Performance Enhancement & Health 9 (2021) 100173

Contents lists available at ScienceDirect

Performance Enhancement & Health

journal homepage: www.elsevier.com/locate/peh

Editorial: The self-regulation of human performance☆

Enduring cognitive or physical performance over extended periods of time is an important ability in daily life, prototypically required in many athletic, educational, and vocational contexts. A critical requirement for maintaining performance at a high level is that individuals continuously self-regulate various affective experiences (e.g., pain or boredom), thoughts (e.g., related to distractions or quitting), and behaviors (e.g., responding to feedback or increasing effort). The ubiquitous importance of self-regulation for performance has been recognized across psychological disciplines. In this special issue, we draw upon diverse insights from these disciplines to better understand the self-regulation of human performance.

1. Resource-based versus reward-based models of self-regulatory control

From a theoretical point of view, understanding the limits of human performance is inextricably linked to an understanding of the limits of self-regulation. Currently, a lively debate centers around the question of whether performance is ultimately limited by an individual's *resources* or *willingness* to apply self-regulatory control. In his viewpoint, Englert (2019) compares two prominent theoretical approaches representing both perspectives on the debate: The strength model of self-control (Baumeister et al., 1998) proposes that prior self-regulatory control leads to performance impairments because this depletes a limited self-control strength (resource), whereas the process model of self-control (Inzlicht & Schmeichel, 2012) postulates that prior self-regulatory control triggers motivational shifts towards more rewarding activities (willingness). Summarizing the state of research, Englert argues that there is currently no conclusive evidence for either approach, not least because of inconsistencies in the way researchers have investigated the effect of prior self- regulatory control on subsequent performance.

In their meta-analysis, Giboin and Wolff (2019) address this methodological issue by quantifying the effect of prior self-regulatory control on subsequent endurance performance and by assessing the effect of different experimental approaches on the magnitude of the observed performance decrements. Specifically, they analyze empirical findings from two separate resource-based lines of research (i.e., ego depletion and mental fatigue) and show that prior self- regulatory control indeed impairs subsequent endurance performance. However, Giboin and Wolff also found that performance decrements after applying self-regulatory control were independent from the duration of these tasks. This finding is difficult to reconcile with a depletable self-regulatory resource (see also Wolff, Sieber et al., 2019).

It instead appears to be more in line with motivational explanations of self- regulatory control, which conceptualize the decision to apply control as a reward-based choice (e.g., Inzlicht & Schmeichel, 2012; Kurzban et al., 2013; Shenhav et al., 2013). According to this view, people adjust their effort depending on how valuable the outcome is to them, how high their expectations of success are, and what costs are associated with summoning the required control. Performance impairments after applying self-regulatory control might thus reflect fluctuations in motivational processes – for instance, because performing yet another task does not seem desirable or because the exertion of control is perceived as increasingly costly. In line with this reasoning, it has been shown that the perceived costs of control indeed rise as a function of task duration without necessarily causing performance impairments (Wolff, Sieber et al., 2019).

2. Value, expectation, and control costs

How variations in self-regulatory control can be explained is not merely a theoretical debate but also has important applied implications. An illustration is the empirical study by Seipp (2019), who focuses on internal disruptions (i.e., self-initiated shifts of attention from a focal to a non-focal task) among company employees. According to resource-based models, these disruptions might serve to restore depleted energy levels. Indeed, Seipp finds that this explanation is well aligned with employees' self-reported perceptions. Interestingly, however, employees also consistently associated internal disruptions with negative emotions like boredom. According to reward-based accounts, this might reflect a decrease in the value of performing the focal task, escalating the costs of maintaining performance until attention shifts away. If this was the case, rather than allowing for breaks *per se* it might be more important for employers to provide interesting and varied environments that keep their employees' attention focused to a task.

