# *Stay calm! Regulating emotional responses by implementation intentions: assessing the impact on physiological and subjective arousal*

Article

Accepted Version

# Stay calm! Regulating emotional responses by implementation intentions: assessing the impact on physiological and subjective arousal.

Lena Azbel-Jackson*, Laurie T. Butler, Judi A. Ellis, Carien M. van Reekum

University of Reading

* Corresponding Author

School of Psychology and Clinical Language Sciences

University of Reading

Whiteknights Campus, Earley Gate

Reading RG6 6AL

UK

Email: sxu06la@googlemail.com or Lena.Azbel-Jackson@reading.ac.uk

Tel: +44 (0)118 378 5556

Fax: +44 (0)118 378 6715

In Press: Cognition and Emotion

## Abstract

Implementation intention (IMP) has recently been highlighted as an effective emotion regulatory strategy (Schweiger Gallo et al., 2009). Most studies examining the effectiveness of IMPs to regulate emotion have relied on self-report measures of emotional change. In two studies we employed electrodermal activity (EDA) and heart rate (HR) in addition to arousal ratings (AR) to assess the impact of an IMP on emotional responses. In Study 1, 60 participants viewed neutral and two types of negative pictures (weapon vs. non-weapon) under the IMP "If I see a weapon, then I will stay calm and relaxed!" or no self-regulatory instructions (Control). In Study 2, additionally to the Control and IMP conditions, participants completed the picture task either under goal intention (GI) to stay calm and relaxed or warning instructions highlighting that some pictures contain weapons. In both studies, participants showed lower EDA, reduced HR deceleration and lower AR to the weapon pictures compared to the non-weapon pictures. In Study 2, the IMP was associated with lower EDA compared to the GI condition for the weapon pictures, but not compared to the weapon pictures in the Warning condition. AR were lower for IMP compared to GI and Warning conditions for the weapon pictures.



*Keywords:*
Emotion regulation; Implementation intentions; Electrodermal activity; Heart rate.

Examining the impact of an implementation intention on emotional responses

On a day-to-day basis people are exposed to a variety of potentially arousing stimuli and frequently engage in some form of emotion regulation to intensify, weaken or completely alter their emotional responses. There is growing evidence that emotion regulatory goals can be achieved by a variety of regulatory strategies (e.g., Gross & Thompson, 2007). Few researchers have examined self-regulation of emotional responses using IMPs (e.g., Eder, 2011; Schweiger Gallo et al., 2009). An IMP is a strategy that takes the form of "If situation *Y* is encountered, then I will perform behavior *Z*", where *Y* identifies an opportunity or cue to implement a goal-directed behavior and *Z* is desired outcome or end state (Gollwitzer, 1997). In contrast to IMPs, a GI takes the form "I intend to achieve X" (Ajzen, 1991). Thus, IMPs and GIs differ in both content and structure; a GI refers to what one intends to achieve, whereas an IMP specifies when, where and how one intends to achieve that goal. Studies have shown that forming an IMP improves the likelihood of goal achievement relative to a GI by facilitating detection of the specified cue(s) and by creating a strong link between the cue and the goal-directed response (e.g., Webb & Sheeran, 2007). When an IMP is formed, action initiation becomes immediate, efficient, and does not require conscious intent. Thus, it has been suggested that IMPs automate action initiation (Gollwitzer, 1999) as opposed to GIs.

Earlier studies have shown IMPs to be effective in changing subjective reports and brain electrocortical activity (e.g., Schweiger Gallo et al., 2009, Study 3), emotional behaviors (Eder, Rothermund, & Proctor, 2010) and emotional response tendencies (Eder, 2011). For instance, Schweiger Gallo and colleagues examined the impact of IMPs on emotional responses (e.g., Schweiger Gallo et al., 2009). In their studies participants viewed emotionally neutral, positive and negative pictures under IMPs (e.g., "I will not

get disgusted, and If I see blood, then I will stay calm and relaxed!") or GIs (e.g., I will not get disgusted!"), or simply view the picture instructions while their changes in subjective reports were measured (Schweiger Gallo et al., 2009, Study 1). The authors found that only those participants who formed IMPs were successful in achieving the emotion regulatory outcome specified in the "then" - part to the picture type specified in the "if" - part of the "if – then" plan (e.g., Schweiger Gallo et al., 2009, Study 1; Schweiger Gallo et al., 2012). Studies have shown that forming an IMP improves the likelihood of goal achievement by facilitating detection of the specified cue(s) and by creating a strong link between the cue and the goal-directed response (e.g., Webb & Sheeran, 2007), which could provide useful means for clinical interventions in emotion dysregulation.

The evidence reviewed above suggesting the efficacy of forming IMPs to reduce experienced emotions was mainly based on self-reports. A potential problem with employing self-report measures is that they could be influenced by demand characteristics, in particular when the participant is explicitly instructed when to invoke a specific regulatory goal. Studies by Eder and colleagues (2010; 2011) and Schweiger Gallo and colleagues (2009, Study 3) however, measured the emotional change by assessing changes in reaction time (Eder, 2011), behaviors (Eder et al., 2010) and brain electrocortical activity (Schweiger Gallo et al., 2009, Study 3). This in part circumvents the issue of demand characteristics and further highlights the potential of IMPs to control emotion.

Additionally, past studies (e.g., Perkins, 1955) have demonstrated that providing an individual with information about the affective content of a stimulus (e.g., appetitive

vs. aversive) allows an individual to prepare for the receipt of stimulation, with as a consequence dampened responses to aversive stimuli and enhanced responses to appetitive ones. In studies that examined emotion regulation using IMPs participants were too provided with information about the stimulus content in the "if" – part of the plan (e.g., "If you see blood...", Schweiger Gallo et al., 2009). The mere highlighting of stimulus content could have altered participants' responses to this stimulus. To determine the extent to which the "if"- part is a necessity, another control condition should be employed in which an individual is given information about a stimulus content and the GI but without using the "if-then" format of IMPs.

The extent to which converging evidence can be found in other components of emotion, such as bodily physiology, is however less known. A key system involved in generation of physiological responses is the Autonomic Nervous System (ANS). The ANS is subdivided into an excitatory Sympathetic Nervous System (SNS) and an inhibitory Parasympathetic Nervous System (PNS) that often interact to produce physiological arousal of varying degree. A substantial body of research has reported that both positive and negative emotions elicited EDA and HR responses (for a review see Bradley & Lang, 2000).

