Original Papers

Polish Psychological Bulletin
2018, vol. 49(1) 59–65
DOI - 10.24425/119472

*Guido H.E. Gendolla**

Implicit Affect and the Intensity of Motivation: From Simple Effects to Moderators[1]

Abstract: *This article reports findings from a program of research on the systematic influence of implicitly perceived facial expressions of emotions on effort mobilization in cognitive tasks. Recently published research on the implicit-affect-primes-effort (IAPE) model (Gendolla, 2012) has revealed replicated evidence for this effect: implicitly perceived facial expressions of sadness, anger, fear, and happiness influence effort-related cardiac response during cognitive performance. In further support of the IAPE model, those studies revealed that the effects of implicitly processed emotional expressions on effort mobilization differ systematically: Implicit fear and sadness expressions that are processed online during task performance render tasks subjectively more difficult, resulting in relatively high effort. Implicit happiness and anger expressions have the opposite effect. Moreover, objective task difficulty and incentive moderated the effect of implicit affect, and especially controlled processing of affect primes turned out to be a boundary condition.*

Keywords*: Implicit Affect, Effort, Automaticity, Cardiovascular Response*

Introduction

Let me start with an anecdote. During the playoffs of the 2014 soccer world-championship, I was in Amsterdam the day the Netherlands lost their half-final match against Argentina. During a talk I gave the next day, the audience agreed that working life in the Netherlands would feel relatively hard after the defeat and that most people had to mobilize more effort than usual to do their work. Moreover, there was agreement that working life must have felt much easier in Germany two days earlier – after the German team had easily defeated Brazil and qualified for the final. Why is this of interest here?

Soccer matches, especially important ones, elicit strong affective states in many people – which in turn influence their judgments and behavior. Studying such motivational effects of affective *experiences* has been a major research topic of our laboratory for a long while (Gendolla, 2000; Gendolla, Brinkmann, & Silvestrini, 2012). However, there is one important point in my anecdote, which is the reason for using it to introduce this article: People in the Amsterdam audience had clear *ideas* about the link between affective states and experienced task demand. They had even ideas about this link in people living in a different country – Germany. That is, they had *emotion knowledge* (see Niedenthal, 2008) – mental *representations* of affective states and how they function. The core idea of this article is that the mere activation of emotion knowledge by implicitly perceived stimuli is sufficient to systematically influence behavior.

The central concept in this analysis is *implicit affect.* It describes the automatic, unintentional activation of individuals' mental representations of affective states (e.g., Quirin, Kazén, & Kuhl, 2009) without the explicit experience of these states. To explain how implicit affect can influence behavior, this article focuses on a recent theory (Gendolla, 2012) and research on how the implicit activation of emotion knowledge influences effort – the mobilization of resources for instrumental behavior (Gendolla & Wright, 2009), which refers to the intensity

* **Section of Psychology, University of Geneva, Switzerland**

Corresponding author: Guido H.E. Gendolla, Geneva Motivation Lab, FPSE, Section of Psychology, University of Geneva, 40, Bd. du Pont-d'Arve, CH-1211 Geneva 4, Switzerland; Telephone: +41 22 379 92 31, Fax: +41 22 379 92 16. E-mail: guido.gendolla@unige.ch

The research reported in this chapter was made possible by grants from the Swiss National Science Foundation (100014-122604, 100014-131760, 100014-140251, 100014-162399) awarded to the author.

[1] This article is based on an invited Keynote at the *Conference on Motivation and Social Perception*, at Gdansk, Poland, in July 2016.

aspect of motivation. I will focus on recently published work on implicit fear that has not been discussed in previous summaries of our research (e.g., Gendolla, 2015). In addition to this, I will highlight variables that moderate implicit affects' impact on effort mobilization.

Implicit Affect and the Intensity of Motivation

Implicit affect refers to the automatic activation of *emotion concepts* (Niedenthal, 2008) – knowledge about affective states that is stored in individuals' long term memory. The activation of implicit affect works according to general principles of knowledge activation – priming. Thus, the effect of affect knowledge on behavior depends on its *availability*, *accessibility*, and *applicability* (see Förster & Liberman, 2007). The basic idea of the present analysis is that performance *ease* or *difficulty* are features of individuals' mental representation of different affective states. Making the ease or difficulty concepts mentally accessible during task performance will influence the level of experienced task demand, and thus – within certain limits – effort mobilization.

