J., Gagné, M., & Bureau, J. (2017). Testing a continuum structure of self-determined motivation: A meta-analysis. *Psychological Bulletin, 143*(12), 1346-1377. https://doi.org/10.1037/bul0000125

Howard, J., Gagné, M., & Morin, A. (2020a). Putting the pieces together: reviewing the structural conceptualization of motivation within SDT. *Motivation and Emotion, 44*, 846-861. https://doi.org/10.1007/s11031-020-09838-2

Howard, J., Gagné, M., Van den Broeck, A., Guay, F., Chatzisarantis, N., Ntoumanis, N., & Pelletier, L. (2020b). A review and empirical comparison of motivation scoring methods: An application to self-determination theory. *Motivation and Emotion, 44*, 534–548. https://doi.org/10.1007/s11031-020-09831-9

Kasser, T., & Ryan, R. M. (1993). A dark side of the American dream: Correlates of financial success as a central life aspiration. *Journal of Personality and Social Psychology, 65*(2), 410–422. https://doi.org/10.1037/0022-3514.65.2.410

Kasser, T., & Ryan, R. M. (1996). Further examining the American dream: Differential correlates of intrinsic and extrinsic goals. *Personality and Social Psychology Bulletin, 22*(3), 280-287. https://doi.org/10.1177/0146167296223006

Michie, S., Richardson, M., Johnston, M., Abraham, C., Francis, J., Hardeman, W., Eccles, M., Cane, J., & Wood, C. (2013). The behavior change technique taxonomy (v1) of 93 hierarchically clustered techniques: building an international consensus for the reporting of behavior change interventions.

Annals of Behavioral Medicine, 46(1), 81-95. https://doi.org/10.1007/s12160-013-9486-6

Ng, J., Ntoumanis, N., Thøgersen-Ntoumani, C., Stott, K., & Hindle, L. (2013). Predicting psychological needs and well-being of individuals engaging in weight management: the role of important others. *Applied Psychology: Health and Well-being, 5*(3), 291-310. https://doi.org/10.1111/aphw.12011

Ntoumanis, N., Ng, J., Prestwich, A., Quested, E., Hancox, J., Thøgersen-Ntoumani, C., Deci, E. L., Ryan, R. M., Lonsdale, C., & Williams, G. (2020). A meta-analysis of self-determination theory-informed intervention studies in the health domain: effects on motivation, health behavior, physical, and psychological health. *Health Psychology Review*, 1–31. https://doi.org/10.1080/17437199.2020.1718529

Ntoumanis, N., Thøgersen-Ntoumani, C., Quested, E., & Hancox, J. (2017). The effects of training group exercise class instructors to adopt a motivationally adaptive communication style. *Scandinavian Journal of Medicine and Science in Sports, 27*(9), 1026-1034. https://doi.org/10.1111/sms.12713

Patrick, H., & Williams, G. (2012). Self-determination theory: its application to health behavior and complementarity with motivational interviewing. *International Journal of Behavioral Nutrition and Physical Activity, 9*, 18. https://doi.org/10.1186/1479-5868-9-18

Rodrigues, F., Bento, T., Cid, L., Neiva, H., Teixeira, D., Moutão, J., Marinho, D., & Monteiro, D. (2018). Can Interpersonal Behavior Influence the Persistence and Adherence to Exercise Practice in Adults? A Systematic Review. *Frontiers in Psychology, 9*, 2141. https://doi.org/10.3389/fpsyg.2018.02141

Rodrigues, F., Pelletier, L., Rocchi, M., Neiva, H., Teixeira, D., Cid, L., Silva, L., & Monteiro, D. (2021). Trainer-exerciser relationship: The congruency effect on exerciser psychological needs using response surface analysis. *Scandinavian Journal of Medicine and Science in Sports, 31*(1), 226-241. https://doi.org/10.1111/sms.13825

Rodrigues, F., Teixeira, D., Cid, L., Machado, S., & Monteiro, D. (2019). The role of dark side of motivation and intention to continue in exercise: A self-determination theory approach. *Scandinavian Journal of Psychology, 60*(6), 585-595. https://doi.org/10.1111/sjop.12582

Rodrigues, F., Teixeira, D., Neiva, H., Cid, L., & Monteiro, D. (2020). The bright and dark sides of motivation as predictors of enjoyment, intention, and exercise persistence. *Scandinavian Journal of Medicine and Science in Sports, 30*(4), 787-800. https://doi.org/10.1111/sms.13617

Russell, J. (1980). A circumplex model of affect. *Journal of Personality and Social Psychology, 39*(6), 1161-1178. https://doi.org/10.1037/h0077714

Ryan, R. M., & Connell, J. (1989). Perceived locus of causality and internalization: examining reasons for acting in two domains. *Journal of Personality and Social Psychology, 57*(5), 749-761. https://doi.org/10.1037//0022-3514.57.5.749

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist, 55*(1), 68-78. https://doi.org/10.1037/0003-066X.55.1.68

Ryan, R. M., & Deci, E. L. (2017). *Self-determination theory: Basic psychological needs in motivation, development, and wellness*. Guilford Press. https://doi.org/10.1521/978.14625/28806

Ryan, R. M., & Deci, E. L. (2020a). Brick by Brick: The origins, development, and future of Self-Determination Theory. *Advances in Motivation Science, 6*, 111-156. https://doi.org/10.1016/bs.adms.2019.01.001

Ryan, R. M., & Deci, E. L. (2020b). Intrinsic and extrinsic motivation from a self-determination theory perspective: Definitions, theory, practices, and future directions. *Contemporary Educational Psychology, 61*, 101860. https://doi.org/10.1016/j.cedpsych.2020.101860

Schmuck, P., Kasser, T., & Ryan, R. M. (2000). Intrinsic and extrinsic goals: Their structure and relationship to well-being in German and U. S. college

students. *Social Indicators Research, 50*(2), 225-241. https://doi.org/10.1023/A:1007084005278

Sebire, S., Standage, M., & Vansteenkiste, M. (2008). Examining intrinsic versus extrinsic exercise goals: cognitive, affective, and behavioral outcomes. *Journal of Sport and Exercise Psychology, 31*(2), 189-210. https://doi.org/10.1123/jsep.31.2.189

Sheldon, K., Ryan, R. M., Deci, E. L., & Kasser, T. (2004). The independent effects of goal contents and motives on well-being: it's both what you pursue and why you pursue it. *Personality and Social Psychology Bulletin, 30*(4), 475–486. https://doi.org/10.1177/0146167203261883

Silva, M., Markland, D., Carraça, E., Vieira, P., Coutinho, S., Minderico, C., Matos, M., Sardinha, L., & Teixeira, P. (2011). Exercise autonomous motivation predicts 3-yr weight loss in women. *Medicine and Science in Sports and Exercise, 43*(4), 728-737. https://doi.org/10.1249/MSS.0b013e3181f3818f

Teixeira, D. S., Rodrigues, F., Monteiro, D., & Cid, L. (2022). The behavioral regulation in exercise questionnaire (BREQ-4): Psychometric evidence of introjected approach regulation in Portuguese health club exercisers. *Psychology of Sport and Exercise, 63,* 1–13. https://doi.org/10.1016/j.psychsport.2022.102286

Teixeira, D., Silva, M., & Palmeira, A. (2018). How does frustration make you feel? A motivational analysis in exercise context. *Motivation and Emotion, 42*, 419-428. https://doi.org/10.1007/s11031-018-9690-6

Teixeira, P., Carraça, E., Markland, D., Silva, M., & Ryan, R. M. (2012). Exercise, physical activity, and self-determination theory: a systematic review. *The International Journal of Behavioral Nutrition and Physical Activity, 9*, 78. https://doi.org/10.1186/1479-5868-9-78

Vallerand, R. J. (1997). Toward a hierarchical model of intrinsic and extrinsic motivation. In M. Zanna (Ed.), *Advances in Experimental Social Psychology* (pp. 271-360). Academic Press.

Vallerand, R. J., & Lalande, D. (2011). The MPIC Model: The Perspective of the Hierarchical Model of Intrinsic and Extrinsic Motivation. *Psychological Inquiry, 22*(1), 45-51. https://doi.org/10.1080/1047840X.2011.545366

Vallerand, R. J., & Ratelle, C. (2002). Intrinsic and extrinsic motivation: A hierarchical model. In E. L. Deci & R. M. Ryan (Eds.), *Handbook of self-determination research* (pp. 37–63). University of Rochester Press.

Vansteenkiste, M., & Ryan, R. M. (2013). On psychological growth and vulnerability: Basic psychological need satisfaction and need frustration as a unifying principle. *Journal of Psychotherapy Integration, 23*(3), 263-280. https://doi.org/10.1037/a0032359

Vansteenkiste, M., Niemiec, C., & Soenens, B. (2010). The development of the five mini-theories of self-determination theory: an historical overview, emerging trends, and future directions. In: T. Urdan and S. Karabenick (Eds.), *The decade ahead: theoretical perspectives on motivation and achievement*. Emerald.

Weinberg, R., & Gould, D. (2007). *Foundations of sport and exercise psychology* (4th ed.). Human Kinetics.

Williams, G., Minicucci, D., Kouides, R., Levesque, C., Chirkov, V., Ryan, R. M., & Deci, E. L. (2002). Self-determination, smoking, diet and health. *Health Education Research, 17*(5), 512-521. https://doi.org/10.1093/her/17.5.512

8. Introduction to hedonic motivation

Bastos, V.[1,2], Zeferino, B.[1,2], & Teixeira, D. S.[1,2]

1 – Faculty of Physical Education and Sport – Lusófona University, Campo Grande 376, 1749-024 Lisboa, Portugal

2 – Research Center in Sports, Physical Education, Exercise and Health (CIDEFES), Campo Grande 376, 1749-024 Lisboa, Portugal

Rationale

There is vast literature demonstrating that physical activity adherence strategies implemented to date have not yielded a significant effect. Beyond international reports (e.g., European Commission [EC], 2022; WHO, 2022), several studies have warned of an increase in sedentary behaviors and a decrease in the practice of physical activity (Guthold et al., 2018; Isakson, 2021; Santos et al., 2022). However, besides the low levels of regular physical activity practice, two other problems emerge: one long-standing, the high dropout rate among those initiating exercise programs, and another, more recently detected, the creation of an automatic aversive response to exercise practice. These issues suggest a disconnect between public health messaging and individual behavioral execution and should be subjects of reflection among professionals and their respective public and private entities (Brand & Ekkekakis, 2018; Cheval & Boisgontier, 2021; Teixeira et al., 2020).

Gyms and health clubs represent one of the main locations for supervised exercise practice among the Portuguese population (EC, 2022). However, approximately 75% of new members in these spaces abandon the practice within the first 18 months (Rodrigues et al., 2021), with 50 to 60% canceling their membership in less than a year (Pedragosa et al., 2022). The dropout percentage tends to decrease gradually over time, with the highest risk occurring in the first

6 months and among individuals who engage in fewer than two sessions per week (Buckworth et al., 2013; Rodrigues et al., 2020a).

Data presented by these studies have argued that exercise practice should be initiated and maintained through a rational approach. That is, the individual begins their practice consciously and deliberately based on intrinsic motives (e.g., improvement of physical and mental health levels) or extrinsic motives (e.g., affiliation with a group; body image), assuming these are drivers of intentionality for exercise practice (Ekkekakis & Zenko, 2016; Jones & Zenko, 2023), regardless of age or sex (Rodrigues et al., 2022). More recent approaches have countered some of these assumptions, arguing that rational processes are not always promoters of behavioral action. This has created space for understanding non-conscious processes that influence a person to act, or not, regarding a specific behavior (e.g., Brand & Ekkekakis, 2018; Cheval & Boisgontier, 2021), giving rise to integrative approaches now recommended to invert this paradigm.

The cognitivist perspective played a fundamental role in understanding human behavior by highlighting the role of rational motivations (e.g., intentions) in the decision-making process and behavioral execution (Ajzen, 1991). According to this approach, individuals are viewed as rational agents who evaluate the consequences of their actions, weigh the pros and cons, and based on this analysis, form intentions. These intentions, in turn, are considered reliable predictors of future behavior (Ajzen, 1991). Various socio-cognitive and humanistic models, such as Self-Efficacy Theory (Bandura, 1994), the Theory of Planned Behavior (Ajzen, 1991), and Self-Determination Theory (Ryan & Deci, 2017), have been valuable in the study of intentions and, consequently, in behavior regulation. In this sense, these reflection-based models have been used in interventions to understand how people make rational decisions regarding, for example, exercise practice or, alternatively, engaging in sedentary behaviors.

However, as evidenced by Vasiljevic et al. (2016), no matter how "good" intentions are, they may fail to materialize into behavior. This phenomenon is

described as the intention-behavior gap (Sheeran & Webb, 2016) and clarifies that, although intention presents relevant explanatory power regarding exercise practice, it is extremely variable according to various factors such as social, behavioral, contextual, personal, motivational, or affective ones. Regarding the behavior under study, only 20-30% is explained by rational and deliberate processes (Hagger & Chatzisarantis, 2014). Although this gap between intention and behavioral operationalization is clear and has been studied on a large scale, researchers have maintained the belief that exercise practice is solely a response to context and deliberate, rational thoughts (Rodrigues et al., 2019, 2021; Rodrigues et al., 2020a; Rodrigues et al., 2020b). In other words, motivational approaches have considered exercise practice as a behavior performed largely in a rational and intentional manner, neglecting the non-intentional processes inherent to the behavior (Ekkekakis & Zenko, 2016; Rebar et al., 2016). It is for this reason that the limitations of the cognitivist perspective have been the subject of investigation, leading to the recognition of the need for more comprehensive and integrative approaches to understand and promote human behavior. It is urgent, therefore, to seek alternatives that can complement and integrate the study of motivation based on socio-cognitive models, and that can help researchers and professionals promote exercise practice as a regular and sustained behavior over time (Teixeira et al., 2021, 2022).

Thus, although the cognitivist perspective explains rational and intentional behaviors, partly and/or within the individual's control, it presents several limitations highlighted by researchers in various social and behavioral areas. First, many behaviors cannot simply be performed by will alone; they require skills, opportunities, resources, or cooperation for their execution (Fishbein, 2008). Second, individuals who tend to have a weak perception of efficacy or capacity regarding the behavior (e.g., "*I am not capable of running*") also tend to present low levels of intention (Rodrigues & Monteiro, 2021). Finally, most of these theoretical motivational models assume that people only make systematic and

rational decisions based on normative evaluations of the behavior, ignoring affective responses (e.g., pleasure/displeasure) and their influences as described, for example, by Brand and Ekkekakis (2018).

More recent approaches enhance the role of affects, feelings, and emotions, offering crucial insights that treat human action as partially intuitive and impulsive, despite having been widely neglected in recent decades (Ekkekakis, 2017; Ekkekakis et al., 2011). In a recent positioning, several researchers place affectivism (i.e., the study of affects) as a line of thought to be considered in various social domains in contemporary studies. They indicate that the concept and scientific advances may have demonstrated that affective processes are unquestionably illuminating and often complementary to existing theoretical models when it comes to understanding cognitive factors as well as the behavior itself (Dukes et al., 2021). When looking at exercise practice, it is logical to consider the affective component (e.g., pleasure or displeasure, tension or relaxation, energy or tiredness) as having potential motivational significance experienced by practitioners. This perspective aligns with hedonistic theories, suggesting that humans naturally gravitate towards behaviors that elicit positive affect. Studies show that the execution (or lack thereof) of exercise practice can be influenced by affective variables (Ekkekakis et al., 2011; Teixeira et al., 2023; Williams, 2008). That is, previous experiences with exercise, or even those occurring in the moment, whether pleasant or unpleasant, may help researchers better understand the determining factors of sustained adherence.

References

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50(2), 179-211. https://doi.org/10.1016/0749-5978(91)90020-T

Bandura, A. (1994). Self-efficacy. In V. S. Ramachaudran (Ed.), *Encyclopedia of Human Behavior* (vol. 4, pp. 71-81). Academic Press.

