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Mood impact on effort-related cardiovascular reactivity depends on task context: Evidence from a task with an unfixed performance standard☆

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ABSTRACT

Gendolla and colleagues have consistently found that negative mood leads to higher effort-related cardiovascular reactivity than positive mood if performers can choose their own performance standard (Gendolla et al., 2001; Gendolla and Krüsken, 2001a, 2002a,b). However, an integration of motivational intensity theory with the mood literature suggests that the impact of mood on cardiovascular activity should vary with task context. In a 2 (task context: demand vs. reward) × 2 (mood valence: negative vs. positive) between-persons design, participants performed a memory task without a fixed performance standard. The results showed the expected interaction. Positive mood led to higher effort mobilization—reflected by increased pre-ejection period and heart rate reactivity—than negative mood if participants had answered questions about task reward before performing the task. If participants had responded to questions about task demand, the pattern was reversed. These results extend and add to preceding research that has demonstrated that mood impact on effort-related cardiovascular activity is not stable but depends on task context.

1. Introduction

One of the basic properties of moods is that they are experienced without the concurrent awareness of their origins (Frijda, 1993). Due to this property, moods do not involve in-built action goals and may influence a wide range of behaviors in different ways. During the last years, numerous studies have shown how different context factors may change the mood–behavior relationship (e.g., Erber, 1996; Erber and Erber, 2000; Martin et al., 1993). In line with these studies, research by Gendolla and Krüsken (2001b, 2002b,c) on the mood-behavior model (Gendolla, 2000) demonstrated that mood effects on effort-related cardiovascular reactivity vary with the difficulty of a task. However, Gendolla and colleagues could demonstrate this context-dependent mood impact only for tasks with a fixed performance standard (e.g., "memorize this list of six letter series within five minutes"). If participants worked on tasks where they were free to choose their own performance standard (*unfixed performance standard*), negative mood always resulted in higher effort than positive mood (Gendolla et al., 2001; Gendolla and Krüsken, 2001a, 2002a,b). Our study aims to demonstrate that this pattern does not reflect a stable mood–behavior relationship but that mood impact on effort-related cardiovascular response generally depends on task context—even under conditions of unfixed performance standards.

To explain their findings for unfixed performance standards, Gendolla and colleagues drew on an integration of motivational intensity theory (Brehm and Self, 1989) and Obrist's (1981) active coping approach by Wright (1996). They posited that individuals in a negative mood perceive the task with an unfixed performance standard as more demanding than individuals in a positive mood and thus mobilize more effort. To support their view, they demonstrated that mood effects on cardiovascular reactivity are mediated by capability appraisals under conditions of unfixed performance standards (Gendolla and Krüsken, 2002b, Experiment 2). Despite this empirical evidence, the reasoning of Gendolla and colleagues conflicts with motivational intensity theory. The theory predicts that individuals should strive for the highest performance level that is justified if they are free to perform at any level (Brehm and Self, 1989). Given that individuals should always invest the maximum effort that is justified, differences in subjective task demand should not lead to differences in effort mobilization and cardiovascular response (see Eubanks et al., 2002; Wright et al., 2002, for short discussions).

This contradiction can be overcome by considering the effect of task context. Motivational intensity theory suggests that task difficulty is the direct determinant of effort mobilization under conditions of fixed performance standards, whereas success importance governs effort mobilization under conditions of unfixed performance standards. One could say that task demand should be salient under conditions of fixed

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performance standards, whereas success importance should be salient under conditions of unfixed performance standards. Martin (e.g., Martin, 2001; Martin et al., 1993) suggested that the impact of mood on behavior is mediated by the impact of mood on the judgments that are salient and that govern behavior in a given situation.[1] Drawing on this idea, one would expect that mood has an impact on either task demand or success importance depending on the salience of these judgments. This implies that the crucial factor determining the mood–effort relationship is not the assigned performance standard but the relative salience of task demand and success importance. It follows that any context factor that modifies the salience of task demand or success importance—like a manipulation check, for instance—may affect the mood–effort relationship.

In light of the above, the results of Gendolla and colleagues for tasks with unfixed performance standards fit with motivational intensity theory's predictions. Gendolla and colleagues instructed their participants to "do their best" to create tasks with an unfixed performance standard. However, in all but one of these studies (Gendolla and Krüsken, 2002a, Experiment 1), participants performed some practice trials and responded to one or more demand-related questions before performing the task. By this means, the participants came in contact with the difficulty of the upcoming task and the salience of task demand was increased. This increased salience of task demand may explain why cardiovascular responses reflected mood-related differences in subjective demand in the studies of Gendolla and colleagues.[2]

The aim of this research is to demonstrate that the pattern that Gendolla and Krüsken have found for unfixed performance standards is not stable but depends on the task context. If the task context urges participants to reflect on the difficulty of the task, mood should influence subjective task demand and hence negative mood should lead to higher effort-related cardiovascular reactivity than positive mood. If the task context urges participants to reflect on determinants of success importance (e.g., the probability of winning a promised reward), mood should affect subjective success importance and positive mood should result in higher cardiovascular reactivity than negative mood.

