International Journal of Psychophysiology 119 (2017) 79–86

Contents lists available at ScienceDirect

International Journal of Psychophysiology

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

Implicit activation of the aging stereotype influences effort-related cardiovascular response: The role of incentive☆

Athina Zafeiriou, Guido H.E. Gendolla *

University of Geneva, Switzerland

ARTICLE INFO

Article history:
Received 5 December 2016
Received in revised form 21 January 2017
Accepted 24 January 2017
Available online 26 January 2017

Keywords:
Effort
Cardiovascular
Priming
Aging stereotype
Incentive

ABSTRACT

Based on previous research on implicit effects on effort-related cardiovascular response and evidence that aging is associated with cognitive difficulties, we tested whether the mere activation of the aging stereotype can systematically influence young individuals' effort-mobilization during cognitive performance. Young participants performed an objectively difficult short-term memory task during which they processed elderly vs. youth primes and expected low vs. high incentive for success. When participants processed elderly primes during the task, we expected cardiovascular response to be weak in the low-incentive condition and strong in the high-incentive condition. Unaffected by incentive, effort in the youth-prime condition should fall in between the two elderly-prime cells. Effects on cardiac pre-ejection period (PEP) and heart rate (HR) largely supported these predictions. The present findings show for the first time that the mere activation of the aging stereotype can systematically influence effort mobilization during cognitive performance—even in young adults.

1. Introduction

We are living in a complex social environment in which people must adapt by finding cognitive tools helping them to simplify their perception, judgments, and actions. Social *stereotypes* are such a cognitive tool—they are mental representations of groups of people that reflect beliefs about group members' characteristics (see McGarty et al., 2002). Most likely, stereotypes' function is to preserve resources and organize our perception of the complex social reality (Macrae et al., 1994).

A typical and strong stereotype in the Western culture is the negative aging-stereotype—the idea that aging is associated with a decline in cognitive efficiency (Harada et al., 2013). Most Western people associate aging with cognitive difficulties (Cuddy et al., 2005; Cuddy and Fiske, 2002; Kite and Wagner, 2002; Kite et al., 2005). Moreover, aging research has shown that older people indeed mobilize more effort in cognitive tasks, mirrored by stronger cardiovascular reactivity, than younger people to attain the same level of cognitive performance (Smith and Hess, 2015). Correspondingly, older people experience higher subjective task demand and show stronger effort-related cardiovascular response than younger individuals if they perform cognitive challenges of the same objective task difficulty level (Hess et al., 2016). Aging effects on subjective task demand are even stronger among elderly suffering from mild cognitive impairment, leading already to disengagement due to excessive subjective demand in objectively easy cognitive tasks (Stewart et al., 2016).

Based on the evidence that aging is associated with cognitive difficulties and that most people in the Western culture believe that this is a general effect, the basic idea of the present research was that the implicit activation of the aging stereotype can systematically influence effort-related cardiovascular response when people are confronted with a cognitive challenge. Extending previous research, we posit that not only biological aging is associated with cognitive difficulties and resulting effects on effort (Smith and Hess, 2015; Hess et al., 2016), but that the mere activation of the aging stereotype should have a similar effect—even in young people. The reason for our hypothesis is that cognitive difficulties are a central feature of the aging stereotype and that the implicit activation of this stereotype should render the performance difficulty concept accessible. This should in turn augment experienced task demand and affect effort during cognitive performance.

Our hypothesis is grounded in a recent research program on the impact of the implicit activation of emotion stereotypes on cognitive effort that was guided by the Implicit-Affect-Primes-Effort (IAPE) model (Gendolla, 2012, 2015). Accordingly, people acquire knowledge about emotions that is stored in long-term memory—they develop emotion concepts (Niedenthal, 2008). People learn that the experience of performance ease or difficulty is typical for different affective states. For example, people learn that coping with a challenge is easier in a happy mood than in sad mood (see Gendolla and Brinkmann, 2005). Likewise, people learn that performance is relatively easy when one is angry, but relatively difficult when one is fearful. The reason is that anger is associated

☆ Author note: This research was supported by a grant from the Swiss National Science Foundation (SNF 100014-140251) awarded to the second author. We thank Tiziana Rao for her help as hired experimenter.

* Corresponding author at: Geneva Motivation Lab, FPSE, Section of Psychology, University of Geneva, 40, Bd. du Pont-d'Arve, CH-1211 Geneva 4, Switzerland.
E-mail address: guido.gendolla@unige.ch (G.H.E. Gendolla).

http://dx.doi.org/10.1016/j.ijpsycho.2017.01.011
0167-8760/

with the experience of high coping potential (i.e. subjective ability), while fear is associated with low coping potential (Lerner and Keltner, 2001). That way, ease and difficulty become features of the mental representations of different emotions, which can become accessible by affect primes—implicitly processed affective stimuli. Effort can then be influenced, because effort mobilization is grounded in a resource conservation principle: People mobilize effort proportionally to subjective demand—but only as long as success is possible and the necessary effort is justified (Brehm and Self, 1989).

Several studies have supported this systematic impact of implicitly processed affect primes on effort-related cardiovascular response in cognitive tasks (e.g., Chatelain and Gendolla, 2015; Freydefont and Gendolla, 2012; Gendolla and Silvestrini, 2011; Lasauskaite et al., 2013). The present research applied a similar logic to explain how the aging stereotype can influence effort mobilization. Accordingly, cognitive performance difficulty should be a central feature of Western individuals' mental representation of the elderly—the aging stereotype. Activating the aging stereotype by implicitly processed aging primes during cognitive performance should render the performance difficulty concept accessible and thus increase experienced task demand and effort—but only as long as success is possible and justified.

