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Strategic Automation of Emotion Regulation

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As implementation intentions are a powerful self-regulation tool for thought and action (meta-analysis by P. M. Gollwitzer & P. Sheeran, 2006), the present studies were conducted to address their effectiveness in regulating emotional reactivity. Disgust- (Study 1) and fear- (Study 2) eliciting stimuli were viewed under 3 different self-regulation instructions: the goal intention to not get disgusted or frightened, respectively, this goal intention furnished with an implementation intention (i.e., an if-then plan), and a no-self-regulation control group. Only implementation-intention participants succeeded in reducing their disgust and fear reactions as compared to goal-intention and control participants. In Study 3, electrocortical correlates (using dense-array electroencephalography) revealed differential early visual activity in response to spider slides in ignore implementation-intention participants, as reflected in a smaller P1. Theoretical and applied implications of the present findings for emotion regulation via implementation intentions are discussed.

Many of life's daily problems are plagued by self-regulation failure. These self-regulatory difficulties have personal as well as social costs (Baumeister, Heatherton, & Tice, 1994) and even burden our daily routines (e.g., eating). The self-regulation of emotions in particular bears upon how smoothly we interact with others in social relations and upon our productivity in work environments (Gross & Muñoz, 1995). Although the inability to self-regulate emotions may even evidence itself in major mental disorders, such as depression, not until recently has emotion regulation been an independent research topic on a theoretical and empirical level. In fact, the topic of emotion regulation was first studied within developmental psychology and afterwards adopted by adult literature, although a lack of integration of both developmental and adult emotion regulation still characterizes the field (Gross & Thompson, 2007).

Two lines of theorizing can be distinguished: one based on general self-regulatory principles (e.g., Baumeister et al., 1994; Bonanno, 2001; Tice & Bratslavsky, 2000) and one focused directly on emotion regulation (e.g., Gross, 1998a, 1998b). In the present research, we suggest the possibility of emotion regulation through strategic automaticity created by implementation intentions (Gollwitzer, 1993, 1999). As research on implementation intentions focuses on the translation of goals into action (Gollwitzer & Sheeran, 2006), we attempt to bring insights of the self-regulation of goal implementation to bear on emotion regulation.

Approaches to Emotion Regulation

We briefly review two central theories of emotion regulation. The first line of theorizing is based on general principles of psychological self-regulation (e.g., Bonanno, 2001; Tice &

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Bratslavsky, 2000). Tice and Bratslavsky (2000) proposed that emotion regulation involves overriding a response set with an alternative incompatible set, such as relaxing in order to control feelings of anxiety. Emotion regulation also includes standards, monitoring, and strength. Standards represent how things should be (i.e., ideals, goals, or other conceptualizations of possible states; Baumeister & Heatherton, 1996), whereas monitoring of the current circumstances focuses on present states and behaviors. Successful self-regulation is said to require a repeated evaluation of one's self and one's actions against relevant standards (Baumeister et al., 1994). Furthermore, it is assumed that self-regulation strength (which is analogous to the concept of willpower; Baumeister et al., 1994) is needed to override impulses. Self-regulation may fail because of underregulation or misregulation. Whereas underregulation refers to failures to exert control over one's self and occurs when the individual does not possess adequate strength or willpower to control the impulse, misregulation refers to using an ineffective strategy to control the impulse (Baumeister et al., 1994). Despite these similarities to other regulatory tasks, emotion regulation is said to represent a specific case of self-regulation that can often undermine attempts at other types of self-regulation (e.g., healthy eating; Tice & Bratslavsky, 2000).

In Gross's (1998b) account, the self-regulation of emotions constitutes "processes by which individuals influence which emotions they have, when they have them, and how they experience and express these emotions" (p. 275). According to Gross (1998a, 1998b), external and internal emotional cues are evaluated in a first step before these evaluations lead to a coordinated set of behavioral, physiological, and experiential emotional response tendencies. The regulation of emotions can thus take place by manipulating inputs or outputs. The latter is referred to as response-focused emotion regulation, whereas the former is labeled antecedent-focused emotion regulation. Within this scheme, Gross distinguishes four antecedent-focused emotion regulation strategies and one response-focused emotion regulation strategy.

The first antecedent-focused emotion regulation strategy (i.e., situation selection) refers to selectively approaching or avoiding persons, places, and objects. The second (i.e., situation modification) relates to changing the emotional impact of the selected situation (e.g., convincing a neighbor to stop parking his car in front of one's driveway). The third (i.e., attention deployment) uses distraction, concentration, or rumination. Although distraction can help to direct attention to nonemotional features of the situation, remove attention from the situation, or alter internal focus, concentration directs attention to a particular task, topic, or emotion trigger (Gross, 1998b, 2002). Rumination, finally, focuses attention on feelings and their consequences. The fourth form of antecedent-focused emotion regulation (i.e., cognitive change) works by activating alternative meanings of the critical situation at hand. In contrast, the fifth strategy (i.e., response modulation) suggested by Gross (1998b) is no longer an antecedent-focused emotion regulation. It is response-focused as the person attempts to modulate the response tendencies that have been triggered by the emotional experience.

In recent years, Gross (2002) has studied two emotion regulation strategies in more detail: the cognitive change strategy of reappraisal and the response-focused strategy of suppression. Even though suppression manages to reduce both negative and positive emotion-expressive behavior, suppression has been shown to have negative cognitive (Richards & Gross, 2000) and affective side effects (Gross, 1998a; Gross & Levenson, 1993, 1997). At the cognitive level, Gross has pointed out that the act of suppression consumes cognitive resources and thus impairs memory. In the affective domain, suppression merely leads to a slight decrease in negative emotional experiences and has costs by also decreasing positive experiences; it is also associated with an increased sympathetic activation of the cardiovascular system. In contrast, the cognitive change strategy of reappraisal seems to be free of these negative cognitive and affective consequences (Gross, 1998a; Richards & Gross, 2000). In fact, reappraisal leads not only to reduced negative emotion experience and expression but rather increases positive emotion experience and expression as well.

Goal Intentions Versus Implementation Intentions

Research on the psychology of goals suggests that successful goal pursuit implies solving two subsequent tasks: goal setting and goal striving (Gollwitzer & Moskowitz, 1996; Oettingen & Gollwitzer, 2001). This distinction between goal setting and goal striving was originally emphasized by Kurt Lewin (1926; Lewin, Dembo, Festinger, & Sears, 1944), who highlighted that goal attainment is not yet secured solely by forming strong commitments to highly desirable and feasible goals and framing these goals in an appropriate manner. There is always the second issue of implementing a set goal. Gollwitzer (1993, 1999) suggested that people need to prepare themselves so that their chances of solving the major problems of goal implementation (e.g., getting started with goal striving and staying on track) are kept high. For all of these problems, the self-regulatory strategy of forming if-then plans (i.e., implementation intentions) has turned out to be beneficial.

Implementation intentions are if-then plans that spell out when, where, and how a set goal is to be put into action: "If situation x is encountered, then I will perform behavior y!" thereby linking a critical situation with a goal-directed behavior. They are to be distinguished from goal intentions that merely specify a desired performance or outcome and have the format of, "I intend to reach z!" Goal intentions only designate desired end-states the individual wants to attain. In contrast, implementation intentions refer to the realization of the goal intention and create a commitment to respond to a specified critical situational cue in a planned, goal-directed manner. Implementation intentions are thus hierarchically subordinate to goal intentions; that is, they are formed in the service of attaining respective goal intentions.

Implementation intentions provide benefits over and above goal intentions: a meta-analysis by Gollwitzer and Sheeran (2006) involving over 8,000 participants in 94 independent studies reported an effect size of $d = .65$. This medium-to-large effect size (J. Cohen, 1992) represents the additional facilitation of goal achievement by implementation intentions compared to goal intentions alone. As goal intentions by themselves already have a facilitating effect on behavior enactment (Webb & Sheeran, 2006), the size of this effect is remarkable. The benefits of forming implementation intentions on goal attainment (Gollwitzer & Sheeran, 2006) are vested in the switch of conscious and effortful goal striving (action control by goal intentions) to automated self-regulation of

goal striving (action control by implementation intentions). As reported by Gollwitzer and Sheeran, various laboratory and field experimental studies targeting different goal intentions (e.g., in the health, academic, and interpersonal domain) have evidenced that implementation intentions help to initiate goal-directed responses (e.g., by not forgetting to perform an intended behavior; McDaniel, Howard, & Butler, 2008), maintain ongoing goal striving (e.g., by shielding goal striving from distracting stimuli; Achtziger, Gollwitzer, & Sheeran, 2008), disengage from ineffective goal striving (e.g., by switching to more effective means; Henderson, Gollwitzer, & Oettingen, 2007), and undertake further goal striving (e.g., by conserving self-regulatory capacity; Webb & Sheeran, 2003), thereby increasing a person's chances that strong goal intentions are actually realized.

How do implementation intention effects come about? The mental if (situational cue)–then (goal-directed response) links created by implementation intentions facilitate goal attainment on the basis of psychological processes that relate to both the anticipated situation (the "if" part of the plan) and the intended response (the "then" part of the plan). Because forming an implementation intention implies the selection of a critical future situational cue, the mental representation of this situation becomes highly activated and hence more accessible (Gollwitzer, 1999). This heightened accessibility of the if part of the plan has been observed in several studies (e.g., Aarts, Dijksterhuis, & Midden, 1999; Parks-Stamm, Gollwitzer, & Oettingen, 2007; Webb & Sheeran, in press) and means that people are in a good position to identify and attend to the critical situation when they subsequently encounter it (e.g., Webb & Sheeran, 2004). Studies have also indicated that implementation intentions forge a strong association between the specified opportunity and the specified response (Webb & Sheeran, 2007). The upshot of these strong links is that the initiation of the goal-directed response specified in the if-then plan becomes automated; that is, it exhibits features of automaticity, including immediacy, efficiency, and redundancy of conscious intent. The idea is that people do not have to deliberate anymore about when and how they should act when they have formed an implementation intention—unlike people who have formed mere goal intentions. Evidence that if-then planners act quickly (Gollwitzer & Brandstätter, 1997, Experiment 3), deal effectively with cognitive demands (Brandstätter, Lengfelder, & Gollwitzer, 2001), and do not need to consciously intend to act at the critical moment (Sheeran, Webb, & Gollwitzer, 2005, Study 2) is consistent with this idea. In sum, strategically forming if-then plans automates goal striving (Gollwitzer & Schaal, 1998) because people delegate control of goal-directed responses to preselected situational cues, with the explicit purpose of facilitating goal striving; that is, automatic response initiation originates in a conscious act of will (if-then planning).

So far, implementation intentions research has primarily focused on the problem of getting started with acting on one's goals. For instance, Gollwitzer and Brandstätter (1997, Study 2) analyzed a goal intention (i.e., writing a report about how the participants spent Christmas Eve) that had to be performed at a time (i.e., during the subsequent Christmas holiday) when people are commonly busy with other things. Still, research participants who had furnished their goal intention with an implementation intention that specified when, where, and how one wanted to get started on this project were about three times more likely to actually write the report than mere goal-intention participants were. Other studies have examined the ability of implementation intentions to foster goal striving that is unpleasant to perform. For instance, the goal to perform regular breast examinations (Orbell, Hodgkins, & Sheeran, 1997) or cervical cancer screenings (Sheeran & Orbell, 2000), resume functional activity after joint replacement surgery (Orbell & Sheeran, 2000), eat a low-fat diet (Armitage, 2004), recycle (Holland, Aarts, & Langendam, 2006), and engage in physical exercise (Milne, Orbell, & Sheeran, 2002) were all more readily acted upon when people had furnished these goals with implementation intentions. Moreover, implementation intentions were found to help attainment of goal intentions where it is easy to forget to act (e.g., regular intake of vitamin pills; Sheeran & Orbell, 1999; the signing of work sheets with the elderly; Chasteen, Park, & Schwarz, 2001).