Brand, R., & Ekkekakis, P. (2018). Affective-Reflective Theory of physical inactivity and exercise: Foundations and preliminary evidence. *German Journal of Exercise and Sport Research*, 48(1), 48-58. https://doi.org/10.1007/s12662-017-0477-9

Buckworth, J., Dishman, R. K., O'Connor, P. J., & Tomporowski, P. D. (2013). *Exercise Psychology* (2nd ed.). Human Kinetics. https://doi.org/10.5040/9781492595502

Cheval, B., & Boisgontier, M. P. (2021). The theory of effort minimization in physical activity. *Exercise and Sport Sciences Reviews*, 49(3), 168-178. https://doi.org/10.1249/JES.0000000000000252

Dukes, D., Abrams, K., Adolphs, R., Ahmed, M. E., Beatty, A., Berridge, K. C., ... Sander, D. (2021). The rise of affectivism. *Nature Human Behaviour*, 5(7), 816-820. https://doi.org/10.1038/s41562-021-01130-8

Ekkekakis, P. (2017). People have feelings! Exercise psychology in paradigmatic transition. *Current Opinion in Psychology*, 16, 84-88. https://doi.org/10.1016/j.copsyc.2017.03.018

Ekkekakis, P., Parfitt, G., & Petruzzello, S. J. (2011). The pleasure and displeasure people feel when they exercise at different intensities: decennial update and progress towards a tripartite rationale for exercise intensity prescription. *Sports Medicine*, 41(8), 641-671. https://doi.org/10.2165/11590680-000000000-00000

Ekkekakis, P., & Zenko, Z. (2016). Measurement of affective responses to exercise. In *Emotion Measurement* (pp. 299-321). Elsevier. https://doi.org/10.1016/B978-0-08-100508-8.00012-6

European Commission (2022). *Special Eurobarometer 525 report - Sport and physical activity*. Retrieved from https://europa.eu/eurobarometer/surveys/detail/2668

Fishbein, M. (2008). A reasoned action approach to health promotion. *Medical Decision Making*, 28(6), 834-844. https://doi.org/10.1177/0272989X08326092

Guthold, R., Stevens, G. A., Riley, L. M., & Bull, F. C. (2018). Worldwide trends in insufficient physical activity from 2001 to 2016: A pooled analysis of 358 population-based surveys with 1.9 million participants. *The Lancet Global Health*, 6(10), e1077-e1086. https://doi.org/10.1016/S2214-109X(18)30357-7

Hagger, M. S., & Chatzisarantis, N. L. D. (2014). An integrated behavior change model for physical activity. *Exercise and Sport Sciences Reviews*, 42(2), 62-69. https://doi.org/10.1249/JES.0000000000000008

Isakson, E. (2021). A sporting chance: Physical activity as part of everyday life. *The Lancet*, 398(10298), 365. https://doi.org/10.1016/S0140-6736(21)01652-4

Jones, L., & Zenko, Z. (2023). A systematic narrative review of extrinsic strategies to improve affective responses to exercise. *Frontiers in Sports and Active Living*, 5, 1186986. https://doi.org/10.3389/fspor.2023.1186986

Pedragosa, V., Cardadeiro, E., & Santos, A. (2022). *Barómetro do Fitness: Relatório Anual*. Universidade Autónoma.

Rebar, A. L., Dimmock, J. A., Jackson, B., Rhodes, R. E., Kates, A., Starling, J., & Vandelanotte, C. (2016). A systematic review of the effects of non-conscious regulatory processes in physical activity. *Health Psychology Review*, 10(4), 395-407. https://doi.org/10.1080/17437199.2016.1183505

Rodrigues, F., Figueiredo, N., Teixeira, D., Cid, L., & Monteiro, D. (2022). The relationship between past exercise behavior and future exercise adherence: A sequential mediation analysis. *Journal of Sports Sciences*, 40(18), 2095-2101. https://doi.org/10.1080/02640414.2022.2135231

Rodrigues, F., Macedo, R., Teixeira, D., Cid, L., & Monteiro, D. (2021). Análise comportamental da prática de exercício físico em adultos em contexto de

ginásio ao longo de dois anos. *Cuadernos de Psicología del Deporte*, 21(1), 282-292. https://doi.org/10.6018/cpd.433261

Rodrigues, F., & Monteiro, D. (2021). *Mudança Comportamental em Atividade Física e Saúde*. Centro de Investigação em Qualidade de Vida.

Rodrigues, F., Monteiro, D., Teixeira, D., & Cid, L. (2020a). O papel dos instrutores de fitness na adesão à prática de exercício físico em Portugal: A importância dos comportamentos de suporte e dos climas motivacionais. *Motricidade*, 16(4), 420-431. https://doi.org/10.6063/MOTRICIDADE.21120

Rodrigues, F., Teixeira, D. S., Cid, L., & Monteiro, D. (2019). Promoting physical exercise participation: the role of interpersonal behaviors for practical implications. *Journal of Functional Morphology and Kinesiology*, 4(2), 40. https://doi.org/10.3390/jfmk4020040

Rodrigues, F., Teixeira, D. S., Neiva, H. P., Cid, L., & Monteiro, D. (2020b). The bright and dark sides of motivation as predictors of enjoyment, intention, and exercise persistence. *Scandinavian Journal of Medicine & Science in Sports*, 30(4), 787-800. https://doi.org/10.1111/sms.13617

Ryan, R. M., & Deci, E. L. (Eds.). (2017). *Self-determination theory: basic psychological needs in motivation, development, and wellness*. Guilford Press. https://doi.org/10.1521/978.14625/28806

Santos, J., Ihle, A., Peralta, M., Domingos, C., Gouveia, É. R., Ferrari, G., ... Marques, A. (2022). Associations of Physical activity and television viewing with depressive symptoms of the European adults. *Frontiers in Public Health*, 9, 799870. https://doi.org/10.3389/fpubh.2021.799870

Sheeran, P., & Webb, T. L. (2016). The intention-behavior gap. *Social and Personality Psychology Compass*, 10(9), 503-518. https://doi.org/10.1111/spc3.12265

Teixeira, D. S., Ekkekakis, P., Andrade, A. J., Bastos, V., & Palmeira, A. L. (2023). Exploring the impact of individualized pleasure-oriented exercise sessions in a health club setting: Protocol for a randomized controlled trial.

Psychology of Sport and Exercise, 67, 102424. https://doi.org/10.1016/j.psychsport.2023.102424

Teixeira, D. S., Monteiro, D., Rodrigues, F., Sousa, A., Chaves, C., & Cid, L. (2020). Ginásios e Health Clubs em Portugal: Estaremos perante uma República das Bananas? *Motricidade*, 16(1), 3-17. https://doi.org/10.6063/MOTRICIDADE.19688

Teixeira, D. S., Rodrigues, F., Machado, S., Cid, L., & Monteiro, D. (2021). Did you enjoy it? The role of intensity-trait preference/tolerance in basic psychological needs and exercise enjoyment. *Frontiers in Psychology*, 12, 682480. https://doi.org/10.3389/fpsyg.2021.682480

Teixeira, D. S., Rodrigues, F., Cid, L., & Monteiro, D. (2022). Enjoyment as a predictor of exercise habit, intention to continue exercising, and exercise frequency: the intensity traits discrepancy moderation role. *Frontiers in Psychology*, 13, 780059. https://doi.org/10.3389/fpsyg.2022.780059

Vasiljevic, M., Ng, Y., Griffin, S. J., Sutton, S., & Marteau, T. M. (2016). Is the intention-behaviour gap greater amongst the more deprived? A meta-analysis of five studies on physical activity, diet, and medication adherence in smoking cessation. *British Journal of Health Psychology*, 21(1), 11-30. https://doi.org/10.1111/bjhp.12152

Williams, D. M. (2008). Exercise, affect, and adherence: an integrated model and a case for self-paced exercise. *Journal of Sport and Exercise Psychology*, 30(5), 471-496. https://doi.org/10.1123/jsep.30.5.471

World Health Organization (2022). *Global status report on physical activity*. World Health Organization. Retrieved from https://www.who.int/teams/health-promotion/physical-activity/global-status-report-on-physical-activity-2022

9. Affect, emotion, and mood in physical activity and exercise

Teixeira, D. S.[1,2], Rodrigues, F.[3,4], & Monteiro, D.[3,4], & Bastos, V.[1,2]

1 – Faculty of Physical Education and Sport – Lusófona University, Campo Grande 376, 1749-024 Lisboa, Portugal

2 – Research Center in Sports, Physical Education, Exercise and Health (CIDEFES), Campo Grande 376, 1749-024 Lisboa, Portugal

3 – ESECS – Polytechnic University of Leiria, Campus 1, Rua Dr. João Soares, Apartado 4045, 2411–901 Leiria, Portugal

4 – Research Center in Sports Sciences, Health Sciences and Human Development (CIDESD), Quinta de Prados, 5001-801 Vila Real, Portugal

Conceptualization

To understand approaches based on the concept of affect and their application in a practical context, it is crucial to conceptualize its different manifestations. Although there are some conceptual differences regarding the terminology related to the concept of affect, there is a consensus that this term serves as a general reference for basic affects (also called core affect) and distinct affective states. Thus, basic affects (hereinafter referred to as core affect) represent the valence (i.e., positive vs. negative; pleasure vs. displeasure) of a response based on momentary experience. In contrast, distinct affective states reflect this basic component (i.e., core affect) alongside a cognitive appraisal component, characterizing themselves as emotions or mood (Ekkekakis & Petruzzello, 2002; Williams, 2008). In a sense, one can affirm that core affect represents a neurophysiological state consciously accessible as a primitive, simple, and non-reflective feeling, which is most evident in the form of emotion

and mood (Russell, 1980). This primitive state operates within a two-dimensional framework known as the Circumplex Model of Affect, defined by the intersection of hedonic valence (pleasure-displeasure) and physiological activation (low-high arousal), providing a continuous assessment of the organism's condition (Posner et al., 2005; Russell, 1980). Therefore, core affect is a part of, but not the whole of, emotions and mood (Ekkekakis, 2013; Russell & Barrett, 1999).

In one of the most consensual lines of thought, emotion is presented through multiple components (core affect, cognitive appraisal, bodily changes), characterized by high intensity but short duration (seconds or minutes), emerging as a response to specific, clearly identifiable stimuli. That is, in emotions, cognitive appraisal is an elemental characteristic, revealing a more complex phenomenon compared to core affect (Ekkekakis, 2013; Ekkekakis & Petruzzello, 2002). For example, core affect can occur individually or as part of an emotion. If we consider pride, defined as a manifestation of how one feels good about oneself, it can be decomposed so that the perception of "feeling good" represents the core affect, and "about oneself" represents the component with a cognitive element (i.e., resulting in the emotion), as described by Russell (2003). For the exercise professional, distinguishing these concepts is not merely semantic but practical: while a training program often aims to improve chronic mood states (e.g., reducing depressive symptoms over weeks), adherence is inextricably linked to the acute emotional or affective response to the specific bout of exercise.

Mood is considered a set of persistent feelings associated with cognitive appraisals (Ekkekakis, 2013). It is characterized by being experienced most of the time (hours, days), with lower intensity than emotions, encompassing multiple components (though not as pronounced as in emotions), and resulting from the cognitive appraisal of something diffuse "[mood is] *the appropriate designation for affective states that are about nothing specific or about everything about the world in general*" (Frijda, 2009, p. 258). The distinction between these three

components, which globally fall under the term affect, is of particular importance for understanding various phenomena (e.g., what to assess? Which instruments?). Although not the objective of this article, for a more in-depth review of the topic, the reading of other works is recommended (e.g., Ekkekakis, 2013; Ekkekakis & Petruzzello, 2002).

Regarding affect, it becomes a central piece in approaches using intuitive systems to explain behavior, particularly concerning core affect. As previously stated, this consciously available subjective manifestation can be experienced as pleasure, displeasure, tension, relaxation, energy, or fatigue. From an evolutionary standpoint, being the oldest system (compared to emotions and mood), its function is to provide the organism with information resulting from experience, allowing for an assessment of more or less desired states. Essentially, the shift from a less desired state to a more desired one is accompanied by positive affect, while negative affect promotes the contrary transition. Thus, this phylogenetically older system allows for the prioritization of various sensory stimuli, supporting the formation of memories with valence (positive or negative) and preferences, where the intensity of that stimulus determines the magnitude of avoidance or approach. This automatic evaluation aligns with the principles of the Affective-Reflective Theory, which posits that Type-1 processing (automatic, affective) often precedes and overpowers Type-2 processing (reflective, cognitive) when a sedentary individual faces the decision to exercise (Brand & Ekkekakis, 2018). This human dyad of seeking to approach what promotes pleasure and avoid what promotes displeasure or pain represents a crucial aspect of motivation formation, as it determines the inclination to move toward (or away from) something (Batson et al., 1992; Ekkekakis, 2013).

In summary, core affect is composed of two constructs of great relevance for a better understanding of human behavior: (1) affective valence (i.e., pleasure/displeasure) and activation (i.e., energy/lethargy) (Russell, 1980). Several studies suggest that affective states during physical exercise have an impact on

future behavior (e.g., Kwan & Bryan, 2010; Rhodes & Kates, 2015; Schneider et al., 2009; Williams, 2008). For instance, Schneider et al. (2009) reported that participants with a more positive affective response during exercise reported a higher weekly frequency of physical activity in the future. Similarly, Williams (2008) demonstrated that the affective response during physical activity was significantly associated with its continued adoption. On the other hand, the affective response after the session did not demonstrate predictive value. That is, it is the affective response during the practice of physical exercise that is a determining variable for the repetition of this behavior in the future, while the core affect perceived after a session does not present this relevance (Ekkekakis et al., 2011; Stevens et al., 2020). This phenomenon is best explained by the Dual-Mode Theory, which suggests that as exercise intensity surpasses the ventilatory threshold, the dominance shifts from cognitive factors (e.g., self-efficacy) to interoceptive cues (e.g., respiratory alkalosis, muscle acidosis), universally precipitating a decline in affective valence if the intensity is not self-regulated (Ekkekakis, 2003). Finally, it should be noted that despite its importance, the mechanisms of how affective states promote the maintenance of physical exercise are not yet fully understood (Jekauc & Brand, 2017).

References

Batson, C. D., Shaw, L. L., & Oleson, K. C. (1992). Differentiating affect, mood, and emotion: Toward functionally based conceptual distinctions. In M. S. Clark (Ed.), *Emotion* (pp. 294–326). Sage Publications, Inc.

Brand, R., & Ekkekakis, P. (2018). Affective-Reflective Theory of physical inactivity and exercise: Foundations and preliminary evidence. *German Journal of Exercise and Sport Research*, 48(1), 48-58. https://doi.org/10.1007/s12662-017-0477-9

Ekkekakis, P. (2003). Pleasure and displeasure from the body: Perspectives from exercise. *Cognition & Emotion*, 17(2), 213–239. https://doi.org/10.1080/02699930302292

Ekkekakis, P. (2013). *The measurement of affect, mood, and emotion: A guide for health-behavioral research*. Cambridge University Press.

Ekkekakis, P., Parfitt, G., & Petruzzello, S. J. (2011). The pleasure and displeasure people feel when they exercise at different intensities: decennial update and progress towards a tripartite rationale for exercise intensity prescription. *Sports Medicine*, 41(8), 641-671. https://doi.org/10.2165/11590680-000000000-00000

Ekkekakis, P., & Petruzzello, S. J. (2002). Analysis of the affect measurement conundrum in exercise psychology: IV. A conceptual case for the affect circumplex. *Psychology of Sport and Exercise*, 3(1), 35-63. https://doi.org/10.1016/S1469-0292(01)00028-0

Frijda, N. H. (2009). Emotion experience and its varieties. *Emotion Review*, 1(3), 264-271. https://doi.org/10.1177/1754073909103595

Jekauc, D., & Brand, R. (2017). Editorial: how do emotions and feelings regulate physical activity? *Frontiers in Psychology*, 8, 1145. https://doi.org/10.3389/fpsyg.2017.01145

Kwan, B. M., & Bryan, A. D. (2010). Affective response to exercise as a component of exercise motivation: Attitudes, norms, self-efficacy, and temporal stability of intentions. *Psychology of Sport and Exercise*, 11(1), 71-79. https://doi.org/10.1016/j.psychsport.2009.05.010

Posner, J., Russell, J. A., & Peterson, B. S. (2005). The circumplex model of affect: An integrative approach to affective neuroscience, cognitive development, and psychopathology. *Development and Psychopathology*, 17(3), 715–734.