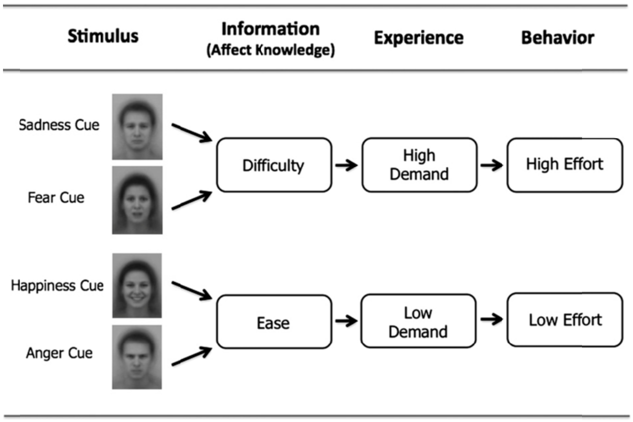
The Implicit-Affect-Primes-Effort (IAPE) Model

In brief, the implicit-affect-primes-effort (IAPE) model (Gendolla, 2012) postulates that implicitly processed affective stimuli (e.g., facial expressions, emotion words, etc.) can influence subjective demand and thus effort by rendering information about performance ease or difficulty accessible. People acquire knowledge about affective states and learn that coping with challenges is easier in some affective states than in others. That way performance ease and difficulty become *available* features of individuals' mental representations of different affective states – their emotion concepts. Making this available information *accessible* during task performance leads to experiences of low or high task demand, because thoughts about ease and difficulty are *applicable* to evaluations of task difficulty. Experienced task demand then determines the effort people mobilize 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 is justified. The basic process of implicit affect's impact on effort mobilization is depicted in Figure 1.

Evidence that experienced sad and happy moods influence subjective demand and effort mobilization (see Gendolla & Brinkmann, 2005; Gendolla et al., 2012 for more extensive reviews) suggests that people should learn that performing tasks is subjectively more demanding in a sad mood than in a happy mood. That way, ease should become a feature of their mental representation of happiness, while difficulty should turn into a feature of people's sadness concept. People should also learn to associate fear with difficulty and anger with ease. Anger, in contrast to fear, is typically linked with high optimism, positive expectations, and experiences of high coping potential (Lerner & Keltner, 2001). In the context of task performance, high coping potential (or ability) reduces the

Figure 1. The basic assumptions of the IAPE model

The Figure shows the general effect of implicit affect on effort mobilization if no further context variables are manipulated. The emotional expression pictures stem from the Averaged Karolinska Directed Faces (AKDEF) database (Lundqvist and Litton, 1998). The Figure is adopted from Gendolla (2012). Copyright: Elsevier (both reprinted with permission).



level of experienced difficulty (see Wright, 1998). Thus, implicit anger should render subjective demand relatively low. The opposite applies to fear: Here, coping potential is typically low and consequently, implicit activation of the fear concept during task performance should increase subjective demand (see Lerner & Keltner, 2001; Scherer, 1993; Smith & Lazarus, 1990).

In summary, the IAPE model posits that sadness and fear are associated with difficulty, while happiness and anger are linked to ease, and that accessibility of the ease and difficulty concepts during task performance will influence effort mobilization. The theory is, however, not limited to these exemplary emotions and can be applied to the representation of any affective state that is associated with ease or difficulty. Before presenting empirical tests of the IAPE model, I will now briefly discuss basic conceptual and methodological issues of effort mobilization research.

Effort Mobilization: Basic Theory and Measurement

Following pioneering work by Gibson (1900), psychologists recognized early that resource mobilization follows a resource conservation principle (e.g., Ach, 1935; Hull, 1943; Tolman, 1932). Accordingly, organisms try and tend to mobilize just the resources that are necessary for goal attainment, but not more. Brehm (1975; Brehm, Wright, Solomon, Silka, & Greenberg, 1983) elaborated the resource conservation principle in his *motivational intensity theory*. Put into one sentence, this theory posits that *effort rises with subjective task difficulty as long as success is possible and the necessary effort is justified* (Brehm & Self, 1989). That is, effort should increase proportionally with subjective demand until (1) demand exceeds a person's abilities (i.e., success is impossible) or (2) the amount of necessary effort is not justified by success importance, which defines the level of *potential motivation* – the hypothetical maximum of justified effort (see Wright, 2008). If one of these limits is attained, effort should drop sharply to avoid the waste of resources.

In an important step forward, Wright (1996) integrated Brehm's motivational intensity theory with Obrist's (1981) active coping approach from psychophysiology, resulting in the important suggestion of an objective, physiological measure of effort mobilization. According to Wright's integrative analysis, beta-adrenergic sympathetic nervous system impact (reflecting activation) on the heart is proportional to experienced task demand as long as success is possible and the necessary effort is justified. Beta-adrenergic sympathetic impact becomes manifest in cardiac pre-ejection period (PEP) – a cardiac contractility measure defined as the time interval between the onset of left ventricular cardiac excitation and the opening of the aortic valve in a cardiac cycle (Berntson, Lozano, Chen, & Cacioppo, 2004). This time interval, which takes about 100 ms during rest, becomes shorter when beta-adrenergic impact increases.

