Emotion
2010, Vol. 10, No. 4, 593–598

1528-3542/10/$12.00 DOI: 10.1037/a0019009

The Prepared Emotional Reflex: Intentional Preparation of Automatic Approach and Avoidance Tendencies as a Means To Regulate Emotional Responding

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Advance preparation of action courses toward emotional stimuli is an effective means to regulate impulsive emotional behavior. Our experiment shows that performing intentional acts of approach and avoidance in an evaluation task influences the unintended activation of approach and avoidance tendencies in another task in which stimulus valence is irrelevant. For the evaluation-relevant blocks, participants received either congruent (positive-approach, negative-avoidance) or incongruent (positive-avoidance, negative-approach) mapping instructions. In the evaluation-irrelevant blocks, approach- and avoidance-related lever movements were selected in response to a stimulus feature other than valence (affective Simon task). Response mapping in the evaluation task influenced performance in the evaluation-irrelevant task: An enhanced affective Simon effect was observed with congruent mapping instructions; in contrast, the effect was reversed when the evaluation task required incongruent responses. Thus, action instructions toward affective stimuli received in one task determined affective response tendencies in another task where these instructions were not in effect. These findings suggest that intentionally prepared short-term links between affective valence and motor responses elicit associated responses without a deliberate act of will, operating like a "prepared reflex."

Keywords: approach and avoidance, emotion regulation, impulsive behavior control, implementation intention, prepared reflex

Essential to the regulation of emotion is the ability to override or change emotional behavioral tendencies and to refrain from acting on them. Such regulatory activities can take place by manipulating the antecedents as well as the consequences of emotions. Antecedent-focused emotion regulation refers to regulatory mechanisms that set in before the emotion response is generated (e.g., selective exposure to, behavioral modification of, and reappraisal of an emotion eliciting situation), whereas response-focused emotion regulation aims at a modulation of emotional responses after an emotion has been elicited (Gross, 2002). Several studies have demonstrated that people can effectively control emotional reactivity when furnished with appropriate behavioral intentions, even though often at the expense of increased energetic and cognitive effort (e.g., Baumeister, Bratslavsky, Muraven, & Tice, 1998; Richards & Gross, 2000).

Most experimental research on response-focused emotion regulation has investigated consequences of inhibiting ongoing emotion-expressive behavior on emotional responses. However, self-control typically involves not only a denial of behavioral impulses but also engaging in some act contrary to hedonistic tendencies (Tice & Bratslavsky, 2000). Examples are active avoidance of temptations (e.g., dieting), persisting on a difficult task, or biting the lip when feeling an urge to vent one's anger. These regulatory activities require a resistance to momentary hedonic impulses in the pursuit of a valued long-term goal.

Most accounts attribute such resistance to a deliberate (controlled, intentional, reflective, or explicit) route of action control that overrides hedonic impulses with executive control or "willpower" (e.g., Hofmann, Friese, & Strack, 2009; Metcalfe & Mischel, 1999). This action route is typically assumed to be effortful, being critically reliant on limited resources (Baumeister et al., 1998). In line with this assumption, studies have shown that impulsive reactions gain increasing control over behavior when cognitive resources like executive attention and inhibitory control are depleted (e.g., Hofmann, Friese, & Roefs, 2009; Logan, Schachar, & Tannock, 1997).

In addition to a deliberate control, there is some evidence for automated forms of emotion regulation (Bargh & Williams, 2007; Mauss, Bunge, & Gross, 2007). For instance, spider-phobics were able to effectively down-regulate fear responses when they were furnished with implementation intentions (i.e., if-then plans) to stay calm and relaxed in the presence of a spider (Schweiger Gallo, Keil, McCulloch, Rockstroh, & Gollwitzer, 2009; see also Gollwitzer, 1999). Thus, behavior intentions in the format "If the emotional Situation X is encountered, then I will perform Behavior Y" might be an effective means to override an impulsive emotional reaction with an alternative response set.

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We thank Stephanie Bauer, Konstantin Falk, Claudia Herold, Karolin Kempfert, and Michael Rost for their help in collecting the data.