Rhodes, R. E., & Kates, A. (2015). Can the affective response to exercise predict future motives and physical activity behavior? A systematic review of

published evidence. *Annals of Behavioral Medicine*, 49(5), 715-731. https://doi.org/10.1007/s12160-015-9704-5

Russell, J. A. (1980). A circumplex model of affect. *Journal of Personality and Social Psychology*, 39(6), 1161-1178. https://doi.org/10.1037/h0077714

Russell, J. A. (2003). Core affect and the psychological construction of emotion. *Psychological Review*, 110(1), 145-172. https://doi.org/10.1037/0033-295X.110.1.145

Russell, J. A., & Barrett, L. F. (1999). Core affect, prototypical emotional episodes, and other things called emotion: Dissecting the elephant. *Journal of Personality and Social Psychology*, 76(5), 805-819. https://doi.org/10.1037/0022-3514.76.5.805

Schneider, M., Dunn, A., & Cooper, D. (2009). Affect, exercise, and physical activity among healthy adolescents. *Journal of Sport and Exercise Psychology*, 31(6), 706-723. https://doi.org/10.1123/jsep.31.6.706

Stevens, C. J., Baldwin, A. S., Bryan, A. D., Conner, M., Rhodes, R. E., & Williams, D. M. (2020). Affective determinants of physical activity: a conceptual framework and narrative review. *Frontiers in Psychology*, 11, 568331. https://doi.org/10.3389/fpsyg.2020.568331

Williams, D. M. (2008). Exercise, affect, and adherence: an integrated model and a case for self-paced exercise. *Journal of Sport and Exercise Psychology*, 30(5), 471-496. https://doi.org/10.1123/jsep.30.5.471

10. Dual-Process Theories and the integration of reason and emotion

Bastos, V.[1,2], Teixeira, D. S.[1,2], Zeferino, B.[1,2], & Monteiro, D.[3,4]

1 – Faculty of Physical Education and Sport – Lusófona University, Campo Grande 376, 1749-024 Lisboa, Portugal

2 – Research Center in Sports, Physical Education, Exercise and Health (CIDEFES), Campo Grande 376, 1749-024 Lisboa, Portugal

3 – ESECS – Polytechnic University of Leiria, Campus 1, Rua Dr. João Soares, Apartado 4045, 2411–901 Leiria, Portugal

4 – Research Center in Sports Sciences, Health Sciences and Human Development (CIDESD), Quinta de Prados, 5001-801 Vila Real, Portugal

Rationale

Dual-process theories represent a comprehensive class of theoretical frameworks that explore the conscious and non-conscious characteristics of human behavior. Historically, psychology oscillated between viewing humans as rational agents driven by utility maximization and impulsive beings driven by instinct. Dual-process theories reconcile these views by positing that the execution (or lack thereof) of a behavior is the result of the interaction between two distinct systems or processing modes. System 1 is defined as fast, automatic, associative, and implicit, requiring minimal cognitive resources, while System 2 is characterized as slower, reflective, rule-based, and explicit (Kahneman et al., 2003; Strack & Deutsch, 2004).

To fully grasp the implications for physical activity, one must understand the architecture of these systems. System 1 operates continuously and effortlessly, constantly constructing a coherent interpretation of what is

happening at any moment. It is evolutionary and governs intuitive judgments, emotional reactions, and habit execution. In contrast, System 2 has been evolving recently and is responsible for reasoning, planning, and self-regulation. However, System 2 is resource-heavy and "lazy" by default. It is often reluctant to expend effort unless necessary (Kahneman, 2011). This creates a dynamic where System 1 generates suggestions for System 2 (e.g., impressions, intuitions, intentions, and feelings). If endorsed by System 2, these become beliefs and voluntary actions. However, when System 1's impulsive suggestions conflict with System 2's long-term goals, a struggle for behavioral control emerges (Hofmann et al., 2008).

It is within this interaction that behavior tends to emerge, and various models derived from this approach have been increasingly used in the context of physical activity. The Reflective-Impulsive Model (Strack & Deutsch, 2004), for example, suggests that while the reflective system (System 2) generates behavioral decisions based on knowledge and values (e.g., "I should exercise to prevent cardiovascular disease"), the impulsive system (System 1) generates behavioral schemata based on associative links and immediate affective evaluations (e.g., "*The couch feels comfortable, running feels hard*"). In sum, behaviors such as exercise practice exist as a result not of one, but of two basic processes or systems, whose interaction allows us to generate mental images oriented toward behavioral action (American College of Sports Medicine, 2025; Brand & Ekkekakis, 2018).

In this approach, when there is an alignment of the two systems, the predictability of behavioral execution is theoretically higher. This is what occurs in "successful exercisers" or those with high habit strength. Both the reflective aspects (e.g., positive attitudes, strong intentions) and the automatic aspects (e.g., positive affective response, automaticity/habit) concur in the same direction, facilitating a frictionless transition from intention to action (Gardner et al., 2020). However, this is not always the case. Particularly in exercise, information processed in System 2 (e.g., rational deliberation on behavior: "*it is important to*

exercise for my health") often does not align with that of System 1 (e.g., recalled negative affective response: "*today is that difficult workout that leaves me exhausted*").

This misalignment is frequently the root cause of the "Intention-Behavior Gap" (Sheeran & Webb, 2016). While purely cognitive models assume that changing an individual's intention is sufficient to change behavior, dual-process theories argue that even the strongest intentions can be derailed by powerful, opposing automatic impulses. This is particularly relevant given the Theory of Effort Minimization in Physical Activity, which posits that humans have an automatic, evolutionary tendency to avoid unnecessary energetic costs (Cheval & Boisgontier, 2021). Our System 1 is biologically "hardwired" to conserve energy, creating an automatic aversive response to the prospect of physical exertion. Consequently, sedentary behavior is often the default option supported by System 1, requiring significant cognitive control (System 2) to override. When cognitive resources are depleted, due to stress, fatigue, or daily demands, System 2's capacity to inhibit System 1 fails, leading to non-adherence despite good intentions (Englert, 2016; Baumeister & Heatherton, 1996).

In these cases of conflict, the realization of the behavior will depend on the interaction between a set of available affective resources and the individual's self-regulation capacity. This highlights the limitation of traditional interventions that rely solely on education (informing System 2). Telling a person that exercise is healthy convinces the reflective system, but it does nothing to silence the aversive signal generated by the impulsive system if the person associates exercise with pain or embarrassment. With particular emphasis on this process lies the affective response. Both core affect (e.g., affective response during training) and other relevant affective variables (e.g., recall of sensations during training) can contribute in an automatic or reflective way to the development of behavior, through the creation of sensations of approach or avoidance (Brand & Ekkekakis, 2018; Ekkekakis et al., 2011; Murphy & Eaves, 2016). The role of memory is crucial

here. According to the "Peak-End Rule," individuals do not judge an experience by the average of its moments, but rather by how they felt at its most intense point (peak) and at its end (Kahneman et al., 1993; Fredrickson, 2000). If a novice exerciser pushes too hard and experiences severe displeasure (negative peak) or finishes the session feeling exhausted and in pain (negative end), the memory encoded will be negative. This negative memory becomes the input for System 1's automatic evaluation before the next session, triggering an avoidance response that System 2 must struggle to overcome (Hargreaves & Stych, 2013; Zenko et al., 2016).

However, it has been suggested that core affect, experienced during exercise, can affect the two systems in distinct ways. Directly, negative affect experienced during exertion sends an immediate signal to stop or reduce intensity, a survival mechanism to prevent catastrophic homeostatic disruption (Ekkekakis, 2003). Indirectly, it shapes future motivation by updating the associative links in the impulsive system. If exercise is consistently paired with displeasure, the very cue of "gym" or "running shoes" will automatically activate negative affect, increasing the cognitive effort required to initiate the behavior (Brand & Ekkekakis, 2018). Conversely, if exercise is engineered to be pleasant (e.g., self-paced, below the ventilatory threshold), it can foster positive implicit associations, reducing the demand for self-control resources over time.

This dual-process perspective shows the necessity of a paradigm shift in how we understand exercise adherence. The four theories/approaches to be developed in the present article explore the idea that the way affective response is experienced during physical exercise will condition various processes and influence behavior oriented toward regular practice. These models move beyond the "rational man" fallacy, acknowledging that human beings are often irrational, emotional, and driven by immediate gratification rather than distant rewards (Williams, 2019). The reflection on these models and their integration into physical exercise promotion interventions will not only help to understand the

difficulty of continued adherence but also the understanding of the possible aversion or sensation of withdrawal that many people manifest in relation to exercise. By understanding how to align the automatic/impulsive system with the reflective/rational system, researchers and practitioners can design more effective strategies that work with human nature, rather than against it.

References

American College of Sports Medicine. (2025). *ACSM's guidelines for exercise testing and prescription (12th ed.)*. Lippincott Connect. ISBN: 9781975219208

Baumeister, R. F., & Heatherton, T. F. (1996). Self-regulation failure: An overview. *Psychological Inquiry*, 7(1), 1-15. https://doi.org/10.1207/s15327965pli0701_1

Brand, R., & Ekkekakis, P. (2018). Affective-Reflective Theory of physical inactivity and exercise: Foundations and preliminary evidence. *German Journal of Exercise and Sport Research*, 48(1), 48-58. https://doi.org/10.1007/s12662-017-0477-9

Cheval, B., & Boisgontier, M. P. (2021). The theory of effort minimization in physical activity. *Exercise and Sport Sciences Reviews*, 49(3), 168-178. https://doi.org/10.1249/JES.0000000000000252

Ekkekakis, P. (2003). Pleasure and displeasure from the body: Perspectives from exercise. *Cognition & Emotion*, 17(2), 213–239. https://doi.org/10.1080/02699930302292

Ekkekakis, P., Parfitt, G., & Petruzzello, S. J. (2011). The pleasure and displeasure people feel when they exercise at different intensities: decennial update and progress towards a tripartite rationale for exercise intensity prescription. *Sports Medicine*, 41(8), 641-671. https://doi.org/10.2165/11590680-000000000-00000

Englert, C. (2016). The strength model of self-control in sport and exercise psychology. *Frontiers in Psychology*, 7, 314. https://doi.org/10.3389/fpsyg.2016.00314

Fredrickson, B. L. (2000). Extracting meaning from past affective experiences: The importance of peaks, ends, and specific emotions. *Cognition & Emotion*, 14(4), 577-606. https://doi.org/10.1080/026999300402808

Gardner, B., Lally, P., & Rebar, A. L. (2020). Does habit weaken the relationship between intention and behaviour? Revisiting the habit-intention interaction hypothesis. *Social and Personality Psychology Compass*, 14(8), e12553. https://doi.org/10.1111/spc3.12553

Hargreaves, E. A., & Stych, K. (2013). Exploring the peak and end rule of past affective episodes within the exercise context. *Psychology of Sport and Exercise*, 14(2), 169-178. https://doi.org/10.1016/j.psychsport.2012.10.003

Hofmann, W., Friese, M., & Wiers, R. W. (2008). Impulsive versus reflective influences on health behavior: A theoretical framework and empirical review. *Health Psychology Review*, 2(2), 111-137. https://doi.org/10.1080/17437190802617668

Kahneman, D. (2011). *Thinking, fast and slow*. Farrar, Straus and Giroux.

Kahneman, D., Diener, E., & Schwarz, N. (Eds.). (2003). *Well-being: The foundations of hedonic psychology*. Russell Sage Foundation.

Kahneman, D., Fredrickson, B. L., Schreiber, C. A., & Redelmeier, D. A. (1993). When More Pain Is Preferred to Less: Adding a Better End. *Psychological Science*, 4(6), 401-405. https://doi.org/10.1111/j.1467-9280.1993.tb00589.x

Murphy, S. L., & Eaves, D. L. (2016). Exercising for the pleasure and for the pain of it: the implications of different forms of hedonistic thinking in theories of physical activity behavior. *Frontiers in Psychology*, 7. https://doi.org/10.3389/fpsyg.2016.00843

Sheeran, P., & Webb, T. L. (2016). The intention-behavior gap. *Social and Personality Psychology Compass*, 10(9), 503-518. https://doi.org/10.1111/spc3.12265

Strack, F., & Deutsch, R. (2004). Reflective and impulsive determinants of social behavior. *Personality and Social Psychology Review*, 8(3), 220-247. https://doi.org/10.1207/s15327957pspr0803_1

Williams, D. M. (2019). *Darwinian hedonism and the epidemic of unhealthy behavior*. Cambridge University Press.

Zenko, Z., Ekkekakis, P., & Ariely, D. (2016). Can you have your vigorous exercise and enjoy it too? Ramping intensity down increases postexercise, remembered, and forecasted pleasure. *Journal of Sport and Exercise Psychology*, 38(2), 149-159. https://doi.org/10.1123/jsep.2015-0286

11. Circumplex model of affect

Rodrigues, F.[1,2], Bastos, V.[3,4], Zeferino, B.,[3,4] & Teixeira, D. S.[3,4]

1 – ESECS – Polytechnic University of Leiria, Campus 1, Rua Dr. João Soares, Apartado 4045, 2411–901 Leiria, Portugal

2 – Research Center in Sports Sciences, Health Sciences and Human Development (CIDESD), Quinta de Prados, 5001-801 Vila Real, Portugal

3 – Faculty of Physical Education and Sport – Lusófona University, Campo Grande 376, 1749-024 Lisboa, Portugal

4 – Research Center in Sports, Physical Education, Exercise and Health (CIDEFES), Campo Grande 376, 1749-024 Lisboa, Portugal

Conceptualization

To understand the nuances of human experience during physical exertion, it is necessary to move beyond simple categorical labels of emotion, such as "happy" versus "sad". Historically, the psychology of emotion attempted to catalog affect as a set of independent dimensions, utilizing six to twelve independent monopolar factors like "distress," "depression," or "excitement". This perspective assumed that each dimension varied independently; for instance, the presence of high excitement would not necessarily imply the absence of depression. However, this perspective has been challenged by evidence suggesting that these affective dimensions are not independent but are interrelated in a highly systematic fashion.

It is within this context that the Circumplex Model of Affect, originally proposed by James Russell (1980), emerges as a fundamental paradigm shift. Russell argued that affective states are best represented not as a list of discrete categories, but as a circle in a two-dimensional bipolar space. This spatial model posits that all affective states arise from the neurophysiological interaction of two

orthogonal dimensions: Hedonic Valence and Physiological Activation. This provides a representation of both the cognitive structure laymen utilize in conceptualizing affect and the structure of affective experience itself.

The anatomy of the model: Valence and Arousal

The core proposition of the Circumplex Model is that the vast array of human emotional states can be defined by the combination of two independent neurophysiological dimensions:

- **Hedonic Valence (The Horizontal Axis)**. This dimension represents the qualitative nature of the experience, ranging on a continuum from extreme pleasure (0°) to extreme displeasure or misery (180°). In the context of physical activity, this dimension answers the fundamental question of whether the immediate somatic experience of effort is perceived as pleasant or unpleasant.
- **Physiological Activation (The Vertical Axis).** This dimension represents the level of perceived energy or mobilization, ranging from sleepiness (270°) to high arousal (90°). This axis is particularly critical in exercise psychology because, unlike other leisure activities, physical exertion inherently involves an increase in physiological arousal (e.g., elevated heart rate, increased respiration), distinguishing the domain of exercise from other sedentary affective experiences.

In this two-dimensional Cartesian space, affective states are distributed along the perimeter of a circle. Specific affective concepts are defined by their angular position; for instance, excitement is not merely a synonym for pleasure but is a combination of high valence and high activation (~45°). Conversely, distress represents high activation coupled with displeasure (~135°), while relaxation

reflects positive valence with low activation (~315°). Finally, depression is defined as a combination of displeasure and low arousal (225°).

Application to the physical activity context

The application of the Circumplex Model to physical activity addresses a critical limitation of traditional mood scales, which often fail to capture the distinct "energizing" versus "tensing" nature of exercise-induced affect. While clinical mental health often focuses on the reduction of low-activation negative affect (e.g., depression), the promotion of physical activity is intrinsically linked to the management of activation and the optimization of valence. By superimposing the core affect construct onto this Cartesian map, researchers and practitioners can identify four distinct quadrants of experience during and after exercise (Ekkekakis et al., 2011):

- **High-Activation Pleasure (Northeast Quadrant, ~0°–90°)**. Characterized by states of energy, vigor, and vitality. This is the optimal state often reported during moderate-intensity exercise or "flow" states, where the physiological demand is matched by perceived competence.
- **High-Activation Displeasure (Northwest Quadrant, ~90°–180°)**. Characterized by tension, distress, and anxiety. This state typically emerges when exercise intensity exceeds the ventilatory threshold or when the individual perceives the physiological load as threatening rather than challenging. Interoceptive cues such as breathlessness and muscle acidosis dominate, driving the affective state toward the negative pole of the valence axis.
- **Low-Activation Displeasure (Southwest Quadrant, ~180°–270°)**. Characterized by fatigue, boredom, and tiredness. This affective state is a primary barrier to exercise initiation, often associated with sedentary behaviors and the feeling of being "too tired" to act.