Cardiac contractility can also systematically influence other indices of cardiovascular activity, like systolic blood pressure (SBP) – the maximal arterial pressure between two heartbeats (Brownley, Hurwitz, & Schneiderman, 2000). Both PEP and SBP respond to the level of experienced task demand (e.g., Richter, Friedrich, & Gendolla, 2008), incentive (e.g., Richter & Gendolla, 2009), and combinations of both variables (e.g., Silvestrini & Gendolla, 2011a). Thus, several studies have used SBP as index of effort (see Wrigth & Kirby, 2001). However, although performance-related changes in SBP are a suitable measure of effort mobilization, PEP is the purer and more sensitive effort measure. SBP is also determined by peripheral vascular resistance, which is independent from beta-adrenergic impact. Therefore, we used PEP reactivity as the main dependent variable reflecting effort mobilization in our research on the IAPE model. The *shorter* PEP becomes during performance in comparison to rest, the higher is the mobilized effort.

Implicit Affect and Effort: Empirical Evidence

To test the IAPE model predictions, we first assessed participants' baseline cardiovascular activity during rest and let them next work on cognitive tasks. During these tasks, we exposed them *online* to affect primes – briefly flashed and backward masked affective stimuli. Our first experiments (Gendolla & Silvestrini, 2011) tested the simple effects of implicit affect on effort-related cardiovascular response during moderately difficult attention and a short-term memory tasks. To activate implicit affect, very briefly flashed low resolution front perspective pictures of facial expressions of happiness, sadness, or anger appeared at the beginning of the experimental trials. As predicted, both experiments revealed stronger sympathetic nervous system impact on the heart when participants were primed with sadness. Compared with baseline activity during rest, PEP became shorter and SBP increased more in the sadness-prime condition than in both the happiness- and anger-prime conditions. Moreover, there was no evidence for affect prime effects on conscious affect, which was measured before and after the task, and task appraisals assessed after performance revealed higher subjective demand in the sadness-prime condition than in both the implicit anger and happiness cells. These studies provided the first evidence for implicit affect's systematic impact on effort mobilization as conceptualized in the IAPE model.

Follow-up studies replicated the effects of happiness- and anger primes on effort-related cardiovascular response. Additionally, these studies revealed that effects on effort were the strongest if the affect primes occurred relatively infrequently, preventing fast habituation (Silvestrini & Gendolla, 2011b). Moreover, forewarning participants about the primes' affective content did not moderate the prime effect. The latter finding further suggests that the affect primes influenced effort on the implicit level, without eliciting conscious affective feelings whose effect could be controlled or corrected (Lasauskaite Schüpbach, Gendolla, & Silvestrini, 2013).

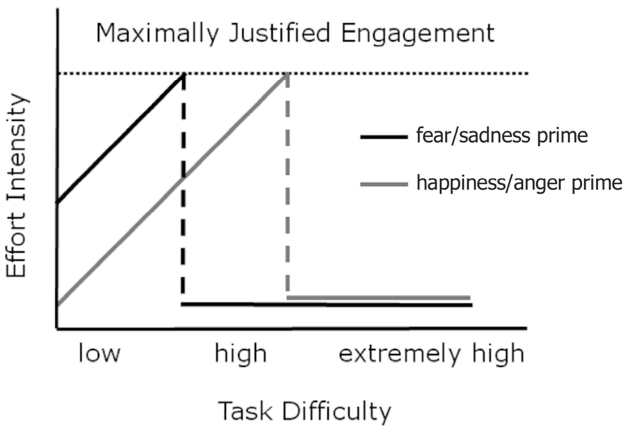
Two experiments by Chatelain and Gendolla (2015) extended the evidence for simple implicit affect prime effects on effort by studying the effects of implicit fear. In one experiment, participants were primed with fear, anger, or happiness during a moderately difficult short-term memory task. In further support of the IAPE model, participants' PEP responses during task performance were significantly stronger in the fear-prime condition than in both the anger- and happiness-prime cells. The second experiment administered a moderately difficult attention task and exposed participants to briefly flashed fear-, anger-, or sadness-primes. Note that these stimuli share the same negative valence, but that they should have different effects on effort mobilization: According to the IAPE model, both fear and sadness primes should activate the difficulty concept, resulting in relatively high effort, while anger-primes should activate the ease concept, leading to lower effort. Results were as expected: Both implicit fear and sadness led to stronger PEP responses than implicit anger. That is, as its basic effect, implicit fear intensified effort in moderately difficult tasks.

Task Difficulty as Moderator

The second wave of studies on implicit affects' impact on effort mobilization tested the idea that two task context variables – objective task difficulty and success incentive – can moderate the above discussed simple effect of affect primes on effort. This research was based on integrating the IAPE logic with the principles of effort mobilization outlined in motivational intensity theory (Brehm & Self, 1989): Effort rises proportionally to the level of subjective demand, but only as long as success is possible and the necessary effort is justified.

First, we studied how implicit affect interacts with objective task difficulty to influence subjective demand, which in turn determines effort. The basic idea was that, for complying with the resource conservation principle, people should pragmatically use all available and applicable information to evaluate task demand. When implicit affect is activated while people work on an objectively easy or difficult task, two sources of information about task demand can be considered that should have an additive effect on subjective demand: (1) Objective task difficulty and (2) mental content. The latter should be influenced by the availability of the ease or difficulty concepts. The resulting effort intensity is depicted in Figure 2.