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In the current article, we extend this idea to an automated elicitation of behavioral responses that are even antagonistic to emotional action tendencies. When an emotional situation is specified as a release condition for a specific behavioral response in advance (i.e., when an implementation intention is formed), we assume that a short-term association is created that instigates an automatic tendency to execute the associated response whenever the release condition is met. Thus, intentionally configured short-term associations are expected to trigger prepared responses in the specified situation without a proximate intention to do so—operating like a prepared reflex (Hommel, 2000).

In the present research, we tested this idea with respect to a strategic control of automatic approach and avoidance tendencies. Many experimental studies have shown that people habitually tend to approach positive and avoid negative stimuli (for a review see Elliot, 2008). For instance, when participants are instructed to respond to affective stimuli according to either a congruent (positive-approach, negative-avoidance) or incongruent mapping rule (positive-avoidance, negative-approach), responses are typically faster in the former than in the latter condition (e.g., Chen & Bargh, 1999). Such response facilitation is even observed when people are instructed to respond with approach and avoidance to a stimulus feature other than valence (the so-called affective Simon-task), making a strong case for an unintended activation of approach and avoidance tendencies (e.g., Krieglmeyer & Deutsch, in press).

Furnishing people with behavioral intentions to approach and avoid affective stimuli in one task is hence expected to elicit the prepared responses even in an unrelated task where those intentions are not in effect. A useful paradigm to investigate this hypothesis is the intermixing of a mapping task, which explicitly links affective valence to approach- and avoidance-related responses, with a Simon task, in which these responses are not directed to valence. In the mapping task, behavioral intentions are implanted through mapping instructions that could be either congruent or incongruent with habitual approach and avoidance tendencies. To the extent that individuals employ these intentions in the mapping task routinely, in a frequent and consistent manner, a temporary association between affective valence and responses should emerge that is expected to potentiate habitual action tendencies in the Simon task in the case of congruent but to weaken, or even reverse, these tendencies in the case of incongruent intentions. In line with this hypothesis, Zhang and Proctor (2008) have shown that intermixing congruent evaluations with saying "good" and "bad" enhances an affective Simon effect; in their study, however, intermixing evaluations with incongruent responses failed to reduce the affective Simon effect relative to a baseline condition, providing inconclusive evidence in support of short-term associations. In the present study, we therefore improved our design by presenting both tasks in blocks rather than in random trial order, and with a shift to a manual task that involves selection between approach- and avoidance-related lever movements.[1]

Experiment

Two classification tasks were presented in a clearly sequenced order: (a) an evaluation task (affective mapping task) that required explicit evaluative classifications of positive and negative pictures with approach- and avoidance-related lever movements according to either a congruent (positive-pull, negative-push) or incongruent (positive-push, negative-pull) mapping rule. (b) A nonaffective semantic categorization task (affective Simon-task), in which participants had to indicate as quickly as possible with identical lever movements whether a presented picture displayed a person or animal. Thus, valence was relevant in half of the blocks (evaluation task) but irrelevant in the other half (semantic categorization task), with no task switches within a block. Half of the participants received congruent mapping rules for the evaluation task (mixed-congruent condition), the other half incongruent valence-movement rules (mixed-incongruent condition). In addition to these mixed-conditions, a pure-Simon condition was realized that exclusively demanded person-animal decisions, and that provided a baseline for the affective Simon effects produced in the mixed-conditions.

With this experimental setup, we tested the following predictions: (a) an enhanced affective Simon effect (i.e., faster semantic decisions when the valence of the word corresponds with the valence of the movement) should be observed in the mixed-congruent condition, (b) and a reversed affective Simon effect was expected in the mixed-incongruent condition relative to the baseline-effect produced in the pure-Simon-condition. (c) Evaluative classifications should be faster with a congruent lever-movement mapping than with an incongruent lever-movement mapping, indicating habitual approach and avoidance tendencies.

Method

Participants. Sixty-five students (45 women) were randomly assigned to the mixed-tasks conditions. Thirty-two additional students (21 women) completed the pure-Simon condition.

Apparatus and stimuli. Participants were seated at a distance of 60 cm from a 17″ VGA color monitor with 70 Hz refresh rate. An IBM-compatible joystick was connected to the game port of the computer.