EDA is widely used as an index of sympathetic arousal and hence the intensity of emotional responses experienced (Lang et al., 1993). Changes in EDA are largely caused by activity in the sympathetically innervated sweat glands, which increase monotonically with intensifying stimulation (Bernstein, 1969). In studies using a variety of affective stimuli, EDA increases concurrently with reports of arousal, independent of whether the

experience is reported as pleasant or unpleasant (Bradley, Cuthbert, & Lang, 1990; Cook, Hawk, Davis, & Stevenson, 1991).

The heart, is innervated by both the sympathetic and parasympathetic branches of the ANS, which exert a regulatory influence on HR. The parasympathetic and sympathetic branches act antagonistically to influence cardiac activity and therefore an increase in HR could arise from either increased sympathetic or decreased parasympathetic activity (Quigley and Berntson, 1990). Using an event related paradigm involving passive viewing of neutral, positive and negative IAPS pictures, a larger HR deceleration is frequently reported for negative relative to those with a pleasant or neutral content (e.g., Bradley, 2009) which seems to be associated with parasympathetic dominance in the ANS (Lang, Bradley, Cuthbert, 1997). Moreover, acceleration of HR is usually found when the information content represents a specific high relevance to the person (e.g., Fredrikson, 2007; Mulberger, Wiedemann, Hermann, & Pauli, 2006) and reflects sympathetic influences on the heart (e.g., Furedy and Heslegrave, 1983; Rau, 1991; Quigley and Berntson, 1990). Studies that examined the effect of cognitive reappraisals on emotional responses have shown that reappraisals focused on decreasing negative emotion decrease EDA (e.g., Urry et al., 2009) and increase (e.g., Urry et al., 2009) or decrease (e.g., Kalish et al., 2005) HR responses.

## Overview of the Current Research

In two studies we examined the impact of the IMP on subjective reports, EDA and HR responses. In Study 1 we tested if the IMP would be successful in achieving the emotion regulatory outcome after viewing the negative weapon pictures. We expected to find a decrease in physiological reactivity to the weapon pictures in the IMP condition

compared to the weapon pictures in the Control and the non-weapon pictures in the IMP condition. In Study 2 to further ascertain if the observed effects on physiological responses were specific to IMPs we introduced two additional control conditions: the GI and the Warning. The GI condition was added to assess the extent to which the "if-then" plan as part of IMPs is required to effectively control emotion. In this condition participants formed the GI "I will stay calm and relaxed!". We also incorporated a Warning condition to control for any effects that may be due to increased attentional demand caused by the cue provided in the "if" part of the plan. Hence, in the Warning condition, in addition to the GI, participants were given instructions which contained information about the stimulus content (i.e., "Please note that you will see some unpleasant pictures including pictures depicting a weapon(s)."). To assess if the self-regulatory conditions differed in commitment or/and control or/and the task difficulty, participants in Study 2 completed the Post Experimental Questionnaire (PEQ, Schweiger Gallo & Gollwitzer, 2007).

## Study 1

The purpose of the study was to examine the impact of IMPs, additionally to subjective reports, on EDA and HR responses. To address this aim we selected neutral and two types of negative pictures from the IAPS: negative pictures containing a specific cue upon which to form IMPs (i.e., a weapon) and negative pictures in which this cue was absent. The weapon and non-weapon negative pictures were matched on valence, arousal, and content. Participants were instructed either to self-regulate their responses to the negative weapon pictures by forming the IMP "If I see a weapon, then I will stay calm and relaxed!" (IMP condition) or to simply view the pictures (Control condition). We

expected the IMP condition participants to show decreased AR, decreased EDA and reduced HR deceleration (i.e. reduced orienting) in responses to the negative weapon pictures relative to the non-weapon pictures in the IMP condition and the weapon pictures in the Control condition.

## Method

### *Participants*

Sixty participants (42 female, ages 18–35, *M*(age) = 21.5, *SD*(age) = 5.36) recruited from the University of Reading campus received course credit or were paid £5.00 as compensation for their time. The sample size was determined by considering sample size of earlier studies that also examined the impact of regulatory strategies on emotional responses (e.g., Schweiger Gallo et al., 2009; Urry, 2009). Participants were randomly allocated to one of two groups, the IMP and Control, with thirty participants in each group. All participants had normal or corrected to normal vision and none scored above the threshold for clinical diagnosis of depression and anxiety, using the Brief Symptoms Inventory (BSI, Marks, 1979). This study was approved by the University of Reading Research Ethics Committee.

### *Stimulus Materials*

During the laboratory session, participants viewed digital colour pictures selected from the International Affective Picture System (IAPS; Lang, Bradley, & Cooper, 2005). Pictures depicting weapons (N = 15) and other negative pictures (N = 15) were selected on the basis of IAPS normative data as highly arousing (from 1 = "least arousing" to 9 = "most arousing", *M* = 6.18, *SD* = 0.65; *M* = 5.88, *SD* = 0.51, respectively) and

unpleasant (from 1 = “most unpleasant” to 9 = “most pleasant” ($M$ = 2.63, $SD$ = 0.50; $M$ = 2.58, $SD$ = 0.64 respectively), with no significant difference in arousal ($t < 1$) and valence ($t < 1$) ratings between the two picture groups. Neutral pictures (N = 30) were selected to be neither pleasant nor unpleasant ($M$ = 5.18, $SD$ = 0.55), and non-arousing ($M$ = 3.49, $SD$ = 0.65). All pictures were matched on luminosity, sociality and complexity (determined by computing the jpeg image file size). The pictures were presented on a 30.5 cm x 23 cm flat screen using E-Prime 2.0 (Psychology Software Tools, PA, USA).

*Measures*

*Arousal ratings*.

The Self-Assessment Manikin (SAM; Bradley & Lang, 1994) was used to assess the AR to each of the presented pictures. The SAM consists of nine arousal manikins that varied from relaxed (left side) to excited (right side) with subjective scores ranging from 1 = “very relaxed” to 9 = “very excited”.

*Psychophysiological measures*

EDA and HR data were collected continuously using ADInstruments hard - and software, and associated accessories (ADInstruments, Australia). A ML-856 Power Lab data acquisition system was used to collect recordings as participants completed the regulatory task. Raw data was acquired using Lab Chart 7.0.

*Electrodermal activity*. Two 15x20 mm contact area MLT116F GSR finger electrodes were attached to the distal phalanges of the index and middle fingers on the non-dominant hand. The raw signal was recorded by a ML-856 Power Lab and passed through a ML-116 GSR Amplifier. The raw signal was sampled at 1 kHz and digitized with 50 kbits/s precision. The data were linearly de-trended on a trial-by-trial basis.