Figure 2. Predicted effort intensity in dependence on implicit affect and objective task difficulty



In objectively easy tasks, sadness or fear primes should lead to higher effort than happiness or anger primes. However, in objectively difficult tasks, this pattern should turn around and processing anger or happiness primes should result in higher effort than sadness or fear primes. The reason is that sadness and fear primes should increase the subjective demand of an objectively easy task, resulting in relatively high effort because of high subjective demand. But the same primes should lead to low effort in objectively difficult tasks, because of disengagement due to excessive subjective demand. This effect of objective task difficulty should be inverted by happiness or anger primes. Priming happiness or anger in objectively easy tasks should lead to low effort due to low subjective demand. By contrast, these primes should result in high effort during objectively difficult tasks, because the subjective demand level should be high but still feasible.

Chatelain, Gendolla, and Silvestrini (2016) tested these predictions in an experiment. Participants worked a mental arithmetic task (adapted from Bijleveld, Custers, & Aarts, 2010) in which they decided about the correctness of arithmetic equations presented on a computer screen under objectively easy vs. difficult conditions: In the difficult condition participants had to respond under higher time pressure than in the easy condition. During performance, participants were exposed to briefly flashed facial expressions of fear vs. anger. As expected, when the task was objectively easy, fear primes led to higher effort in terms of stronger PEP reactivity than anger primes. But when the task was objectively difficult, implicit fear led to lower effort than implicit anger, as it was theoretically predicted (see Figure 2). This moderator effect on implicit affects' impact on effort mobilization corresponds to the results of other experiments that manipulated exposure to happiness- vs. sadness-primes (Silvestrini & Gendolla, 2011c; see also Blanchfield, Hardy, & Marcora, 2014) and anger- vs. sadness-primes (Freydefont, Gendolla, & Silvestrini, 2012) during objectively easy or difficult tasks. That is, objective task difficulty is a powerful moderator of implicit affects' impact on effort mobilization and its effects are easily predictable by applying the principles of motivational intensity theory.

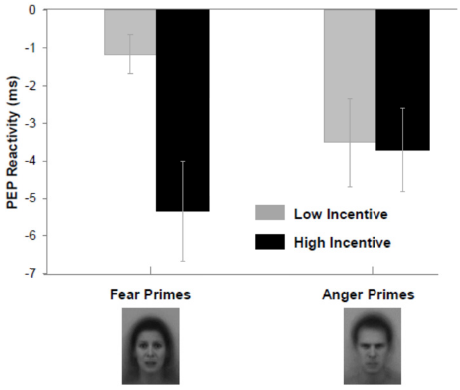
The Role of Success Incentive

The next moderator variable of implicit affect's effect on effort mobilization we investigated was success incentive. As discussed above, the Chatelain et al. (2016) experiment revealed a predicted effort mobilization deficit in participants who were primed with fear during an objectively difficult task: The high subjectively necessary effort was not justified, leading to disengagement to prevent the waste of resources. Applying the logic of motivational intensity theory suggests that high performance-contingent incentive should compensate this effort mobilization deficit. High incentive should justify the subjectively high necessary effort in this condition, leading to boosted resource mobilization instead of disengagement.

To test this idea, Chatelain and Gendolla (2016) primed participants with fear vs. anger expressions during an objectively difficult short term memory task and promised low vs. high monetary reward for success: In a low-incentive condition participants were promised 1 Swiss Franc for 90% correct responses in the task. By contrast, participants expected to earn 20 Swiss Francs for attaining the same performance standard in a high-incentive condition. We predicted the lowest effort in the fear-prime/low-incentive condition, because the subjectively high necessary effort was not justified, which should result in disengagement. This effect corresponds to the results in the above discussed study by Chatelain et al. (2016). Most relevant, high incentive should justify high effort. Therefore, we expected the highest effort in the fear-prime condition. In both incentive conditions, effort in the anger-prime condition should be lower, because of lower subjective demand. Here, justifying high effort was not necessary for preventing disengagement. Altogether, this led to the prediction that effort should be the lowest in the fear-prime/low-incentive condition and the strongest in the fear-prime/high-incentive condition. The anger-prime conditions should fall in between these cells. As depicted in Figure 3, results for PEP reactivity during task performance supported these predictions. SBP reactivity did so, too.

These findings correspond to those of three other studies, which also revealed that high monetary success incentive could eliminate the effort mobilization deficit of people working on an objectively difficult task while being primed with stimuli that should make the difficulty concept accessible. One experiment found evidence for priming sadness (vs. anger) (Freydefont & Gendolla, 2012). Moreover, extending our research on implicit influences on effort mobilization, Silvestrini (2015) found that high monetary incentive also increased effort-

Figure 3. Means and standard errors of cardiac pre-ejection period responses (in ms) during task performance in the experiment by Chatelain and Gendolla (2016)



related cardiovascular responses of participants who implicitly processed pain-related words vs. control words during a difficult cognitive task. Likewise, Zafeiriou and Gendolla (2017) found a corresponding effect of monetary incentive for implicitly processed aging (vs. youth) primes in a difficult task (see also Zafeiriou & Gendolla, 2018). Those studies extended the applicability of the IAPE model logic in that they reasoned that both pain and aging are associated with cognitive performance difficulties.