As many goals cannot be accomplished by a simple discrete one-shot response and require that people keep striving for the goal over an extended period of time, more recent implementation intention research has addressed the problem of staying on track. When certain external (e.g., temptations, distractions) or internal (e.g., being anxious, tired, overburdened) stimuli are not conducive to goal realization but instead generate interferences, staying on track becomes a crucial issue. Implementation intentions have been observed to help people with shielding ongoing goal strivings from disruptive external stimuli (e.g., distracting attractive video clips while performing a math test; Gollwitzer & Schaal, 1998) and inner states (e.g., craving for junk food in people aiming at reducing snacking; Achtziger, Gollwitzer, & Sheeran, 2008, Study 1; feelings of exhaustion in tennis players aiming at winning a tennis match; Achtziger, Gollwitzer, & Sheeran, 2008, Study 2). It is the research on shielding goal pursuits from disruptive inner states, in particular, that suggests the possibility of regulating emotional reactivity through implementation intentions.

That emotional reactivity can be regulated by implementation intentions is further suggested by implementation intention research that has shown that habitual responses that conflict with the initiation and execution of goal-directed responses can be down-regulated by if-then plans. For instance, Holland et al. (2006) observed that implementation intentions, not mere goal intentions, could help break unwanted habits and replace them with new wanted behaviors in a field experiment on recycling behavior. A.-L. Cohen, Bayer, Jaudas, and Gollwitzer (2008, Study 2) explored the suppression of habitual responses in a more controlled laboratory experiment using the Simon (1990) task. In the task paradigm used in the Cohen et al. study, participants were asked to respond to a nonspatial aspect of a stimulus (i.e., whether a presented tone was high or low) by pressing a left or right key and to ignore the location of the stimulus (i.e., whether it was presented on the left or on the right side of the participant). The difficulty of this task lies in ignoring the spatial location (left or right) of the tone in one's classification response (Simon, 1990). The cost in reaction time is seen when the location of the tone (e.g., right) and required key press (e.g., left) are incongruent, as people habitually respond to stimuli presented on the right or left side with the corresponding hand. Cohen et al. found that implementation intentions eliminated the Simon effect for the stimulus that was specified in the implementation intention (e.g., "And if I hear the

low tone on the left side, then I'll press the right button especially fast!"). Reaction times for the critical (planned) stimulus no longer differed between the congruent and incongruent trials. Finally, extending earlier work by Gollwitzer and Schaal (1998), Stewart and Payne (in press) reported that implementation intentions (but not goal intentions) also managed to reduce automatic stereotyping in a weapon identification task (Studies 1 and 2) and an implicit association task (Study 3).

Regulating Emotional Reactivity by Implementation Intentions

Assuming that a person's emotional reactivity to disgust- and fear-provoking stimuli carries features of automaticity similar to those of habitual behavioral or cognitive responses, we propose that implementation intentions formed in the service of the goal to reduce emotional reactivity should help to down-regulate it. As forming implementation intentions has been shown to produce ad hoc increases in the degree of automaticity of initiating goal-directed responses, we predict that the initiation of the goal-directed responses specified in an implementation intention (e.g., staying calm and relaxed) might—using a simple race horse metaphor—"outrun" the initiation of the emotional responses triggered by disgust- and fear-eliciting stimuli. As the two responses of staying calm on the one hand and showing fear or disgust on the other are antagonistic (i.e., exclude each other), this faster initiation of the staying calm/relaxed response should actually block the emergence of fear/disgust responses.

In the present research, we presented participants with disgust- (Study 1) and fear-eliciting pictures (Studies 2 & 3). Disgust was selected as a critical emotion for Study 1 because it is almost universally considered to be a basic emotion in the literature (Rozin, Haidt, & McCauley, 1993, 1999). Fear was selected because anxiety disorders, such as panic disorders or phobias, are common and affect many people's lives. Indeed, countries such as Germany and the United States have a 12% and 17% prevalence of anxiety disorders, respectively (Bijl et al., 2003). Accordingly, we selected a sample of spider-fearful participants and confronted them with spider pictures.

The participants had to report on the intensity and direction of the elicited emotions by rating experienced arousal (Study 1 to 3), as well as hedonic valence and dominance (Studies 2 & 3). This allowed us to compare effects across the three different studies using different unpleasant emotion-eliciting pictures (i.e., disgust, fear); neutral and pleasant pictures were added as control stimuli (i.e., not specified in the implementation intention) in each study. The if-then plans formed by participants always specified the critical stimulus in the if part (a disgusting picture in Study 1 and a depicted spider in Studies 2 & 3). The goal-oriented responses described in the then parts differed among Studies 1 to 3.

In Study 1, we used a strategy (i.e., "... then I will stay calm and relaxed!") that, according to Gross (1998a, 1998b), can be classified as response-focused emotion regulation. Even though such an emotion regulation strategy is said to be rather effortful (Gross, 2002), we expected that using the if-then format of an implementation intention would make this response-focused strategy very effective as it would now be strategically automated. In Study 2, we wanted to replicate the postulated effectiveness of response-focused implementation intentions with the emotion of fear. Specifically, we tested whether even spider-fearful participants are in a position to down-regulate fear in the face of spider pictures when using such implementation intentions. Second, we explored whether implementation intentions that describe an antecedent-focused strategy (i.e., "... then I will ignore it!") would also be effective in down-regulating fear. In line with previous research (e.g., Gross, 2002), we expected that triggering antecedent-focused emotion regulation should help self-regulate high spider fear.

Finally, little is known about the psychological and neural mechanisms of down-regulating emotional reactivity, particularly concerning its temporal dynamics. Given this apparent dearth, Study 3 assessed the underlying electrocortical correlates of the postulated effectiveness of ignore implementation intentions in the down-regulation of spider fear as indicated by self-report data. These correlates should allow us to gain further insights into the postulated processes (i.e., creation of automaticity) underlying the effectiveness of forming ignore implementation intentions. Importantly, the inclusion of physiological data in Study 3 represents the first contribution that specifically addresses the electrophysiological correlates of forming ignore implementation intentions.

In all three studies, next to a control condition, a mere goal-intention condition was established. In this condition, the participants formed the goal to down-regulate their emotional responses: "I will not get disgusted!" (Study 1) and "I will not get frightened!" (Studies 2 & 3). As the emotional reactivity under scrutiny (i.e., disgust and spider fear) can be assumed to carry features of automaticity, these mere goal intentions should turn out to be quite ineffective. At least, that is what has been suggested by prior implementation intention research on the control of automatic behavioral and cognitive responses; there, mere goal intentions consistently failed to have an effect (e.g., A.-L. Cohen et al., 2008; Holland et al., 2006).

Study 1: The Self-Regulation of Disgust

Method

Participants

Fifty-six female students of the University of Konstanz (Konstanz, Germany) participated in return for either €5 (~$7.36) or 1 hr of course credit. Two participants opted to not continue with the experiment after seeing the four example slides. We only invited women to take part in this experiment as women commonly show higher scores in disgust sensitivity (Rozin et al., 1993, 1999) and thus allow for a more critical test of our hypothesis.

Design

The present study uses a 3 × 3 factorial design with the between-participants factor Self-Regulation Condition (control condition, goal-intention condition, implementation-intention condition) and the within-participants factor Type of Pictures (neutral, pleasant, disgusting). A Self-Assessment Manikin (SAM) scale

(Bradley & Lang, 1994) was used to assess the arousal experienced by participants with respect to each of the pictures presented (described in detail later).

Stimuli

The picture material consisted of 45 slides taken from the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 1999), which were selected based on pleasure and arousal ratings. Thus, pleasant pictures had been rated high on the valence dimension and medium on the arousal dimension, whereas neutral pictures had medium standard emotional valence and low arousal ratings. Finally, the unpleasant pictures had low valence and high arousal scores. Fifteen of the pictures showed disgusting material (e.g., bloody scenes of burn victims and mutilations), 15 presented pleasant material (e.g., happy infants, appetizing food), and the final 15 showed neutral material (e.g., household objects).

The IAPS is a standard, well-established paradigm that permits controlled exposure and accurate replications within and between experiments and laboratories (Bradley, Greenwald, & Hamm, 1993; Bradley & Lang, 2000; Lang, 1995). The affective responses for both male and female participants have been established in several countries (e.g., West Germany, Italy, Sweden, United States; Bradley et al., 1993).

Presentation

Each trial began with the presentation of a fixation cross for 800 ms. Next, one of the 45 pictures was presented in a randomized order for 100 ms and then masked for 200 ms with a black-and-white pattern mask. This method was used to preclude in-depth processing and elaboration of the stimulus while allowing for processing the key elements in the picture, which can be completed as early as 30–50 ms after onset (Pessoa, Japee, & Ungerleider, 2005). Then, the SAM scale (described in detail later) appeared on the screen, and participants had to report their arousal rating. After 2,000 ms, a beeping sound lasting 200 ms (at 500 Hz) signaled the end of the response window. Once participants had rated their arousal, an intertrial interval ensued that varied between 3 and 8 s, followed by the fixation cross signaling the beginning of a new trial. All pictures were shown on a 19-inch (48.3-cm) computer monitor with a refresh rate of 100 Hz. The distance between the computer screen and the participants' eyes was 80 cm.

Procedure

Participants were told that they would be requested to view a number of slides and rate their emotional responses to each of these slides. For ethical reasons, participants were first exposed to four example slides (one of them presented a disgusting stimulus) and then were asked whether they wanted to participate. They were also told that they could terminate their participation at any time during the experiment if they wanted to do so for whatever reason. After informed consent was obtained, participants were randomly assigned to one of the three self-regulation conditions.

Next, the SAM scale rating procedure was explained to the participants. The advantage of this answer scale (Bradley & Lang, 1994) compared to other scales, such as the Semantic Differential Scale (Snider & Osgood, 1969), is that it is nonverbal and allows for quick assessment of the experience of negative affect. More specifically, participants were told that they would be asked to estimate their arousal after the presentation of each picture using a scale consisting of five graphic figures. These figures were the arousal manikins of the SAM scales that varied from excited (left side) to relaxed (right side). Beneath the five manikins, a line of nine empty circles was presented so that the manikins stood on top of the first, third, fifth, seventh, and ninth circle. Participants were told that they could indicate their ratings anywhere along this line, placing an "X" into one of the circles by moving and clicking the computer mouse. Further, they were advised to always rate how they felt at the moment they saw the pictures.

Different instructions were then given to participants in the goal-intention and implementation-intention conditions. Participants in the goal-intention condition were asked to form the goal intention "I will not get disgusted!" As implementation intentions operate in the service of a respective superordinate goal intention (Sheeran et al., 2005), implementation-intention participants were first asked to form this goal intention and then add the following if-then plan: "And if I see blood, then I will stay calm and relaxed!" Participants were not given a specific time to form their goals and/or implementation intentions but were asked to read the instructions very carefully and repeat them to themselves by using inner speech. Thereafter, all participants were allowed to perform four practice trials to ensure rapid responses to the SAM scale rating procedure.

Postexperimental Questionnaire

After viewing the pictures, both goal-intention and implementation-intention participants received a questionnaire that assessed how committed they felt to meeting the goal of down-regulating disgust: "How committed did you feel to the self-regulation intention?" and "How much did you try to control negative feelings?"

We also assessed their perceived performance: "How difficult was it to control negative feelings?", "Did your self-regulation intention help you control negative feelings?", and "How well did you succeed in realizing your self-regulation intention?"

All of these items were accompanied by 9-point answer scales ranging from 1 (*not at all*) to 9 (*very*). At the end of the experiment, all participants were debriefed about the purpose of the experiment, given their monetary compensation or 1 hr of course credit, and thanked.