*Heart Rate.* A 15 mm circular contact area MP100 Pulse Transducer was attached to the distal phalanges of the ring finger. Raw signal was recorded by a ML-856 Power Lab 26T sampled at 1 kHz and digitized with 24-bit precision. Interbeat intervals (IBI) were calculated by identifying R-spikes using automated LabChart 7.0 algorithms. R-spikes that were missed, thus leading to an erroneously long period between successive R-spikes, or incorrectly identified were marked for exclusion by hand. The IBIs were then converted to HR in beats per minute.

*Procedure*

Upon arrival, each participant was informed "Please note you will view a series of negative and neutral pictures which will be presented one at a time on the computer screen and rate your emotional responses to each image while your EDA and HR responses recorded." After informed consent was obtained, participants were randomly assigned to either the Control or the IMP condition and asked to complete the BSI (Marks, 1979). Participants were then instructed to report their subjectively experienced level of arousal after the presentation of each picture using the SAM (Bradley & Lang, 1994) scale by clicking on a relevant manikin using a computer mouse.

Next, participants were seated at a set distance of 55 cm from the computer screen and the sensors to measure EDA and HR were attached. Further, they were instructed to always rate how they felt at the moment that they saw each picture. Participants then performed 8 practice trials to ensure that they were okay with the pictures and understood the rating scale. Next, in both conditions participants were asked to rate how each picture made them feel using arousal rating scale. Then, participants in the Control and the IMP conditions were asked to familiarize themselves with the instructions "Rate the pictures

without changing the way you think about them." and "If I see a weapon, then I will stay calm and relaxed!" respectively for thirty seconds. When thirty seconds elapsed they were asked to read instructions twice out loud.

Each trial began with a black fixation cross presented in the centre of a white screen for 0.8 s. Next, one of the 60 pictures was randomly selected and presented for 1 s followed 6 s later by the SAM arousal rating scale, which was displayed for maximally 6 s. Once participants had rated their arousal, an inter-trial interval ensued for 4 s, followed by the fixation cross signalling the beginning of a new trial. Thus, in total the trials ranged in duration from 12 to 15 seconds. Participants viewed each picture twice, giving a total of 120 trials. Participants then completed an emotion regulation questionnaire (data not reported).

*Data Reduction and Analysis*

Physiological data were baseline corrected by subtracting the signal recorded during the 1 s time window just before stimulus onset from all time points within a 7 s window immediately after picture onset. Data trials that fell more than 4 SDs from the within-subjects mean on a measure-by-measure basis for each participant were eliminated. To control for individual differences in participants' HR and EDA responses, the data were z-scored and aggregated across trials for each picture type on a second-by-second basis to provide a time course of the responses for illustrative purposes. For the multivariate GLM, we further aggregated across time before assessing the effects of condition (Control vs. IMP), Picture Type (neutral vs. non-weapon vs. weapon) on each physiological measure. AR were similarly analysed. Results were considered statistically

significant at $\alpha = .05$ and estimates of effect size, partial eta-squared ($\eta^2$), are reported for each effect.

## Results

### *The impact of the IMP on EDA responses*

After verifying that emotion had been elicited by the negative pictures[1] the impact of the IMP on EDA responses was examined. Consistent with our prediction, the multivariate GLM analysis of changes in EDA responses showed a statistically significant Condition x Type of Pictures interaction, $F(2, 57) = 4.52$, $p = .02$, $\eta^2 = 0.14$ (Figure 1). Follow-up pairwise comparisons revealed that the IMP condition participants showed lower EDA in response to the weapon pictures relative to the non-weapon pictures ($M_{\text{weapon}} = -0.04$, $SD = 0.11$ vs. $M_{\text{non-weapon}} = 0.11$, $SD = 0.16$), $t(19) = 6.76$, $p = .0001$, $d = 0.61$. The EDA to weapon and no-weapon pictures was not significantly different within the Control condition, $t < 1$. Furthermore, forming the IMP resulted in lower EDA in response to the weapon pictures relative to the weapon pictures in the Control condition, $F(1, 58) = 4.281$, $p = .04$, $\eta^2 = 0.07$. The difference in EDA responses to the non-weapon pictures in the IMP relative to the Control condition was not statistically significant, $F(1, 58) = 2.52$, $p = .12$, $\eta^2 = 0.04$.

[1] We tested whether viewing of the weapon and non-weapon pictures in the Control condition resulted in increased EDA and in a greater HR deceleration compared to the neutral pictures. The analysis revealed a significant increase in EDA during the weapon ($M = 0.02$, $SD = 0.12$), $t(29) = 4.28$, $p = .0001$, $d = 1.18$ and non-weapon ($M = 0.03$, $SD = 0.20$), $t(29) = 2.82$, $p = .01$, $d = 0.89$ compared to neutral ($M = -0.11$, $SD = 0.10$) pictures. No significant difference was established in EDA in response to the weapon and non-weapon pictures, $t < 1$. Similarly, suggesting increased orienting to negative information (Bradley & Lang, 2000; Bradley, 2009), HR significantly decreased during the weapon ($M = -0.05$, $SD = 0.11$), $t(29) = -2,985$, $p = .006$, $d = 0.99$ and non-weapon ($M = -0.03$, $SD = 0.11$), $t(29) = -2.171$, $p = .038$, $d = 0.80$ pictures compared to the Neutral ($M = 0.05$, $SD = 0.09$) pictures. We found no significant difference in HR reactivity between the weapon ($M = -0.05$, $SD = 0.11$) and non-weapon ($M = -0.03$, $SD = 0.11$) pictures, $t(29) = 1.022$, $p = .315$, $d = 0.18$. These results confirm that the negative pictures produced a greater increase in EDA and a greater HR deceleration than the neutral pictures.

