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Monetary incentive moderates the effect of implicit fear on effort-related cardiovascular response

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ABSTRACT

Integrating the implicit-affect-primes-effort model (Gendolla, 2012, 2015) with the principles of motivational intensity theory (Brehm & Self, 1989) we investigated if the effort mobilization deficit observed in people exposed to fear primes (vs. anger primes) in a difficult short-term memory task could be compensated by high monetary incentive. Effort was operationalized as cardiac response. We expected that fear primes should lead to the strongest cardiac pre-ejection period (PEP) reactivity when incentive was high (high subjective demand and high justified effort) and to the weakest response when incentive was low (high subjective demand but only low justified effort). PEP reactivity in the anger-prime conditions should fall in between (high but feasible demand). We obtained the predicted pattern on responses of PEP and systolic blood pressure. The present findings show for the first time that the effort mobilization deficit of participants exposed to fear primes in a difficult cognitive task could be compensated by a high incentive.

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1. Introduction

Research on the implicit-affect-primes-effort (IAPE) model (Gendolla, 2012, 2015), has yielded growing evidence for the systematic impact of implicitly processed affective stimuli on effort-related cardiac response. It was found that processing sadness- or fear-primes in moderately difficult cognitive tasks led to stronger cardiac response than processing happiness- or anger-primes (e.g., Chatelain & Gendolla, 2015; Gendolla & Silvestrini, 2011; Lasauskaite, Gendolla, & Silvestrini, 2013). Beside these simple affect prime effects, it was also found that implicit affect's impact is not stable and can be moderated by task context variables, such as objective difficulty (Chatelain, Silvestrini, & Gendolla, 2016; Freydefont, Gendolla, & Silvestrini, 2012; Lasauskaite Schüppbach, Gendolla, & Silvestrini, 2014; Silvestrini & Gendolla, 2011c) and success incentive (Freydefont & Gendolla, 2012, see also Silvestrini, 2015). Accordingly, affect priming effects on effort are highly context-dependent. The present study aimed at testing if the previously found effort mobilization deficit shown by people performing a difficult task while being exposed to implicitly processed fear primes could be eliminated by high success-contingent incentive.

The IAPE model (Gendolla, 2012, 2015) posits that people acquire knowledge about emotions that is stored in long-term memory. That is, people develop emotion concepts (Niedenthal, 2008). In this process people learn to associate different affective states with performance ease or difficulty, which is typically experienced when they perform tasks in those states. Consequently, ease or difficulty become features of the mental representations of different emotions. Making the idea of "ease" or "difficulty" accessible as features of emotion concepts during task performance should result in experiences of low vs. high task demand. This, in turn, should influence effort mobilization according to the principles of motivational intensity theory (Brehm & Self, 1989): effort rises with subjective demand as long as success is possible and the necessary effort to succeed is justified.

More specifically, the IAPE model posits that happiness and anger are associated with ease whereas fear and sadness are associated with difficulty. This happens, because people make the experience that performing tasks in a happy mood appears to be easier than in a sad mood (see Gendolla & Brinkmann, 2005; Gendolla, Brinkmann, & Silvestrini, 2012). Moreover, anger is linked with high control and high coping potential whereas fear is linked with low control and low coping potential (Lerner & Keltner, 2001).

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Consequently, people should learn to associate anger with ease and fear with difficulty.

1.1. Evidence for implicit affect effects on effort-related cardiac response

A number of studies have supported the IAPE model ideas, showing simple affect prime effects on effort-related cardiac response—especially cardiac pre-ejection period (PEP), which is the time interval between ventricular excitation and the opening of heart's left ventricular valve in a cardiac cycle (Berntson, Lozano, Chen, & Cacioppo, 2004). As expected, processing very briefly flashed sadness or fear expressions led to stronger PEP reactivity in attention or short term memory tasks than processing happiness- or anger-primes (e.g., Chatelain & Gendolla, 2015; Gendolla & Silvestrini, 2011; Lasauskaite et al., 2013).

Further studies have found that objective task difficulty moderates these simple affect prime effects on effort-related cardiac response according to the principles of motivational intensity theory (Brehm & Self, 1989). In objectively easy tasks, sadness- and fear-primes lead to higher effort mobilization than happiness- or anger-primes. By contrast, happiness- and anger-primes result in stronger cardiac reactivity than sadness and fear primes in objectively difficult tasks (e.g., Chatelain et al., 2016; Freydefont et al., 2012; Lasauskaite Schüppbach et al., 2014; Silvestrini & Gendolla, 2011c; see also Blanchfield, Hardy, & Marcora, 2014). These effects were predicted, because the information about objective difficulty and the activation of the ease and difficulty concepts by the affect primes should have an additive effect on subjective demand during performance. Consequently, in an easy task, sadness- and fear-primes should result in higher effort than anger- or happiness-primes, because subjective demand is high in the former priming conditions. By contrast, in difficult tasks, anger- and happiness-primes should lead to higher effort than sadness- and fear-primes, because the former result in high but feasible subjective demand, while the latter lead to excessive subjective demand, resulting in disengagement. That is, in objectively difficult tasks, implicit sadness and fear result in an effort-mobilization deficit.