Response-imperative stimuli were 96 pictures that depicted either persons or animals, most of them selected from the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 2005). Half of the person and animal pictures portrayed negative scenes (e.g., mutilated body, attacking animal), the other half showed positive scenes (e.g., babies, puppies). The pictures were divided into two sets of 48 pictures each, with assignment to the tasks counterbalanced across participants. Two additional sets of 16 pictures were selected for task practice. The pictures were presented at the center of the screen at a visual angle of about 11.2° (±3.1°) in the horizontal and 11.4° in the vertical dimensions.

[1] As Proctor and Vu (2002) have argued, a vocal response set might induce a tendency to "name" the stimuli reacted to, even if an incongruent response is to be made in irrelevant trials. In the study of Zhang and Proctor (2008), a verbal coding of affective stimuli into "positive" and "negative" might thus have primed the corresponding vocal response under mixed conditions, counteracting a reversal of the Simon effect in the mixed-incongruent condition. With a manual response set, as used in the present research, participants are less likely to code the valences verbally, allowing for a more sensitive test for an influence of short-term associations.

Procedure

Participants were assigned to one of three conditions. In the pure-Simon condition, picture valence was irrelevant in all trials, and participants had to categorize the pictures semantically (person vs. animal) as quickly as possible with pushing and pulling lever movements. In the mixed conditions, participants additionally had to perform evaluative picture classifications, with both tasks alternating in blocks of trials. In the evaluation task of the mixed-congruent condition, participants were to indicate a positive picture with a lever pull toward the body (approach) and a negative meaning with a lever push away from the body (avoidance); in the mixed-incongruent condition, the movement assignment was reversed (i.e., positive-push, negative-pull). In all three conditions, the assignments of the movements to the person/animal decisions were counterbalanced across participants.

Each trial started with the presentation of a white fixation cross (200 ms), a blank period (100 ms), and a picture that remained on the screen until movement registration. At the end of a trial, feedback was given on an incorrect lever position, a movement in a wrong direction, and on a reaction time above 1.5 s. The next trial started after 250 ms.

In task instructions, great emphasis was put on a movement framing in a pull "toward" the body and a push "away" from the body. This movement framing was ingrained in 16 trials that required speeded reactions to the written response labels *HIN* (toward) and *WEG* (away) with a respective lever movement (Eder & Rothermund, 2008). In the mixed-conditions, two practice blocks followed with 32 trials each, the first practicing evaluative decisions and the second practicing person/animal decisions. Twelve additional trials were randomly interspersed in these blocks with lever movements to written response labels instead of picture classifications. The practice blocks were followed by 24 miniblocks with 12 trials each (including four trials to written response labels), half of them required evaluations and the other half person/animal decisions. Participants were informed in advance that the tasks will alternate from one block to the next one, and a screen informed the participant at the start of each block about the upcoming classification task.

The pure-Simon condition followed the procedure of the mixed tasks, with the following exceptions: First, practice of the evaluation task was eliminated. Second, the experimental phase was reduced to 12 miniblocks. Third, each block was separated by a self-paced break that announced the next block. Stimuli, trial numbers, and presentation conditions were identical with the semantic classification task of the mixed-conditions, to maintain utmost comparability.

Results

Trials with reactions to written response labels were not included in the analyses. Trials with erroneous lever movements in the mixed-conditions (8.4% of trials) and in the pure-Simon condition (3.5% of trials) were discarded from reaction time analyses. In addition, individual Tukey (1977) outlier thresholds were computed for each condition to identify response latency outliers; this truncation removed 1.6% of evaluation-relevant trials and 1.7% of evaluation-irrelevant trials from the mixed-groups and 1.8% of trials from the pure-Simon group.

Evaluation-irrelevant and evaluation-relevant trials were analyzed separately as described below. For the evaluation-irrelevant blocks, affective Simon effects were computed for each individual by subtracting mean performance (reaction times [RT], error rate) in the compatible trials from performance in the incompatible trials (i.e., affective Simon effect = $M_{incompatible} - M_{compatible}$). To test the predicted influence of instructed mapping rules on an automatic regulation of emotional responding, affective Simon effects in the evaluation-irrelevant trials were compared for congruent and incongruent mapping conditions: An enhanced affective Simon effect was hypothesized for the group with a congruent response-mapping in the evaluation task (mixed-congruent condition); in contrast, a reversed affective Simon effect (i.e., faster reactions in incompatible trials than in compatible trials) was expected for the group with an incongruent response-mapping in the evaluation task (mixed-incongruent condition). In addition, a block analysis explored whether practice of the response-mapping in the evaluation task is necessary to enhance or decrease affective Simon effects effectively.