- **Low-Activation Pleasure (Southeast Quadrant, ~270°–360°)**. Characterized by calm, relaxation, and serenity. This is the hallmark affective response following an acute bout of exercise (the "rebound effect" or "feel-better" effect), representing a return to homeostasis accompanied by a reduction in tension.

The utility of the Circumplex Model lies in its ability to map the "affective trajectory" of an individual. A typical exercise session involves a dynamic movement through this space: an individual may arrive at the gym in a state of low energy (Southwest), transition to high energy (Northeast) during the warm-up, potentially drift toward tension (Northwest) if the intensity becomes excessive, and finally settle into a state of relaxation (Southeast) during recovery. Empirical evidence suggests that the trajectory along the horizontal axis (Valence) during the bout of exercise is a potent predictor of future behavior (Teixeira et al., 2024). The Peak-End Rule suggests that global retrospective evaluations of an experience are heavily weighted by the peak intensity of the affect (positive or negative) and the affect experienced at the very end (Bastos et al., 2025). If the intensity forces the individual into the "displeasure" side (left hemisphere), particularly the High-Activation Displeasure quadrant (e.g., a "maximal effort" finisher), a negative affective memory is encoded. This may deter future participation, regardless of the health benefits. Conversely, protocols that manage intensity to ensure the session concludes in a pleasurable state (e.g., ramping down intensity) have been shown to improve forecasted pleasure and future intention. Recent research highlights that manipulating the intensity trajectory, specifically avoiding prolonged exposure to the Northwest quadrant, can optimize the affective experience without compromising physiological adaptation.

While the Circumplex Model provides a robust descriptive map of what an individual feels (e.g., distinguishing between the tension of high-intensity

intervals and the fatigue of burnout), it remains a structural model. It describes the landscape of affect but does not fully explain the dynamic mechanisms of how these momentary states interact with long-term cognitions to drive behavior. To bridge this gap, it is necessary to integrate this descriptive map into a dual-process framework. Understanding that a specific exercise intensity places a client in the "High-Activation Displeasure" quadrant is critical, but we must further understand how this automatic aversive signal (System 1) competes with the reflective intention to "be healthy" (System 2). This dynamic interaction between the current affective state, precisely mapped by the Circumplex, and behavioral decision-making is the focus of the Affective-Reflective Theory (Brand & Ekkekakis, 2018). The Affective-Reflective Theory builds upon the dimensional reality of valence and arousal to explain how automatic associations can override reflective plans, a concept we will explore in the following chapter. Dual-process theories represent a comprehensive class of theoretical frameworks that explore the conscious and non-conscious characteristics of human behavior.

References

Bastos, V., Ekkekakis, P., Andrade, A. J., & Teixeira, D. S. (2025). The peak and end rule, affect-related cognitions, enjoyment, and exercise frequency: A randomized controlled trial ancillary study. *Psychology of Sport and Exercise, 81*, 102963. https://doi.org/10.1016/j.psychsport.2025.102963

Brand, R., & Ekkekakis, P. (2018). Affective–Reflective Theory of physical inactivity and exercise: Foundations and preliminary evidence. *German Journal of Exercise and Sport Research, 48*(1), 48–58. https://doi.org/10.1007/s12662-017-0477-9

Ekkekakis, P., Parfitt, G., & Petruzzello, S. J. (2011). The pleasure and displeasure people feel when they exercise at different intensities: Decennial update and progress towards a tripartite rationale for exercise intensity prescription.

Sports Medicine, 41(8), 641–671. https://doi.org/10.2165/11590680-000000000-00000

Ekkekakis, P., & Petruzzello, S. J. (2002). Analysis of the affect measurement conundrum in exercise psychology: IV. A conceptual case for the affect circumplex. *Psychology of Sport and Exercise, 3*(1), 35–63. https://doi.org/10.1016/S1469-0292(01)00028-0

Kahneman, D., Fredrickson, B. L., Schreiber, C. A., & Redelmeier, D. A. (1993). When more pain is preferred to less: Adding a better end. *Psychological Science, 4*(6), 401–405. https://doi.org/10.1111/j.1467-9280.1993.tb00589.x

Russell, J. A. (1980). A circumplex model of affect. *Journal of Personality and Social Psychology, 39*(6), 1161–1178. https://doi.org/10.1037/h0077714

Teixeira, D. S., Bastos, V., Andrade, A. J., Palmeira, A. L., & Ekkekakis, P. (2024). Individualized pleasure-oriented exercise sessions, exercise frequency, and affective outcomes: a pragmatic randomized controlled trial. *The International Journal of Behavioral Nutrition and Physical Activity, 21*(1), 85. https://doi.org/10.1186/s12966-024-01636-0

12. Affective-Reflective Theory of physical inactivity and exercise

Bastos, V.[1,2], Monteiro, D.[3,4], Rodrigues, F.[3,4,] & Teixeira, D. S.[1,2]

1 – Faculty of Physical Education and Sport – Lusófona University, Campo Grande 376, 1749-024 Lisboa, Portugal

2 – Research Center in Sports, Physical Education, Exercise and Health (CIDEFES), Campo Grande 376, 1749-024 Lisboa, Portugal

3 – ESECS – Polytechnic University of Leiria, Campus 1, Rua Dr. João Soares, Apartado 4045, 2411–901 Leiria, Portugal

4 – Research Center in Sports Sciences, Health Sciences and Human Development (CIDESD), Quinta de Prados, 5001-801 Vila Real, Portugal

Theoretical foundations

The Affective-Reflective Theory of physical inactivity and exercise (Brand & Ekkekakis, 2018) aims to predict and explain human behavior in situations where an individual has the option to remain inactive or initiate physical exercise. This theory presents a dual-process model that seeks to explain why physical inactivity continues to prevail over regular exercise practice. The Affective-Reflective Theory is primarily inspired by Lewin's (1943) field theory, which postulates that human behavior must be interpreted through a perspective of "forces" and "tensions" acting upon the individual. In this theory, behavior is understood through these forces, comprised of interrelated factors that constitute our "dynamic field," which will either draw us closer to a given behavior or maintain us in the current one. This dynamic is defined by "systems of tension", forces that pull us toward or push us away from an action.

The Affective-Reflective Theory suggests that momentary affective response can play a significant role in this system, acting as attractive forces (positive affective valence) or repulsive forces (negative affective valence) that can give rise to a new behavior or the maintenance of the current one. In the context of physical inactivity and exercise, this means that core affect can act as a promoter or a barrier to the adoption of regular exercise practice, depending on its valence (pleasure vs. displeasure). Consequently, the affective response holds a central role in the Affective-Reflective Theory, with the authors of this dual-process theory intending to add a hedonic perspective (Type-1 processing) to motivational approaches (Type-2 processing) for physical exercise practice.

Additionally, the Affective-Reflective Theory distinguishes itself from other cognitively oriented theories, such as Self-Determination Theory (Deci & Ryan, 1985), by contemplating the restraining forces to exercise practice, rather than considering only the promoting force and its magnitude (i.e., more controlled or more autonomous motivational quality). In this way, a better understanding of the totality of the situation in which a decision is made (e.g., to exercise or not) can be achieved through the concurrent forces influencing it at the moment (e.g., going to train vs. resting on the sofa after a hard day's work) and the psychological processes leading to that behavior.

Dual-process dynamics: Type-1 and Type-2 processing

As a dual-process theory, the Affective-Reflective Theory of physical inactivity and exercise seeks to explain decision-making for action through two types of processes: Type-1 (fast, automatic, and effortless) and Type-2 (slow, cognitive, and effortful). The Affective-Reflective Theory posits that Type-1 processing serves as the foundation and can, depend on the situation, subsequently "inform" Type-2 processing. This sequence occurs the moment exercise-related perceptions are presented through external stimuli (e.g., being

advised to exercise by a family member) or internal stimuli (e.g., remembering the advice).

These stimuli activate automatic associations of past experiences encoded in memory regarding the stimulus object (e.g., physical exercise) and related concepts (e.g., current state of physical inactivity). In turn, these associations create an automatic affective valuation toward the source of the stimulus (e.g., exercise), the resulting affective valence of which is crucial for an action impulse (to practice exercise or remain in the current state of physical inactivity). Here, a positive affective valence will potentiate an impulse to practice exercise, whereas a negative affective valence will create an impulse of aversion to this practice (Chen & Bargh, 1999). Furthermore, an automatic affective valuation that portrays a specific leisure (in)activity (e.g., watching television while sitting on the sofa) as more pleasurable than training will exert a significant influence on the resulting action impulse. This entire automatic affective valuation process may or may not be conscious (Strack & Deutsch, 2004).

Depending on the available self-control resources (Hofmann et al., 2008), the automatic affective valuation will reach Type-2 processes. The processing of this affective information converges with the memory of past experiences to create an anticipated affective response, a mental simulation of how a person believes they will feel while practicing physical exercise. High-level cognitive operations also reside in these processes, such as individual needs and values (Deci & Ryan, 1985), the pros and cons of behavioral change (Bandura, 1986), or subjective beliefs (Ajzen, 1985), thereby connecting the Affective-Reflective Theory with relevant cognitive theories. These reflective evaluations can originate action plans (e.g., intentions and goals for behavioral change) which, like action impulses, can constitute promoting or restraining forces for the adoption of exercise practice.

Type-1 and Type-2 processes interact with each other in three distinct ways (Hofmann et al., 2008):

a) Automatic associations are created through learned past affective experiences.
b) Each activation of an automatic association leaves traces in the association network, acting as an "update" of previous associations with exercise.
c) Through the arrival of the automatic affective valuation to Type-2 processes, provided there are available self-control resources.

The first two forms of interaction create a feedback cycle crucial for human learning, forming and updating affective validations and reflective evaluations related to physical exercise. The third interaction qualifies the Affective-Reflective Theory as a default-interventionist model, with the automatic affective validation representing the default response upon which a reflective evaluation is based. In this inter-system interaction, if both are aligned toward physical exercise practice (e.g., preparing all necessary training equipment, converging with a family member's advice to exercise more regularly), psychological barriers to adopting the behavior are not expected, as both plans and the action impulse converge. However, in the existence of conflict between systems (e.g., intention to follow the family member's advice, but the action impulse is to remain in physical inactivity), and in the absence of necessary self-control resources, the action impulse is expected to prevail over the outlined plans (Baumeister & Heatherton, 1996; Englert, 2016; Hofmann et al., 2008). The automatic affective validation can only be rejected in the presence of self-control resources, which may be "spent" for this purpose, thereby rejecting the impulse for an action one wishes to counteract (e.g., maintenance of physical inactivity) in favor of the action plans one wishes to implement.

Core affect thus plays a key role in the Affective-Reflective Theory of physical inactivity and exercise. The affective valence experienced during exercise will

create automatic associations that become encoded in memory, associations that will be activated when the opportunity to practice exercise presents itself again. If the affective valence during exercise is negative, this association (i.e., exercise causes displeasure) becomes automated, with each unpleasant training session reinforcing it. Simultaneously, if a more positive automatic affective validation exists toward physical inactivity, the action impulse will be to remain inactive. Although this impulse can be counteracted through Type-2 processes, this rejection always requires self-control resources, which are limited.

References

Ajzen, I. (1985). From intentions to actions: a theory of planned behavior. In: J. Kuhl and J. Beckmann (Eds.), *Action Control. SSSP Springer Series in Social Psychology*. Springer. https://doi.org/10.1007/978-3-642-69746-3_2

Bandura, A. (1986). *Social foundations of thought and action*. Prentice-Hall.

Baumeister, R. F., & Heatherton, T. F. (1996). Self-regulation failure: An overview. *Psychological Inquiry, 7*(1), 1-15. https://psycnet.apa.org/doi/10.1207/s15327965pli0701_1

Brand, R., & Ekkekakis, P. (2018). Affective-Reflective Theory of physical inactivity and exercise: Foundations and preliminary evidence. *German Journal of Exercise and Sport Research, 48*(1), 48-58. https://doi.org/10.1007/s12662-017-0477-9

Chen, M., & Bargh, J. A. (1999). Consequences of automatic evaluation: Immediate behavioral predispositions to approach or avoid the stimulus. *Personality and Social Psychology Bulletin, 25*(2), 215-224. https://doi.org/10.1177/0146167299025002007

Deci, E. L., & Ryan, R. M. (1985). *Intrinsic motivation and self-determination in human behavior*. Springer Science & Business Media.

Englert, C. (2016). The strength model of self-control in sport and exercise psychology. *Frontiers in Psychology, 7*, 314. https://doi.org/10.3389/fpsyg.2016.00314

Hofmann, W., Friese, M., & Wiers, R. W. (2008). Impulsive versus reflective influences on health behavior: A theoretical framework and empirical review. *Health Psychology Review, 2*(2), 111-137. https://doi.org/10.1080/17437190802617668

Lewin, K. (1943). Defining the 'field at a given time.' *Psychological Review, 50*(3), 292-310. https://doi.org/10.1037/h0062738

Strack, F., & Deutsch, R. (2004). Reflective and impulsive determinants of social behavior. *Personality and Social Psychology Review, 8*(3), 220-247. https://doi.org/10.1207/s15327957pspr0803_1

13. Theory of Effort Minimization in Physical Activity

Teixeira, D. S.[1,2], Zeferino, B., Monteiro, D.[3,4], & Bastos, V.[1,2]

1 – Faculty of Physical Education and Sport – Lusófona University, Campo Grande 376, 1749-024 Lisboa, Portugal

2 – Research Center in Sports, Physical Education, Exercise and Health (CIDEFES), Campo Grande 376, 1749-024 Lisboa, Portugal

3 – ESECS – Polytechnic University of Leiria, Campus 1, Rua Dr. João Soares, Apartado 4045, 2411–901 Leiria, Portugal

4 – Research Center in Sports Sciences, Health Sciences and Human Development (CIDESD), Quinta de Prados, 5001-801 Vila Real, Portugal

Theoretical foundations

The Theory of Effort Minimization in Physical Activity (Cheval et al., 2017; Cheval & Boisgontier, 2021) shares its foundational pillars with the Affective-Reflective Theory of physical inactivity and exercise, as well as other similar dual-process models. In these frameworks, the adoption of regular exercise depends on the interactions between automatic and reflective processes and the subsequent actions they generate (e.g., impulses and/or plans). However, Theory of Effort Minimization in Physical Activity aims to enhance the precision of these models by supplementing their approach with a specific automatic affective evaluation previously overlooked: an evolutionary attraction of the human being toward the minimization of physical effort. While Affective-Reflective Theory focuses broadly on the hedonic valuation of the exercise stimulus, Theory of Effort Minimization in Physical Activity specifically posits that the "cost" of effort is

automatically encoded as a negative affective attribute, creating a default bias toward sedentary behavior.

The evolutionary paradox: Built to move, wired to rest

To understand this innate attraction to effort minimization, we must first consider the evolution of the human relationship with physical activity. Over millions of years, the anatomy and physiology of our ancestors adapted to the necessities of their hunting and gathering strategies, strategies indispensable for survival. These adaptations turned humans into physically active and energetically efficient beings. This is often referred to as the "Mismatch Hypothesis," suggesting that our physiology is adapted for a high-activity environment that no longer exists (Lieberman, 2013). This evolutionary process resulted in the optimization of our organism for physical activity, to the point where it became essential for our health (Guthold et al., 2018). This evolution appears to have had not only a physical effect but also a psychological one, with our brain potentially being neurophysiologically conditioned to create a positive affective response to the practice of physical activity (Crombie et al., 2018; Raichlen et al., 2012).

Nevertheless, not all affective responses to physical activity are positive. Indeed, at low-to-moderate intensities, the affective response tends to be positive (Ekkekakis et al., 2011; Ladwig et al., 2017). However, consistent with the Dual-Mode Theory, once the intensity surpasses the ventilatory threshold, an heterogeneity in core affect is observed (e.g., due to individual differences in preferred and tolerated intensity; Ekkekakis et al., 2005). Furthermore, at intensities exceeding the respiratory compensation point, displeasure becomes dominant (Ekkekakis et al., 2011; Ladwig et al., 2017). This affective response to vigorous intensities may result from the shift in the predominant energy system (i.e., from aerobic to anaerobic after the ventilatory threshold), resulting in interoceptive sensations of displeasure aimed at maintaining the organism's homeostasis (e.g., avoiding injury or metabolic exhaustion).