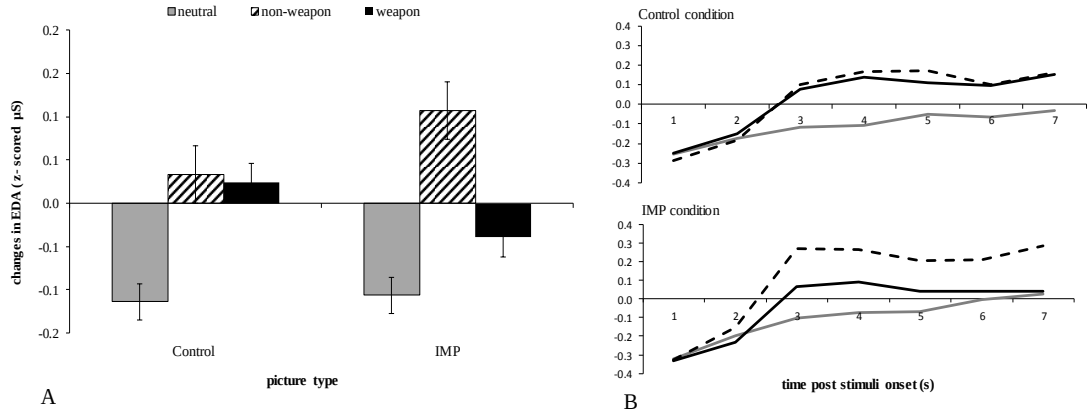


Figure 1. *Figure A presents participants' baseline corrected z-scored mean changes in Electrodermal Activity (EDA) for the neutral, non-weapon and weapon pictures in the Control and the Implementation Intention (IMP) conditions. Solid grey bars indicate changes in participants responses after viewing neutral pictures, while black/white and black solid bars indicate changes in participants responses after viewing the non-weapon and weapon pictures. Error bars represent ± 1 standard error. Figure B presents the second-by-second EDA data for illustrative purposes to highlight changes in EDA over time as a function of condition. Participants' baseline corrected z-scored second-by-second changes in EDA in the Control (top) and IMP (bottom) conditions during the seven seconds post picture onset. Solid grey lines indicate changes in participants' EDA after viewing the neutral pictures, while solid black and black dash lines changes in participants' EDA to the weapon and non-weapon pictures respectively.*

### *The impact of the IMP on HR responses*

With respect to HR responses there was a significant Condition x Type of Pictures interaction, $F(2, 57) = 9.36$, $p < .01$, $\eta^2 = 0.12$. Participants who formed the IMP showed reduced HR deceleration to the weapon pictures ($M = 0.02$, $SD = 0.14$) compared to the non-weapon pictures ($M = -0.14$, $SD = 0.11$), $t(29) = -4.39$, $p = .001$, $d = 1.16$. No such difference between the weapon and the non-weapon pictures was found in the Control condition. In the IMP condition participants produced reduced HR deceleration to the weapon pictures compared to controls, $F(1, 58) = 4.42$, $p < .05$, $\eta^2 = 0.07$, and increased HR deceleration to the non-weapon pictures compared to controls, $F(1, 58) = 13.82$, $p <$

.01, $\eta^2 = 0.19$ (Figure 2). Thus, forming the IMP resulted in reduced HR deceleration in response to the weapon pictures and increased HR deceleration in response to the non-weapon pictures.

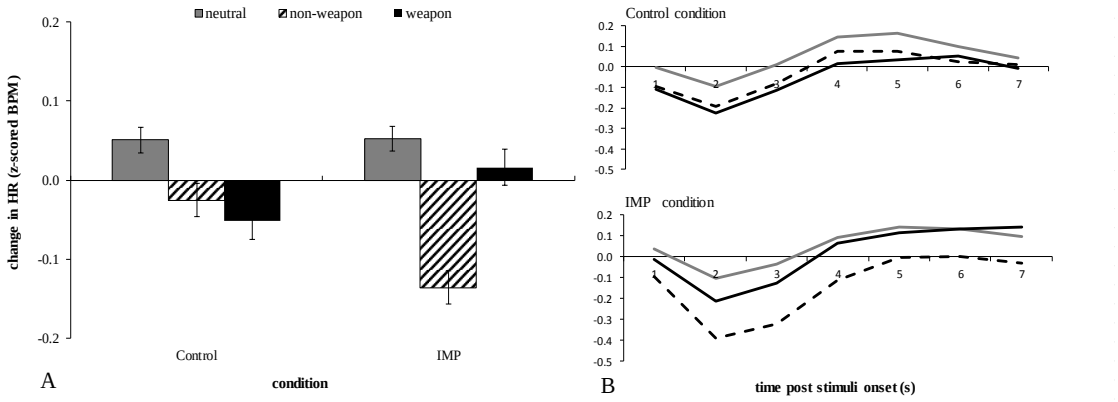


Figure 2. *Figure A presents participants' baseline corrected z-scored mean changes in Heart Rate (HR) for the neutral, non-weapon and weapon pictures in the Control and the Implementation Intention (IMP) conditions. Solid grey bars indicate changes in participants responses after viewing neutral pictures, while black/white and black solid bars indicate changes in participants responses after viewing the non-weapon and weapon pictures. Error bars represent ±1 standard error. Figure B presents the second-by-second EDA data for illustrative purposes to highlight changes in HR over time as a function of condition. Participants' baseline corrected z-scored second-by-second changes in HR in the Control (top) and IMP (bottom) conditions during the seven seconds post picture onset. Solid grey lines indicate changes in participants' EDA after viewing the neutral pictures, while solid black and black dash lines changes in participants' EDA to the weapon and non-weapon pictures respectively.*

*The impact of the IMP on AR*

Replicating prior findings (e.g., Schweiger Gallo et al., 2009), we found a significant interaction between Condition and the Type of Picture, $F(2, 116) = 10.98$, $p = .001$, $\eta^2 = 0.16$. Comparisons of means across the negative pictures within the experimental conditions also revealed a significant decrease in AR to the weapon ($M = 3.39$, $SD = 1.59$) compared to the non-weapon ($M = 4.55$, $SD = 1.45$) pictures in the IMP, $t(29) = -5.114$, $p = .0001$, $d = 0.76$ and no significant difference in AR between the

weapon ($M$ = 5.64, $SD$ = 1.53) and non-weapon ($M$ = 5.75, $SD$ = 1.43) pictures in the Control condition, $t < 1$.

As expected, the IMP condition participants also reported feeling calmer than the Control condition participants on the weapon picture trials, $F(1, 58) = 23.63$, $p = .001$, $\eta^2 = 0.29$. Unexpectedly, this analysis also revealed that, in the IMP condition, participants reported feeling calmer after viewing the non-weapon pictures relative to the Control condition participants, $F(1, 58) = 8.43$, $p = .005$, $\eta^2 = 0.13$.

## Discussion

While past studies measured the impact of IMPs on self-reports and electrocortical activity, we investigated whether an IMP changes bodily concomitants of the emotional response, notably EDA and HR. We predicted that the IMP "If I see a weapon, then I will stay calm and relaxed!" would be successful in achieving the instruction specific emotion regulatory goal to the instruction specific cue. In line with prior studies, we observed a typical increase in EDA and HR deceleration after viewing the weapon and non-weapon pictures in the Control condition, in the absence of differences in either HR or EDA between the negative picture types. Participants in the IMP condition, however, showed decreased EDA and reduced HR deceleration after viewing the weapon pictures relative to the non-weapon pictures, and the weapon pictures in the Control condition. This pattern signifies achievement of the intended emotion regulatory goal.