Performance in the evaluation-relevant blocks was compared between participant groups that received either congruent or incongruent mapping rules. In line with habitual approach and avoidance tendencies, we expected superior performance with a congruent lever-movement mapping compared with an incongruent lever-movement mapping (i.e., an affective mapping effect).

Evaluation-Irrelevant Trials

RTs. Mean RTs and affective Simon effects are shown in Table 1. A mixed analysis of variance (ANOVA) with valence-movement compatibility (compatible vs. incompatible) as within-

Table 1
Mean Response Time (RT in Milliseconds), Mean Percentage Error (PE), and Mean Affective Simon Effect as a Function of Task-Condition and Valence-Movement Compatibility (SD in Parentheses)

	Affective S-R compatibility					
	Compatible		Incompatible		Affective Simon effect	
Task	RT	PE	RT	PE	RT	PE
Pure	665 (76)	3.0 (4.1)	672 (76)	3.5 (4.5)	7 (19)	0.5 (3.6)
Mixed-congruent	708 (91)	2.5 (4.5)	741 (104)	8.8 (5.8)	33 (50)	6.3 (5.1)
Mixed-incongruent	767 (135)	8.9 (7.6)	740 (118)	4.1 (5.3)	−27 (51)	−4.8 (6.6)

subjects factor and task condition (mixed-congruent vs. pure-Simon vs. mixed-incongruent) as between-subjects factor yielded a main effect of task condition, $F(2, 94) = 6.01$, $p < .01$. Responses were faster in the pure-Simon condition ($M = 669$ ms) than in the mixed-congruent and mixed-incongruent conditions (Ms = 725 and 754 ms, respectively). Valence-movement compatibility was not significant, $F(1, 94) = 1.05$, $p = .31$, but the interaction was, $F(2, 94) = 15.76$, $p < .001$, indicating an influence of task condition on affective Simon effects.

Planned comparisons of the means revealed that stimulus valence influenced the speed of compatible and incompatible lever movements in the pure-Simon condition ($\Delta M = 7$ ms, Cohen's $d = 0.35$), $t(31) = -2.01$, $p < .05$ (one-tailed). However, a more pronounced Simon effect ($\Delta M = 33$ ms, $d = 0.66$) emerged in the mixed-congruent condition, $t(32) = -3.77$, $p < .001$, that was reversed in the mixed-incongruent condition ($\Delta M = -27$ ms, $d = 0.52$), $t(31) = 2.96$, $p < .01$. Comparisons of the mixed-congruent and mixed-incongruent conditions with the pure-Simon condition showed that both effects differed significantly from the difference produced in the pure-Simon condition, $t(63) = 2.74$, $p < .01$, and $t(62) = -3.49$, $p < .001$, respectively. The absolute magnitudes of the Simon effects in the mixed-conditions were not different, $t < 1$, indicating a complete reversal of the affective Simon effect in the mixed-incongruent condition.

Block analysis. Affective Simon effects in the mixed-conditions were analyzed for an influence of mapping practice in the course of the experiment. Figure 1 displays the mean effects collapsed across two consecutive Simon-blocks, starting with the practice of the semantic categorization task as the first block. An ANOVA with block as within-subjects factor and task condition (mixed-congruent vs. mixed-incongruent) as between-subjects factor revealed an interaction of task condition with the linear trend of the block factor, $F(1, 63) = 4.40$, $p < .05$. Follow-up contrasts within each task-condition showed that the reversed affective Simon effect increased linearly across blocks in the mixed-incongruent condition, $F(1, 31) = 4.82$, $p < .05$, whereas the positive Simon effect remained stable in the mixed-congruent condition, $F < 1$.