The value of a task is but one determinant of performance according to reward-based accounts, another one is the cost associated with exerting the required self-regulatory control. In their conceptual review, Schüler, Zimanyi, and Wegner (2019) argue that these costs vary as a function of both the task at hand and interindividual differences. Specifically, they assume that more self- regulatory control is required for tasks that are perceived as difficult, involve unrewarding activities, or pitch conflicting motives against each other. This perspective highlights that differ-

DOI of original article: https://doi.org/10.1016/j.peh.2020.100166.
☆ The articles of this special issue can be accessed here: https://www.sciencedirect.com/journal/performance-enhancement-and-health/special-issue/10KKH297073.

https://doi.org/10.1016/j.peh.2020.100173

ences in control costs may affect performance over and beyond the value of the task and expectations of success. An example are professional athletes who may enjoy the challenges associated with regulating negative affect during a competition (e.g., effort) and thus bear lower control costs than recreational athletes. This calls for powerful volitional strategies people can use to deal with self-regulatory demands (see Bieleke et al., 2019; Wolff, Bieleke et al., 2019 for examples in the athletic domain).

To some extent there might be individual differences not only in self- regulatory control costs but also in the expected value of control more generally. Dietrich and Latzko (2020) report empirical research in which they investigate differences in chronic action control styles among pre-service teachers. They classify these teachers into one of two types depending on whether they tend to chronically adopt an action orientation or a state orientation and then continue to show that the former is associated with better well-being and more academic success than the latter. Interestingly, the characteristic difference between both orientations pertains to the degree to which people flexibly change their current course of action in response to changing circumstances (Kuhl, 1994). One tentative interpretation is that some people might be less sensitive to decreasing task values or expectations of success than others, making them less prepared to proactively exert self-regulatory control.

3. The role of self-regulatory control costs for physical activity

Beyond the educational (Dietrich & Latzko) and the vocational context (Seipp), self-regulatory control is a key requirement for adopting and maintaining exercise behavior. In their empirical paper, Roloff et al. (2020) highlight the validity of self-reported affective valence as a marker for exercise stress in high-intensity interval training. This is an important insight because research shows that exercising at intensities above the critical power limit induces displeasure, and the corresponding negative affect requires self-regulatory control to be dealt with. From a reward-based point of view, exercising at high intensities escalates control costs (Bieleke & Wolff, 2017). This likely biases the perceived net reward of being physically active, thereby affecting the likelihood of further engagement in exercise behavior.

Physical activity adoption and maintenance also lies at the heart of a model introduced by Strobach, Englert, Jekauc, and Pfeffer (2020), which draws upon the distinction between explicit and implicit processes to explain and predict whether people engage in physical exercise. The model attributes special importance to interactions between these processes: For instance, people may initially become physically active due to a corresponding intention that is shielded against alternative activities by exerting self-regulatory control. With time and repetition, however, engaging in exercise might become a habitual behavior that is performed with increasing automaticity and associated with decreasing control costs. Supporting evidence for such a reasoning comes from research on the self-regulation strategy of forming implementation intentions (Gollwitzer, 1999), an explicit strategy that alleviates control costs by automating behavior (Keller et al., 2019; Wolff et al., 2018). Interestingly, the model proposed by Strobach and colleagues also predicts that affective sensations during the exercise moderate the automation of behavior.

4. Conclusion

Taken together, the contributions in this special issue exemplify the diversity of research questions that are concerned with the self-regulation of human performance. The empirical contributions highlight the importance of self-regulatory control in athletic (Giboin & Wolff, 2019; Roloff et al., 2020), educational (Dietrich & Latzko, 2020), and vocational (Seipp, 2019) settings, with profound consequences for health and well-being. Further, the intricate role of individual differences in creating self-regulatory control costs (Schüler et al., 2019) and the differentiation of processes that rely on more or less control (Strobach et al., 2020) highlight the need for further theory-development and integration. Referring to the very fundamental question regarding the operating principles of self-regulatory control, theoretical (Englert, 2019) and empirical contributions (Giboin & Wolff, 2019) reiterate concerns regarding resource-based accounts on the limits for self-regulatory control. In line with this, the inferences drawn from the contributions of this special issue fit well into theoretical accounts that conceptualize control as a reward-based choice that must not incorporate a depletable metabolic resource.

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Available online 5 October 2020