An unexpected finding was that of a greater HR deceleration after participants viewed the negative non-weapon pictures in the IMP condition (compared to Control). Prior research has shown that HR deceleration indexes "openness to sensory information"

(Bradley, 2009, p. 5) and is evident during the tasks involving perception or/and environmental detection (e.g., Veltman & Gaillard, 1998). Furthermore, as Urry (2009) also states, emotion regulation - at least studied in the laboratory using the commonly employed picture paradigm - involves both attentional processes associated with detecting and processing the image as well as processes associated with generating an appropriate framing of the situation depicted. Since implementation of the goal-directed response, specified in the "then" part of the plan when the IMP is formed, relies on successful detection of the cue specified in the "if" part of the plan (e.g., Webb & Sheeran, 2007), it is plausible that HR deceleration in response to the non-weapon picture trials is a result of participants visually evaluating negative pictures to identify the specified cue.

Consistent with Schweiger Gallo et al. (2007, 2009), we found that participants in the IMP condition reported feeling calmer after viewing the weapon pictures compared to the non-weapon pictures and to the weapon pictures by participants in the Control condition. Unexpectedly, however, the participants in the IMP condition also reported feeling calmer after viewing the non-weapon pictures, relative to controls. It is possible that in the IMP condition participants reported feeling calmer after viewing the non-weapon pictures because they were focusing more on identifying the cue, and less on evaluating the pictures' emotional content. To address these unexpected findings, we performed a second study.

## Study 2

The aim of Study 2 was to replicate Study 1 findings that the IMP was effective in achieving the instruction specific emotion regulatory goal to the instruction specific cue. Findings of others consistently showed IMPs to be more effective than GIs in achieving the emotion regulatory goal (e.g., Schweiger Gallo et al., 2009). Additionally, studies in which participants were given information about the affective content of stimuli before exposure to them demonstrated reduction in reactivity to these stimuli (e.g., Averill, 1973). Thus, to establish if the changes in the participants' responses in Study 1 were specific to the "if – then" plan they formed, including the anomalous findings on the non-weapon picture trials (i.e., increased HR deceleration), we introduced two additional control conditions, the GI condition and the Warning condition[2]. In the GI condition, participants were asked to form the GI "I will stay calm and relaxed!". In the Warning condition additionally to the GI participants were given information about the content of upcoming stimuli (i.e., "Please note that you will see some unpleasant pictures including pictures depicting a weapon(s)."). We expected the IMP condition participants to experience less arousal on the weapon picture trials than the GI and the Warning condition participants. Additionally, considering Study 1 findings, we anticipated the IMP condition participants to feel calmer on the weapon picture trials relative to the non-weapon pictures. No such difference in responses between the negative pictures we expected for the GI and Warning conditions.

[2] In the original study, which was conducted as a part of Azbel-Jackson's doctoral thesis, an additional Observer Mental Imagery condition was included, the results of which are not reported in the manuscript.

## Method

### *Participants*

Eighty participants (68 female, ages 18–35, *M*(age) = 22.2, *SD*(age) = 2.10), recruited from the University of Reading campus, received course credit or were paid £5.00 as compensation for their time. Participants were randomly allocated to one of four conditions, Control, GI, IMP, and Warning, with 20 participants in each group. All participants had normal or corrected to normal vision and none scored above the threshold for clinical diagnosis of depression and anxiety, using the BSI (Marks, 1979). This study was approved by the University of Reading Research Ethics Committee.

### *Stimulus Materials and Procedure*

Materials and procedure were identical to Study 1 except as noted. Participants in the Warning and the GI condition were asked to familiarize themselves with the following instructions for thirty seconds "Please note that you will see some negative pictures, including pictures depicting a weapon(s)." and "I will stay calm and relaxed!" or "I will stay calm and relaxed!". On completion of the picture rating task participants in the GI, IMP and the Warning conditions were asked to complete the PEQ (Schweiger Gallo & Gollwitzer, 2007). The questionnaire consisted of five items and was aimed to evaluate participants' commitment to achieving the emotion regulatory outcome of "staying calm and relaxed": "How committed did you feel to the self regulation intention?" and "How much did you try to control negative feelings?". Additionally we 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".

*Design*

A 4 × 3 factorial design was employed, with the between factor self-regulation condition (Control, GI, IMP, Warning) and the within factor type of pictures (neutral, negative weapon, negative non-weapon pictures).

*Measures*

To establish the impact of the self-regulatory instructions on participants' responses in the present study the measures employed in Study 1 were employed here. The data reduction and analysis approach was the same as for Study 1.

## Results

*The impact of instructions on EDA responses*

After testing if viewing of the negative pictures in the Control condition resulted in increased EDA and in a greater HR deceleration compared to the neutral pictures[3] the impact of the IMP on EDA was examined. We expected a decrease in EDA to the weapon pictures compared to the non-weapon pictures and compared to the weapon pictures in the Control, GI and the Warning conditions. The multivariate GLM analysis of EDA showed indeed a significant Condition x Type of Pictures interaction, $F(6, 152) = 4.27$, $p < .001$, $\eta^2 = 0.14$ (Figure 4). Follow-up pairwise comparisons revealed, as

[3] Baseline corrected mean z-scores across the weapon, non-weapon and neutral picture trials revealed a significant increase in EDA during the weapon ($M = 0.03$, $SD = 0.09$), $t(19) = 3.651$, $p = .002$, $d = 1.17$ and non-weapon ($M = 0.03$, $SD = 0.14$), $t(19) = 3.63$, $p = .002$, $d = 0.88$, compared to neutral ($M = -0.07$, $SD = 0.08$) pictures with no significant difference in EDA between the non-weapon and the weapon pictures, $t < 1$ (Figure 3). Similarly, suggesting increased orienting to negative information (e.g., Bradley, 2009), HR significantly decreased during the weapon ($M = -0.05$, $SD = 0.10$), $t(19) = -3.11$, $p = .006$, $d = 1.27$ and non-weapon ($M = -0.06$, $SD = 0.09$), $t(19) = -3.62$, $p = .002$, $d = 1.49$ picture trials compared to the neutral ($M = 0.06$, $SD = 0.07$), with no significant difference in HR between the weapon and non-weapon pictures, $t(19) = 1.02$, $p = .32$, $d = 0.11$. These results confirm that the negative pictures produced a greater increase in EDA and a greater HR deceleration than the neutral pictures, together with a comparable intensity of physiological responses to the weapon and non-weapon unpleasant pictures.

expected, that forming the IMP resulted in lower EDA on the weapon picture trials relative to the non-weapon pictures ($M_{weapon}$ = - 0.06, $SD$ = 0.08 vs. $M_{non\text{-}weapon}$ = 0.16, $SD$ = 0.09), $t(19) = 6.76$, $p = .0001$, $d = 0.61$. The EDA to weapon and no-weapon pictures was not significantly different within the Control, GI ($M_{weapon}$ = 0.04, $SD$ = 0.10 vs. $M_{non\text{-}weapon}$ = 0.01, $SD$ = 0.17) and the Warning ($M_{weapon}$ = - 0.04, $SD$ = 0.19 vs. $M_{non\text{-}weapon}$ = 0.06, SD = 0.14) conditions, all $t$s < 1.