Despite increasing evidence regarding the relevance of core affect for exercise adherence (e.g., Baldwin et al., 2016; Rhodes & Kates, 2015; Williams, 2008), the authors of Theory of Effort Minimization in Physical Activity argue that the displeasure associated with anaerobic activities does not fully explain the high levels of global physical inactivity. A complementary hypothesis is the existence of automatic affective valuations regarding other behaviors that may represent a more attractive alternative than physical exercise. These are typically sedentary behaviors, viewed as more pleasurable due to an innate attraction to effort minimization.

Economy vs. Efficiency: The mechanisms of minimization

This apparent paradox, humans being optimized to be physically active while simultaneously possessing an attraction to effort minimization, can be explained by how humans tend to manage physical activity. This innate tendency to minimize effort appears to have developed through natural selection in our ancestors, where energy reserves were crucial for somatic and reproductive needs (Gibson & Mace, 2006; Pontzer et al., 2016). It is probable that humans evolved to conserve energy through two distinct mechanisms: (1) improved economy (e.g., reduction of energy expenditure for a given task) and (2) greater efficiency (e.g., less waste) in physical activity.

Applying this to a practical context, better energy economy refers to how an activity can be performed with the lowest possible energy cost (e.g., if running is necessary, what is the minimum speed required to meet the need?; in climbing stairs, how slowly can it be done without being late?). Conversely, greater energy efficiency means selecting the option that wastes fewer resources to achieve a specific goal (e.g., using a bicycle or car instead of running to reach a destination, taking an elevator instead of stairs). This aligns with the broader scientific "Principle of Least Effort," which dictates that biological systems will naturally choose the path of minimum energy expenditure to achieve a goal.

Although both mechanisms remain active in human behavior, energy efficiency has gained a more preponderant role in effort minimization due to various tools and technologies developed for this purpose. For instance, traveling to a restaurant to consume an energy-dense meal is no longer necessary; the meal can easily come to us via a mobile app. It seems, therefore, that humans evolved to be physically active, but in an efficient manner, with scientific literature demonstrating various examples of this energy efficiency optimization (Abram et al., 2019; Alexander, 1996; Prévost et al., 2010).

However, this tendency can be overridden by higher-effort behaviors if these align with the individual's goals (e.g., climbing stairs to be physically active, going to the gym to lose weight). Additionally, a behavior that counteracts effort minimization, if performed frequently over time, can become a habit. Habit formation promotes automaticity, which paradoxically results in a saving of cognitive resources, even if the physical cost remains high (e.g., spontaneously heading toward the stairs or gym). Nevertheless, effort minimization processes do not cease after a decision is made; they exert influence during the multiple phases of behavioral regulation. For example, this means that minimization can still influence a behavior already in progress, biasing its execution toward lower energy expenditure. This minimization can be counteracted through motivation to maintain the behavior and other strategies, such as the manipulation of perceived effort (Iodice et al., 2019; Marcora, 2016).

Physiological state and individual differences as moderators

Despite the possibility of counteracting an automatic evaluation for effort minimization, the necessary conditions for such rejection may not be available. This brings us to another foundational component of Theory of Effort Minimization in Physical Activity: the inclusion of the individual's physiological state at the moment of exposure to an exercise-related stimulus as a moderator of automatic evaluation processes. For example, fatigue can cause a higher

perception of effort regarding physical exercise compared to when fatigue levels are lower (Iodice et al., 2017). Consequently, a fatigued individual may have distinct automatic evaluations that, at that moment, do not favor exercise practice. Additionally, it is expected that an individual's physical fitness (e.g., cardiorespiratory fitness, muscular strength) influences the momentary automatic affective evaluation of exercise, with untrained individuals possibly presenting higher perceptions of effort than trained individuals.

Beyond the physiological state, individual differences in the attraction and tolerance of physical effort must be considered. Evidence demonstrates that while some individuals avoid cognitive effort, others actively seek it due to higher "Need for Cognition" (Cacioppo et al., 1996). Similarly, individuals possess distinct preferences and tolerances for exercise intensity, which manifests in the affective response and physiological relationship with effort (Marques et al., 2023; Teixeira et al., 2021, 2022).

Finally, Theory of Effort Minimization in Physical Activity also contemplates the environment surrounding the individual, as this can constitute an external stimulus that triggers the automatic and controlled processes underlying behavior. For example, the existence of sidewalks, parks, bike paths, and exercise infrastructures creating an environment oriented toward practice can act as facilitators (Benton et al., 2016). This is often referred to in behavioral architecture as "reducing friction" for active behaviors. However, as Theory of Effort Minimization in Physical Activity postulates, this effect is always dependent on the affects and motivation regarding the practice.

Theory of Effort Minimization in Physical Activity is a dual-process model distinguished by its innovative integration of perceived effort and its influence on both automatic and controlled processes. Movement-based behaviors are considered on an energetic continuum, tending toward effort minimization to create greater energy efficiency. This is dependent on movement-related external

stimuli, which are evaluated positively or negatively by automatic and controlled processes.

This evaluation is dependent on the individual's current physiological state (i.e., fatigue levels, physical fitness) and whether these movement stimuli are considered necessary or dispensable. The perception of effort associated with the stimulus is influenced by the result of this evaluation, which, in turn, impacts the automatic and controlled processes leading to their respective behavioral precursors (e.g., anticipated affective response in the case of automatic processes; intentions for practice in the case of controlled processes). For these precursors to support movement-based behaviors with higher energy expenditure, the automatic and controlled processes favoring this behavior must subsequently overcome the processes favoring the minimization of perceived effort. The weight these precursors hold in decision-making depends on multiple moderating factors, such as fatigue, required cognitive load, and habit strength. In individuals intending to be physically active, a negative automatic evaluation can be dismissed through the utilization of self-control resources. However, drawing upon the Ego Depletion theory (Baumeister et al., 1998), if these reserves are exhausted, it is likely that automatic processes will reign sovereign in decision-making, including the automatic attraction to effort minimization.

Analyzing the entire Theory of Effort Minimization in Physical Activity process leading to decision-making and subsequent behavioral operationalization allows us to identify where affects play a fundamental role. As an integral part of automatic processes, an unfavorable automatic affective evaluation of physical exercise will trigger a negative anticipated affective response and an aversion reaction toward its practice. These precursors will then favor a tendency toward effort minimization, which will likely prevail as a result of these automatic processes. This tendency can be rejected in the presence of self-control resources, thus resulting in the operationalization of the exercise session.

However, herein lies the problem previously reported in Affective-Reflective Theory. The limitations of self-control resources. In the absence of sufficient resources to reject an automatic affective evaluation favoring effort minimization, the latter will likely prevail. Additionally, the stronger this tendency (resulting from, for example, greater aversion to exercise), the more self-control resources will be required to reject it, making the adoption and subsequent maintenance of regular exercise practice even more unlikely.

References

Abram, S. J., Selinger, J. C., & Donelan, J. M. (2019). Energy optimization is a major objective in the real-time control of step width in human walking. *Journal of Biomechanics*, 91, 85–91. https://doi.org/10.1016/j.jbiomech.2019.05.010

Alexander, R. M. (1996). *Optima for animals*. Princeton University Press.

Baldwin, A. S., Kangas, J. L., Denman, D. C., Smits, J. A. J., Yamada, T., & Otto, M. W. (2016). Cardiorespiratory fitness moderates the effect of an affect-guided physical activity prescription: A pilot randomized controlled trial. *Cognitive Behaviour Therapy*, 45(6), 445–457. https://doi.org/10.1080/16506073.2016.1194454

Baumeister, R. F., Bratslavsky, E., Muraven, M., & Tice, D. M. (1998). Ego depletion: Is the active self a limited resource? *Journal of Personality and Social Psychology*, *74*(5), 1252–1265. https://doi.org/10.1037/0022-3514.74.5.1252

Benton, J. S., Anderson, J., Hunter, R. F., & French, D. P. (2016). The effect of changing the built environment on physical activity: A quantitative review of the risk of bias in natural experiments. *International Journal of Behavioral Nutrition and Physical Activity*, 13, 107. https://doi.org/10.1186/s12966-016-0433-3

Cacioppo, J. T., Petty, R. E., Feinstein, J. A., & Jarvis, W. B. G. (1996). Dispositional differences in cognitive motivation: The life and times of individuals varying

in need for cognition. *Psychological Bulletin*, 119(2), 197–253. https://doi.org/10.1037/0033-2909.119.2.197

Cheval, B., & Boisgontier, M. P. (2021). The theory of effort minimization in physical activity. *Exercise and Sport Sciences Reviews*, 49(3), 168–178. https://doi.org/10.1249/JES.0000000000000252

Cheval, B., Sarrazin, P., Boisgontier, M. P., & Radel, R. (2017). Temptations toward behaviors minimizing energetic costs (BMEC) automatically activate physical activity goals in successful exercisers. *Psychology of Sport and Exercise*, 30, 110–117. https://doi.org/10.1016/j.psychsport.2017.02.006

Crombie, K. M., Brellenthin, A. G., Hillard, C. J., & Koltyn, K. F. (2018). Endocannabinoid and opioid system interactions in exercise-induced hypoalgesia. *Pain Medicine*, 19(1), 118–123. https://doi.org/10.1093/pm/pnx058

Ekkekakis, P., Hall, E. E., & Petruzzello, S. J. (2005). Some like it vigorous: Measuring individual differences in the preference for and tolerance of exercise intensity. *Journal of Sport and Exercise Psychology*, 27(3), 350–374. https://doi.org/10.1123/jsep.27.3.350

Ekkekakis, P., Parfitt, G., & Petruzzello, S. J. (2011). The pleasure and displeasure people feel when they exercise at different intensities: Decennial update and progress towards a tripartite rationale for exercise intensity prescription. *Sports Medicine*, 41(8), 641–671. https://doi.org/10.2165/11590680-000000000-00000

Gibson, M. A., & Mace, R. (2006). An energy-saving development initiative increases birth rate and childhood malnutrition in rural Ethiopia. *PLoS Medicine*, 3(4), e87. https://doi.org/10.1371/journal.pmed.0030087

Guthold, R., Stevens, G. A., Riley, L. M., & Bull, F. C. (2018). Worldwide trends in insufficient physical activity from 2001 to 2016: A pooled analysis of 358 population-based surveys with 1.9 million participants. *The Lancet Global*

Health, 6(10), e1077–e1086. https://doi.org/10.1016/S2214-109X(18)30357-7

Iodice, P., Calluso, C., Barca, L., Bertollo, M., Ripari, P., & Pezzulo, G. (2017). Fatigue increases the perception of future effort during decision making. *Psychology of Sport and Exercise*, 33, 150–160. https://doi.org/10.1016/j.psychsport.2017.08.013

Iodice, P., Porciello, G., Bufalari, I., Barca, L., & Pezzulo, G. (2019). An interoceptive illusion of effort induced by false heart-rate feedback. *Proceedings of the National Academy of Sciences*, 116(28), 13897–13902. https://doi.org/10.1073/pnas.1821032116

Ladwig, M. A., Hartman, M. E., & Ekkekakis, P. (2017). Affect-based exercise prescription: An idea whose time has come? *ACSM's Health & Fitness Journal*, 21(5), 10–15. https://doi.org/10.1249/FIT.0000000000000332

Lieberman, D. E. (2013). *The story of the human body: Evolution, health, and disease*. Pantheon.

Marcora, S. (2016). Can doping be a good thing? Using psychoactive drugs to facilitate physical activity behaviour. *Sports Medicine*, 46(1), 1–5. https://doi.org/10.1007/s40279-015-0412-x

Marques, P., Andrade, A. J., Evmenenko, A., Monteiro, D., Faria, J., Rodrigues, F., Cid, L., & Teixeira, D. S. (2023). The preference for and tolerance of exercise intensity: An exploratory analysis of intensity discrepancy in health clubs settings. *Current Psychology*, 42(24), 20629–20637. https://doi.org/10.1007/s12144-022-03149-0

Pontzer, H., Durazo-Arvizu, R., Dugas, L. R., Plange-Rhule, J., Bovet, P., Forrester, T. E., Lambert, E. V., Cooper, R. S., Schoeller, D. A., & Luke, A. (2016). Constrained total energy expenditure and metabolic adaptation to physical activity in adult humans. *Current Biology*, 26(3), 410–417. https://doi.org/10.1016/j.cub.2015.12.046

Prévost, C., Pessiglione, M., Météreau, E., Cléry-Melin, M.-L., & Dreher, J.-C. (2010). Separate valuation subsystems for delay and effort decision costs. *Journal of Neuroscience*, 30(42), 14080–14090. https://doi.org/10.1523/JNEUROSCI.2752-10.2010

Raichlen, D. A., Foster, A. D., Gerdeman, G. L., Seillier, A., & Giuffrida, A. (2012). Wired to run: Exercise-induced endocannabinoid signaling in humans and cursorial mammals with implications for the 'runner's high.' *Journal of Experimental Biology*, 215(8), 1331–1336. https://doi.org/10.1242/jeb.063677

Rhodes, R. E., & Kates, A. (2015). Can the affective response to exercise predict future motives and physical activity behavior? A systematic review of published evidence. *Annals of Behavioral Medicine*, 49(5), 715–731. https://doi.org/10.1007/s12160-015-9704-5

Teixeira, D. S., Rodrigues, F., Machado, S., Cid, L., & Monteiro, D. (2021). Did you enjoy it? The role of intensity-trait preference/tolerance in basic psychological needs and exercise enjoyment. *Frontiers in Psychology*, 12, 682480. https://doi.org/10.3389/fpsyg.2021.682480

Teixeira, D. S., Rodrigues, F., Cid, L., & Monteiro, D. (2022). Enjoyment as a predictor of exercise habit, intention to continue exercising, and exercise frequency: The intensity traits discrepancy moderation role. *Frontiers in Psychology*, 13, 780059. https://doi.org/10.3389/fpsyg.2022.780059

Williams, D. M. (2008). Exercise, affect, and adherence: An integrated model and a case for self-paced exercise. *Journal of Sport and Exercise Psychology*, 30(5), 471–496. https://doi.org/10.1123/jsep.30.5.471

14. Physical Activity Adoption and Maintenance Model

Bastos, V.[1,2], Zeferino, B.[1,2], Rodrigues, F.[3,4], & Teixeira, D. S.[1,2]

1 – Faculty of Physical Education and Sport – Lusófona University, Campo Grande 376, 1749-024 Lisboa, Portugal

2 – Research Center in Sports, Physical Education, Exercise and Health (CIDEFES), Campo Grande 376, 1749-024 Lisboa, Portugal

3 – ESECS – Polytechnic University of Leiria, Campus 1, Rua Dr. João Soares, Apartado 4045, 2411–901 Leiria, Portugal

4 – Research Center in Sports Sciences, Health Sciences and Human Development (CIDESD), Quinta de Prados, 5001-801 Vila Real, Portugal

Theoretical foundations

Another approach grounded in dual-process theory is the Physical Activity Adoption and Maintenance Model (Strobach et al., 2020). While the Affective-Reflective Theory of physical inactivity and the Theory of Effort Minimization in Physical Activity focus primarily on why most of the global population remains physically inactive, the Physical Activity Adoption and Maintenance Model aims to identify predictors of both behavioral adoption and long-term maintenance. According to its authors, addressing implicit (i.e., automatic) and explicit (i.e., controlled) processes within a dual-process framework plays a crucial role in the entire trajectory of regular physical activity practice. Like other dual-process models discussed in this book, the Physical Activity Adoption and Maintenance Model posits that human behavior is the result of the interaction between implicit and explicit processes. Herein lies one of the primary distinctions between the Physical Activity Adoption and Maintenance Model and other approaches to

behavioral adoption and maintenance (e.g., Physical Activity Maintenance Theory; Nigg et al., 2008). The Physical Activity Adoption and Maintenance Model avoid simultaneously placing too much emphasis on reflective processes while neglecting automatic ones.

Similar to the Affective-Reflective Theory (Brand & Ekkekakis, 2018), the authors of the Physical Activity Adoption and Maintenance Model assume that implicit processes (i.e., habit, affect) constitute the "default response" upon which explicit processes are based and developed (i.e., intention, self-regulation traits, executive functions). Depending on the intensity of the habit and affects, implicit processes can affect the explicit system (Strack & Deutsch, 2004). If self-regulation skills are available, then implicit processes may influence, but not necessarily override, explicit processes in determining behavior. In this scenario, the two types of processes can be concordant (e.g., the impulse to enjoy a sunny walk aligns with the intention to increase physical activity levels) or conflicting (e.g., the impulse to rest on the couch after a workday conflicts with the intention of being physically active).