1.1. Effort-related cardiovascular response

Integrating the predictions of motivational intensity theory (Brehm and Self, 1989) with the active coping approach (Obrist, 1981), Wright (1996) posited that β-adrenergic sympathetic impact on the heart responds proportionally to the level of experienced task demand as long as success is possible and justified. The purest non-invasive measure of β-adrenergic impact is cardiac pre-ejection period (PEP)—the time interval between the beginning of left ventricular excitation and the opening of the left ventricular cardiac valve in a cardiac cycle (Berntson et al., 2004). PEP reflects the force of myocardial contractility—it becomes shorter with stronger contractility of the heart's left ventricle. Supporting Wright's integrative hypothesis, studies have shown that PEP sensitively responds to variations in experienced task demand (e.g., Richter et al., 2008), incentive value (e.g., Richter and Gendolla, 2009), and combinations of both (e.g., Silvestrini and Gendolla, 2011a).

Several studies have also operationalized effort as response of systolic blood pressure (SBP)—the maximal pressure in the vascular system between two heart beats—which is systematically influenced by cardiac contractility through its impact on cardiac output (see Gendolla and Richter, 2010; Wright and Gendolla, 2012; Wright and Kirby, 2001). However, SBP is also influenced by peripheral vascular resistance, which is not systematically influenced by β-adrenergic impact (Levick, 2003). That is, SBP can mirror effort, but PEP is the more sensitive measure. The same applies to an even stronger degree to diastolic blood pressure (DBP)—the minimal arterial pressure between to heart beats. Still other studies have used heart rate (HR) to assess effort (e.g., Brinkmann and Gendolla, 2007; Eubanks et al., 2002; Gendolla, 1998). But given that HR is determined by both sympathetic and parasympathetic nervous system activity, it should reflect effort mobilization only when the sympathetic impact is stronger—which is not always the case (Berntson et al., 1993). Consequently, PEP is the most reliable and valid indicator of effort mobilization among these parameters (Kelsey, 2012).

1.2. Incentive as moderator of age prime effects on effort

Motivational intensity theory states that effort is mobilized proportionally to subjective demand—but only as long as success is possible and justified (Brehm and Self, 1989). Consequently, high incentive is needed to justify the high effort that appears to be necessary for a subjectively highly difficult task. Without high incentive, high demand should lead to effort withdrawal due to disengagement. Importantly, previous research has shown that the implicit activation of the difficulty concept by sadness or fear primes during an objectively difficult cognitive task in fact leads to effort withdrawal when no high success incentive is provided (Blanchfield et al., 2014; Chatelain et al., 2016; Freydefont et al., 2012; Lasauskaite Schüpbach et al., 2014; Silvestrini and Gendolla, 2011b). However, high success incentive could eliminate this effort mobilization deficit and boosted effort-related cardiovascular response (Chatelain and Gendolla, 2016; Freydefont and Gendolla, 2012). Extending this effect, Silvestrini (2015) found that high incentive also increased effort-related cardiovascular responses of participants who implicitly processed pain-primes during a difficult cognitive task. The present experiment tested if the same would apply to the effect of elderly primes.

1.3. The present experiment

Extending the IAPE model logic (Gendolla, 2012, 2015) to the effect of age primes on effort mobilization, we tested whether high monetary incentive could eliminate the expected effort-mobilization deficit of young individuals who process elderly-primes during an objectively difficult cognitive task—similarly as it was previously found for implicitly processed sadness-primes (Freydefont and Gendolla, 2012), fear-primes (Chatelain and Gendolla, 2016), or pain-primes (Silvestrini, 2015). As outlined above, effort was operationalized as performance-related cardiovascular response, especially cardiac PEP.

Participants worked on an objectively difficult version of a short-term memory task (Sternberg, 1966) during which they processed very briefly presented pictures of faces of elderly vs. young individuals. To manipulate success incentive, participants expected a low vs. high monetary reward for success. With the prime manipulation, we expected to activate participants' related cognitive representations—the stereotype related to elderly people (aging stereotype) and that related to young people (youth stereotype). Evidence from the literature discussed above on the aging stereotype allows us to posit a link between the elderly primes and accessibility of the concept of difficulty. For the youth primes this is less clear. We think that cognitive performance ease should be a feature of the youth stereotype, but in contrast to the elderly-difficulty link, we are not aware of any reported evidence that youth is clearly associated with performance ease. Our predictions are depicted in Fig. 1.

In the low-incentive condition, depicted in Panel A of Fig. 1, we expected the weakest effort-related cardiovascular response in the elderly-prime condition, because the low incentive did not justify the subjectively high necessary effort, resulting in disengagement. We assumed that effort in the youth-prime condition should be higher, because the task should appear as difficult but still feasible since youth is not associated with cognitive performance difficulties. By contrast, as depicted in Panel B of Fig. 1, high incentive should boost effort-related cardiovascular response in the elderly prime condition by justifying the very high subjectively necessary effort, leading to the strongest effort. In the youth-prime condition, we expected lower effort, because the task should still appear as feasible. Consequently, incentive should have no effect in the youth-prime condition, because here it was not necessary to justify the necessary effort. Taken together, we predicted effort-related cardiovascular response to be the weakest in the elderly-prime/low-incentive condition and the strongest in the elderly-prime/high-incentive condition. Unaffected by incentive, effort in the youth-prime condition should fall in between the two elderly-prime cells.

2. Method

2.1. Participants and design

We aimed at collecting valid data of at least 20 participants per condition (see Simmons et al., 2011). Therefore, 89 university students from different disciplines (51 women, 38 men, mean age 25 years)