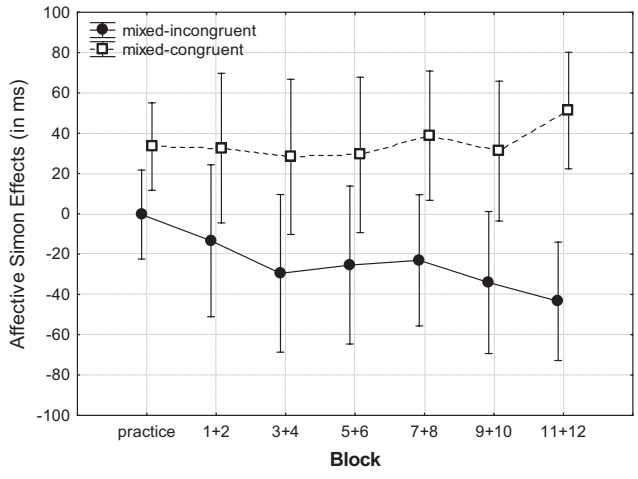

Figure 1. Mean affective Simon effects in the mixed-conditions collapsed across two consecutive Simon blocks (16 trials), starting with practice of the nonaffective semantic categorization task as the first block (32 trials). Error bars display the 0.95% CI.

Percentage errors. A mixed ANOVA of lever movement errors corroborated the reaction time analyses reported above. Movement errors were less frequent in the pure-Simon condition ($M = 3.3\%$) than in the mixed-congruent ($M = 5.7\%$) and mixed-incongruent conditions ($M = 6.5\%$), $F(2, 94) = 3.95$, $p < .05$. The main effect of valence-movement compatibility did not reach significance, $F(1, 94) = 1.60$, $p = .21$, but the interaction between both factors was significant, $F(2, 94) = 35.99$, $p < .001$. As Table 1 shows, compatible responses were more frequently correct than incompatible ones in the mixed-congruent condition ($\Delta M = 6.3\%$, $d = 1.23$), $t(32) = -7.07$, $p < .001$; in contrast, this pattern was reversed to a relative facilitation of incompatible responses in the mixed-incongruent condition ($\Delta M = -4.8\%$, $d = 0.72$), $t(31) = 4.09$, $p < .001$. In the pure-Simon condition, movement errors did not differ between compatible and incompatible trials ($\Delta M = 0.5\%$, $d = 0.14$), $t < 1$. Effect comparisons showed that the effects in the mixed-congruent condition and in the mixed-incongruent condition differed significantly from the difference produced in the pure-Simon condition, $t(63) = 5.22$, $p < .001$, and $t(62) = -3.97$, $p < .001$, respectively. The absolute magnitudes of the effects in the mixed-conditions were not different, $t(63) = 1.03$, $p = .31$.

Evaluation-Relevant Trials

RTs. An ANOVA with task condition (mixed-congruent vs. mixed-incongruent) as between-subjects factor revealed a reliable difference between congruent and incongruent mapping conditions in the evaluation latencies. Consistent with the assumption of habitual approach and avoidance tendencies, participants responded to picture valence faster with affectively congruent lever movements ($M = 802$ ms) than with affectively incongruent lever reactions ($M = 868$ ms), $F(1, 63) = 4.87$, $p < .05$.

Percentage errors. The distribution of movement errors in the congruent and incongruent mapping conditions corroborated the analysis above. Participants with incongruent mapping instructions produced more movement errors ($M = 11.6\%$) than participants with a congruent movement assignment ($M = 8.1\%$), $F(1, 63) = 3.83$, $p < .05$ (one-tailed).

Discussion

The idea of a "prepared reflex" assumes that stimuli can reflexively trigger behavioral responses once they are intentionally linked to this behavior in preparation for action. As Woodworth (1938) stated: "The reaction is involuntary, that is, no new will impulse is needed after the entrance of the stimulus in order that the reaction shall follow. The only voluntary act is the preparation" (p. 305). This basic notion, originally introduced by Exner (1879), has experienced a revival in modern theorizing on voluntary action control (e.g., Gollwitzer, 1999; Hommel, 2000), and conclusive evidence is accumulating in support of it (e.g., Cohen, Bayer, Jaudas, & Gollwitzer, 2008; Cohen-Kdoshay & Meiran, 2009; Miles & Proctor, 2008). In the present article, we extended this idea to emotionally evocative situations, arguing that preparation of action courses toward emotional events might similarly endow these events with a capability to elicit prepared actions reflexively, without an intervening act of "will." This view was supported by