Results

Dependent Variable

A 3 (Self-Regulation Condition: control condition, goal-intention condition, implementation-intention condition) × 3 (Type of Pictures: neutral, pleasant, disgusting) analysis of variance (ANOVA) revealed a significant interaction effect of Type of Pictures and Self-Regulation Condition on arousal ratings, $F(4, 102) = 6.60$, $p < .01$ (see Figure 1). There was also a

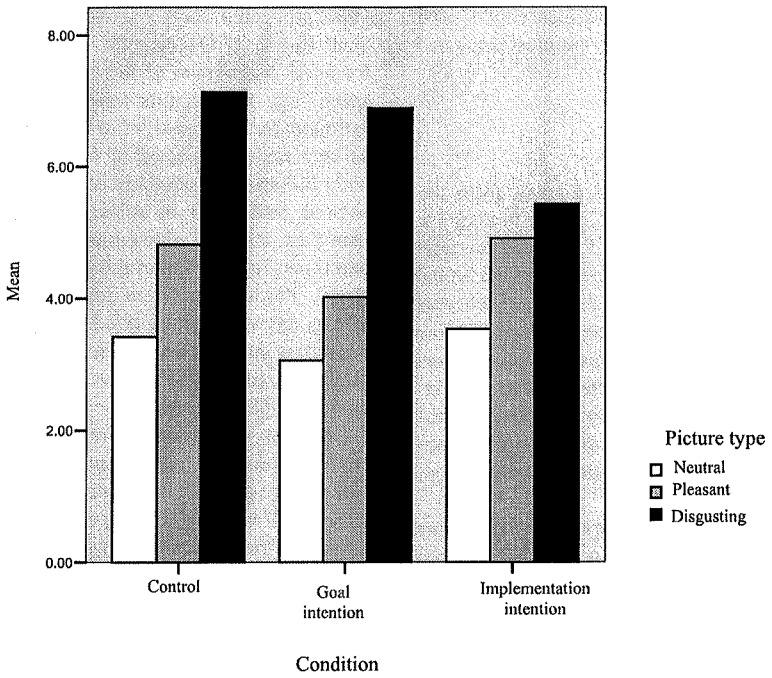

Figure 1. Mean ratings of reported arousal for picture type by condition (Study 1).

significant main effect for Type of Pictures, $F(2, 102) = 108.26$, $p < .01$, indicating that neutral pictures ($M = 3.33$, $SD = 1.18$) were rated as evoking less arousal than the pleasant pictures did ($M = 4.58$, $SD = 1.56$), $t(53) = 7.60$, $p < .01$, and the pleasant pictures were rated as less arousing than the disgusting pictures were ($M = 6.48$, $SD = 1.61$), $t(53) = 6.89$, $p < .01$. The main effect for the Self-Regulation Condition was not significant, $F(2, 51) = 1.26$, *ns*.

The results of follow-up one-factorial ANOVAs yielded no significant Self-Regulation Condition effects for the neutral pictures ($F < 1$) and the pleasant pictures, $F(2, 51) = 1.83$, *ns*, but a significant effect for the disgusting pictures, $F(2, 51) = 7.34$, $p < .01$. As we anticipated (see Figure 1), planned contrasts showed both a significant difference between the control ($M = 7.13$, $SD = 1.11$) and the implementation-intention conditions ($M = 5.43$, $SD = 1.79$), $t(51) = 3.54$, $p < .01$, as well as between the goal-intention ($M = 6.89$, $SD = 1.36$) and the implementation-intention conditions, $t(51) = 3.04$, $p < .01$. No significant difference was found between the control and the goal-intention conditions ($t < 1$). Hence, only participants who had furnished their goal intention with a respective implementation intention felt less aroused than control participants did when looking at the disgusting pictures.

Further Analyses

To analyze whether the observed effects in arousal ratings relied on differences in commitment to the self-regulation goal and perceived performance, we compared the two self-regulation groups (i.e., the goal-intention vs. the implementation-intention condition) on these variables.

Reported goal commitment. Participants in the goal-intention condition ($M = 6.28$, $SD = 1.71$) and those in the implementation-intention condition ($M = 6.67$, $SD = 1.37$) did not differ with respect to how committed they felt to the self-regulation intention ($t < 1$). The two conditions also did not differ on how much they tried to control their negative feelings ($t < 1$; $M = 4.61$, $SD = 1.88$ vs. $M = 5.28$, $SD = 2.61$, respectively). Moreover, when using these two commitment variables as covariates, the difference between the goal-intention and the implementation-intention conditions with respect to reported arousal stayed significant ($p < .01$).

Perceived performance. No significant difference concerning participants' reported difficulties in controlling their negative feelings emerged between the goal-intention ($M = 4.78$, $SD = 1.83$) and the implementation-intention conditions ($M = 5.44$, $SD = 2.68$; $t < 1$). Moreover, regarding the question of whether the given self-regulation intention helped in controlling negative feelings, responses did not differ significantly between the goal-intention ($M = 5.22$, $SD = 1.86$) and the implementation-intention conditions ($M = 5.39$, $SD = 2.38$; $t < 1$). Only when asked about perceived successes in self-regulation, a difference approaching significance was observed between the goal-intention and the implementation-intention conditions ($M = 6.61$, $SD = 2.12$ vs. $M = 5.22$, $SD = 2.24$, respectively), $t(34) = 1.91$, $p < .07$, indicating that goal-intention participants tended to falsely perceive themselves as performing better than implementation-intention participants.

Discussion

Disgust can be controlled effectively by forming implementation intentions that support a goal intention. Specifically, when a goal intention ("I will not get disgusted!") was furnished with an implementation intention ("And if I see blood, then I will remain calm and relaxed!"), arousal ratings of disgusting pictures were reduced compared to when forming only a goal intention or no goal intention at all (control condition). The goal intention did not achieve the desired reduction of arousal; arousal in the control condition and the goal-intention condition was high and close to identical.

Interestingly, the achieved down-regulation of arousal by implementation intentions with respect to disgusting pictures did not involve any costs in terms of experiencing excitement with respect to pleasant pictures. Pleasant pictures led to the same arousal levels as observed in the goal-intention and control conditions. Also, the arousal level reported for neutral pictures stayed unaffected. It is also important to note that implementation intentions managed to reduce the arousal induced by disgusting pictures to a level that was close to that observed for pleasant pictures. In other words, down-regulation of disgust via implementation intentions is not only very effective (as compared to control and goal-intention individuals) but it also does not spill over so that one can no longer get excited about pleasant stimuli (i.e., implementation-intention effects are specific in the sense of only applying to the stimuli spelled out in the if part of the intention).

The observed control of disgust by implementation intentions is neither based on experimenter demand, as suggested by a follow-up study with a sample of independent raters,[1] nor on a heightened commitment to the intention to self-regulate in implementation-intention participants (i.e., goal-intention and implementation-intention participants reported the same commitment to the intention to self-regulate). This latter finding is in line with other research on the effects of implementation intentions. Even though implementation intentions that are backed up by strong goal intentions consistently achieved stronger effects than did implementation intentions that are backed up by weak goal intentions (e.g., Sheeran et al., 2005), the act of forming an implementation intention is commonly not found to increase the strength of commitment of the respective goal intention (e.g., Orbell et al., 1997; Sheeran & Orbell, 1999; for a meta-analysis, see Webb & Sheeran, in press).

In the present study, implementation-intention participants also did not report better performance in down-regulating disgust. If anything, goal-intention participants tended to feel that they were more successful in realizing their self-regulation intention than implementation-intention participants did. This finding is in line with Gollwitzer's (1993, 1996) assumption that implementation-intention effects rest on automatic processes (i.e., instigate immediate and efficient action control that does not require conscious involvement; Bargh, 1994) that commonly escape introspection and thus are difficult to report on.

Study 2: The Self-Regulation of Fear

In Study 1 we were interested in how implementation intentions might help reduce the intensity of the disgust experience by focusing on ratings of emotional arousal (i.e., the focus was on ratings of emotional arousal given our hypothesis of a reduced emotional intensity as a function of type of intention manipulation). In Study 2, we wanted to know whether the down-regulation by implementation intentions would not only affect experienced arousal but also extend to evaluative dimensions, such as the unpleasantness of the critical stimuli and feeling controlled by them. Thus, we added a valence and a dominance scale to the arousal scale of Study 1. Furthermore, we chose a different negative emotion (i.e., fear) and a special population (i.e., spider-

[1] In order to investigate the potential influence of experimenter demand on the obtained pattern of findings in Studies 1 and 2, two different samples of 47 participants from the University of Konstanz read a detailed description of the experimental scenario. More specifically, participants were randomly assigned to descriptions of the course of events of one of the three self-regulation conditions (in Study 2, the two implementation-intention conditions were collapsed by stating that participants were assigned either the response-focused implementation intention or the antecedent-focused implementation intention). All participants were thereafter asked to respond to the following statements on a 1 (*does not apply to*) to 9 (*applies to*) answer scale: "The research participant assumes that the experimenter wants her to suppress her disgust feelings/to control her fear!" and "The research participant assumes that the experimenter is confident that she will pursue the task of suppressing her disgust feelings/controlling her fear throughout the experiment!"

With respect to the assumption that the experimenter wanted the described research participant to try to suppress her disgust feelings, we observed a difference approaching significance between the control and the goal-intention conditions in Study 1 ($M = 3.63$, $SD = 2.25$ vs. $M = 5.47$, $SD = 2.95$, respectively), $t(29) = 1.96$, $p < .06$, and a significant difference in Study 2 ($M = 3.19$, $SD = 2.17$ vs. $M = 5.93$, $SD = 3.13$), $t(29) = 2.86$, $p < .01$. We also observed a significant difference between the control condition and the implementation-intention condition in Study 1 ($M = 3.63$, $SD = 2.25$ vs. $M = 5.94$, $SD = 2.74$), $t(30) = 2.61$, $p < .05$, and in Study 2 ($M = 3.19$, $SD = 2.17$ vs. $M = 7.00$, $SD = 2.34$), $t(30) = 4.78$, $p < .01$. However, no significant differences were found between the implementation-intention and goal-intention conditions in Study 1 ($M = 5.94$, $SD = 2.74$ vs. $M = 5.47$, $SD = 2.95$), $t(29) = 0.46$, *ns*, and in Study 2 ($M = 7.00$, $SD = 2.34$ vs. $M = 5.93$, $SD = 3.13$), $t(29) = 1.08$, *ns*.

The same pattern of answers was observed when asked whether the research participant assumed that the experimenter was confident that she would pursue the task of suppressing her disgust feelings (Study 1), as significant differences were observed between the control condition and both the goal-intention condition ($M = 4.94$, $SD = 2.17$ vs. $M = 6.73$, $SD = 2.37$), $t(29) = 2.2$, $p < .05$, and the implementation-intention condition ($M = 6.69$, $SD = 2.12$ vs. $M = 4.94$, $SD = 2.17$), $t(30) = 2.31$, $p < .05$. Again, no significant difference emerged between the implementation-intention and goal-intention conditions ($M = 6.69$, $SD = 2.12$ vs. $M = 6.73$, $SD = 2.37$), $t(29) = 0.06$, *ns*. Concerning the experimenter's assumed confidence of successful fear control (Study 2), significant differences were observed between the control condition and both the goal-intention condition ($M = 4.31$, $SD = 2.12$ vs. $M = 6.80$, $SD = 1.94$), $t(29) = 3.41$, $p < .01$, and the implementation-intention condition ($M = 4.31$, $SD = 2.12$ vs. $M = 6.38$, $SD = 2.39$), $t(30) = 2.58$, $p < .05$. Again, no significant difference emerged between the implementation-intention and goal-intention conditions ($M = 6.38$, $SD = 2.39$ vs. $M = 6.80$, $SD = 1.94$), $t(29) = 0.54$, *ns*.