Summing up, applying the logic of motivational intensity theory permitted well working predictions for two task-context variables' moderator effects on implicit stimuli's impact on effort mobilization: Objective task difficulty and success incentive.

Prime Visibility: From Implicit to Controlled Prime Processing

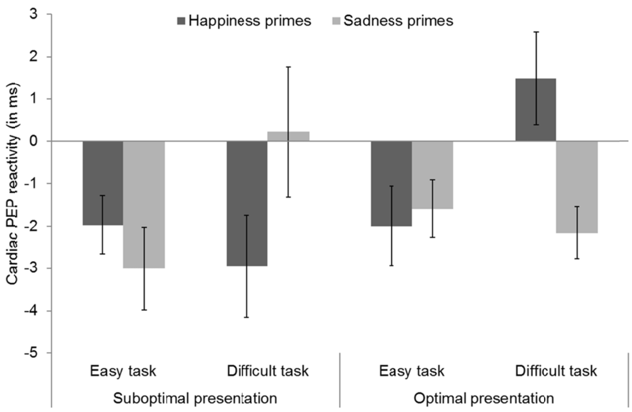
The studies discussed so far revealed replicated evidence that implicit affect systematically influences effort mobilization. Affect primes had the predicted effects when they were processed automatically, on the implicit level. This fits with approaches that suggest that automaticity functions especially if individuals regard their actually primed mental content as a valid basis for their behavior. This means that individuals have to be unaware that their thoughts have been influenced by external stimulation. Accordingly, Wheeler, DeMarree, and Petty (2007) have suggested that primes operate by influencing persons' current self-concept. Loersch and Payne (2011) posited that people must misattribute their primed mental content to their own thoughts instead of an external source. Under such conditions, judgments and behavior are usually assimilated to the accessible mental content – the typical priming effect. But what happens if primes are processed in an explicit, controlled way – for example, because they are clearly visible during a task?

An experiment by Lasauskaite Schüpbach, Gendolla, and Silvestrini (2014) investigated if clearly visible affect primes would have different effects on effort mobilization than hardly visible primes. We reasoned that our affect prime effects reported so far depended on unawareness of their content and influence. Prime awareness test in our experiments had never found evidence for the possibility that participants had been aware of the primes' affective content when they performed the cognitive tasks. We reasoned further that clearly visible and task irrelevant affective stimuli should induce suspicion and thus stimulate behavior correction. The result should be a significantly reduced or even reversed (i.e., contrast) effect of the primes, which can occur if external influences become aware (e.g., Herr, 1986).

Participants in the Lasauskaite et al. (2014) experiment worked on an objectively easy vs. difficult arithmetic task during which they were exposed to facial expressions of happiness vs. sadness. In a "suboptimal-prime-presentation" condition, the affect primes were very briefly flashed, as in the studies discussed so far. By contrast, in an "optimal-prime-presentation" condition, the appearing facial expressions were clearly visible. As presented in Figure 4, these manipulations yielded a significant three-way interaction on PEP reactivity, supporting the idea that clearly visible primes resulted in a prime contrast effect on effort.

Figure 4. Means and standard errors of cardiac pre-ejection period reactivity (in ms) during task performance in the experiment by Lasauskaite Schüpbach, Gendolla, and Silvestrini (2014)

"Suboptimal" primes were presented very briefly; "optimal" primes were clearly visible.



In both prime presentation conditions, effects in the difficult condition were stronger than in the easy condition—probably, because the easy condition was in fact very easy, leaving little space for prime effects on experienced demand during performance. However, when the primes were briefly flashed, their effect replicated the findings by Silvestrini and Gendolla (2011c): stronger PEP responses in the happiness-prime/difficult condition than in the sadness-prime/difficult condition. Most relevant, this effect was reversed in the optimal prime presentation condition. Recently, Framorando and Gendolla (2017) found that prime visibility was also a boundary condition for the effects of anger and fear primes on effort-related cardiac response. That is, conscious awareness of the primes and their content moderated their effect on effort mobilization (see also Chaillou, Giersch, Bonnefond, Custers, & Capa, 2015).

The deeper motivational reason for behavior correction effects as those reported here may rely in psychological reactance (Brehm, 1966). If people prefer autonomy and basically think that they act in accordance with their own decisions, they should dislike being manipulated (see Ryan & Deci, 2000). Visible primes that appear during a task without having anything to do with the task itself should elicit suspicion that one is manipulated. This should lead to behavior correction with the effect of attenuated prime effects – or even contrast effects in the case of overcorrection.