the results of the present experiment that revealed an influence of intentional acts of approach and avoidance in an evaluation task on automatic approach and avoidance tendencies in an evaluation-irrelevant task: Unintended activations of affectively corresponding responses were enhanced when the prepared evaluation-action link was congruent with habitual approach and avoidance tendencies; in contrast, a reversed affective Simon effect was observed when the temporary link was incongruent to long-term response facilitations. Thus, temporary links between evaluation and behavior that were established through task instructions and mapping practice might have elicited assigned behavioral responses in an automatic fashion just like their more permanent counterparts—operating like a "prepared emotional reflex."

Adopting a behavior strategy to approach negative and avoid positive stimuli hence appears to be an effective means to override hedonic action tendencies. However, the present study also shows that incongruent behavioral intentions, in contrast to congruent ones, must be repeatedly practiced to modulate automatic action tendencies effectively. Thus, short-term associations between valence and motor responses might be implemented with different speed and effort in working memory, depending on their match with long-term associations, suggesting that enhancing emotional responses is easier than overriding them. Once established, however, even antagonistic short-term associations gain increasing control over impulsive behavior, to the point of reversing habitual action tendencies.

In the present study, training participants to approach and avoid was hypothesized to establish a temporary link between representations of emotional stimuli and responses that influences affective response tendencies whenever the emotional situation is met. Given that these temporary links refer to the distal goal of responses, rather than to their motor part (Eder & Rothermund, 2008), we expect approach-avoidance training to influence choice behavior even when it involves another behavior on a motor level. In line with this assumption, several studies have shown that such a transfer is indeed the case. In one study (Fishbach & Shah, 2006), participants sorted words that were related to the category "healthy" (e.g., apple, yogurt) or to the category "tasty" (e.g., cookie, fries) with a lever pull and push. When participants approached healthy items and avoided tasty items, they chose more frequently healthy than fatty food at the end of the experiment than a comparison group with the reverse movement assignment. Even more impressive, training effects were also shown to influence addictive behavior. Wiers, Rinck, Kordts, Houben, and Strack (in press) trained heavy drinkers to avoid alcohol-related pictures with a lever push and to approach soft drinks with a lever pull. Results showed less actual beer consumption in a subsequent test-and-rate task among the participants trained to avoid alcohol as compared with controls who were trained to approach alcohol. Another study (Kawakami, Phills, Steele, & Dovidio, 2007) examined the impact of approach-avoidance training on interracial interaction. Participants who were trained to approach Black faces and to avoid White faces sat closer to and oriented their bodies more directly toward a Black confederate in a subsequent interaction task than participants who were trained to avoid Blacks. Finally, Huijding and colleagues (Huijding, Field, De Houwer, Vandenbosch, & Rinck, 2009) reported effects of training to approach or avoid novel animals on fear-related responses in children. After the training, girls reported more fear and avoidance of the pushed animal than of the pulled animal. In combination, these studies suggest that (re)training approach and avoidance tendencies may help to gain control over impulsive emotional behavior, pointing to new intervention-possibilities.

Emotion regulation is typically conceived as an outcome of a tug-of-war or conflict between impulses on the one hand and intentional control on the other hand (e.g., Hofmann et al., 2009; Metcalfe & Mischel, 1999). The present findings make an argument for a different point of view that conceives of intentional and automatic processes, not as being different in kind, but rather as taking place at different points in time, with intentional processes setting the stage for an automated control of action (cf. Gollwitzer, 1999; Hommel, 2000). Hence, multiple behavioral strategies may exist to regulate impulsive emotional reactions, some of them might be more antecedent, prompting new action tendencies on their own, and others might be more reactive, operating on instigated action tendencies. Future research will reveal which regulatory activity is more effective with which type of situated behavior, and how these strategies might interact in the regulation of complex emotional behavior.

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Received October 14, 2008
Revision received December 15, 2009
Accepted December 15, 2009 ■