Aligned with the Affective-Reflective Theory (Brand & Ekkekakis, 2018), it is assumed that the interaction between implicit and explicit processes can be characterized as a competition for control over the behavioral response (Lewin, 1951). If self-regulation capabilities are at the individual's disposal, conflicting impulses, such as the negative affect associated with a specific physical activity (e.g., unpleasant but important exercise) or a strong habit for sedentary behaviors, can be inhibited. Consequently, behavior can be regulated according to explicit goals and intentions (i.e., the probability of behavioral execution is high). In other words, if the person is motivated and possesses sufficient self-regulation capabilities, behavior will be guided by explicit processes, such as intentions and deliberate decisions (e.g., the plan to go to the gym overrides the impulse to stay on the couch). However, it is crucial to reinforce that the explicit system depends heavily on the availability of these self-regulation resources. If these resources are

unavailable, the implicit process will dominate behavior. In such cases, the strongest positive automatic affective validation will prevail and originate the respective action impulse. That is, if at that moment an alternative to physical exercise exists that appears more pleasurable (e.g., resting on the couch), it is likely that this alternative behavior will be operationalized (Strack & Deutsch, 2004).

Adoption Phase: The predominance of explicit processes

In the Physical Activity Adoption and Maintenance Model's primary focus, the adoption and maintenance of physical activity, explicit and implicit processes have differentiated roles, with distinct preponderances across the different phases of behavioral adoption. In the behavioral adoption phase, explicit processes appear to be of greater importance. For instance, a decision based on the perception that a physically inactive lifestyle has negative health implications can originate an intention for behavioral change toward a more active lifestyle (e.g., joining a gym and starting to exercise). The socio-cognitive literature points to intention as a critical variable for the adoption of a new behavior, including physical activity practice (Ajzen, 1991; Hagger et al., 2002). However, evidence has consistently demonstrated that, in isolation, intention is unable to account for the full variance in human behavior (Rhodes & De Bruijn, 2013; Sheeran & Webb, 2016). This unexplained variance represents the well-known intention-behavior gap (Sheeran & Webb, 2016).

While the intention to adopt a new behavior appears necessary, it is not sufficient for its maintenance. Here, self-regulation skills become relevant for overcoming difficulties and barriers to regular physical exercise practice. However, these self-regulation skills are an individual characteristic (i.e., a trait), with some individuals presenting superior self-regulation to others (Englert, 2016). This trait appears to be particularly relevant for physical activity, with higher levels of self-regulation associated with higher levels of physical activity (Allom et

al., 2016), while individuals with lower self-regulation demonstrate poor persistence in physical endurance tasks (Englert & Wolff, 2015). The Physical Activity Adoption and Maintenance Model thus assumes that individuals with a low self-regulation trait will have greater difficulty bridging their intentions to practice physical activity and the behavior itself (Rodrigues et al., 2022). Within explicit processes, executive functions (i.e., inhibition, updating, and shifting; Miyake et al., 2000) may also have a moderating effect between intention and behavior (Hofmann et al., 2012). More specifically:

- The inhibition function may be particularly relevant for suppressing health-detrimental behaviors (e.g., sedentary behavior), thus making room for a new, more beneficial behavior (e.g., physical activity).
- The updating function allows for the creation of mental representations of the goal and the means to achieve it, as well as diminishing the impact of unwanted and incompatible affects toward the goal in question.
- The shifting function allows for flexibility in the means used, enabling the individual to seize unexpected opportunities that deviate from the original plan but may be more effective.

Additionally, these executive functions interact with the self-regulation trait (Hofmann et al., 2012; Pfeffer & Strobach, 2017). The shifting function seems to benefit self-regulation by providing adaptability to the adopted behavior in unexpected circumstances, just as self-regulation seems to provide balance to high levels of shifting (e.g., avoiding premature disengagement from a set goal). Similarly, the self-regulation trait can compensate for low levels of inhibition and updating executive functions. In summary, both the self-regulation trait and executive functions can moderate the relationship between intention and behavioral implementation, making them critical variables in the initial phase of adopting physical activity.

Maintenance Phase: The shift to implicit processes

Regarding the maintenance of physical activity practice in the medium and long term, the concomitance of dual processes remains, but with a progressive inversion of the dominant process. It appears that the more the intended behavior is repeated and systematized, the stronger the implicit processes become in guiding behavior toward automaticity (Gardner et al., 2020; Rodrigues & Monteiro, 2021; Rodrigues & Teixeira, 2023a).

It is precisely in this transition that one of the Physical Activity Adoption and Maintenance Model 's implicit process variables plays a central role: habit formation. The Physical Activity Adoption and Maintenance Model postulates that habit formation is characterized by the gradual transition from reflective and cognitively demanding control processes (i.e., intention) to automatic processes activated by environmental cues. A habit is thus formed through the repetition of a given behavior within a stable environment, eventually requiring no reflective processes (Ouellette & Wood, 1998), and its automaticity makes it resistant to change. Indeed, habit strength can predict physical activity practice even on days when the intention to do so is low (Rebar et al., 2014). Generally, both habit and intention predict physical activity practice without interacting with each other but rather presenting a cumulative effect on this prediction (Rodrigues & Teixeira, 2023b).

Regarding habit, it is important to note that some types of behavior may be more difficult to automate. For instance, physical activities of greater complexity and intensity may not reach full automation (e.g., due to a more dynamic environment), remaining permanently dependent on some degree of explicit regulation (Gardner & Lally, 2018; Hagger, 2020; Pfeffer & Strobach, 2020). A sport involving complex motor skills and tactical components, or vigorous-intensity exercise, will hardly achieve the same level of automaticity as a simpler physical activity like taking the stairs instead of the elevator. Additionally, a sport may present a considerably dynamic environment (e.g.,

training at different times/locations; competitions involving travel), whereas some opportunities to be physically active present themselves in daily life in a more stable manner (e.g., using the stairs every day to reach the office). Serving as a less drastic example, practicing physical exercise mostly at the same time of day (e.g., after work) and performing known activities (e.g., a group class or a training plan where the individual already has competence) may be strategies that facilitate the automation of this behavior.

Also, within implicit processes, affective reactions (i.e., core affect) to physical activity play an equally important role. The authors of the Physical Activity Adoption and Maintenance Model propose that automatic affective validations can be crucial for habit, functioning as enhancers or inhibitors of its formation depending on their valence (i.e., positive vs. negative). Considering that these affective validations represent learned associations with a given behavior, pleasurable affective reactions during its execution, repeated and sustained over time, may result in a stronger physical activity habit. Conversely, unpleasant affective reactions can create an avoidance reaction to the practice. Core affect also appears relevant as a moderator of the relationship between intention and behavior, with positive affective responses increasing the probability that intention results in the operationalization of the respective behavior, while the opposite occurs for negative affective responses (Zhu & Thagard, 2002). Regarding physical activity, the literature has indeed verified this moderating effect (Kwan & Bryan, 2010; Raedeke et al., 2007). Additionally, this effect seems to influence not only adoption but also maintenance, with positive core affect potentially creating temporal stability in the operationalization of intention (Sheeran & Abraham, 2003).

References

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*(2), 179–211. https://doi.org/10.1016/0749-5978(91)90020-T

Allom, V., Mullan, B., & Hagger, M. (2016). Does inhibitory control training improve health behaviour? A meta-analysis. *Health Psychology Review, 10*(2), 168–186. https://doi.org/10.1080/17437199.2015.1051078

Brand, R., & Ekkekakis, P. (2018). Affective–Reflective Theory of physical inactivity and exercise: Foundations and preliminary evidence. *German Journal of Exercise and Sport Research, 48*(1), 48–58. https://doi.org/10.1007/s12662-017-0477-9

Englert, C. (2016). The strength model of self-control in sport and exercise psychology. *Frontiers in Psychology, 7*, 314. https://doi.org/10.3389/fpsyg.2016.00314

Englert, C., & Wolff, W. (2015). Ego depletion and persistent performance in a cycling task. *International Journal of Sport Psychology, 46*(2), 137–151. https://doi.org/10.7352/IJSP2015.46.137

Gardner, B., & Lally, P. (2018). Modelling habit formation and its determinants. In B. Verplanken (Ed.), *The Psychology of Habit: Theory, Mechanisms, Change, and Contexts* (pp. 207–229). Springer. https://doi.org/10.1007/978-3-319-97529-0_11

Gardner, B., Lally, P., & Rebar, A. L. (2020). Does habit weaken the relationship between intention and behaviour? Revisiting the habit-intention interaction hypothesis. *Social and Personality Psychology Compass, 14*(8), e12553. https://doi.org/10.1111/spc3.12553

Hagger, M. S. (2020). Redefining habits and linking habits with other implicit processes. *Psychology of Sport and Exercise, 46*, 101606. https://doi.org/10.1016/j.psychsport.2019.101606

Hagger, M. S., Chatzisarantis, N. L. D., & Biddle, S. J. H. (2002). A meta-analytic review of the theories of reasoned action and planned behavior in physical activity: Predictive validity and the contribution of additional variables. *Journal of Sport and Exercise Psychology, 24*(1), 3–32. https://doi.org/10.1123/jsep.24.1.3

Hofmann, W., Schmeichel, B. J., & Baddeley, A. D. (2012). Executive functions and self-regulation. *Trends in Cognitive Sciences, 16*(3), 174–180. https://doi.org/10.1016/j.tics.2012.01.006

Kwan, B. M., & Bryan, A. D. (2010). Affective response to exercise as a component of exercise motivation: Attitudes, norms, self-efficacy, and temporal stability of intentions. *Psychology of Sport and Exercise, 11*(1), 71–79. https://doi.org/10.1016/j.psychsport.2009.05.010

Lewin, K. (1951). *Field theory in social science: Selected theoretical papers*. Harper & Row.

Miyake, A., Friedman, N. P., Emerson, M. J., Witzki, A. H., Howerter, A., & Wager, T. D. (2000). The unity and diversity of executive functions and their contributions to complex "frontal lobe" tasks: A latent variable analysis. *Cognitive Psychology, 41*(1), 49–100. https://doi.org/10.1006/cogp.1999.0734

Nigg, C. R., Borrelli, B., Maddock, J., & Dishman, R. K. (2008). A theory of physical activity maintenance. *Applied Psychology, 57*(4), 544–560. https://doi.org/10.1111/j.1464-0597.2008.00343.x

Ouellette, J. A., & Wood, W. (1998). Habit and intention in everyday life: The multiple processes by which past behavior predicts future behavior. *Psychological Bulletin, 124*(1), 54–74. https://doi.org/10.1037/0033-2909.124.1.54

Pfeffer, I., & Strobach, T. (2017). Executive functions, trait self-control, and the intention-behavior gap in physical activity behavior. *Journal of Sport and Exercise Psychology, 39*(4), 277–292. https://doi.org/10.1123/jsep.2017-0112

Pfeffer, I., & Strobach, T. (2020). Influence of a planning intervention on physical activity behavior: The moderating role of intentions and executive functions in a randomized controlled trial. *International Journal of Behavioral Medicine, 27*(5), 506–519. https://doi.org/10.1007/s12529-020-09864-x

Raedeke, T. D., Focht, B. C., & Scales, D. (2007). Social environmental factors and psychological responses to acute exercise for socially physique anxious females. *Psychology of Sport and Exercise, 8*(4), 463–476. https://doi.org/10.1016/j.psychsport.2006.10.005

Rebar, A. L., Elavsky, S., Maher, J. P., Doerksen, S. E., & Conroy, D. E. (2014). Habits predict physical activity on days when intentions are weak. *Journal of Sport and Exercise Psychology, 36*(2), 157–165. https://doi.org/10.1123/jsep.2013-0173

Rhodes, R. E., & De Bruijn, G.-J. (2013). How big is the physical activity intention–behaviour gap? A meta-analysis using the action control framework. *British Journal of Health Psychology, 18*(2), 296–309. https://doi.org/10.1111/bjhp.12032

Rodrigues, F., Figueiredo, N., Teixeira, D., Cid, L., & Monteiro, D. (2022). The relationship between past exercise behavior and future exercise adherence: A sequential mediation analysis. *Journal of Sports Sciences, 40*(18), 2095–2101. https://doi.org/10.1080/02640414.2022.2135231

Rodrigues, F., & Monteiro, D. (2021). *Mudança Comportamental em Atividade Física e Saúde*. Centro de Investigação em Qualidade de Vida.

Rodrigues, F., & Teixeira, D. (2023a). Testing assumptions of the physical activity adoption and maintenance model: A longitudinal perspective of the relationships between intentions and habits on exercise adherence. *Perceptual and Motor Skills, 130*(5), 2123–2138. https://doi.org/10.1177/00315125231188240

Rodrigues, F., & Teixeira, D. (2023b). The relationships between passions, intentions, habit and exercise frequency. *Journal of Sports Sciences, 41*(8), 803–811. https://doi.org/10.1080/02640414.2023.2240622

Sheeran, P., & Abraham, C. (2003). Mediator of moderators: Temporal stability of intention and the intention-behavior relation. *Personality and Social Psychology Bulletin, 29*(2), 205–215. https://doi.org/10.1177/0146167202239046

Sheeran, P., & Webb, T. L. (2016). The intention-behavior gap. *Social and Personality Psychology Compass, 10*(9), 503–518. https://doi.org/10.1111/spc3.12265

Strack, F., & Deutsch, R. (2004). Reflective and impulsive determinants of social behavior. *Personality and Social Psychology Review, 8*(3), 220–247. https://doi.org/10.1207/s15327957pspr0803_1

Strobach, T., Englert, C., Jekauc, D., & Pfeffer, I. (2020). Predicting adoption and maintenance of physical activity in the context of dual-process theories. *Performance Enhancement & Health, 8*(1), 100162. https://doi.org/10.1016/j.peh.2020.100162

Zhu, J., & Thagard, P. (2002). Emotion and action. *Philosophical Psychology, 15*(1), 19–36. https://doi.org/10.1080/09515080120109397

15. Affect and Health Behavior Framework

Bastos, V.[1,2], Zeferino, B.[1,2], Rodrigues, F.[3,4], Monteiro, D.[3,4], & Teixeira, D. S.[1,2]

1 – Faculty of Physical Education and Sport – Lusófona University, Campo Grande 376, 1749-024 Lisboa, Portugal

2 – Research Center in Sports, Physical Education, Exercise and Health (CIDEFES), Campo Grande 376, 1749-024 Lisboa, Portugal

3 – ESECS – Polytechnic University of Leiria, Campus 1, Rua Dr. João Soares, Apartado 4045, 2411–901 Leiria, Portugal

4 – Research Center in Sports Sciences, Health Sciences and Human Development (CIDESD), Quinta de Prados, 5001-801 Vila Real, Portugal

Theoretical foundations

A comprehensive understanding of the affective determinants of physical activity requires an integrative approach that consolidates disparate affective constructs into a cohesive theoretical architecture. The Affect and Health Behaviour Framework (Stevens et al., 2020; Williams & Evans, 2014) emerges as a pivotal conceptual model designed to map the complex affective landscape underlying health-oriented behaviors. Rather than treating affect as a monolithic variable, the Affect and Health Behaviour Framework delineates a multi-dimensional structure composed of four distinct yet interconnected domains that collectively substantiate the decision-making process and adherence to physical exercise. These dimensions are:

- Affective response (e.g., core affect) in response to physical activity practice.
- Incidental affect (e.g., how we feel during the day, independent of the intended behavior).

- Affective processing (e.g., anticipated affective response and affective judgments).
- Affectively charged motivational states (e.g., intrinsic motivation, fear, desire, and hedonic motivation).

Dimension 1: Affective response to exercise

The first dimension includes the affective response to exercise, previously detailed in this book. The core affect related to physical exercise practice is characterized by how each person feels during or immediately after exercising. For this purpose, affective valence (pleasure-displeasure) and activation (arousal) have been the most prominent constructs in assessments within this dimension (Andrade et al., 2022; Bastos et al., 2022; Henriques et al., 2023).