Furthermore, forming the IMP resulted in lower EDA in response to the weapon pictures relative to the weapon pictures in the Control, $t(76) = -2.54$, $p = .007$, $d = 0.60$ and the GI condition, $t(76) = -2.62$, $p = .005$, $d = 0.60$. However, no significant difference in EDA in response to the weapon pictures was found between the IMP and the Warning condition participants responses, $t < 1$.

As in Study 1, on the non-weapon picture trials in the IMP condition participants showed increased EDA relative to the other three conditions (vs. Control, $t(76) = 3.11$, $p = .003$, $d = 0.71$; vs. GI, $t(76) = 4.37$, $p = .0001$, $d = 1$, and vs. Warning, $t(76) = 2.55$, $p = .01$, $d = 0.59$).

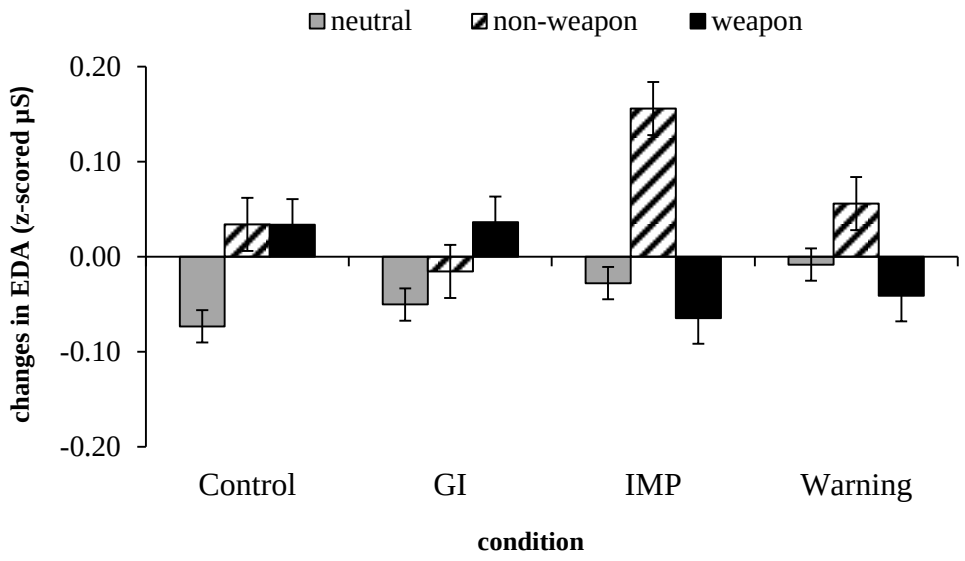


Figure 3 *Figure presents participants' baseline corrected z-scored mean changes in Electrodermal Activity (EDA) for the neutral, non-weapon and weapon pictures in the Control, Goal Intention (GI), Implementation Intention (IMP) and Warning conditions. Solid grey bars indicate changes in participants responses after viewing neutral pictures, while black/white and black solid bars indicate changes in participants responses after viewing the non-weapon and weapon pictures. Error bars represent ±1 standard error.*

*The impact of instructions on HR responses*

The multivariate GLM analysis of HR responses showed a statistically significant Condition x Type of Pictures interaction, $F(6, 152) = 4.27$, $p < .001$, $\eta^2 = 0.14$. Follow-up pairwise comparisons revealed that, as expected, HR responses between the negative pictures was increased for the weapon relative to the non-weapon pictures in the IMP condition ($M_{weapon} = 0.04$, $SD = 0.08$ vs. $M_{non\text{-}weapon} = -0.08$, $SD = 0.12$), $t(19) = 3.24$, $p = .004$, $d = 4.16$. HR to the weapon and the non-weapon pictures within the Control, GI ($M_{weapon} = 0.04$, $SD = 0.12$ vs. $M_{non\text{-}weapon} = 0.01$, $SD = 0.17$), or the Warning ($M_{weapon} = -0.3$, $SD = 0.13$ vs. $M_{non\text{-}weapon} = 0.01$, $SD = 0.11$) conditions were not significantly different, all $t$s < 1. In addition, forming the IMP resulted in relatively higher HR after viewing the weapon pictures as compared to the Control, $t(76) = 2.55$, $p$

= .01, $d$ = 0.59, and to the Warning condition, $t(76) = 2.12$, $p = 0.04$, $d = 0.49$. No significant differences in HR responses to the weapon pictures were found between the IMP and the GI conditions, $t < 1$.

Not unlike the findings in Study 1, on the non-weapon picture trials the IMP condition participants showed lower HR than those in the Warning, $t(76) = 2.11$, $p = .038$, $d = 0.48$ and the GI condition, $t(76) = 2.20$, $p = .03$, $d = 0.50$, but the difference in HR between the IMP and Control conditions for these pictures was not significant, $t < 1$.