The moderator effects of objective task difficulty on affect primes' effects on effort—related cardiac response accord with the principles of motivational intensity theory (Brehm & Self, 1989) in that effort rises with demand as long as success is possible and justified. However, if these principles really fit, justifying the necessary high subjective effort of people exposed to fear- and sadness-primes in a difficult task should eliminate the effort mobilization deficit and boost effort. Freydefont and Gendolla (2012) tested this idea by manipulating incentive by promising monetary reward for success on an objectively difficult short-term memory task during which participants processed sadness vs. anger primes. As expected, high incentive could eliminate the effort-mobilization deficit of people primed with sadness during the difficult task. Most relevant, the strongest PEP response occurred in the sadness-prime/high-incentive condition. Here, the high incentive justified the subjectively necessary high effort and could eliminate the effort mobilization deficit of people primed with sadness. A corresponding effect of high incentive was recently reported by Silvestrini (2015) for the impact of primed pain on effort-related cardiovascular response. Moreover, the weakest PEP response was found in the sadness-prime/low-incentive condition, reflecting disengagement because the subjectively high necessary effort was not justified. The two anger-prime conditions fell in between these cells. This was anticipated, because implicit anger should have set subjective demand to a high but feasible level. Consequently, it was not necessary to justify higher effort and incentive had no effect. The major aim of the present research was testing if high incentive could also eliminate the effort mobilization deficit of people primed with fear during an objectively difficult task (see Chatelain et al., 2016).

1.1.1. Effort-related cardiovascular response

Wright (1996) has integrated motivational intensity theory (Brehm & Self, 1989) with Obrist's (1981) active coping approach from psychophysiology. This led to the prediction that ß-adrenergic sympathetic impact on the heart responds proportionally to the level of subjective task demand as long as success is possible and justified. The best noninvasive measure of ß-adrenergic activity impact is cardiac PEP—the time interval between ventricular excitation and the opening of heart's left ventricular valve in a cardiac cycle (Berntson et al., 2004). PEP is a cardiac contractility index. It becomes shorter with stronger contractility of the heart. Existing data support Wright's integrative hypothesis that PEP sensitively responds to variations in experienced task demand (Richter, Friedrich, & Gendolla, 2008), incentive value (Richter & Gendolla, 2009), and combinations of both (Silvestrini & Gendolla, 2011a). However, to assure that PEP responds as a function of ß-adrenergic sympathetic impact rather than preload (ventricular filling) or afterload (arterial pressure) effects, blood pressure and heart rate (HR) should always be assessed together with PEP (Sherwood et al., 1990).

Several other studies have operationalized effort as reactivity of systolic blood pressure (SBP) – the maximal vascular pressure in a pulse wave – because SBP is systematically influenced by cardiac contractility (Gendolla & Richter, 2010; Wright & Kirby, 2001). However, SBP and diastolic blood pressure (DBP) are also influenced by peripheral vascular resistance, which is not systematically influenced by ß-adrenergic impact and can be masked by it (Levick, 2003). Still, some other studies have used HR as measure of effort (e.g., Eubanks, Wright, & Williams, 2002). But HR is influenced by both sympathetic and parasympathetic nervous system activity, and should only reflect effort mobilization to the degree to which the sympathetic impact is stronger (Berntson, Cacioppo, & Quigley, 1993). Thus, PEP is the most valid and reliable indicator of effort mobilization among these parameters (Kelsey, 2012).

1.1.2. The present experiment

To better understand the moderation of affect primes' effect on effort-related cardiac response by task context variables, the present experiment tested if the effort mobilization deficit observed when people implicitly process fear-primes during an objectively difficult cognitive task could be eliminated by high success-contingent monetary incentive. Finding support for this effect would further sustain the idea that affect prime effects on effort-mobilization are context-dependent rather than fixed. In addition, we aimed at providing further evidence that affect prime effects are emotion-category specific rather than valence-specific (e.g., Chatelain & Gendolla, 2015; Chatelain et al., 2016; Freydefont & Gendolla, 2012; Freydefont et al., 2012). Therefore we investigated the effects of primes of two negative emotions, which are highly arousing—but which can lead to different patterns of physiological activation (see Kreibig, 2010 for a review): Participants worked on an objectively difficult version of a short-term memory task (Sternberg, 1966) during which they processed very briefly flashed facial expressions of fear vs. anger. To manipulate success incentive, participants expected a low vs. high monetary reward for successful performance. Our predictions, which are depicted in Fig. 1, were based on the integration of the IAPE model (Gendolla, 2012, 2015) with the principles of motivational intensity theory (Brehm & Self, 1989).

In the low-incentive condition, depicted in Panel A of Fig. 1, we expected the weakest PEP response in the fear-prime condition, because the subjectively high necessary effort was not justified, resulting in disengagement. Effort in the anger-prime condition

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