Dimension 2: Incidental Affect

The second dimension of the Affect and Health Behaviour Framework is incidental affect, which pertains to how an individual feels throughout the day, directly independent of physical activity. It can be experienced in its most elementary form as core affect, or in a broader dimension as distinct affective states (e.g., fatigue), emotions, and mood (Ekkekakis, 2013). Regarding behavior, positive incidental affects have demonstrated predictive value for physical activity practice (Cameron et al., 2018; Emerson et al., 2018; Liao et al., 2015). This may occur due to an alignment or congruence of the incidental affective state with what is experienced during physical activity. Additionally, physical activity is also associated with higher levels of positive incidental affect following its practice (Emerson et al., 2018). Nevertheless, some evidence shows that individuals with eating disorders and/or high levels of body dissatisfaction tend to practice physical activity compulsively as a mode of affective regulation. In other words, they exercise to attenuate or suppress a negative incidental affective state. However, this phenomenon does not appear to occur outside of clinical

populations, with negative incidental affect generally demonstrating a decrease in physical activity practice (Burg et al., 2017; Kerrigan et al., 2020). These results suggest that promoting a more positive incidental affect appears to be a viable strategy for improving physical activity participation levels. Such strategies could involve promoting a more positive affective valence during periods of the day when incidental affect risks reaching negative levels.

Dimension 3: Affective Processing

Affective processing corresponds to the third dimension of the Affect and Health Behaviour Framework, and concerns constructs that reflect the processing of previous affective responses (Williams & Evans, 2014). Its factors are distinct from the affective response because they can be solicited at any moment outside the context of the target behavior, whereas the affective response to a behavior (and incidental affect) can only be experienced in vivo. This affective processing includes both automatic processes (i.e., affective and implicit associations) and controlled processes (i.e., affective attitudes, anticipated affective response, and remembered affect). Theoretically, in controlled processes, an individual first remembers their affective response to a given behavior, subsequently anticipating what the affective response will be if they repeat it in the future, finally forming an affective attitude. In automatic processes, memory and anticipation represent a single phase called affective associations, which, by aggregation, result in implicit attitudes. Affective associations are defined as associations existing in memory between physical activity and previously experienced affective responses to the same behavior (Kiviniemi et al., 2007; Kiviniemi & Klasko-Foster, 2018).

Implicit attitudes are also defined as automatically triggered associations between two stimuli, making them conceptually similar to affective associations. However, implicit attitudes are broader than affective associations, as the former may or may not involve affect. Unlike affective associations, which are typically

assessed by self-report, implicit attitudes are assessed through reaction-time tasks where individuals respond to words or images related to physical activity paired with affective descriptors (e.g., good-bad) (Chevance et al., 2017; Conroy et al., 2010; Forrest et al., 2016; Padin et al., 2017).

Anticipated affective response is considered the expectation of how an individual will feel when practicing, or not practicing, a given physical activity. This response can be short-term (e.g., immediately before starting a training session) or long-term (e.g., a hypothetical future session). Short-term anticipation has been associated with the affective response to the session itself, but with a tendency to underestimate how pleasurable the exercise practice will be, a phenomenon known as affective forecasting bias (Loehr & Baldwin, 2014; Ruby et al., 2011). Conversely, long-term anticipated affective response has proven to be a strong predictor of future physical activity practice (Dunton & Vaughan, 2008). A predictive value not found in short-term anticipation (Helfer et al., 2015; Kwan et al., 2017).

Another construct of affective processing that demonstrates predictive value for physical activity is remembered affect (Hutchinson et al., 2023; Zenko et al., 2016). Defined as a recollection of the affective response felt when practicing physical activity in the past, remembered affect distinguishes itself from other constructs by referring to a specific training session (vs. an aggregation of responses from various sessions). Being a memory, remembered affect is prone to biases and often does not correspond to the affective response that was actually experienced (Broderick et al., 2008; Giske et al., 2010). Our memory can be influenced by cognitive heuristics such as the Peak-End Rule (Fredrickson, 2000; Kahneman et al., 1993), which postulates that how we remember a given event tends to be biased toward the moments of greatest magnitude (i.e., affective peaks) and the affective response at the end of the experience.

Affective judgments are composed of two of the most studied affective processing factors in the literature: affective attitudes and enjoyment (Rhodes et

al., 2019). Affective attitudes are defined as evaluations of physical exercise based on an aggregation of the likelihood and evaluation of affective outcomes (e.g., the probability that it will be pleasant and how important that is to the individual). This contrasts with instrumental attitudes, which are based on instrumental outcomes (e.g., health benefits). Enjoyment is sometimes encompassed with affective attitudes under the broader concept of affective judgments (Rhodes et al., 2019) due to measurement similarities.

Dimension 4: Affectively charged motivational states

Finally, affectively charged motivation includes motivational states based on past affective responses to physical activity, such as intrinsic motivation, desires, cravings, dread, and fear (Williams & Evans, 2014). These constructs differ from reflective motivation constructs, like intentions and goals, which are a function of more deliberate consideration of potential outcomes. Within this fourth category, intrinsic motivation is defined as the propensity for seeking pleasure, novelty, aesthetics, and spontaneous interest, performing a behavior for the inherent satisfaction it provides (Ryan & Deci, 2017). It represents the prototype of self-determined behavior. According to Self-Determination Theory, intrinsic motivation plays a more significant role than extrinsic motivation in adoption and especially in maintenance (Ryan & Deci, 2017; Teixeira et al., 2018). Additionally, higher frequency of training associated with higher intrinsic motivation leads to greater identification with the behavior, promoting maintenance (Gillman et al., 2017).

We also have hedonic motivation, conceptualized as a mechanism by which past affective responses automatically influence future behavior (Williams, 2019; Williams et al., 2018). Through associative learning, behaviors eliciting immediate favorable responses (pleasure) become targets of hedonic desires/cravings, while those eliciting unfavorable responses (displeasure) become targets of hedonic dread. It is important to note that, although

consciously experienced, hedonic motivation is produced automatically without deliberate cognitive or affective processing. For the context of physical activity, hedonic desires may be important for exercise "dependence," while hedonic dread, an automatic aversion caused by past displeasure (Williams & Bohlen, 2019), seems more relevant to the problem of physical inactivity. Lastly, fear is an emotion motivating active avoidance of behaviors previously associated with negative valence (displeasure). Although the relationship between fear and physical activity has been less studied, anxiety sensitivity (the "fear of fear"; Craske & Barlow, 2015) has received significant attention. Anxiety sensitivity is the fear of arousal-related somatic sensations (e.g., rapid heartbeat, breathlessness) due to the erroneous appraisal of these sensations as dangerous (Reiss & McNally, 1985). This factor contributes to low tolerance during physical activity and avoidance of the behavior (Hearon et al., 2014; Moshier et al., 2013, 2016). This inverse relationship may be exacerbated in individuals with high body mass index and high anxiety sensitivity, who are more susceptible to sensations of displeasure (Smits et al., 2010). A possible mechanism explaining this is an overestimated perception of effort; individuals more sensitive to anxiety tend to report higher effort levels and are less predisposed to reach vigorous intensities (Muotri et al., 2017).

References

Andrade, A. J., Ekkekakis, P., Evmenenko, A., Monteiro, D., Rodrigues, F., Cid, L., & Teixeira, D. S. (2022). Affective responses to resistance exercise: Toward a consensus on the timing of assessments. *Psychology of Sport and Exercise*, 62, 102223. https://doi.org/10.1016/j.psychsport.2022.102223

Bastos, V., Andrade, A. J., Rodrigues, F., Monteiro, D., Cid, L., & Teixeira, D. S. (2022). Set to fail: Affective dynamics in a resistance training program designed to reach muscle concentric failure. *Scandinavian Journal of*

Medicine & Science in Sports, 32(12), 1710–1723. https://doi.org/10.1111/sms.14222

Broderick, J. E., Schwartz, J. E., Vikingstad, G., Pribbernow, M., Grossman, S., & Stone, A. A. (2008). The accuracy of pain and fatigue items across different reporting periods. *Pain*, 139(1), 146–157. https://doi.org/10.1016/j.pain.2008.03.024

Burg, M. M., Schwartz, J. E., Kronish, I. M., Diaz, K. M., Alcantara, C., Duer-Hefele, J., & Davidson, K. W. (2017). Does stress result in you exercising less? Or does exercising result in you being less stressed? Or is it both? Testing the bi-directional stress-exercise association at the group and person (N of 1) level. *Annals of Behavioral Medicine*, 51(6), 799–809. https://doi.org/10.1007/s12160-017-9902-4

Cameron, D. S., Bertenshaw, E. J., & Sheeran, P. (2018). Positive affect and physical activity: Testing effects on goal setting, activation, prioritisation, and attainment. *Psychology & Health*, 33(2), 258–274. https://doi.org/10.1080/08870446.2017.1314477

Chevance, G., Héraud, N., Guerrieri, A., Rebar, A., & Boiché, J. (2017). Measuring implicit attitudes toward physical activity and sedentary behaviors: Test-retest reliability of three scoring algorithms of the Implicit Association Test and Single Category-Implicit Association Test. *Psychology of Sport and Exercise*, 31, 70–78. https://doi.org/10.1016/j.psychsport.2017.04.007

Conroy, D. E., Hyde, A. L., Doerksen, S. E., & Ribeiro, N. F. (2010). Implicit attitudes and explicit motivation prospectively predict physical activity. *Annals of Behavioral Medicine*, 39(2), 112–118. https://doi.org/10.1007/s12160-010-9161-0

Craske, M. G., & Barlow, D. H. (2015). *Panic disorder and agoraphobia*. In D. H. Barlow (Ed.), *Clinical handbook of psychological disorders: A step-by-step treatment manual* (5th ed., pp. 1–61). The Guilford Press.

Dunton, G. F., & Vaughan, E. (2008). Anticipated affective consequences of physical activity adoption and maintenance. *Health Psychology*, 27(6), 703–710. https://doi.org/10.1037/0278-6133.27.6.703

Ekkekakis, P. (2013). *The measurement of affect, mood, and emotion: A guide for health-behavioral research*. Cambridge University Press.

Emerson, J. A., Dunsiger, S., & Williams, D. M. (2018). Reciprocal within-day associations between incidental affect and exercise: An EMA study. *Psychology & Health*, 33(1), 130–143. https://doi.org/10.1080/08870446.2017.1341515

Forrest, L. N., Smith, A. R., Fussner, L. M., Dodd, D. R., & Clerkin, E. M. (2016). Using implicit attitudes of exercise importance to predict explicit exercise dependence symptoms and exercise behaviors. *Psychology of Sport and Exercise*, 22, 91–97. https://doi.org/10.1016/j.psychsport.2015.06.006

Fredrickson, B. L. (2000). Extracting meaning from past affective experiences: The importance of peaks, ends, and specific emotions. *Cognition & Emotion*, 14(4), 577–606. https://doi.org/10.1080/026999300402808

Gillman, A., Stevens, C., & Bryan, A. (2017). Exercise identity and behavior maintenance after a supervised exercise intervention. *Annals of Behavioral Medicine*, 51 (Suppl. 1), S1608–S1609.

Giske, L., Sandvik, L., & Røe, C. (2010). Comparison of daily and weekly retrospectively reported pain intensity in patients with localized and generalized musculoskeletal pain. *European Journal of Pain*, 14(9), 959–965. https://doi.org/10.1016/j.ejpain.2010.02.011

Hearon, B. A., Quatromoni, P. A., Mascoop, J. L., & Otto, M. W. (2014). The role of anxiety sensitivity in daily physical activity and eating behavior. *Eating Behaviors*, 15(2), 255–258. https://doi.org/10.1016/j.eatbeh.2014.03.007

Helfer, S. G., Elhai, J. D., & Geers, A. L. (2015). Affect and exercise: Positive affective expectations can increase post-exercise mood and exercise intentions.

Annals of Behavioral Medicine, 49(2), 269–279. https://doi.org/10.1007/s12160-014-9656-1

Henriques, L., Ekkekakis, P., Bastos, V., Rodrigues, F., Monteiro, D., & Teixeira, D. S. (2023). Affective responses to stretching exercises: Exploring the timing of assessments. *Psychology of Sport and Exercise*, 69, 102490. https://doi.org/10.1016/j.psychsport.2023.102490

Hutchinson, J. C., Jones, L., Ekkekakis, P., Cheval, B., Brand, R., Salvatore, G. M., Adler, S., & Luo, Y. (2023). Affective responses to increasing- and decreasing-intensity resistance training protocols. *Journal of Sport & Exercise Psychology*, 45(3), 121–137. https://doi.org/10.1123/jsep.2022-0243

Kahneman, D., Fredrickson, B. L., Schreiber, C. A., & Redelmeier, D. A. (1993). When more pain is preferred to less: Adding a better end. *Psychological Science*, 4(6), 401–405. https://doi.org/10.1111/j.1467-9280.1993.tb00589.x

Kerrigan, S. G., Schumacher, L., Manasse, S. M., Loyka, C., Butryn, M. L., & Forman, E. M. (2020). The association between negative affect and physical activity among adults in a behavioral weight loss treatment. *Psychology of Sport and Exercise*, 47, 101507. https://doi.org/10.1016/j.psychsport.2019.03.010

Kiviniemi, M. T., & Klasko-Foster, L. B. (2018). The behavioral affective associations model. In D. M. Williams, R. E. Rhodes, & M. T. Conner (Eds.), *Affective determinants of health behavior* (pp. 185–203). Oxford University Press. https://doi.org/10.1093/oso/9780190499037.003.0009

Kiviniemi, M. T., Voss-Humke, A. M., & Seifert, A. L. (2007). How do I feel about the behavior? The interplay of affective associations with behaviors and cognitive beliefs as influences on physical activity behavior. *Health Psychology*, 26(2), 152–158. https://doi.org/10.1037/0278-6133.26.2.152

Kwan, B. M., Stevens, C. J., & Bryan, A. D. (2017). What to expect when you're exercising: An experimental test of the anticipated affect-exercise relationship. *Health Psychology*, 36(4), 309–319. https://doi.org/10.1037/hea0000453

Liao, Y., Shonkoff, E. T., & Dunton, G. F. (2015). The acute relationships between affect, physical feeling states, and physical activity in daily life: A review of current evidence. *Frontiers in Psychology*, 6, 1975. https://doi.org/10.3389/fpsyg.2015.01975

Loehr, V. G., & Baldwin, A. S. (2014). Affective forecasting error in exercise: Differences between physically active and inactive individuals. *Sport, Exercise, and Performance Psychology*, 3(3), 177–183. https://doi.org/10.1037/spy0000006

Moshier, S. J., Hearon, B. A., Calkins, A. W., Szuhany, K. L., Utschig, A. C., Smits, J. A. J., & Otto, M. W. (2013). Clarifying the link between distress intolerance and exercise: Elevated anxiety sensitivity predicts less vigorous exercise. *Cognitive Therapy and Research*, 37(3), 476–482. https://doi.org/10.1007/s10608-012-9489-9

Moshier, S. J., Szuhany, K. L., Hearon, B. A., Smits, J. A. J., & Otto, M. W. (2016). Anxiety sensitivity uniquely predicts exercise behaviors in young adults seeking to increase physical activity. *Behavior Modification*, 40(1-2), 178–198. https://doi.org/10.1177/0145445515603704

Muotri, R. W., Bernik, M. A., & Neto, F. L. (2017). Misinterpretation of the Borg's Rating of Perceived Exertion Scale by patients with panic disorder during ergospirometry challenge. *BMJ Open Sport & Exercise Medicine*, 3(1), e000164. https://doi.org/10.1136/bmjsem-2016-000164

Padin, A. C., Emery, C. F., Vasey, M., & Kiecolt-Glaser, J. K. (2017). Self-regulation and implicit attitudes toward physical activity influence exercise behavior. *Journal of Sport and Exercise Psychology*, 39(4), 237–248. https://doi.org/10.1123/jsep.2017-0056

Reiss, S., & McNally, R. J. (1985). The expectancy model of fear. In S. Reiss & R. R. Bootzin (Eds.), *Theoretical issues in behavior therapy* (pp. 107–121). Academic Press.