Conclusions

As discussed now, implicit affect's impact on effort mobilization can be manifold. We have found replicated support for the predictions of the IAPE model (Gendolla, 2012) in terms of simple affect prime effects on effort-related cardiovascular response. Activating the mental representations of different affective states seems indeed to make ideas about ease and difficulty accessible, which in turn determines task demand and effort. Aside from the here discussed findings on implicit affects' effect on effort mobilization, it is of note that a recent series of experiments by Lasauskaite, Gendolla, Bolmont, and Freydefont (2017) tested whether there are indeed automatically activated links between emotional stimuli and ease and difficulty concepts. These studies applied a sequential priming paradigm and have provided first evidence for automatically activated associative links between implicit affect and ease and difficulty. Accordingly, implicit sadness is indeed associated with difficulty and ease is linked to implicit happiness. Future studies will test for associative links between other emotions and ease and difficulty.

Beside the general effect of implicit affect on effort, the here discussed research also informs about moderator variables of automaticity – more specifically, automatic resource mobilization. We found evidence that implicit affect's impact could be moderated by task context variables, like objective task difficulty and success incentive. The effects of these moderator variables occurred systematically and were predictable by applying the principles of effort mobilization as outlined in motivational intensity theory (Brehm & Self, 1989). Additionally, implicit affect's influence on effort could be further moderated by affect primes' visibility that made a shift from automatic to controlled prime processing possible. This points our attention to controlled prime processing as a boundary condition of automaticity in general.

The identification of variables that moderate automaticity effects in behavior is of special importance. In a larger perspective, identifying moderator variables that have a systematic and thus predictable impact contributes to understanding when, why, and how automaticity functions. Without recognizing such moderators and their underlying psychological processes, one could only expect simple main effects of behavior priming procedures and conclude that automaticity is very fragile or does not really exist if such main effects do not occur (see Dijksterhuis, Van Knippenberg, & Holland, 2014; Locke, 2015). That is, besides providing insight into how implicit affect influences resource mobilization – the intensity aspect of behavior – the research discussed here on implicit affect's impact on effort mobilization has also important implications for better understanding automaticity in general.

References

Ach, N. (1935). *Analyse des Willens* [Analysis of the will]. Berlin, Germany: Urban & Schwarzenberg.

Berntson, G.G., Lozano, D.L., Chen, Y.-J., & Cacioppo, J.T. (2004). Where to Q in PEP. *Psychophysiology*, *41*, 333–337. doi: 10. 1111/j.1469-8986.2004.00156.x.

Bijleveld, E., Custers, R., & Aarts, H. (2010). Unconscious reward cues increase invested effort, but do not change speed–accuracy tradeoffs. *Cognition*, *115*, 330–335. doi: 10.1016/j.cognition.2009.12.012.

Blanchfield, A., Hardy, J., & Marcora, S. (2014). Non-conscious visual cues related to affect and action alter perception of effort and endurance performance. *Frontiers in Human Neuroscience*, *8*, 967. doi: 10.3389/fnhum.2014.0096

Brehm, J.W. (1966). *A theory of psychological reactance*. New York: Academic Press.

Brehm, J.W. (1975). *Research on motivational suppression*. Research Proposal submitted to the National Science Foundation. Department of Psychology, University of Kansas.

Brehm, J.W., & Self, E.A. (1989). The intensity of motivation. *Annual Review of Psychology*, *40*, 109–131. doi: 10.1146/annurev.ps.40. 020189.000545

Brehm, J.W., Wright, R.A., Solomon, S., Silka, L., & Greenberg, J. (1983). Perceived difficulty, energization, and the magnitude of goal valence. *Journal of Experimental Social Psychology*, *19*, 21–48. doi: 10.1016/0022-1031(83)90003-3

Brownley, K.A., Hurwitz, B.E., & Schneiderman, N. (2000). Cardiovascular psychophysiology. In: J.T. Cacioppo, L.G. Tassinary, and G.G. Berntson (Eds.), *Handbook of psychophysiology* (2nd ed.) (pp. 224–264). New York: Cambridge University Press.

Chaillou, A.C., Giersch, A., Bonnefond, A., Custers, R., & Capa, R.L. (2015). Influence of positive subliminal and supraliminal affective cues on goal pursuit in schizophrenia. *Schizophrenia Research*, *161*, 291–298. doi: 10.1016/j.schres.2014.10.052

Chatelain, M., & Gendolla, G.H.E. (2015). Implicit fear and effort-related cardiac response. *Biological Psychology*, *111*, 73–82. doi: 10.1016/j.biopsycho.2015.08.009

Chatelain, M., Silvestrini, N., & Gendolla, G.H.E. (2016). Task difficulty moderates implicit fear and anger effects on effort-related cardiac response. *Biological Psychology*, *115*, 94–100. doi: 10.1016/j.biopsycho.2016.01.01

Chatelain, M., & Gendolla, G.H.E. (2016). Monetary incentive moderates the effect of implicit fear on effort-related cardiovascular response. *Biological Psychology*, *117*, 150–158. doi: 10.1016/j.biopsycho.2016.03.014

Dijksterhuis, A., Van Knippenberg, A., & Holland, R.W. (2014). Evaluating behavior priming research: Three observations and a recommendation. *Social Cognition*, *32*(Special Issue), 196–208.