In all, the lack of differences ascribed to goal-intention participants and implementation-intention participants suggests that the effects of implementation intentions on disgust and fear control rely on processes triggered by implementation intentions (i.e., strategic automaticity) rather than on differential experimenter demand caused by assigning goal intentions versus implementation intentions.

fearful participants) to more critically test our assumption that implementation intentions allow for effective down-regulation of negative emotions. In addition, following Gross's (1998a, 1998b) differentiation between various types of self-regulation of emotions, we added an antecedent-focused implementation intention to the response-focused implementation intention used in Study 1. The antecedent-focused implementation intention was thought to make emotion regulation possible by blocking the emergence of the negative emotion (i.e., fear) at its onset. Finally, we added a group of participants without a fear of spiders to the design to function as an additional control group (i.e., nested, nontreatment control group).

In line with the findings of Study 1, we expected that the goal intention would be quite ineffective in controlling fear of spiders as compared to both a response-focused implementation intention and an antecedent-focused implementation intention. Both implementation intentions should allow participants to view the spider pictures as being more positive (valence) and evoking less arousal, as well as helping them to feel more in control (dominance). Control participants without fear of spiders (nested control group) were expected to rate the spider pictures as more positive, less arousing, and feeling more in control as compared to participants with a fear of spiders in both the control and goal-intention conditions. For the ratings of the pleasant and neutral slides, no significant differences were predicted between groups.

Method

Pilot Study

To assess which of several fears were the most prevalent among the student population of the University of Konstanz, 280 female participants filled out 47 items from the Emotionality, Activity, Sociability, and Impulsivity Questionnaire (Buss & Plomin, 1975), which is designed to assess fears such as social fear, spider fear, snake fear, or fear of dentists, with scales ranging from 0 (*strongly disagree*) to 4 (*strongly agree*). Participants who scored 3 or higher on the item "When I see a spider in the room, I can't relax until it's gone" qualified for participation in the present study, along with those students without any spider fear who scored 0 on this item (i.e., potential control participants).

Participants

Seventy-one female students with high spider fear and 17 without any spider fear were asked to take part in the study. The data from 3 participants in the control condition with spider fear were excluded from the experiment because 2 participants reported spontaneously forming the goal to not get frightened, and another participant did not follow the instructions to rate the presented pictures. All received either €5 or 1 hr of course credit. We asked only women to take part in the experiment because they are known to show stronger responses to threatening pictures (Bradley & Lang, 2000).

Design

This study uses a 4 × 3 × 3 factorial design with Self-Regulation Condition (control, goal intention, response-focused implementation intention, antecedent-focused implementation intention) as the between-factor and Type of Pictures (neutral, pleasant, spiders) and Type of Rating (valence, arousal, dominance) as the within factors. We also added a nested control condition of participants without spider fear and no self-regulation instructions. The valence, arousal, and dominance ratings were assessed by three different SAM scales (described later).

Stimuli

The visual material consisted of 45 slides (15 neutral slides, 15 pleasant slides, and 15 spider slides). Pictures were taken from the IAPS (Lang et al., 1999). As the IAPS did not have enough spider pictures, we added 11 spider pictures that had been judged to be highly frightening by 10 independent raters. Times and order of presentation of the stimuli were the same as in Study 1.

Procedure

Participants were informed that they would be requested to look at emotion-evoking slides and rate their experienced feelings to each of the pictures. After being exposed to five example slides and having given informed consent, students with spider fear were randomly assigned to four self-regulation conditions; students without spider fear all took part in the no-self-regulation control group. All participants were informed how the SAM scales (Bradley & Lang, 2000) were to be used for rating the presented pictures and that they should indicate spontaneously how they felt at the moment they saw the pictures before the warning signal (indicating the end of the response window) sounded. Each of the three scales (i.e., valence, arousal, and dominance) consisted of five graphic figures depicting the same manikin in different affective states and a line of nine empty circles presented beneath these figures representing values along the affective dimensions of valence (*happy* to *unhappy*), arousal (*excited* to *relaxed*), and dominance (*controlled* vs. *in control*).

Next, goal-intention and implementation-intention participants were given different self-regulation instructions. Those in the goal-intention condition were asked to only tell themselves "I will not get frightened!", whereas the participants in the response-focused implementation intention condition were asked in addition to tell themselves "And if I see a spider, then I will remain calm and relaxed!", and those in the ignore implementation-intention condition "And if I see a spider, then I will ignore it!" Finally, the four practice trials were administered and then the 45 experimental trials were started.

Postexperimental Questionnaire

The same questionnaire as in Study 1 was administered, which contained questions on participants' commitment to meet the goal of down-regulating their negative feelings as well as their perceived success of doing so. After the experiment, the participants were debriefed, given their monetary compensation or 1 hr of course credit, and thanked.

Results

Dependent Variables: Negative Affect Index

A 4 between (Self-Regulation Condition: control, goal intention, response-focused implementation intention, antecedent-focused

implementation intention) × 3 within (Type of Pictures: pleasant, neutral, spider) × 3 within (Type of Rating: valence, arousal, dominance) factorial ANOVA yielded the predicted interaction of Self-Regulation Condition and Type of Picture, $F(6, 128) = 4.80$, $p < .01$; this interaction effect was not qualified by a higher interaction with the Type of Rating factor ($F < 1$, *ns*). Accordingly, we constructed a negative affect index that incorporates the three different ratings; high scores on this index indicate a negative emotional experience (high negative valence, high arousal, and low control). We wanted one single measure for the three-dimensional affective space proposed by Lang (1994); the reliability of our grouping was checked by computing a Cronbach's alpha coefficient of internal consistency, which was .79.

Using this index as our dependent variable, we found that both neutral pictures ($M = 10.75$, $SD = 2.34$) and pleasant pictures ($M = 11.53$, $SD = 2.56$) produced less negative affect than the fearful pictures did ($M = 19.49$, $SD = 5.17$), $t(67) = 13.46$, $p < .01$, and $t(67) = 12.41$, $p < .01$, respectively. There was also a significant interaction effect between Type of Pictures and Self-Regulation Condition, $F(6, 128) = 4.80$, $p < .01$, as well as a significant main effect for the Self-Regulation Condition, $F(3, 64) = 3.84$, $p < .05$ (see Figure 2).

In line with our hypotheses, the results of follow-up one-factorial ANOVAs yielded significant differences for the spider pictures, $F(3, 64) = 6.32$, $p < .01$, but not for the pleasant ($F < 1$, *ns*) and neutral ones, $F(3, 64) = 1.37$, *ns*. As expected, planned comparisons revealed significant or close to significant differences when comparing the response-focused implementation-intention condition ($M = 18.33$, $SD = 4.09$) with both the control ($M = 22.51$, $SD = 2.69$), $t(64) = 2.58$, $p < .02$, and the goal-intention conditions ($M = 21.28$, $SD = 4.71$), $t(64) = 1.90$, $p < .07$. The same pattern was found when comparing the antecedent-focused implementation-intention condition ($M = 16.15$, $SD = 6.21$) with the control, $t(64) = 3.87$, $p < .01$, and the goal-intention conditions, $t(64) = 3.27$, $p < .01$. The difference between the control and the goal-intention participants was not significant ($t < 1$, *ns*), and the same was true for the comparison between the two implementation-intention conditions, $t(64) = 1.39$, *ns*. The observed pattern of results indicates that participants who formed a goal intention in tandem with either an antecedent-focused or response-focused implementation intention experienced the fearful slides as eliciting less negative affect than did control as well as goal-intention participants.

The nested no-spider-fear control group. Most interesting, the no-spider-fear control group showed the same negative affect rating as both the spider-fear response-focused implementation-intention and the spider-fear antecedent-focused implementation-intention group. With respect to the no-spider-fear control group and the spider-fear response-focused implementation-intention group, comparisons of responses to pleasant ($M = 12.09$, $SD = 3.04$ vs. $M = 11.61$, $SD = 2.13$) and fearful pictures ($M = 18.13$, $SD = 2.76$ vs. $M = 18.33$, $SD = 4.09$) were all nonsignificant ($ts < 1$), although the comparison of responses to neutral pictures ($M = 11.41$, $SD = 2.34$ vs. $M = 10.01$, $SD = 2.34$) approached significance, $t(33) = 1.77$, $p < .09$. The same pattern was found for the comparisons of responses to pleasant ($M = 12.09$, $SD = 3.04$ vs. $M = 11.18$, $SD = 3.44$), neutral ($M = 11.41$, $SD = 2.34$ vs. $M = 11.12$, $SD = 2.66$), and fearful pictures ($M = 18.13$, $SD =$

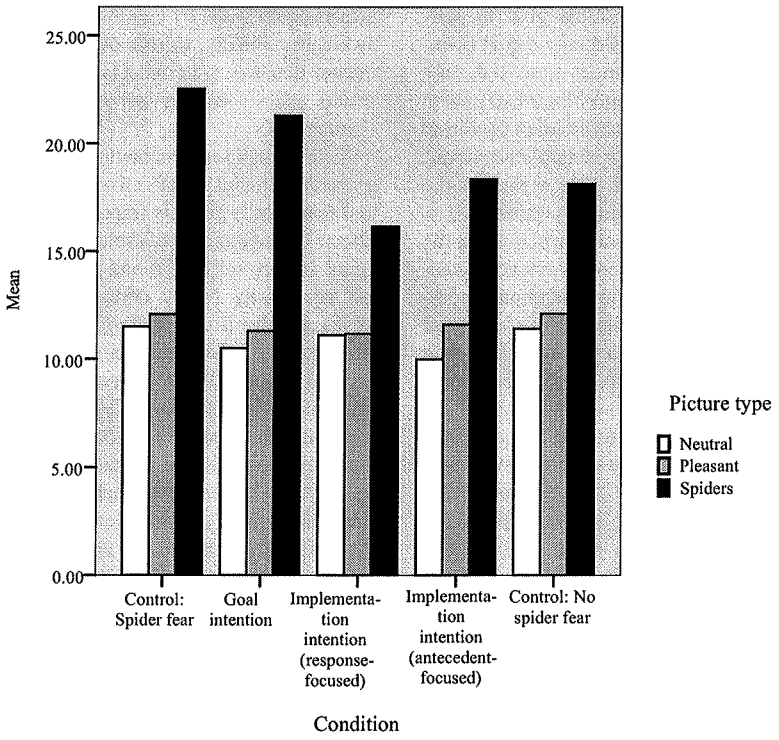

Figure 2. Mean ratings of reported negative affect for picture type by condition (Study 2).

2.76 vs. $M = 16.15$, $SD = 6.21$) between the no-spider-fear control group and the spider-fear antecedent-focused implementation-intention group, which were all nonsignificant ($ts < 1.2$).

Finally, comparing the two control groups (i.e., the nested no-spider-fear control group with the spider-fear control group) showed nonsignificant differences for neutral ($M = 11.41$, $SD = 2.34$ vs. $M = 11.51$, $SD = 1.97$) and pleasant pictures ($M = 12.09$, $SD = 3.04$ vs. $M = 12.08$, $SD = 1.92$; $ts < 1$) but a highly significant difference for fearful pictures ($M = 18.13$, $SD = 2.76$ vs. $M = 22.51$, $SD = 2.69$), $t(30) = 4.55$, $p < .01$, indicating that spider pictures indeed failed to negatively affect no-fear controls. The same pattern emerged when comparing the goal-intention participants with the no-spider-fear control group; no differences between groups were found for neutral ($M = 10.50$, $SD = 2.21$ vs. $M = 11.41$, $SD = 2.34$), $t(33) = 1.18$, *ns*, and pleasant stimuli ($M = 11.31$, $SD = 2.59$ vs. $M = 12.09$, $SD = 3.04$; $t < 1$), but a significant difference was observed for fearful pictures ($M = 21.28$, $SD = 4.71$ vs. $M = 18.13$, $SD = 2.76$), $t(33) = 2.40$, $p < .05$.