Rhodes, R. E., Gray, S. M., & Husband, C. (2019). Experimental manipulation of affective judgments about physical activity: A systematic review and meta-analysis of adults. *Health Psychology Review*, 13(1), 18–34. https://doi.org/10.1080/17437199.2018.1530067

Ruby, M. B., Dunn, E. W., Perrino, A., Gillis, R., & Viel, S. (2011). The invisible benefits of exercise. *Health Psychology*, 30(1), 67–74. https://doi.org/10.1037/a0021859

Ryan, R. M., & Deci, E. L. (2000). Intrinsic and extrinsic motivations: Classic definitions and new directions. *Contemporary Educational Psychology*, 25(1), 54–67. https://doi.org/10.1006/ceps.1999.1020

Ryan, R. M., & Deci, E. L. (Eds.). (2017). *Self-determination theory: Basic psychological needs in motivation, development, and wellness*. Guilford Press. https://doi.org/10.1521/978.14625/28806

Smits, J. A. J., Tart, C. D., Presnell, K., Rosenfield, D., & Otto, M. W. (2010). Identifying potential barriers to physical activity adherence: Anxiety sensitivity and body mass as predictors of fear during exercise. *Cognitive Behaviour Therapy*, 39(1), 28–36. https://doi.org/10.1080/16506070902915261

Stevens, C. J., Baldwin, A. S., Bryan, A. D., Conner, M., Rhodes, R. E., & Williams, D. M. (2020). Affective determinants of physical activity: A conceptual framework and narrative review. *Frontiers in Psychology*, 11, 568331. https://doi.org/10.3389/fpsyg.2020.568331

Teixeira, D. S., Marques, M., & Palmeira, A. L. (2018). Associations between affect, basic psychological needs and motivation in physical activity contexts: Systematic review and meta-analysis. *Revista Iberoamericana de Psicología del Ejercicio y el Deporte*, 13(2), 225–233.

Williams, D. M. (2019). *Darwinian hedonism and the epidemic of unhealthy behavior*. Cambridge University Press.

Williams, D. M., & Bohlen, L. C. (2019). Motivation for exercise: Reflective desire versus hedonic dread. In M. H. Anshel (Ed.), *APA handbook of sport and exercise psychology* (Vol. 2, pp. 357–379). American Psychological Association. https://doi.org/10.1037/0000124-019

Williams, D. M., & Evans, D. R. (2014). Current emotion research in health behavior science. *Emotion Review*, 6(3), 277–287. https://doi.org/10.1177/1754073914523052

Williams, D. M., Rhodes, R., & Conner, M. (2018). Psychological hedonism, hedonic motivation, and health behavior. In D. M. Williams, R. E. Rhodes, & M. T. Conner (Eds.), *Affective determinants of health behavior* (pp. 204–234). Oxford University Press. https://doi.org/10.1093/oso/9780190499037.003.0010

Zenko, Z., Ekkekakis, P., & Ariely, D. (2016). Can you have your vigorous exercise and enjoy it too? Ramping intensity down increases postexercise, remembered, and forecasted pleasure. *Journal of Sport and Exercise Psychology*, 38(2), 149–159. https://doi.org/10.1123/jsep.2015-0286

16. Comparative analysis of dual-process theories in physical activity and exercise

Teixeira, D. S.[1,2], Zeverino, B.[1,2], Monteiro, D.[3,4], & Bastos, V.[1,2]

1 – Faculty of Physical Education and Sport – Lusófona University, Campo Grande 376, 1749-024 Lisboa, Portugal

2 – Research Center in Sports, Physical Education, Exercise and Health (CIDEFES), Campo Grande 376, 1749-024 Lisboa, Portugal

3 – ESECS – Polytechnic University of Leiria, Campus 1, Rua Dr. João Soares, Apartado 4045, 2411–901 Leiria, Portugal

4 – Research Center in Sports Sciences, Health Sciences and Human Development (CIDESD), Quinta de Prados, 5001-801 Vila Real, Portugal

Terminological heterogeneity and conceptual roots

These dual-process models present several commonalities, despite defining the same core concepts in distinct ways. For instance, it is possible to observe heterogeneous terminology for System 1 processes (e.g., automatic, implicit, irrational) and System 2 processes (e.g., controlled, explicit, reflective) across models. These differences can be partially explained by the divergent conceptual roots of dual-process theories, resulting in orientations toward distinct aspects of human behavior. For example, the Associative-Propositional Evaluation Model focuses on mental processes, which results in the terminology of "implicit" and "explicit" (Gawronski & Bodenhausen, 2011). Nevertheless, a terminological convergence in future studies may be crucial to facilitate readability for those less familiar with the subject and to enhance theoretical robustness (Williams, 2023).

Another difference between models is simultaneously a point where they appear to complement each other: their primary objective regarding the problem of physical inactivity. Specifically, we can observe that the Affective-Reflective Theory and the Theory of Effort Minimization in Physical Activity seek to explain why most of the global population remains inactive. In contrast, the Physical Activity Adoption and Maintenance Model focuses on key factors for the adoption and long-term maintenance of physical activity practice. Meanwhile, the Affect and Health Behaviour Framework structures and organizes the different affective variables studied in the literature and their relationship with healthy behaviors, specifically, physical activity in its multiple health-oriented dimensions.

Future research considering the focus of each theoretical model will be able to more easily determine which one is most suitable to underpin a specific intervention:

- Studies focused on exploring the impact of affective variables on adherence to physical activity practice may find theoretical support in the Affect and Health Behaviour Framework (e.g., formulation of study hypotheses based on the expected relationship between certain variables; selection of appropriate instruments and their usage).
- Studies seeking to understand the influence of physical effort on physical activity levels will find an appropriate theoretical basis in the Theory of Effort Minimization in Physical Activity (e.g., understanding the effect of perceived effort on automatic and/or controlled processes; exploring how an innate tendency for effort minimization contributes to decreased physical activity levels).
- Finally, larger-scale and longitudinal studies may seek theoretical support not just in one, but in several models, leveraging their complementary strengths.

Despite these differences, there are several commonalities among the theoretical models presented in this review, the most striking being the importance of automatic processes (i.e., System 1; implicit processes) in the final decision to be adopted. In the Affective-Reflective Theory, automatic valuations are the default response to an exercise-related stimulus, upon which reflective processes may be based (when self-control resources are available). The same default response is observed in the Theory of Effort Minimization in Physical Activity, with a greater focus on the automaticity of effort minimization. Similarly, in the Physical Activity Adoption and Maintenance Model, implicit processes involving habit and affect constitute the baseline. While cognitive processes always play an important role in these models, they ultimately possess limited predictive power when isolated. This aligns with the broader shift in behavioral science acknowledging that human action is often driven by "fast" thinking rather than "slow" deliberation.

Another commonality is the preponderance of affect within the automatic processes of each model. In the Affective-Reflective Theory and the Theory of Effort Minimization in Physical Activity, it is the automatic affective validations that dictate an approach effect (in the case of automatic pleasure associations) or an avoidance effect (in the case of automatic displeasure associations) toward the intended behavior. In the Physical Activity Adoption and Maintenance Model, affect plays an equally preponderant role, demonstrating a direct and indirect effect on other variables of implicit processes (i.e., positive affective responses may facilitate the habit formation of a given behavior) and a positive moderating effect on the gap between intentions and the intended behavior (i.e., implementation of the intention to perform a behavior considered pleasurable).

The organization and structure presented by the Affect and Health Behaviour Framework can further explain specifically which affective constructs create the various interactions in other models. For instance, affective associations, presented in the third dimension of the Affect and Health Behaviour

Framework, may give rise (possibly with some overlap) to the automatic affective validations or evaluations presented in the Affective-Reflective Theory and the Theory of Effort Minimization in Physical Activity. Hedonic motivation may also be associated here, as it is based on learned associations that result in desires or cravings (i.e., approach effects toward a behavior) or hedonic dread (i.e., avoidance effects).

Remembered affect and anticipated affective response can, in turn, be part of reflective or controlled evaluation processes. The former constitutes the recollection of a past affective response to physical activity or exercise practice, while the latter acts as an anticipation of the affective response if that behavior is repeated. These are crucial due to the tendency for decision-making to be based on the recollection of how an individual felt while performing a given behavior and, consequently, anticipating how they will feel if they repeat it (Kahneman et al., 1993; Redelmeier et al., 2003). Finally, it is important to mention the relevance of incidental affect, which is not directly contemplated in the other three models. The Theory of Effort Minimization in Physical Activity presents an approximation to the influences of factors independent of the intended behavior by contemplating the individual's physiological state at the moment they are subjected to a movement-related stimulus (e.g., how a fatigued individual tends to have an exaggerated perception of effort). However, the affective state at the moment of this stimulus is also important, with evidence demonstrating that positive incidental affect presents predictive value for physical activity.

References

Gawronski, B., & Bodenhausen, G. V. (2011). The associative-propositional evaluation model: Theory, evidence, and open questions. *Advances in Experimental Social Psychology*, 44, 59–127. https://doi.org/10.1016/B978-0-12-385522-0.00002-0

Kahneman, D., Fredrickson, B. L., Schreiber, C. A., & Redelmeier, D. A. (1993). When more pain is preferred to less: Adding a better end. *Psychological Science*, 4(6), 401–405. https://doi.org/10.1111/j.1467-9280.1993.tb00589.x

Redelmeier, D. A., Katz, J., & Kahneman, D. (2003). Memories of colonoscopy: A randomized trial. *Pain*, 104(1–2), 187–194. https://doi.org/10.1016/S0304-3959(03)00003-4

Williams, D. M. (2023). A meta-theoretical framework for organizing and integrating theory and research on motivation for health-related behavior. *Frontiers in Psychology*, 14, 1130813. https://doi.org/10.3389/fpsyg.2023.1130813

17. Integrative perspectives on behavioral change towards physical activity and exercise

Rodrigues, F.[1,2], Bastos, V.[3,4], Zeferino, B.[3,4], Monteiro, D.[1,2], & Teixeira, D. S.[3,4]

1 – ESECS – Polytechnic University of Leiria, Campus 1, Rua Dr. João Soares, Apartado 4045, 2411–901 Leiria, Portugal

2 – Research Center in Sports Sciences, Health Sciences and Human Development (CIDESD), Quinta de Prados, 5001-801 Vila Real, Portugal

3 – Faculty of Physical Education and Sport – Lusófona University, Campo Grande 376, 1749-024 Lisboa, Portugal

4 – Research Center in Sports, Physical Education, Exercise and Health (CIDEFES), Campo Grande 376, 1749-024 Lisboa, Portugal

Theoretical Synthesis

Physical inactivity remains one of the most pressing public health challenges of the 21st century, stubbornly resisting decades of interventions primarily grounded in health education and rational exercise prescription. Throughout this volume, we have navigated the complexity of human behavior, traversing from classic socio-cognitive models, which emphasize human agency and conscious deliberation, to contemporary dual-process theories that illuminate the automatic, affective, and evolutionary mechanisms governing our actions. At this juncture, it is imperative not to view these approaches as antagonistic paradigms, but rather as complementary pieces of a complex behavioral puzzle. The true understanding of exercise adherence resides in the synergistic integration of "reason" (Type-2 processing) and "emotion/impulse" (Type-1 processing).

The legacy and limits of the socio-cognitive approach

Socio-cognitive theories, such as the Theory of Planned Behavior (Ajzen, 1991) and Self-Determination Theory (Ryan & Deci, 2017), have provided the necessary foundation for understanding the initiation of behavior. These frameworks posit that humans require motives, a sense of competence and autonomy, and a structured plan to act. Without conscious intention, an explicit process, the adoption of a novel and complex behavior like structured exercise is improbable. However, as discussed in the chapters regarding Habit Theory and dual-process models, relying exclusively on rationality assumes that the individual possesses infinite self-regulation resources. The pervasive evidence of the "intention-behavior gap" (Sheeran & Webb, 2016) unequivocally demonstrates that knowing what is healthy and wanting to be healthy is often insufficient. When an individual is fatigued, stressed, or when cognitive resources are depleted (i.e., ego depletion), deliberative processes falter, and the automatic system assumes control. It is here that socio-cognitive models, in isolation, reveal their limitations in explaining long-term maintenance versus short-term adoption.

The affective revolution and dual-process dynamics

The introduction of dual-process theories, specifically the Affective-Reflective Theory (Brand & Ekkekakis, 2018) and the Theory of Effort Minimization (Cheval & Boisgontier, 2021), has opened the "black box" of implicit processes. We now understand that human beings possess an evolutionary tendency to conserve energy, generating an automatic aversive response to unnecessary physical effort. This automatic affective response (i.e., core affect), often experienced as displeasure during vigorous intensities (Ekkekakis et al., 2011), creates a neuropsychological conflict. While "System 2" (reflective) plans to visit the gym for long-term health benefits, "System 1" (impulsive) sends avoidance signals based on past experiences of discomfort or an innate preference for

sedentary behavior. If habit strength or positive affective valence is not present to counterbalance this minimization impulse, inactivity prevails. Consequently, ignoring the hedonic dimension of exercise is akin to ignoring the biological wiring of the human organism.

Implications

The scientific conclusion emerging from the joint analysis of these models is that the promotion of physical activity requires a biphasic and multi-level approach, as suggested by the Physical Activity Adoption and Maintenance Model (Strobach et al., 2020). In the Adoption Phase (Explicit Predominance), the focus must lie on socio-cognitive variables. It is crucial to promote autonomous motivation (e.g., Self-Determination Theory), ensuring the individual internalizes the value of exercise, while simultaneously strengthening self-efficacy and planning (e.g., Theory of Planned Behavior). In this stage, education, goal setting, and cognitive restructuring are fundamental to "start the engine." In the Maintenance Phase (i.e., Transition to Implicit), the focus must progressively shift toward managing the affective experience and habit formation. For behavior to persist when motivation fluctuates, exercise must generate a positive (or at least non-aversive) affective response. This validates the importance of intensity regulation (e.g., Dual-Mode Theory) and the creation of environments that satisfy basic psychological needs, thereby reducing behavioral "friction" and counteracting the tendency toward effort minimization.

For the exercise professional, this theoretical integration implies a paradigm shift. The role of the professional evolves from merely being a "prescriber of loads" (physiological focus) or a "verbal motivator" (cognitive focus) to becoming an "architect of experiences" (dual-affective focus). Future interventions must be designed to:

- Minimize Displeasure: Avoid protocols that induce negative valence in novices, respecting individual tolerance and preventing the encoding of traumatic affective memories (Brand & Ekkekakis, 2018).
- Maximize Autonomy: Allow for the self-regulation of intensity, which has been proven to enhance the affective response and subsequent adherence (Williams, 2008).
- Automate Behavior: Utilize consistent contextual cues (the habit loop) to transfer control from the resource-heavy reflective system to the efficient impulsive system, liberating mental resources for other life demands (Gardner, 2015).

The dichotomy between "rational" and "irrational" approaches to exercise behavior is a false one. The human brain operates on both levels simultaneously. Socio-cognitive models provide the map and the destination (intention), while dual-process and affective theories provide the fuel and the engine (impulse and affect). Sustainable behavioral change does not reside in the victory of reason over emotion, but in the alignment of both. When exercise is perceived as valuable by the mind (cognition) and felt as pleasurable by the body (affect), the gap between intention and behavior closes, paving the way for a resilient and active lifestyle.

References

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50(2), 179-211. https://doi.org/10.1016/0749-5978(91)90020-T

Brand, R., & Ekkekakis, P. (2018). Affective-Reflective Theory of physical inactivity and exercise: Foundations and preliminary evidence. *German Journal of Exercise and Sport Research*, 48(1), 48-58. https://doi.org/10.1007/s12662-017-0477-9

Cheval, B., & Boisgontier, M. P. (2021). The theory of effort minimization in physical activity. *Exercise and Sport Sciences Reviews*, 49(3), 168-178. https://doi.org/10.1249/JES.0000000000000252

Ekkekakis, P., Parfitt, G., & Petruzzello, S. J. (2011). The pleasure and displeasure people feel when they exercise at different intensities: decennial update and progress towards a tripartite rationale for exercise intensity prescription. *Sports Medicine*, 41(8), 641-671. https://doi.org/10.2165/11590680-000000000-00000

Gardner, B. (2015). A review and analysis of the use of 'habit' in understanding, predicting and influencing health-related behavior. *Health Psychology Review*, 9(3), 277-295. https://doi.org/10.1080/17437199.2013.876238

Ryan, R. M., & Deci, E. L. (2017). *Self-determination theory: Basic psychological needs in motivation, development, and wellness*. The Guilford Press.

Sheeran, P., & Webb, T. L. (2016). The intention-behavior gap. *Social and Personality Psychology Compass*, 10(9), 503-518. https://doi.org/10.1111/spc3.12265

Strobach, T., Englert, C., Jekauc, D., & Pfeffer, I. (2020). Predicting adoption and maintenance of physical activity in the context of dual-process theories. *Performance Enhancement & Health*, 8(1), 100162. https://doi.org/10.1016/j.peh.2020.100162

Williams, D. M. (2008). Exercise, affect, and adherence: an integrated model and a case for self-paced exercise. *Journal of Sport and Exercise Psychology*, 30(5), 471-496. https://doi.org/10.1123/jsep.30.5.471