Förster, J., & Liberman, I. (2007). Knowledge activation. In: A.W. Kruglanski & E.T. Higgins (Eds.), *Social psychology: Handbook of basic principles* (2nd ed., pp. 201–231). New York, NY: Guilford.

Framorando, D., & Gendolla, G.H.E. (2017). *The effect of affect prime visibility on effort-related cardiovascular response.* Poster at the 29th Annual Convention of the Association for Psychological Science (APS) in Boston, MA, 26–29 May 2017.

Freydefont, L., Gendolla, G.H.E., & Silvestrini, N. (2012). Beyond valence: the differential effect of masked anger and sadness stimuli on effort-related cardiac response. *Psychophysiology*, *49*, 665–671. doi: 10.1111/j.1469-8986.2011.01340.x

Freydefont, L., & Gendolla, G.H.E. (2012). Incentive moderates the impact of implicit anger versus sadness cues on effort-relate cardiac response. *Biological Psychology*, *91*, 120–127. doi: 10.1016/j.biopsycho.2012.04.002.

Gendolla, G.H.E. (2000). On the impact of mood on behavior: An integrative theory and a review. *Review of General Psychology*, *4*, 378–408. doi: 10.1037/1089-2680.4.4.378

Gendolla, G.H.E. (2012). Implicit affect primes effort: A theory and research on cardiovascular response. *International Journal of Psychophysiology*, *86*, 123–135. doi: 10.1016/j.ijpsycho.2012.05.003

Gendolla, G.H.E. (2015). Implicit affect primes effort: Basic processes, moderators, and boundary conditions. *Social and Personality Psychology Compass*, *9*, 606–619. doi: 10.1111/spc3.1220

Gendolla, G.H.E., & Brinkmann, K. (2005). The role of mood states in self-regulation: Effects on action preferences and resource mobilization. *European Psychologist*, *10*, 187–198. doi: 10.1027/1016-9040.10.3.187

Gendolla, G.H.E., Brinkmann, K., & Silvestrini, N. (2012). Gloomy and lazy? On the impact of mood and depressive symptoms on effort-related cardiovascular response. In: R.A. Wright & G.H.E. Gendolla (Eds.), *How motivation affects cardiovascular response: Mechanisms and applications* (pp. 139–155). Washington DC: APA Press.

Gendolla, G.H.E., & Silvestrini, N. (2011). Smiles make it easier and so do frowns: Masked affective stimuli influence mental effort. *Emotion*, *11*, 320–328. doi: 10.1037/a0022593

Gendolla, G.H.E., & Wright, R.A. (2009). Effort. In: D. Sander & K.R. Scherer (Eds.), *The Oxford companion to emotion and the affective sciences* (pp. 134–135). New York, NY: Oxford University Press.

Gendolla, G.H.E., Wright, R.A., & Richter, M. (2012). Effort intensity: Some insights from the cardiovascular system. In: R.M. Ryan (Ed.), *The Oxford handbook on motivation* (pp. 420–438). New York, NY: Oxford University Press.

Gibson, W.R.B. (1900). The principles of least action as a psychological principle. *Mind*, *9*, 469–495. doi: 10.1093/mind/IX.36.469

Hull, C. (1943). *Principles of behavior*. New York, NY: Appleton-Century-Crofts.

Lasauskaite Schüppbach, R., Gendolla, G.H.E., & Silvestrini, N. (2013). Do sadness primes make me work harder, because they make me sad? *Cognition and Emotion*, *27*, 158–165. doi: 10.1080/02699931.2012.689756

Lasauskaite, R., Gendolla, G.H.E., & Silvestrini, N. (2014). Contrasting the effects of suboptimally versus optimally presented affect primes on effort-related cardiac response. *Motivation and Emotion*, *38*, 748–758. doi: 10.1007/s11031-014-9438-x

Lasauskaite, R., Gendolla, G.H.E., Bolmont, M., & Freydefont, L. (2017). Implicit happiness and sadness are associated with ease and difficulty: Evidence from sequential priming. *Psychological Research*, *81*, 321–331. doi: 10.1007/s00426-015-0732-3

Lerner, J.S., & Keltner, D. (2001). Fear, anger, and risk. *Journal of Personality and Social Psychology*, *81*, 146–159. doi: 10.1037/0022-3514.81.1.146

Locke, E.A. (2015). Theory building, replication, and behavioral priming: Where do we need to go from here? *Perspectives on Psychological Science*, *10*, 408–4414. doi: 10.1177/1745691614567231

Loersch, C., & Payne, B.K. (2012). On mental contamination: The role of (mis)attribution in behavior priming. *Social Cognition*, *30*, 241–252. doi:10.1521/ soco.2012.30.2.241

Niedenthal, P.M. (2008). Emotion concepts. In: M. Lewis, J.M. Haviland-Jones, & L.M. Barrett (Eds.), *Handbook of emotion* (3rd. ed., pp. 587–600). New York, NY: Guilford Press.