Further Analyses

Reported goal commitment. In the postexperimental questionnaire, no significant difference in commitment to self-regulate was observed between participants with a goal intention ($M = 6.25$, $SD = 1.66$) versus those with a response-focused implementation intention ($M = 7.00$, $SD = 1.37$), $t(34) = 1.48$, *ns*. However, a significant difference was observed between participants with a goal intention and those with an antecedent-focused implementation intention ($M = 7.41$, $SD = .87$), $t(33) = 2.56$, $p < .05$, indicating that antecedent-focused implementation-intention participants reported being more committed to the goal to self-regulate than did those participants who formed only a goal intention. With respect to the second commitment item (i.e., the question of how hard participants tried to control their fear), there was no significant difference between the goal-intention condition ($M = 5.72$, $SD = 2.61$) and the response-focused implementation-intention condition ($M = 5.67$, $SD = 2.63$; $t < 1$) as well as the antecedent-focused implementation-intention condition ($M = 6.65$, $SD = 2.09$), $t(33) = 1.15$, *ns*. Importantly, when using the two commitment items as covariates, the difference between goal-intention and response-focused implementation-intention participants on the affect index turned out to be significant ($p < .01$), and this was also true for the difference between the goal-intention and the antecedent-focused implementation-intention participants ($p = .05$).

Perceived performance. Regarding the question of how difficult it was to control one's fear, no significant difference emerged between participants' answers in the goal-intention condition ($M = 5.39$, $SD = 2.70$) versus in the response-focused ($M = 5.06$, $SD = 2.34$) or antecedent-focused ($M = 6.68$, $SD = 1.81$) implementation-intention conditions ($ts < 1.7$). The same was true with respect to the question of whether participants felt that the received self-regulation instruction helped in controlling their fear: goal-intention condition ($M = 4.03$, $SD = 2.49$) versus response-focused implementation-intention condition ($M = 5.06$, $SD = 2.21$), $t(34) = 1.31$, *ns*, and antecedent-focused implementation-intention condition ($M = 5.44$, $SD = 1.75$), $t(33) = 1.93$, $p < .10$. Also, no significant difference was observed concerning participants' reported success in realizing their self-regulation intention: goal intention ($M = 5.42$, $SD = 2.38$) versus response-focused ($M = 5.50$, $SD = 1.98$) and antecedent-focused ($M = 5.24$, $SD = 2.31$) implementation intentions ($ts < 1$).

Discussion

In Study 2, we replicated and extended the findings of the first study by analyzing the down-regulation of fear and by adding a new type of implementation intention. In our sample of spider-fearful participants, implementation-intention participants evidenced better down-regulation of spider fear than did participants in the control and goal-intention conditions. Compared to control participants with spider fear, implementation-intention participants but not goal-intention participants responded to the spider pictures with reduced negative affect. Apparently, even people with high spider fear can use implementation intentions to effectively reduce the fear elicited by spiders, as revealed by self-report data, whereas goal intentions do not suffice. Most interesting, the down-regulation of spider fear achieved by implementation intentions reduced this fear to the level observed with participants who had no fear of spiders. This suggests that the fear produced by the spider pictures in spider-fearful participants was completely eliminated by forming implementation intentions of either the response-focused or antecedent-focused type.

Moreover, the observed patterns of data with respect to commitment to emotion regulation preclude alternative explanations of the effects of implementation intentions on down-regulation of spider fear in terms of strength of goal commitment. And the findings on perceived performance of down-regulation of negative affect are in line with the claim that implementation-intention effects come about by automatic processes that operate outside of awareness. Finally, to rule out interpretations in terms of experimenter demand, we conducted a second follow-up study and the results again speak against such an alternative explanation (see Footnote 1).

Even though implementation intentions have been shown in the preceding studies to effectively down-regulate disgust (Study 1) and fear (Study 2), it is important to recognize that the observed effects of implementation intentions are based on self-report measures. In fact, self-report and physiological indices of emotion are not necessarily highly correlated (Lang, Bradley, & Cuthbert, 1998), and therefore a combination of self-report and physiological variables (i.e., event-related potentials [ERPs]), as attempted in Study 3, would allow for a more critical test of the effectiveness of implementation intentions. Moreover, Study 3 aimed to complement and elucidate the previous self-report data with physiological correlates to facilitate a deeper understanding of the temporal dynamics and attentional mechanisms underlying the effectiveness of forming implementation intentions. The analysis of ERPs offers the possibility to determine at what point in time implementation intentions exert their effects after the critical emotional stimuli are encountered.

One component among the ERPs that has been shown to be highly sensitive to the presentation of highly arousing negative stimuli is the P1 (e.g., Carretié, Hinojosa, Martín-Loeches, Mercado, & Tapia, 2004; Smith, Cacioppo, Larsen, & Chartrand, 2003; Smith et al., 2006). The P1 refers to the immediate time window (around 100 ms) after stimulus presentation. It seems to

reflect initial and low-level processing of a presented stimulus in the posterior visual cortex (Hillyard & Anllo-Vento, 1998).

Antecedent-focused implementation intentions specify an ignore response with respect to negatively charged stimuli in the then component of if-then plans, and this response is assumed to be elicited immediately once the critical stimulus is faced. Accordingly, the P1 enhancement commonly associated with the presentation of negative stimuli should be reduced by this type of implementation intention. In other words, ignore implementation intentions should block the emergence of emotional reactivity at its onset, as evidenced by a modulation of the P1. Response-focused implementation intentions, on the other hand, cannot be expected to affect such early, low-level processes; rather, their effects on down-regulating negative affect may involve the automation of higher level processes. As higher level processes are not reflected in the P1, we decided to exclude response-focused implementation intentions from Study 3.

Study 3: Electrocortical Correlates of the Self-Regulation of Fear

The present study assessed the electrocortical correlates of the self-regulation of emotion through ignore implementation intentions. ERPs served as measures of these brain correlates, as we were interested in the question of the temporal dynamics of the processing of emotional stimuli. The assessment of ERPs represents a noninvasive technique that allows for recording the time course of cortical processes time-locked to cognitive or affective events. Compared to other brain imaging techniques, such as positron emission tomography or functional magnetic resonance imaging, ERPs have the advantage of a high temporal resolution (Luck & Girelli, 1998).

In the present study, we analyzed the functioning of antecedent-focused (i.e., ignore) implementation intentions, examining a series of ERP components representing different aspects of stimulus processing. The component of primary interest was thus the P1 (or P100) component, which reflects electrocortical activity in higher level extrastriate areas of the visual cortex (Luck & Girelli, 1998) and is assessed in a time window around 100 ms after stimulus presentation. The P1 has been reported to discriminate between affective stimulus content, with high-arousing negative stimuli often eliciting larger P1 amplitudes. This has been taken as evidence that these stimuli may more strongly engage the visual cortex, possibly reflecting an attentional bias toward unpleasant arousing visual scenes (Carretié et al., 2004; Smith et al., 2003). In fact, the P1 has typically been studied in the context of spatial selective attention, and its amplitude tends to be increased when attention is allocated toward the location of a stimulus (Hillyard & Anllo-Vento, 1998). Findings of early ERP modulation have repeatedly been observed in other studies (Keil et al., 2001) and have received additional support by Carretié, Hinojosa, Mercado, and Tapia (2005), who demonstrated that there was greater ventromedial prefrontal cortex activation in response to spiders as compared to nonfrightening butterflies and snowflakes around 150 ms after stimulus onset.

We also examined the peak of the so-called late positive potential (LPP) in a time range between 400 and 460 ms poststimulus. Even with small trial numbers, the enhancement of the LPP for emotionally arousing compared to emotionally neutral pictures has been a robust finding (e.g., Cuthbert, Schupp, Bradley, Birbaumer, & Lang, 2000; Keil et al., 2002). It has been related to late reentrant facilitation of the visual cortex as a function of emotional arousal (Keil et al., 2002), potentially reflecting higher order processes interacting with affective vision. Indeed, it has been suggested that the LPP is related to sustained attentive processing due to the appetitive or defensive motivational significance of the stimuli (Cuthbert et al., 2000). The first of these motive systems is activated in situations that promote survival, including sustenance, procreation, and nurturance, whereas the defensive system has a behavioral repertoire founded on withdrawal, escape, and attack, as it is principally activated in contexts involving threat (Bradley, Codispoti, Cuthbert, & Lang, 2001). Accordingly, in the present study we used the LPP as a manipulation check for the type of presented pictures (neutral, pleasant, spiders), assuming that the pleasant and spider pictures should lead to higher mean amplitudes than neutral pictures would.

Finally, in the present study we also examined potential late parietal or frontal control processes over parietal and anterior electrodes in an even later time segment (slow wave; 550–750 ms poststimulus). In prospective memory research (West, Herndon, & Ross-Munroe, 2000), it has been discovered that directed search, that is, recovery from memory (after detecting the prospective cue), and realization of an intention are reflected in slow waves maximal in amplitude over the parietal and right frontal sites. In the present experiment, whenever spider pictures are presented, both goal and implementation-intention participants attempt to realize a stored self-regulation intention, whereas the control participants do not. Accordingly, we wondered whether—in comparison to control participants—both the goal and implementation-intention participants would show a modulation of the slow wave in parietal and frontal sites.

Based on the results of Study 2, we hypothesized that spider-fearful participants would show the same electrocortical activation when looking at spider pictures, no matter whether a goal intention to not get frightened (goal-intention condition) was formed or not (control condition). In contrast, an inhibition of the emotional response to spider pictures, and thus a reduction of the P1, was predicted as a consequence of forming an ignore implementation intention. The mechanisms by which this antecedent-focused implementation intention achieves its effect are assumed to be related to blocking negative emotions at their outset. Moreover, as the P1 is generated in the visual cortex (Luck & Girelli, 1998), we expected differential modulation over parieto–occipital regions, respectively. For the valence, arousal, and dominance self-report ratings used to assess the experienced negative affect, the same results as in Study 2 were predicted with respect to participants' ratings of spider pictures.

Method

Participants

Thirty-five female students with normal or corrected-to-normal vision from the University of Konstanz participated in return for either €10 (~$14.73) or 2 hrs, of course credit. Only female participants who scored 3 or 4 in each of the two specific items "When I see a spider in the room, I can't relax until it's gone" and "Spiders are one of the things I'm most afraid of" (each accom-

panied by a 4-point scale, ranging from 1 = *strongly disagree* to 4 = *strongly agree*) were invited to participate. In addition, it was made certain that they did not suffer from epilepsy or other neurological disorders. One participant was excluded due to bad ERP data (see description of artifact handling).

Design

The present study uses a 3 × 3 factorial design with Self-Regulation Condition (control condition, goal-intention condition, ignore-implementation intention) as the between factor and Type of Pictures (neutral, pleasant, spiders) as the within factor. ERPs and ratings on the three SAM scales (Bradley & Lang, 1994) combined to form a negative affect index were used to assess participants' success in down-regulating their fear of spiders.

Stimuli

As the picture series of the IAPS did not comprise a sufficient number of spider stimuli, 50 spider pictures interspersed in a series of pictures of plants and mushrooms were rated by 37 university students with high spider fear in a pilot study. A total of 69 slides (23 pleasant, 23 neutral, 4 spiders from the IAPS; Lang et al., 1999; and 19 spider pictures from the pilot study) were ultimately selected as the stimuli used in Study 3. The number of pictures presented was increased in Study 3 (as compared to Studies 1 & 2) to heighten the signal-to-noise ratio of the ERP signals.

