from motivation intensity theory concerned with fatigue influence on effort and associated cardiovascular responses in people confronted with performance challenges (Wright & Stewart 2012; see also Wright & Kirby 2001).

The elaboration takes as a working "given" a venerable hypothesis in cardiovascular psychophysiology that beta-adrenergic influence on the heart and vasculature is proportional to effort ("active coping") in action circumstances (Obrist 1981). It also takes as a given the common understanding that difficulty appraisals increase with fatigue within relevant performance systems, that is, the depletion of resources in active performance structures (Fairclough 2001). With these givens in place, the elaboration applies motivation intensity theory to derive interactional implications regarding fatigue influence, assuming – like motivation intensity theory – that effort is a mechanism through which energy is mobilized and that effort processes are designed to maximize energy efficiency, that is, to make the best use of energy stores.

Core propositions of motivation intensity theory are that effort (motivation intensity) should be (1) proportional to the perceived difficulty of a performance challenge so long as success is viewed as possible and worthwhile, and (2) low when success is viewed as impossibly difficult or excessively difficult, given the importance of meeting the challenge (i.e., the value of the benefit that can be accrued). In combination with the elaboration givens, this implies that fatigue should augment, retard, or leave unaffected effort and associated cardiovascular responses, depending on the difficulty of the challenge at hand and the importance of meeting it. In theory, fatigue should augment effort and cardiovascular responsiveness when it leaves unchanged a perception that success is possible and worthwhile, generating compensatory striving (i.e., effort exertion: Fig. 1, sect. A). By contrast, fatigue should retard effort and cardiovascular responsiveness when it causes success to appear impossible or excessively difficult, leading performers to withhold effort (Fig. 1, sect. B). By further contrast, fatigue should have no effect on effort and cardiovascular responsiveness when it reinforces a perception that success is impossible or excessively difficult, confirming performers' intention not to try (Fig. 1, sect. C).

Cardiovascular implications above have been confirmed repeatedly in fatigue studies involving a range of procedures and conducted in different laboratories (e.g., Marcora et al. 2008; Schmidt et al. 2010; Wright et al. 2003; 2012). Moreover, they can be profitably brought to bear with respect to inhibition, a topic to which Kurzban et al. devote considerable attention. The implications can be brought to bear assuming (1) that behavioral restraint (a particular type of performance challenge) requires a degree of effort determined by the strength of the relevant behavioral impulse, and (2) that inhibitory performance systems can in fact become fatigued (weakened through the depletion of resources). Insofar as these assumptions are warranted, the suggestion is that inhibitory system fatigue should augment effort when it leaves unchanged a perception that inhibitory success is possible and worthwhile; retard effort when it causes inhibitory success to appear impossible or excessively difficult; and have no effect on effort when it reinforces a perception that inhibitory success is impossible or excessively difficult.

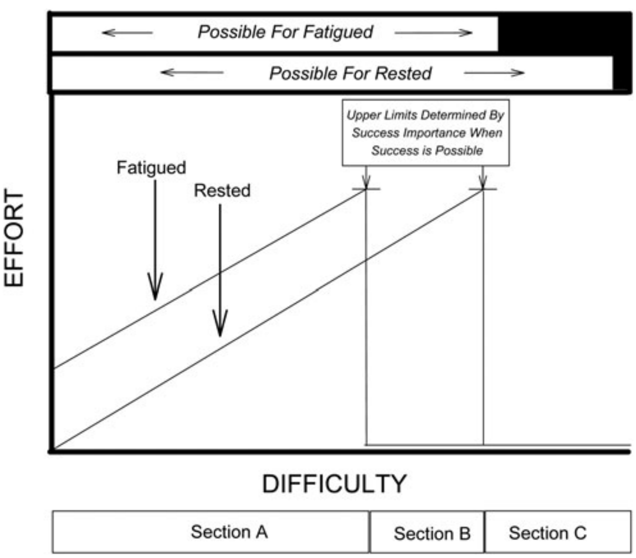

Figure 1 (Wright & Pantaleo). Relation between challenge difficulty and effort for fatigued and rested performers (from Figure 1 in Stewart et al. 2009).

