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How does achievement motivation influence mental effort mobilization? Physiological evidence of deteriorative effects of negative affects on the level of engagement

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ABSTRACT

We tested whether the effect of achievement motivation on effort is modulated by two possible factors of the motivational intensity theory (Wright and Kirby, 2001): perceived difficulty and maximally justified effort. Approach-driven ($N=16$) and avoidance-driven ($N=16$) participants were first instructed to perform a reaction time task to the best of their abilities. Next, the participants were instructed to consistently beat their performance standard established in the first condition. Approach-driven participants showed a stronger decrease of midfrequency band of heart rate variability, which was used as an index of mental effort, than avoidance-driven participants in the second instruction condition. Moreover, avoidance-driven participants showed a higher corrugator supercilii reactivity, which was used as an index of negative affects, than approach-driven participants in the second instruction condition. No difference of perceived difficulty between groups was observed. Results suggested that avoidance-driven participants developed negative affects in the second instruction condition decreasing the maximally justified effort and their level of engagement.

The motivational intensity theory is probably the most productive and relevant theory on cardiovascular reactivity related to mental effort (for reviews see Brehm and Self, 1989; Gendolla and Wright, 2005; Wright and Kirby, 2001). Mental effort is defined as the attentional resources voluntarily allocated by an individual to perform a task (Kahneman, 1973). This theory predicts a linear relationship between mental effort investment and perceived difficulty. The higher the subjective difficulty level, the more effort the individual invests in the task until the individual perceives the level of difficulty as impossible and disengages (Fig. 1A). Mobilization of mental effort is also determined by the maximally justified effort, or the peak of what an individual would be willing to do to succeed. This is also known as the potential motivation (Fig. 1A). A host of research has demonstrated the effects of situational factors affecting the perceived difficulty (e.g. Wright et al., 1997) and the maximally justified effort (e.g. Gendolla and Richter, 2005). Most recently, the effects of dispositional factors such as depression (Brinkmann and Gendolla, 2007, 2008), extraversion (Kemper et al., 2008), and achievement motivation (Capa et al., 2008a,b) have been studied. The effects of depression and extraversion on cardiovascular reactivity related to mental effort have been clearly identified and have been proven to be modulated by perceived difficulty. Interpretation of the effect of achievement motivation according to the motivational intensity theory is less clear. The purpose of the study was to clarify whether the effect of achievement motivation on mental effort is modulated by the perceived difficulty or by the maximally justified effort.

One previous study demonstrated the interactive effect of achievement motivation and difficulty on mental effort mobilization (Capa et al., 2008a). In this study, approach-driven and avoidance-driven participants had to perform a reaction time task in two different mapping conditions. The first mapping condition was compatible S–R mapping and the second was incompatible S–R mapping. Participants in both conditions were first instructed to "do your best". Next, they performed the same reaction time task in both mapping conditions, but they received a new set of instructions. The second set of instructions required them to consistently beat their performance standard previously established from the first set of instructions. Approach-driven participants had a higher cardiovascular reactivity related to mental effort than avoidance-driven participants, and especially those during the incompatible S–R mapping condition. On the other hand, no interactive effect between groups and the different sets of instructions was significant. This point could be explained by the fact that the level of difficulty of instructions was too easy to highlight the effect of achievement motivation on mental effort. However, the manipulation of compatibility and instruction induced a similar increase of subjective difficulty. This implies that the level of difficulty of the instructions was probably sufficient. Another possibility is to consider the lack of reliability of the participants' selection used in this study (Capa et al., 2008a). Approach-driven and avoidance-driven participants were selected on the basis of

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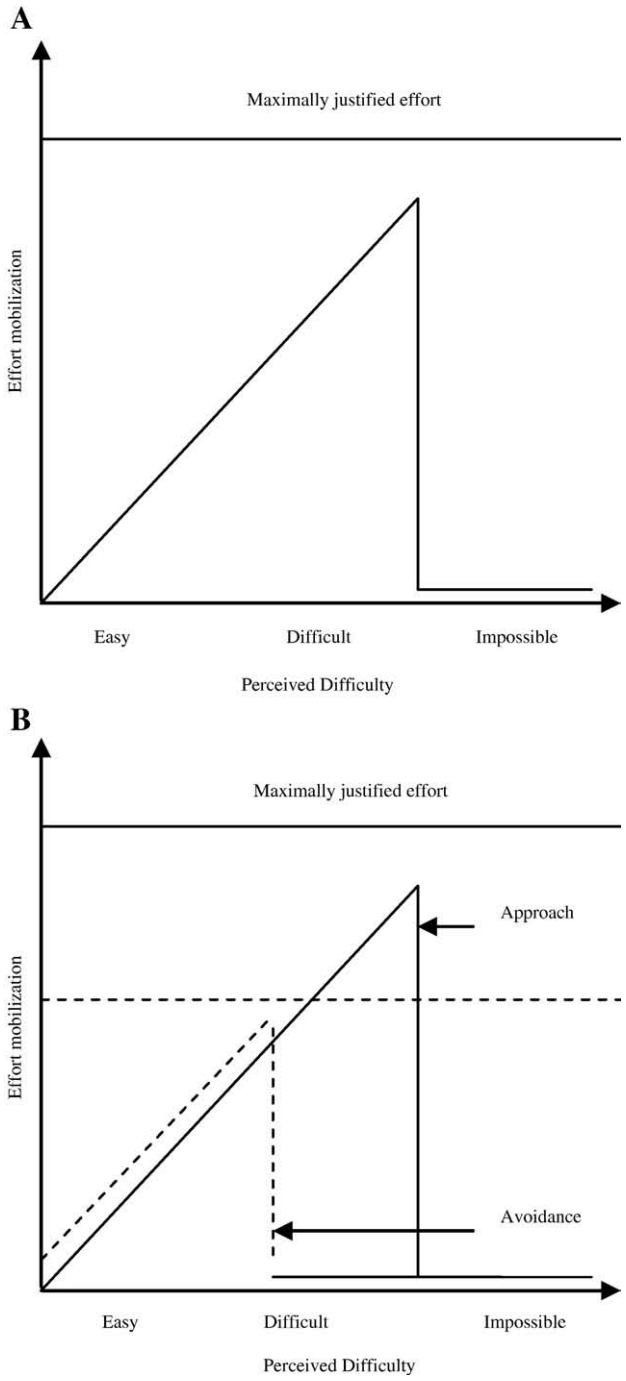