Presentation

Each trial began with a fixation cross (800 ms presentation time) before a stimulus slide was presented for 300 ms that was then masked for 100 ms. The intertrial interval was 3,000 ms. These longer presentation times were used to avoid contamination of the LPP window with potential off-responses that might be expected for the short stimulus duration used in Studies 1 and 2. In addition, previous ERP work has shown stronger effects for stimulus durations longer than 100 ms.

All pictures were randomly presented twice, and a new presentation order was constructed for each participant. ERPs were recorded during the first presentation of the 69 pictures, and participants' affect ratings were taken during their second presentation. Participants rated experienced valence, arousal, and dominance with respect to each of the presented pictures on the respective SAM scales (Bradley & Lang, 1994), which appeared on the screen after the presentation of each picture. As in Studies 1 and 2, after 2,000 ms, a beeping sound for 200 ms with 500 Hz reminded participants of the end of the response window. All pictures were presented on a 19-inch (48.3-cm) computer monitor with a refresh rate of 100 Hz.

Procedure

Upon arrival at the laboratory, participants were informed about the procedures of the study. They were instructed that they would see a series of pictures in the first part of the experiment and, in the second part of the experiment, would be asked to rate these pictures in terms of the emotional responses they elicit. Exemplary slides were presented to make subjects familiar with the neutral (e.g., household objects), pleasant (e.g., appetizing food), and unpleasant (i.e., spiders) picture categories. Participants were reminded that they could end the experiment at any time, oral and written informed consent was obtained, and participants were randomly assigned to one of the three self-regulation conditions.

After preparation for the electroencephalography recording and the sensor net had been applied (discussed in detail later), all participants were instructed to fixate on the cross in the middle of the screen and to avoid eye blinks as well as bodily movements throughout picture presentation. Participants in the control condition received no further instructions. In the goal-intention condition, participants received the further instruction to form the intention of "I will not get frightened!" Those in the implementation-intention condition were first assigned this goal intention and were then asked to furnish it with the following ignore implementation intention: "And if I see a spider, then I will ignore it!" Participants were seated comfortably and a chin rest was adjusted to prevent head movements. In the second part of the experiment (i.e., second presentation of the stimuli), the experimenter explained the SAM rating procedure and then ran four practice trials. Moreover, participants were asked whether they remembered the task instructions (i.e., irrelevant goal intention, relevant goal intention, relevant goal intention plus ignore implementation intention). Participants were then asked to view and rate the 69 pictures. When they had done this, the sensor net was removed, and the same postexperimental questionnaire as used in Studies 1 and 2 was administered. Finally, all participants were debriefed, given their money or hours of course credit, and thanked.

Electrophysiological Recordings

An Electrical Geodesics high-density electrode array consisting of 129 sensors was used to record electroencephalography results continuously. It was digitized at a rate of 250 Hz, and the vertex (Cz) was chosen as reference. Scalp impedances of each sensor were kept below 50 kΩ. All channels were preprocessed on-line by means of 0.1-Hz high-pass and 30 Hz low-pass filtering.

Data Reduction and Analysis

Three time windows corresponding roughly to P1 (60–150 ms), LPP (400–460 ms), and slow wave (550–750 ms) were determined by visual inspection. Each component was evaluated statistically at electrode groups showing maximum amplitude of the respective component. Given the symmetric, near-midline topography of all deflections of interest (i.e., P1, LPP, and slow wave) at frontal and parieto–occipital regions, we performed statistical analyses for the regions of interest, which were formed by averaging across electrodes in symmetric electrode clusters (see, e.g., Keil et al., 2002, for a similar procedure). Averages across time points and electrodes were obtained for six clusters (right occipital, left occipital, right parietal, left parietal, right frontal, and left frontal lobes) and were submitted to statistical analysis for the P1 (occipital and parietal), the LPP (parietal), and the slow wave (parietal and frontal).

Two kinds of ANOVAs were computed: First, as a manipulation check, we examined the LPP at parietal sensors, comparing mean amplitudes for pleasant, neutral, and spider pictures, to test whether the expected effects (pleasant and spider > neutral) were present across experimental groups. Such a finding with respect to

the most reliable ERP index of affect would indicate that the emotional picture stimuli were capable of eliciting the expected emotion modulation. To this end, ANOVAs were used that had as within-subject factors Picture Content (pleasant, neutral, spider) and Hemisphere (left, right).

Second, effects of experimental conditions on the ERPs elicited by spider pictures were evaluated by ANOVAs with a between-subject factor of Self-Regulation Condition (i.e., control, goal intention, implementation intention) and a within-subjects factor of Hemisphere (left, right) for each ERP component at occipital and parietal (P1), parietal (LPP), as well as parietal and frontal (slow wave) electrode clusters. These analyses aimed to specifically examine the time course of ERP modulations related to the manipulation of the self-regulation intention. Again, to examine the specificity of effects, the same ANOVAs were conducted for pleasant and neutral picture content. Significant interactions of Condition × Hemisphere were followed up by post hoc ANOVAs at single regions of interest (i.e., left and right electrode clusters for each region) and *t*-tests were used to examine specific group differences.

Results

Dependent Variables: Negative Affect Index

A 3 between (Self-Regulation Condition: control condition, goal intention, implementation intention) × 3 within (Type of Pictures: pleasant, neutral, spiders) factorial ANOVA on the negative affect index yielded a significant main effect for Type of Pictures, $F(2, 62) = 278.15$, $p < .01$. Neutral pictures ($M = 9.27$, $SD = 2.52$) and pleasant pictures ($M = 10.20$, $SD = 2.51$) produced less negative affect than spider pictures did ($M = 22.52$, $SD = 3.63$), $t(33) = 17.54$, $p < .01$, and $t(33) = 15.99$, $p < .01$, respectively. Moreover, the interaction between Type of Pictures and Self-Regulation Condition, as well as the main effect for the Self-Regulation Condition, also reached significance, $F(4, 62) = 3.89$, $p < .01$, and $F(2, 31) = 4.54$, $p < .05$, respectively.

As expected (see Figure 3), follow-up one-factorial ANOVAs indicated a significant Self-Regulation Condition effect for the pictures portraying spiders, $F(2, 31) = 10.55$, $p < .01$, but for neither the pleasant nor the neutral pictures ($Fs < 1$). Planned contrasts revealed significant differences for the spider pictures between the control condition ($M = 23.83$, $SD = 2.69$) and the implementation-intention condition ($M = 19.00$, $SD = 3.05$), $t(31) = 3.91$, $p < .01$, as well as between the goal-intention condition ($M = 24.14$, $SD = 2.94$) and the implementation-intention condition ($M = 19.00$, $SD = 3.05$), $t(31) = 4.16$, $p < .01$. The contrast between the control and goal-intention conditions was not significant ($t < 1$). Thus, individuals with a fear of spiders experienced less negative affect when looking at spider pictures after having formed an ignore implementation intention compared to both goal-intention and control participants.

ERPs

Manipulation check for type of pictures: LPP. Replicating previous work, emotionally arousing picture content was associated with greater parietal LPP amplitude compared to neutral pictures, resulting in a main effect of Picture Content (see Figure 4), $F(2, 62) = 11.69$, $p < .01$.

P1. As predicted, one-factorial ANOVAs on mean ERP amplitudes in the 60–150 ms P1 window for spider pictures revealed differences between the three self-regulation conditions at parietal sensors, $F(2, 31) = 3.17$, $p < .06$, and occipital sensors, $F(2, 31) = 2.79$, $p < .08$, reflecting significant self-regulation effects at right occipital, $F(2, 31) = 3.46$, $p < .05$, and right parietal sensors,

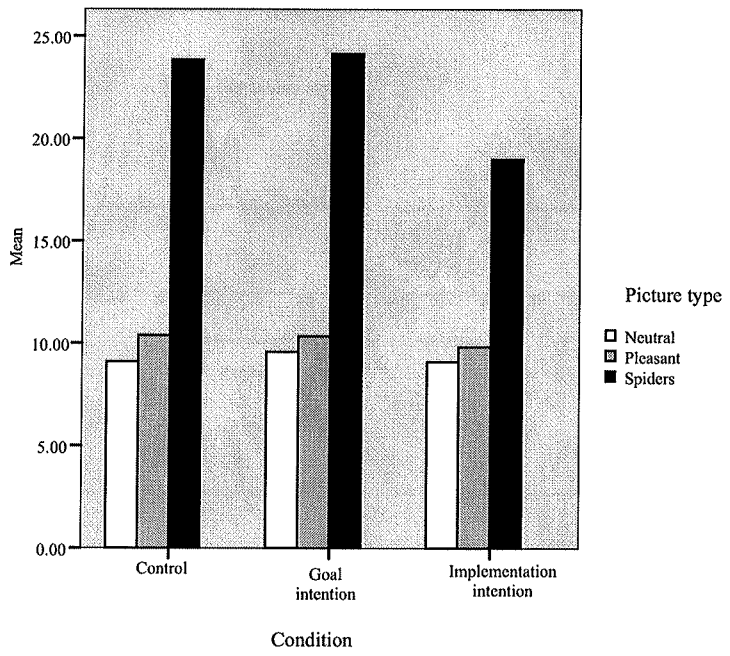

Figure 3. Mean ratings of reported negative affect for picture type by condition (Study 3).

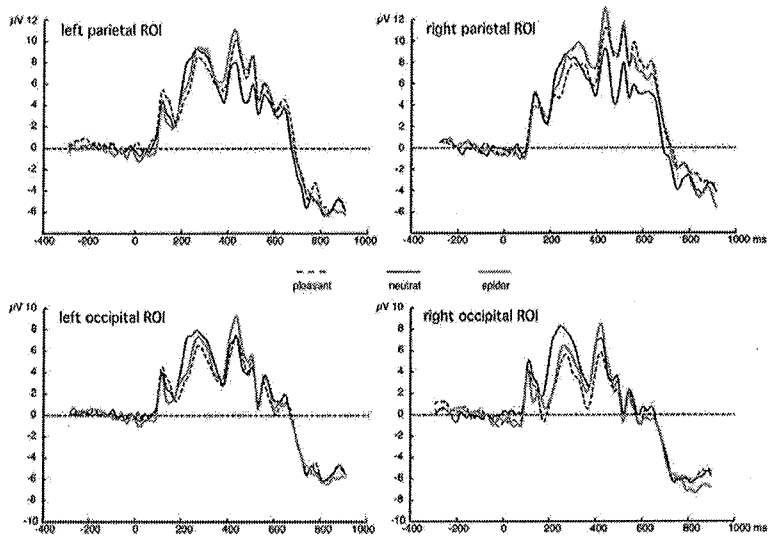

Figure 4. Grand mean event-related potential time series for four posterior regions of interest (ROIs), averaged across experimental groups, shown for pleasant, neutral, and spider pictures (Study 3). This analysis served as a manipulation check. As expected, less positivity was observed occipitally (lower panels) for arousing pictures (i.e., spider and pleasant pictures) compared with neutral pictures in the time range following the N1 component (around 190 ms after picture onset). In addition, the positive deflections at 300 ms and later showed the expected enhancement for emotionally arousing pictures compared to neutral pictures, including the right-hemispheric preponderance.

$F(2, 31) = 5.10$, $p < .05$, where this component was most pronounced (see Figure 5). No significant effects were found over the left hemisphere for the occipital, $F(2, 31) = 1.62$, *ns*, or the parietal clusters ($F < 1$). Also, in line with our hypotheses, we observed no significant differences between self-regulation conditions for either pleasant ($F < 1$, *ns*) or neutral pictures, $F(2, 31) = 1.21$, *ns*.

Slow wave. For the spider-evoked ERP in the 552–752 ms window, Hemisphere and Condition again interacted at parietal sensors, $F(2, 31) = 4.15$, $p < .05$. As shown by post hoc ANOVAs, groups differed in the left parietal region specifically, $F(2, 31) = 3.56$, $p < .05$. At frontal sensors, we observed a Hemisphere × Condition interaction, $F(2, 31) = 3.24$, $p < .06$, indicating differential sensitivity to the self-regulation conditions.