Importantly, although relevant cardiovascular responses in fatigue studies referenced above have consistently comported with effort expectations based on the elaborated fatigue analysis, subjective effort and performance outcomes have not. Disparities between cardiovascular outcomes, on the one hand, and subjective effort and performance outcomes, on the other, might be taken as evidence contrary to an effort interpretation of the cardiovascular results. However, they should not be so taken, because effort reports and performance outcomes have long been recognized as highly fallible indices of actual engagement levels. Regarding effort reports, there is reason to believe that performers sometimes over-report effort in order to please (e.g., experimental) observers and sometimes under-report effort to protect self-esteem in the event of failure. Further, it is possible that performers are not always aware of how engaged they are in goal pursuits (e.g., in the midst of "flow") and that effort appraisals are sometimes impacted by outcomes other than effort itself, including opportunity costs (Kanfer 2011). Regarding performance outcomes, depending on a variety of considerations, improved effort might or might not result in their improvement. Indeed, improved effort has potential for producing performance decrements (Harkins 2006).

Potential lessons are multifold. Effort is a mechanism involved in energy mobilization, that is, the process of converting energy stores into energy. It arguably is multifaceted, with physical and phenomenological components that might or might not correspond with one another. Fatigue is distinct from – and bears an interactional relation to – effort. Fatigue can serve a "stop" function, but also a "go" function insofar as it produces compensatory striving in certain performance circumstances. Fatigue can leave effort unaffected as well, in which case one might say it serves a "stay the course" function. Improved effort can, but will not necessarily, improve performance outcomes, which calls into question the use of such outcomes in making effort inferences. The authors' thesis that opportunity costs might systematically influence effort appraisals is reasonable in some respects, and testable, and could account for some empirical (e.g., performance) outcomes. However, we struggle to see how the thesis can explain effort, fatigue, and performance processes in general. Considering the function of effort, it seems that effort qualia are more likely to index that which is being lost (expended), than that which might be gained by altering the direction of behavior.

Persistence: What does research on self-regulation and delay of gratification have to say?

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Abstract: Despite the simplicity of Kurzban et al.'s framework, we argue that important information is lost in their simplification. We discuss research on delay of gratification and self-regulation that identifies key situational and psychological factors affecting how people represent rewards and costs. These factors affect the expected utilities of behavioral options and thus dramatically influence whether individuals persist on a difficult task.

Make everything as simple as possible, but not simpler.
— Albert Einstein

When faced with either working on math problems to prepare for an upcoming test or texting with friends, why does one student (Mat) choose to work on the math problems, while another student (Tex) chooses to text with his friends? Kurzban et al.'s model provides a simple framework for these decisions: The expected utilities of the two activities as estimated by Mat and Tex differ. Mat chooses to study because he values doing the math problems more than texting. And Tex chooses to text because he associates higher value to texting than to studying. Moreover, according to the authors, if Tex were to work on math problems, he would experience fatigue because of the greater expected utility he assigns to texting, and this subjective experience is likely to disengage him from studying.

Despite the appeal of the simplicity of the Kurzban et al. framework, we argue that important information is lost in their simplification. One unifying theme in research on self-regulation and delay of gratification (e.g., Mischel et al. 2011; Zayas et al., in press), which is largely unaddressed by Kurzban et al., has implications for the factors that influence how people assign value to rewards and costs of various behavioral options. *Why* does Mat assign a higher utility to studying (vs. texting), compared to Tex? Below we summarize research that identifies key situational and psychological factors that affect how people represent rewards and costs in each behavioral option, and how these, in turn, naturally influence whether people persist on difficult tasks.