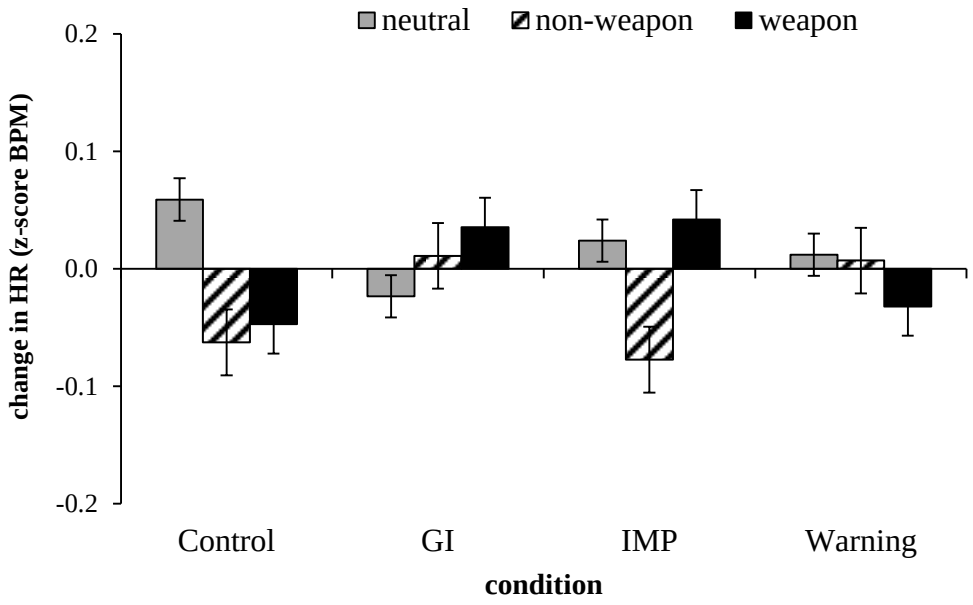


Figure 4. *Figure presents participants' baseline corrected z-scored mean changes in Heart Rate for the neutral, non-weapon and weapon pictures in the Control, Goal Intention (GI), Implementation Intention (IMP) and Warning conditions. Solid grey bars indicate changes in participants responses after viewing neutral pictures, while black/white and black solid bars indicate changes in participants responses after viewing the non-weapon and weapon pictures. Error bars represent ±1 standard error.*

*The impact of self-regulatory instructions on AR*

Similar to Study 1, we found a significant Condition x Picture Type interaction, $F(6, 152) = 2.81$, $p = .01$, $\eta^2 = 0.10$. The IMP condition participants reported the weapon pictures to be less arousing than the non-weapon pictures ($M_{weapon} = 3.81$, $SD = 1.07$ vs. $M_{non\text{-}weapon} = 4.74$, $SD = 0.95$), $t(19) = -6.51$, $p = .0001$, $d = 0.92$. No difference between the weapon and the non-weapon pictures AR was found within the Control ($M_{weapon} = 5.13$, $SD = 1.33$ vs. $M_{non\text{-}weapon} = 5.27$, $SD = 1.28$, or the GI ($M_{weapon} = 4.79$, $SD = 1.70$ vs. $M_{non\text{-}weapon} = 4.99$, $SD = 1.89$) or the Warning ($M_{weapon} = 5.44$, $SD = 1.94$ vs. $M_{non\text{-}weapon} = 5.46$, $SD = 1.67$) conditions (all $t$s < 1). Demonstrating the specificity of this effect to the IMP, in the IMP condition participants reported the weapon pictures to be significantly less arousing than those in the Control, $t(76) = -2.70$, $p = .01$, $d = 0.62$; the GI, $t(76) = -2.01$, $p = .05$, $d = 0.46$ or the Warning, $t(76) = -3.33$, $p = .001$, $d = 0.76$ condition.

*Analysis of responses to the PEQ*

Participants' responses to the PEQ revealed no significant differences across self-regulatory conditions in participants' commitment to achieve the emotion regulatory outcome ($M_{IMP} = 6.10$, $SD = 1.17$ vs. $M_{GI} = 6.40$, $SD = 1.19$ vs. $M_{Warning} = 6.85$, $SD = 1.22$) , $F(2, 57) = 2.00$, $p = .14$, $\eta^2 = 0.07$, how much they tried ($M_{IMP} = 6.75$, $SD = 0.79$ vs. $M_{GI} = 6.90$, $SD = 0.91$ vs. $M_{Warning} = 6.35$, $SD = 1.31$), $F(2, 57) = 1.53$, $p = .23$, $\eta^2 = 0.05$, or how difficult ($M_{IMP} = 6.20$, $SD = 1.15$ vs. $M_{GI} = 6.45$, $SD = 1.10$ vs. $M_{Warning} = 6.25$, $SD = 1.16$), $F < 1$ it was to control their negative feelings. Moreover, no significant differences between self-regulatory conditions were observed in participants' responses to the questions "Did your goal help you to control your negative feelings?" ($M_{IMP}$ =

5.70, *SD* = 1.22 vs. *M*GI = 5.85, *SD* = 1.18 vs. *M*Warning = 5.805, *SD* = 1.20), $F < 1$, and "How much did you succeed in realizing your goal?" (*M*IMP = 6.70, *SD* = 1.13 vs. *M*GI = 6.55, *SD* = 0.94 vs. *M*Warning = 6.20, *SD* = 1.15), $F$ (2, 57) = 1.13, $p = .33$, $\eta^2 = 0.04$.

## Discussion

The aims of Study 2, were to replicate Study 1 findings and to ascertain if the effects reported in Study 1 were specific to the IMP. To determine this in Study 2 we introduced two additional control conditions: the GI and the Warning. We expected the IMP to be more effective than the other self-regulatory instructions in downregulating emotional responses to the weapon pictures.

Replicating Study 1 results, we found that in the IMP conditions participants showed lower EDA, decreased HR deceleration and lower AR in response to the weapon pictures compared to the Control condition. Extending Study 1 and earlier results (e.g., Schweiger Gallo et al., 2009), we found the IMP to be more effective than the GI at reducing not only AR, but also physiological arousal evoked by the weapon pictures. Thus, demonstrating that forming a more general GI failed to downregulate sympathetically mediated arousal evoked by the weapon pictures whilst implementing a specific intention to stay calm and relaxed resulted in achieving the desired goal.

We also expected the IMP condition participants to be more successful than the Warning condition participants in downregulating emotional responses to the weapon pictures. Our findings showed that although the IMPs resulted in lower levels of self-reported arousal and increased HR than the warning instructions, the latter were as effective as IMPs in reducing physiological arousal, measured by changes in EDA after the presentation of the weapon pictures. These results suggest that participants **in the**

Warning condition, similar to those in the IMP condition, accomplished the emotion regulatory goal by linking the instruction specific cue (i.e., a weapon) with the instructions specific response (i.e., staying calm and relaxed) even when they were not explicitly asked to do so. The latter findings run counter to the proposal that only IMPs led to automatization in goal attainment (Gollwitzer & Sheeran, 2006). More specifically, an absence of differences between IMP and Warning in responses to the weapon pictures is likely due to the similarities in the content of the instructions participants received in these conditions: In both conditions, instructions contained information about the impending stimuli and the goal directed outcome they were expected to achieve. This conclusion is also in line with past findings, where reduced reactivity in response to aversive stimuli was observed in participants who, prior to viewing the stimulus, received information about it affective content (e.g., Perkins, 1955). Thus, at least in an emotional context, merely highlighting the cue and the regulatory goal may result in implementation of the goal, without the need for explicitly linking the cue to the goal.