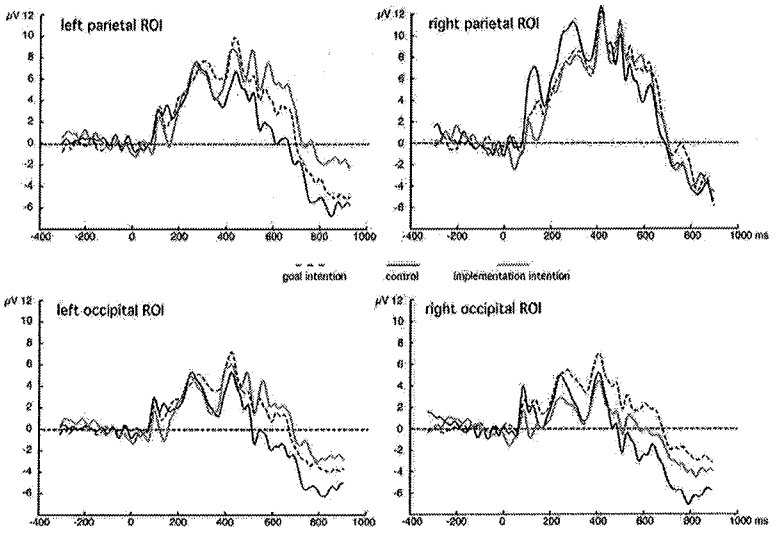

Figure 5. Grand mean event-related potential time series for four posterior regions of interest (ROIs) for the spider pictures only, shown for the three experimental groups (Study 3). Note the P1 reduction over occipital and parietal regions for the implementation-intention group.

This effect reflected ERP modulations at right frontal sensors, $F(2, 31) = 5.40$, $p < .05$. No significant differences were found for the neutral ($Fs < 1$) or pleasant pictures at right hemispheric sites, $F(2, 31) = 2.51$, $p = .10$, and left hemispheric sites, $F(2, 31) = 1.61$, *ns*.

Specific comparisons between self-regulation groups: P1 and slow wave. We specifically examined the differences between the control, goal-intention and implementation-intention conditions for the P1 and slow wave windows. Consistent with the assessed self-report data, planned contrasts for the spider pictures revealed significant differences in the P1 in the right occipital region (see Figure 6) between the implementation-intention condition and both the control, $t(31) = 2.51$, $p < .05$, and goal-intention condition, $t(31) = 2.04$, $p < .05$, but not between the control condition and the goal-intention condition ($t < 1$; see Table 1, left column). Over right parietal sensors (see Figure 7), a significant difference emerged for the spider pictures between the implementation-intention condition and the control condition, $t(31) = 3.17$, $p < .01$; this difference only approached significance between the goal-intention condition and the control condition, $t(31) = 1.88$, $p < .10$. No significant difference was observed between the goal-intention and implementation-intention conditions ($t < 1.4$, see Table 1, right column).

Further examining the group differences in the left parietal region for the slow wave window, we found smaller ERP amplitudes in the control condition ($M = 0.23$, $SD = 4.31$) compared to the implementation-intention condition ($M = 6.22$, $SD = 7.03$), $t(31) = 2.64$, $p < .05$, but no differences emerged between the control condition and the goal-intention condition ($M = 3.75$, $SD = 4.52$), $t(31) = 1.63$, *ns*, nor between the goal-intention and the implementation-intention condition, $t(31) = 1.08$, *ns*. When comparing the control condition ($M = 2.55$, $SD = 8.81$) with the goal-intention condition ($M = -6.78$, $SD = 6.85$), as well as the control condition with the implementation-intention condition ($M = -6.60$, $SD = 7.75$) at right frontal sensors, significant differences emerged, $t(31) = 2.91$, $p < .05$, and $t(31) = 2.72$, $p < .05$, respectively. Between the goal-intention condition and the implementation-intention conditions, no significant differences were observed ($t < 1$).

Table 1
Mean (Standard Deviation) Amplitudes (in μV) in the P1 (60–150 ms) Window (Study 3)

	Brain regions	
Condition	Right occipital	Right parietal
Control	2.51 (3.97)	4.36 (3.90)
Goal intention	1.84 (2.06)	1.85 (2.05)
Implementation intention	−1.07 (3.71)	−0.07 (3.61)

Further Analyses

Ocular movements. We visually controlled and statistically tested the horizontal and vertical electrooculogram as calculated from ocular electrodes, which are part of the electrode net. No differences of ocular movement were evident among experimental conditions.

Reported goal commitment. Goal-intention ($M = 7.75$, $SD = 1.29$) and implementation-intention participants ($M = 7.10$, $SD = 0.88$) did not differ with respect to their commitment to the

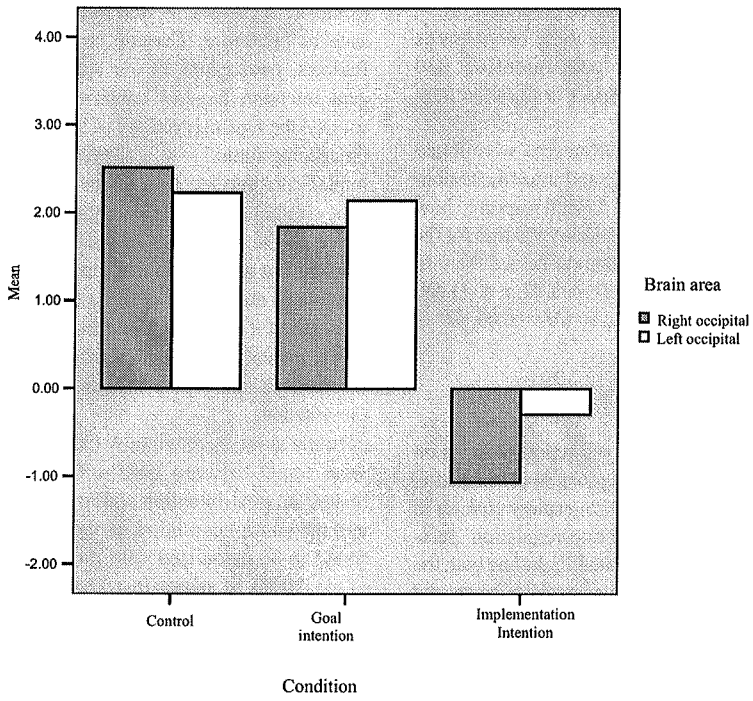

Figure 6. Event-related potential global power for the P1 calculated for the occipital areas in response to spider pictures, shown for the three conditions (Study 3).

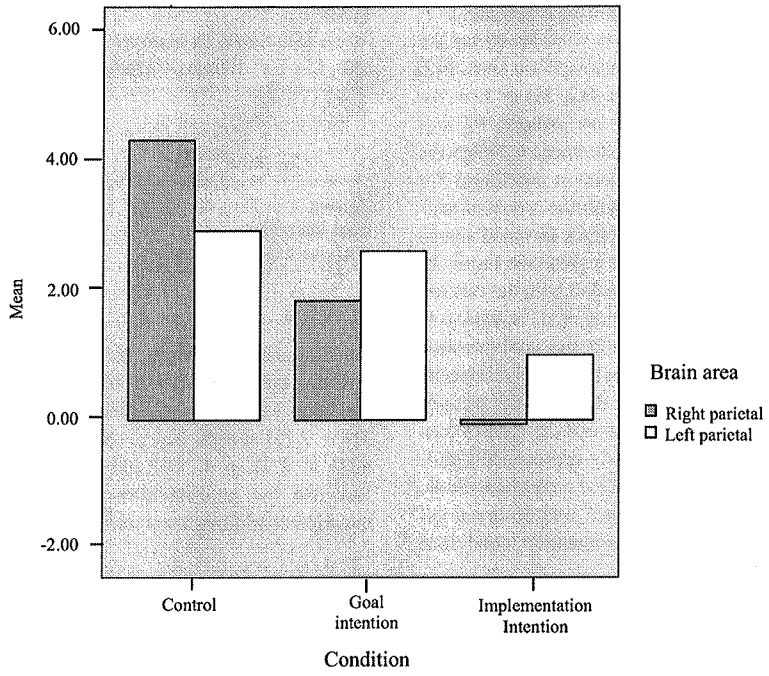

Figure 7. Event-related potential global power for the P1 calculated for the parietal areas in response to spider pictures, shown for the three conditions (Study 3).

self-regulation goal, $t(20) = 1.35$, *ns*. The same was true for participants' reported effort to control negative feelings (goal intention: $M = 5.55$, $SD = 2.5$; implementation intention, $M = 6.56$, $SD = 1.59$), $t(18) = 1.05$, *ns*. When using these two items as covariates, the difference between the goal-intention and implementation-intention conditions with respect to reported negative affect stayed significant ($p < .01$).

Perceived performance. No significant differences were found between goal-intention ($M = 5.91$, $SD = 2.21$) and implementation-intention participants ($M = 6.0$, $SD = 1.80$; $t < 1$) with respect to how difficult they felt it was to control their fear. The same was true for the question of how much their self-regulation intention helped them to do so ($M = 4.92$, $SD = 2.07$ vs. $M = 5.40$, $SD = 2.22$; $t < 1$) and how successful they thought they were in doing so ($M = 6.08$, $SD = 1.68$ vs. $M = 6.30$, $SD = 1.57$; $t < 1$).

Discussion

In Study 3, we replicated and extended the self-report findings on the control of fear as observed in Study 2. Ignore implementation intentions led to lower negative affect when viewing spider pictures in comparison to control participants and emotion-regulation goal-intention participants (i.e., "I will not get frightened!"). In line with the results of Studies 1 and 2, implementation-intention participants did not differ from goal-intention and control participants in experiencing the pleasant and neutral pictures. More important, participants who added ignore implementation intentions to their goal intentions to not get frightened showed a lower positivity in the P1 when viewing spider pictures as compared to mere goal-intention and control participants; no such difference was found for pleasant or neutral pictures. Indeed, previous research has shown that the P1 can discriminate highly arousing negative stimuli from neutral and positive stimuli (Smith et al., 2003), as well as spiders from nonthreatening animals such as butterflies (Carretié et al., 2005). In line with these latter findings, participants in our study without any emotion-regulation goal intention (control condition) or those with a goal intention showed the typical positivity of the P1 at about 120 ms after detecting threatening stimuli (e.g., Carretié et al., 2004). In contrast, forming an implementation intention led to a down-modulation of this component, resulting in a significantly lower positivity of the P1. This again attests to the specificity of the implementation-intention effect and supports our assumption that forming implementation intentions leads to strategic automation of the goal-directed responses specified in the then part of if-then plans, as conscious efforts to inhibit the activation of the mental representation of a presented stimulus are commonly assumed to show their effects more than 300 ms after stimulus presentation.

In the slow wave window (552–752 ms), significant differences were found between both self-regulatory conditions on the one hand (i.e., goal-intention and implementation-intention conditions) and the control condition on the other. As the slow wave has been found to be associated with prospective memory processes (West et al., 2000), it seems that keeping the self-regulation intentions (i.e., goal intentions as well as implementation intentions) of the present study in mind and attempting to realize them when the critical pictures (i.e., the spiders) are encountered does also involve prospective memory processes. Indeed, Gollwitzer and Cohen (2008) have pointed out that goal intentions and the intentions meant to fulfill them (i.e., implementation intentions) are drawing

on prospective memory processes. This is also suggested by the fact that previous prospective memory research (West et al., 2000) has found the same parietal and right frontal activations that we observed in the present study.