All situations are not equal: Situations involving immediate versus delayed outcomes. Does a person study now for a reward to-be-obtained in the future, or instead chat with friends on the phone? This situation reflects a typical delay of gratification dilemma, which involves forgoing an immediately available reward for the sake of a more desirable reward in the future. Surprisingly, Kurzban et al. provide little discussion of how inherent, structural differences in these competing situations affect how they are construed and ultimately which tasks individuals pursue. As we discuss next, situational and psychological factors likely influence the estimation of rewards and costs, and thus the activities to which one decides to allocate computational resources.

Immediate/concrete outcomes loom larger than distal/abstract outcomes. Differences in the temporal nature of the competing situations (delayed vs. immediate) affect a person's estimates of the costs and rewards. In situations discussed by Kurzban et al., the rewards of the current activity (doing math) are delayed but its costs are immediate. In contrast, in situations involving a tempting alternative (texting), the rewards are immediate but its costs are delayed. All things being equal, immediately available rewards weigh more than rewards accrued sometime in the future, and likewise, the costs in an immediate situation weigh more than costs in a delayed situation (e.g., Ainslie 1975). Hence, differences in the temporal nature of the competing situations affect the expected utilities of the current and alternative activities, thereby favoring the allocation of resources toward situations in which the rewards are immediately available.

Reflexively responding to the immediate and reflectively conjuring the future. The competing situations (immediate vs. delayed) in a delay of gratification dilemma also differ in their inherent difficulty. First, the activities themselves differ on the effortful versus automatic dimension. In situations involving immediately available rewards, obtaining the rewards is typically achieved relatively effortlessly. Mindlessly texting simply requires engaging in more reflexive and automatic processes (e.g., Hofmann et al. 2009). In contrast, in situations involving delayed rewards, obtaining the rewards is typically associated with greater effort. Working on math problems to earn good grades in the future presumably requires effortful and more reflective processes.

A second difference in the inherent difficulty of the two competing situations emerges in how the goals are represented. Whereas immediate outcomes are readily available and easily processed, delayed outcomes must be envisioned. Indeed, individuals must keep the delayed rewards in mind, albeit not necessarily consciously, to continue working toward the goal and simultaneously inhibit tempting, highly accessible alternative representations (e.g., Hofmann et al. 2012). The ability to control the content of working memory is a key ability in cognitive control and facilitates delay of gratification (Berman et al. 2013; Casey et al. 2011; Eigsti et al. 2006).

Thus, situations that differ in the immediacy (vs. delay) of the rewards and costs possess another inherent asymmetry: All things being equal, the computational costs in a situation involving delayed rewards are higher than those in which the rewards are immediately available.

Representations of future rewards affect expected utilities. Given the structural reasons why delaying gratification is difficult (as described above), not surprisingly considerable research has shown that being able to control mental representations of various behavioral options and associated outcomes is a key factor influencing whether one persists in working on a difficult task (for a review, see Zayas et al., in press). For example, being able to bring to mind goal-relevant representations, keep them active in working memory, and shield them from competing goals lessens tempting aspects of the situation and facilitates persistence on difficult tasks (Fujita 2011). In some situations, representing delayed goals may increase the salience of future rewards (in a sense it makes them more immediate), and increase motivation. However, in some cases, focusing on delayed rewards may be detrimental (see Metcalfe & Mischel 1999).

Moreover, keeping a delayed reward in mind may even affect the mental effort of pursuing the current mental activity. When the value of the future reward (obtaining a good grade) increases relative to the value of the alternative option (texting), pursuing the current activity may require less effort and less executive functions to inhibit the tempting alternative (in a sense, temptations are no longer as salient and alluring; Ferguson 2008).

In sum, why does Mat choose to study for his math test whereas Tex chooses to text with his friends instead? The fact that one values texting more than studying is fairly self-evident. The important question is *why* does one student value texting more than studying. To provide a comprehensive framework of self-regulation that accounts for these individual differences and situational factors, Kurzban et al.'s model should incorporate psychological processes that affect representations of costs and rewards.

Authors' Response

Cost-benefit models as the next, best option for understanding subjective effort

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