Obrist, P.A. (1981). *Cardiovascular psychophysiology: A perspective*. New York, NY: Plenum Press.

Quirin, M., Kazén, M., & Kuhl, J. (2009). When nonsense sounds happy or helpless: The Implicit Positive and Negative Affect Test (IPANAT). *Journal of Personality and Social Psychology*, *97*, 500–516. doi: 10.1037/a0016063

Richter, M., Friedrich, A., & Gendolla, G.H.E. (2008). Task difficulty effects on cardiac activity. *Psychophysiology*, *45*, 869–875. doi: 10.1111/j.1469-8986.2008.00688.x

Richter, M., & Gendolla, G.H.E. (2009). The heart contracts to reward: Monetary incentives and pre-ejection period. *Psychophysiology*, *46*, 451–457. doi: 10.1111/j.1469-8986.2009.00795.x

Ryan, R.M., & Deci, E.L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist*, *55*, 78–88. doi: 10.1037/0003-066X.55.1.68

Scherer, K.R. (2009). Coping potential (appraisal of). In: D. Sander & K.R. Scherer (Eds.). *The Oxford companion to emotion and the affective sciences* (pp. 103–104). New York, NY: Oxford University Press.

Schwarz, N., & Clore, G.L. (1988). How do I feel about it? The informative function of affective states. In: K.F. &. J.P. Forgas (Ed.), *Affect, cognition and social behavior* (pp. 44–62). Göttingen, Germany: Hogrefe.

Silvestrini, N., (2015). The effort-related cost of implicit pain. *Motivation Science*, *1*, 151–164. doi: 10.1037/mot0000020

Silvestrini, N., & Gendolla, G.H.E. (2011a). Beta-adrenergic impact underlies the effect of mood and hedonic instrumentality on effort-related cardiovascular response. *Biological Psychology*, *87*, 209–217. doi: 10.1016/j.biopsycho.2011.02.017

Silvestrini, N., & Gendolla, G.H.E. (2011b). Do not prime too much: Prime frequency effects of masked affective stimuli on effort-related cardiovascular response. *Biological Psychology*, *87*, 195–199. doi: 10.1016/j.biopsycho.2011.01.00

Silvestrini, N., & Gendolla, G.H.E. (2011c). Masked affective stimuli moderate task difficulty effects on effort-related cardiovascular response. *Psychophysiology*, *48*, 1157–1164. doi: 10.1111/j.1469-8986.2011.01181.x

Smith, C.A., & Lazarus, R.S. (1990). Emotion and adaption. In: L.A. Pervin (Ed.), *Handbook of personality* (pp. 609–637). New York, NY: The Guilford Press.

Tolman, E.C. (1932). *Purposive behavior in animals and men*. New York: The Century Co.

Wheeler, S.C., DeMarree, K.G., & Petty, R.E. (2007). Understanding the role of the self in prime-to-behavior effects: The active-self account. *Personality and Social Psychology Review*, *11*, 234–261. doi: 10.1177/1088868307302223

Wright, R.A. (1996). Brehm's theory of motivation as a model of effort and cardiovascular response. In: P.M. Gollwitzer & J.A. Bargh (Eds.), *The psychology of action: Linking cognition and motivation to behavior* (pp. 424–453). New York, NY: Guilford.

Wright, R.A. (1998). Ability perception and cardiovascular response to behavioral challenge. In: M. Kofka, G. Weary, & G. Sedek (Eds.), *Personal control in action: Cognitive and motivational mechanisms* (pp. 197–232). New York, NY: Guilford.

Wright, R.A. (2008). Refining the prediction of effort: Brehm's distinction between potential motivation and motivation intensity. *Social and Personality Psychology Compass*, *2*, 682–701. doi: 10.1111/j.1751-9004.2008.00093.x

Wright, R.A., & Kirby, L.D. (2001). Effort determination of cardiovascular response: An integrative analysis with applications in social psychology. *Advances in Experimental Social Psychology*, *33*, 255–307. doi: 10.1016/S0065-2601(01)80007-1

Zafeiriou, A., & Gendolla, G.H.E. (2017). Implicit activation of the aging stereotype influences effort-related cardiovascular response: The role of incentive. *International Journal of Psychophysiology*. doi: 10.1016/j.ijpsycho.2017.01.011

Zafeiriou, A., & Gendolla, G.H.E. (2018). Implicit aging: Masked age primes influence effort-related cardiovascular response in young adults. *Adaptive Human Behavior and Physiology*, *4*, 1–20. doi: 10.1007/s40750-017-0074-z