Finally, as we visually controlled and statistically tested the ocular movements between experimental conditions, an alternative explanation of the observed implementation-intention effects on the down-regulation of emotion in terms of distinct eye movements in implementation-intention participants is not viable. The observed P1 effects can thus be attributed to the self-regulation achieved by implementation intentions but not to differential closing of one's eyes or focusing them away from the presented stimuli in implementation-intention participants. Also, no differences between goal-intention and implementation-intention participants on commitment to emotion regulation and perceived performance in the down-regulation of fear were observed. Again, this precludes alternative interpretations of the findings in terms of higher commitment in implementation-intention participants, and it suggests that implementation-intention effects are based on automatic processes.

General Discussion

Gross (1998b) stated that "an empirical account of individuals' emotion regulatory goals is sorely needed. Such an account would permit a more complete analysis of the costs and benefits of different forms of emotion regulation as they are used in the service of various goals" (p. 286). The present studies aimed to contribute to the research on emotion regulation by analyzing new forms of antecedent-focused and response-focused emotion regulation that use implementation intentions.

As forming implementation intentions is a self-regulation strategy that furthers the degree of automaticity of goal striving (Gollwitzer, 1999; Gollwitzer & Sheeran, 2006), the present studies explored whether adding implementation intentions to emotion-regulation goals would make these goals more effective. In Study 1, participants were exposed to a series of pictures used to elicit disgust. When participants had formed a response-focused implementation intention, they were able to reduce arousal in the face of disgusting pictures (as compared to a no-self-regulation control group). Because of the high emotional reactivity associated with these pictures, we expected and observed that participants who operated under a mere goal to not get disgusted did not manage to do so.

Study 2 analyzed the control of spider fear in spider-fearful participants and observed that both participants with response-focused and participants with antecedent-focused implementation intentions experienced less negative affect in the face of spider pictures as compared to a no-self-regulation control group; again, goal intentions failed to achieve this effect. Importantly, spider-fearful participants using implementation intentions even managed to control their fear to the low level observed with a sample of participants who were preselected on the basis of having no fear of spiders at all. Finally, Study 3 replicated the effectiveness of ignore implementation intentions for the control of spider fear in spider-fearful participants, and the collected electrocortical data suggest that these effects are indeed based on the postulated strategic automation of the ignore response (Gollwitzer, 1993, 1999).

Across the three studies, there was a stable pattern of findings regarding the lack of effectiveness of forming goal intentions as compared to implementation intentions. This supports the idea that self-regulation by goal intentions is rather slow and effortful and thus runs into problems when immediate and strong emotional reactivity (as induced by highly disgusting pictures or spider pictures presented to spider-fearful participants) has to be down-regulated. Moreover, it is in line with previous studies that compared the effectiveness of goal and implementation intentions on the self-regulation of habitual behavioral and cognitive responses (for a review, see Gollwitzer & Sheeran, 2006), as well as previous findings on effective emotion regulation via implementation intentions even under cognitive load (Schweiger Gallo & Gollwitzer, 2007).

One may wonder whether the effects of implementation intentions versus goal intentions in the present studies merely rest on the fact that implementation-intention participants were offered additional information on how to deal with the critical stimuli. Participants in the implementation-intention condition were not only given more information but also more precise information about what to do when the critical stimuli were encountered, whereas those in the goal-intention group were given information only on what needed to be achieved. Recent research by Bayer and Gollwitzer (2007) discourages such an interpretation. They assessed the self-regulation effects of goal intentions versus goal intentions plus implementation intentions versus goal intention plus information on the behavioral strategy spelled out in the implementation intention and observed that participants in the goal intention plus information on strategy condition not only failed to perform at the same high level as did implementation-intention participants but rather showed a performance level that was as weak as that of goal-intention participants. Apparently, it is the if(situational cue)–then(goal-directed response) link created by forming implementation intentions that accounts for their positive self-regulation effects.

Another possible criticism concerns the suspicion that participants in the response-focused implementation-intention condition succeeded with staying calm and relaxed simply because they spontaneously reframed the given implementation intention into an antecedent-focused emotion regulation strategy (e.g., they formed ignore implementation intentions). As we had asked implementation-intention participants of both conditions to report the self-regulation strategy they had followed once the study was over, we could check whether this was the case. As it turned out, implementation-intention participants of the two conditions in each case strictly followed the assigned self-regulation instructions.

Contributions of the Present Research to Emotion Regulation

Interpreting the modulation of the P1 by ignore implementation intentions as an indication that emotion regulation has become automated is in line with previous findings in research on implementation intentions. For instance, participants who formed implementation intentions to master demanding cognitive tasks did not become as ego-depleted by the task performance as mere goal-intention participants did (e.g., the Stroop task; Webb & Sheeran, 2003). Also, Schweiger Gallo and Gollwitzer (2007) observed that forming implementation intentions for the purpose of controlling fear did enable participants to down-regulate their fear even under cognitive load. Apparently, self-regulation by implementation intentions is efficient; it does not deplete self-

regulatory resources (Webb & Sheeran, 2003), and it can operate even when these resources are sparse.

Research on implementation intentions (e.g., Achtziger, Bayer, & Gollwitzer, 2008; Parks-Stamm, Gollwitzer, & Oettingen, 2007; Webb & Sheeran, 2007) suggests that this automatic functioning of self-regulation by implementation intentions is also based on processes that relate to the if component (i.e., heightened activation of the mental representation of the specified cues) and not just to the then component (i.e., the strong mental link that is formed from these cues to a select response) of if-then plans. The present results are consistent with a heightened accessibility assumption. A modulation of the P1 should be facilitated if the critical cue is more easily detected and more readily attended to, both being a consequence of the heightened activation of the mental representation of the specified critical cue (Achtziger, Bayer, & Gollwitzer, 2008).

Emotion regulation via implementation intentions should thus be void of unwanted cognitive consequences, such as impaired memory (Gross, 2002), and therefore should not undermine other self-regulatory attempts (Tice & Bratslavsky, 2000). As well, no affective and social consequences, such as an increased sympathetic activation of the cardiovascular system, should be associated with this strategy. Still, future research is warranted to further explore the physiological correlates of down-regulating emotions via implementation intentions versus goal intentions and to undertake a simultaneous analysis of positive emotion-expressive behavior (i.e., facial behavior; Gross, 1998a) and of social costs (e.g., weaker social support; Gross, 2002).

In the present studies, the then component of the implementation intention specified either remaining calm and relaxed or ignoring the critical stimulus. Both of these self-regulatory responses belong to the so-called cool system of self-control. Mischel and colleagues (Metcalfe & Mischel, 1999; Mischel & Ayduk, 2004) made a distinction between a cognitive and reflective cool system and an emotional, reflexive hot system. Both systems constantly interact, but whereas the first one constitutes a complex and emotionally neutral "know" system, the hot "go" system favors simple and fast emotional processing. From this perspective, the format of the implementation intentions used in the present studies is geared toward switching from the hot to the cool system of self-control, and this may be why the implementation intentions suggested to our research participants were so effective in reducing negative affect.

Finally, the present approach nicely complements Bargh and Williams's (2007) recently proposed approach to the automation of emotion regulation. According to Bargh and Williams, a person experiences an emotional state before deciding whether or not and how to regulate the emotion. Then, based on situational demands, the decision is made, and the regulatory strategy or goal is pursued. This conscious emotion-regulation process purportedly can become nonconscious given repeated regulatory attempts in a particular environment or context. Once the association between the regulatory strategy and the context is sufficiently strengthened, the strategy should become automatically activated and applied whenever the same context is encountered. The present research suggests that an alternative way of creating this association between a self-regulatory strategy and a particular context is available by forming implementation intentions. What distinguishes the automatic processes underlying implementation intentions from habitually formed links is that the former are based on a single mental act of linking an anticipated critical situation to a desired goal-directed response (Gollwitzer, 1999; Gollwitzer & Schaal, 1998) and are not the result of frequent and consistent goal-directed responding to the same situation (Aarts & Dijksterhuis, 2000; Bargh & Gollwitzer, 1994).

Contributions to Clinical and Applied Psychology

Not only basic motivational and self-regulatory research but also applied research and clinical interventions are informed by the present research. Implementation-intention interventions should be particularly valuable for both professionals who have to deal daily with severe disgust feelings (e.g., health professionals) and patients with phobias. Also, depressed patients and those with an obsessive-compulsive disorder might benefit from forming implementation intentions as they could compensate for their general failure to suppress unwanted or dysfunctional thoughts (Wenzlaff & Wegner, 2000). Making simple if-then plans could complement traditional, long-term clinical interventions (e.g., systematic desensitization) that aim at facilitating the control of negative emotions. The simple act of forming an implementation intention to keep calm and relaxed whenever seeing an unpleasant stimulus, such as blood or a spider, allows for immediate self-regulation of disgust or fear. It should also be possible to ad hoc regulate other important daily emotions, such as anger, by the simple preparatory volitional act of forming implementation intentions. Indeed, no extensive training in forming implementation intentions is necessary (Gollwitzer & Sheeran, 2006), and due to the automatic action control instigated by implementation intentions, no cognitive resources should be consumed and thus the performance of ongoing dual tasks should stay unaffected (Brandstätter et al., 2001). This latter aspect is particularly relevant to professionals who need to give their best attention to the task at hand.

Moreover, patients with anxiety disorders have been found to show attention biases toward threatening information and biases in a variety of judgment tasks (e.g., probability judgments of the occurrence of critical events; summary by MacLeod, 1999). In this domain, ignore implementation intentions should be particularly helpful as they disengage attention from threatening stimuli immediately. As evidenced by the modulation of the P1, the ignore response specified in the then part of the implementation intention seems to be initiated automatically as soon as the critical stimulus is encountered. As ignore implementation intentions manage to affect early sensory processing, they may also be used to reduce the perceptual prerequisites for developing a fear response. Therefore, the nonconscious and preattentive activation of fear networks (Öhman, 1993; Öhman, Flykt, & Lundqvist, 2000; Öhman & Wiens, 2003) by critical stimuli might be diminished when forming ignore implementation intentions, and the rapid activation of autonomic response patterns to fear-relevant stimuli, such as spiders and snakes (Globisch, Hamm, Esteves, & Öhman, 1999), could be averted. In this regard, our research suggests that the reflexive activation of fear responses could be overcome by forming ignore implementation intentions. Thus, although forming implementation intentions increases attention to the specified stimulus, the automatic instigation of the ignore response should prevent fear reactions to the critical stimulus. Due to the immediate instigation of the specified response of ignoring the stimulus, the elicitation of fear responses is "outrun."

Future Directions

The present studies represent an initial attempt to explore the effectiveness of implementation intentions in emotion regulation. So far, we have limited our analysis to a response-focused implementation intention (i.e., ". . . , then I will stay calm and relaxed!") and to an antecedent-focused implementation intention (i.e., ". . . , then I will ignore it!"). When exploring the electrocortical correlates of the functioning of implementation intentions in Study 3, we even limited our analysis to antecedent-focused (i.e., ignore) implementation intentions only. Thus the analysis of the effectiveness and electrocortical correlates of other contents in the then component of an implementation intention seems warranted to analyze the differential mechanisms by which they achieve emotion control. Specifying an antagonistic response of approaching the threatening stimulus, for example, seems a promising further response-focused implementation intention. But other antecedent-focused emotion-regulation strategies, such as cognitive reframing, also come to mind. People with animal phobias could form, for example, the antecedent-focused implementation intention of taking the perspective of a veterinary surgeon to deal with the threatening animals.

Finally, further ERP studies are needed in order to compare specifically the effects of response-focused versus antecedent-focused emotion-regulation strategies. Given that fearful reactivity involves activation of a network encompassing sensory, motor, and memory aspects, one wonders which aspects are best down-regulated by which type of implementation intention. Collecting ERP data may help to find answers to this question.

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