Fig. 1. Mobilization of mental effort as a function of perceived difficulty and the maximally justified effort (A), and theoretical predictions for the effect of achievement motivation on effort mobilization (B).

achievement motivation scales administrated in an introductory-level psychology course. However, stability of the participants' characteristics was not ascertained in the context of the experimental session and the reliability of the participants' selection was probably low. The purpose of the present study was to clarify the effect of achievement motivation and difficulty on mental effort by using a similar experimental design to Capa et al.'s study (2008a) and by selecting approach-driven and avoidance-driven participants on a test–retest measure.

Hypotheses are formulated in accordance with the characteristics of avoidance-driven and approach-driven individuals (Atkinson and Raynor, 1974; McClelland et al., 1953). An avoidance-driven person is an individual in whom the motive to avoid failure is stronger than the motive to achieve success. The motive to avoid failure is a relatively stable personality disposition to experience negative affects given non-attainment of a goal (Atkinson and Raynor, 1974; McClelland et al., 1953). Inversely, an approach-driven person is an individual in whom the motive to achieve success is stronger than the motive to avoid failure. The motive to achieve success is a relatively stable personality disposition to experience pride in accomplishment (Atkinson and Raynor, 1974; McClelland et al., 1953). From these characteristics, the first expectation addresses the difficult tasks. As the likelihood of non-attainment of a goal, or the probability of failure, is high in the difficult tasks, avoidance-driven individuals should, in this hypothesis, develop negative affects when compared to approach-driven individuals. The peak of what individuals would be willing to do is determined by variables related to the importance of success (Brehm and Self, 1989; Gendolla and Wright, 2005; Wright and Kirby, 2001).

In active avoidance situations, the possibility of avoiding a severe punishment is associated with greater negative affects compared to the possibility of avoiding a mild punishment. Moreover, the importance of success is greater when facing the severe punishment condition than when facing the mild punishment condition (Fowles, 1983; Wright et al., 1992). Negative affects, however, related to the task performance should decrease the importance of success in situations in which the individual must not make a response to avoid punishment (Ryan and Deci, 2000; Silvestrini and Gendolla, 2009). So, in the difficult tasks, the maximally justified effort of avoidance-driven individuals and their level of engagement should be low compared to approach-driven individuals (Fig. 1B). Approach-driven individuals should not develop negative affects in performing difficult tasks. In contrast to avoidance-driven individuals, the maximally justified effort of approach-driven participants in the difficult tasks and their level of engagement should be high (Fig. 1B). The second expectation deals with the easy tasks. As the likelihood of non-attainment of a goal is low in the easy tasks, avoidance-driven individuals should not develop negative affects. We can conclude that approach-driven and avoidance-driven individuals should have the same level of engagement in the easy tasks (Fig. 1B).

1. Overview of the experiment

The goal of the study was to determine whether the effect of achievement motivation on mental effort is modulated by the perceived difficulty or by the maximally justified effort. To address these issues, participants had to perform a reaction time task in a compatible S–R mapping condition (the easy task) and in an incompatible S–R mapping condition (the difficult task). Participants were first instructed to "respond as quickly as possible without making errors". Next, they performed the compatible and incompatible conditions with a second set of instructions. The second set of instructions required them to "beat your reaction time reference as often as possible, but without increasing error rate". To test the hypotheses, two physiological measures were used: heart rate variability and facial electromyography. Fluctuations in the midfrequency band of heart rate variability are associated with short-term regulation of blood pressure related to mobilization of mental effort (Mulder et al., 1995). Variability in this band has been shown to decrease during effortful mental processing (e.g. Iani et al., 2004; Fairclough et al., 2005). There are several studies showing that activity of the corrugator supercilii respond to the experience of negative affects without resource mobilization (for reviews see Bradley, 2000; Tassinary and Cacioppo, 2000).

2. Method

2.1. Selection of participants

2.1.1. Motive measures

A total of 670 (388 men, age: $M = 22.8$ years; $SD = 2.9$) students enrolled in psychology courses at the University of Poitiers filled out a