There is preliminary evidence that supports the view that mood may exert an impact on effort mobilization by means of mood congruency effects on success importance (i.e., positive mood leads to high success importance, whereas negative mood leads to low success importance). First, mood may have an impact on the estimated probability of winning a reward (Nygren et al., 1996) or on the expectancy of positive outcomes (Cunningham, 1988). Both judgments refer to the instrumentality of task success—a variable that determines success importance (Wright, 2008; Wright and Gregorich, 1991; Wright et al., 1992). The more likely it appears that success will indeed lead to a desired reward, the more important it is to succeed and the more effort is justified.

Second, a study by Richter and Gendolla (2009a) investigated mood effects on effort-related cardiovascular responses using a task with a fixed but unknown performance standard. In this study, participants could earn the chance to win a monetary reward by successfully performing the task. The results showed that participants in a positive mood invested more effort (i.e., showed a stronger cardiovascular response) than participants in a negative mood. Furthermore, this mood impact on cardiovascular reactivity was mediated by a mood congruency effect on the probability of winning the reward. This study thus provided first evidence that mood may influence effort-related cardiovascular reactivity by means of a mood congruency effect on the determinants of success importance. However, since Richter and Gendolla (2009a) employed a task with a fixed but unknown performance standard, it is possible that their results cannot be generalized to tasks with unfixed performance standards.

The present experiment investigated the moderating impact of task context on the mood–effort relationship under conditions of unfixed performance standards. For this purpose, the participants performed a memory task with an unfixed performance standard after being induced into a negative or a positive mood. By successfully performing the task, the participants could earn the chance to win a monetary reward. To manipulate task context, the participants answered different questions before working on the task. One half of the participants answered questions about task demand, the other half responded to questions about the monetary reward and the probability of winning this reward. As outlined above, we hypothesized that the effects of mood on effort-related cardiovascular reactivity should vary with task context. If the participants reflect on task demand, negative mood should lead to stronger cardiovascular reactivity than positive mood. If the participants reflect on the reward, the pattern should be reversed.

Consistent with preceding studies that have tested the predictions of motivational intensity theory, effort mobilization was operationalized as cardiovascular reactivity—i.e., the change in cardiovascular activity from rest to task performance. The application of cardiovascular measures to test motivational intensity theory's predictions draws on Wright's (1996) integration of the active coping approach (Obrist, 1981) with motivational intensity theory. Drawing on Obrist's demonstration that task engagement is associated with increased myocardial beta-adrenergic (sympathetic) activity, Wright suggested that beta-adrenergic-driven cardiovascular measures are associated with effort mobilization and enable tests of motivational intensity theory's effort-related predictions. Most of the research on the theory has assessed heart rate (HR), systolic blood pressure (SBP), and diastolic blood pressure (DBP) to test the theory's predictions. Among these three cardiovascular parameters, SBP is supposed to be the most directly linked to myocardial beta-adrenergic activity (Wright, 1996), and, consequently, research has mainly relied on SBP reactivity to test motivational intensity theory's predictions (Richter et al., 2006; Wright and Kirby, 2001, for reviews).

However, recent research on motivational intensity theory has acknowledged the limits of SBP as an indicator of myocardial beta-adrenergic activity (e.g., Richter et al., 2008; Richter and Gendolla, 2009b). Increased myocardial beta-adrenergic activity increases the speed and the force of myocardial contraction (e.g., Berne and Levy, 1977). Correspondingly, increased beta-adrenergic activity results in increased HR and increased stroke volume (the amount of blood ejected with a single heart beat). By this means, increased myocardial beta-adrenergic activity leads to increased cardiac output, which in turn elevates blood pressure. However, this beta-adrenergic effect on blood pressure can be masked by changes in total peripheral resistance—the second major determinant of blood pressure. Moreover, parasympathetic activity also exerts an impact on cardiac output and blood pressure by affecting heart rate. Beta-adrenergic effects on blood pressure may thus not only be masked by changes in total peripheral resistance but also by changes in parasympathetic activity. Furthermore, changes in total peripheral resistance or changes in parasympathetic activity may lead to changes in blood pressure that resemble beta-adrenergic effects.

To overcome these problems of blood pressure as an indicator of myocardial sympathetic activity, recent research on motivational intensity theory (e.g., Annis et al., 2001; Richter et al., 2008; Richter and Gendolla, 2009b) has employed pre-ejection period (PEP)—the time interval between the beginning of the electrical excitation of the left ventricle and the opening of the aortic valve—as an indicator of beta-adrenergic activity. PEP reflects the force of myocardial contraction and constitutes probably the best non-invasive indicator of myocardial sympathetic activity that is available (e.g., Harris et al., 1967; Newlin

[1] This perspective has also been adopted by the mood–behavior model that constituted the theoretical framework of Gendolla and colleagues' studies on unfixed performance standards.

[2] In one of Gendolla and Krüsken's studies on unfixed performance standards (Gendolla and Krüsken, 2002b, Study 2), the participants rated the importance of a good outcome—in addition to performing practice trials and to indicating their ability to perform well. However, given that the findings did not differ from the other studies on unfixed performance standards, we regard it as likely that task demand was—despite the good outcome importance rating—more salient than success importance in this study.