In accordance with Study 1 results, we expected participants in the IMP condition to show reduced emotional responses to the weapon pictures relative to the non-weapon pictures. We replicated this pattern observed in Study 1. In addition, we found no difference between the weapon and the non-weapon pictures within the other experimental conditions. It is worth noting, however, that we did not find significant differences in subjective reports and physiological responding between the weapon and the no-weapon pictures in the Warning condition, in contrast to the IMP condition. These findings could be due to a generalization of regulatory control to both negative picture types, since only participants in the Warning condition were explicitly informed that they

would be viewing weapon pictures and negative non-weapon pictures. This point merits further testing in studies on IMPs.

However, in Study 1, participants in the IMP condition also showed (relative to the controls) increased EDA and a significant increase in HR deceleration on the non-weapon picture trials. This pattern was replicated in this study for EDA, although the difference in HR responses to the non-weapon pictures between the IMP and the Control conditions was not significant. Moreover, even though the pattern of EDA and HR findings for the Warning condition resembles that of the IMP condition, the IMP condition was nonetheless associated with a significant increase in EDA and deceleration of HR to the non-weapon pictures relative to the Warning condition. These findings are further discussed in the General Discussion.

Responses to the PEQ confirmed that the differences in responses during the picture rating task between the self regulatory conditions in the present study could not be explained by the differences in their commitment or their ability to control or the task difficulty.

## General Discussion

In two studies we examined if forming IMPs would lead to the successful downregulation of self-reported and physiological arousal to the instruction specific stimuli (i.e., a weapon) and determine it success by measuring changes in AR, EDA and HR responses relative to the no self-regulatory Control (Study 1 & 2), GI and Warning (Study 2) conditions. Participants' responses in both studies consistently demonstrated that the IMP was successful in downregulating physiological arousal to the instruction specific stimuli . Participants who formed the IMP showed decreased EDA, reduced HR

deceleration and lower AR on the weapon picture trials relative to the Control condition participants. Furthermore, in Study 2, the IMP was more effective than the GI in decreasing AR evoked by the weapon pictures. Thus, extending Study 1 findings and those of others (e.g., Schweiger Gallo et al., 2009). Importantly, sympathetic arousal measured objectively in our study was also lower in the IMP relative to the GI condition for the weapon pictures, although HR was not significantly different.

Moreover, on the non-weapon picture trials in the IMP condition, participants showed increased EDA (Study 2) and HR deceleration (Studies 1 & 2) relative to the Control, GI and the Warning conditions and relative to the weapon pictures in the IMP condition. No such difference between the negative pictures was found within the other conditions.Prior research has shown that increased EDA and HR deceleration reflect changes in the level of attention and is evident in tasks involving perception or/and environmental detection (e.g., Graham, 1979). Since implementation of the goal-directed outcome, specified in the "then" – part of the plan, when an IMP is formed, relies on successful identification of the cue specified in the "if" – part of the plan, we propose that the observed changes in physiological responses in the IMP condition to the non-weapon pictures are the result of participants visually searching pictures to identify the cue specified in the instruction condition. Of note, the participants in the Warning condition were also alerted to the presence of weapons in some of the pictures, which similarly may have resulted in a visual search. However, the unique pattern of physiological responses observed to the non-weapon pictures in the IMP condition further strengthens the notion that forming the "if-then" plan specifically engages the active pursuit of cue finding.

To disentangle effects of cue detection from goal instantiation, future research should include a control condition which involves cue detection that bears no relevance to emotion regulation. Future research will also be useful in addressing a limitation of the current studies. The designs of our studies imply a dimensional rather than discrete theory of emotion. The dimensional approach suggests that changes in the emotion are well described by dimensions, arousal (activation) and valence (pleasantness). Pictures were therefore selected to be both highly unpleasant and highly arousing, but were not selected with respect to specific emotions, and no pleasant states were evaluated. It may well be possible that specific negative or positive emotions would produce a different set of findings.

Experimental evidence indicates that difficulty in controlling emotional responses to positive stimuli is associated with maintenance of bipolar disorder (e.g., Gruber, Harvey & Johnson, 2009). Bipolar disorder is a severe and chronic psychiatric illness associated with profound functional impairment and morbidity (Coryell et al., 1993). Thus, in the future studies it would be interesting to test if IMPs could also be successful in controlling physiological arousal associated with viewing of positive stimuli.

Thus, the findings from the studies demonstrated that the IMP was more effective than the general GI in downregulating not only subjective reports but also physiological arousal to the weapon pictures. Secondly, the concept of IMPs postulates that IMPs are successful in goal attainment because, unlike other plans, they specify when, where and how the goal directed behavior should be achieved and connect a future critical cue, specified in the "if" – part with the specific goal directed behavior, specified in the "then" – part of the plan, thereby leading to automitization (Gollwitzer & Sheeran, 2006). In

accordance with the concept, we anticipated the IMP to be more effective than the warning instructions in accomplishing the instruction specific emotion regulatory outcome to the instruction specific stimuli. In contrast to our prediction, we found that participants who formed the IMP or were given the warning instructions, achieved the emotion regulatory outcome, measured by changes in EDA, to the picture type specified in the instructions. The latter findings are inconsistent with the proposal that only IMPs led to automatization in goal attainment (Gollwitzer & Sheeran, 2006). A theoretical implication of these findings is that it demonstrates that when accomplishing the emotion regulatory goals instructions content and not their format have an impact on a goal attainment.

## References

Ajzen, I. (1991). The theory of plan behaviour. *Organizational Behaviour and Human Decision Processes, 50(2),* 179-211.

Averill, J. R. (1973). Personal control over aversive stimuli and its relationship to stress. *Psychological Bulletin, 80*(4), 286-303.

Berstein, A. S. (1969). The orienting response and direction of stimulus change. *Psychonomic Science, 112,* 127-128.

Bradley, M. M. (1994). *Emotional memory: A dimensional analysis.* In N. E. V. d. P. S. Van Goozen, & J.A. Sergeant (Ed.). The emotions: essay on emotion theory (pp. 97-134). Hillsdale, NJ: Erlbaum.

Bradley, M. M. (2000). *Emotion and Motivation*. In J. T. Cacioppo, L. G. Tassinary & G. G. Berntson (Eds.), Handbook of Psychophysiology (pp. 602-642). Cambridge: University Press.

Bradley, M. M., Hamby, S., Low, A., & Lang, P. J. (2007). Brain potentials in perception: Picture complexity and emotional arousal. *Psychophysiology, 44,* 364-373.

Bradley, M. M. (2009). Natural selective attention: Orienting and emotion. *Psychophysiology, 46,* 1-11.

Bradley, M. M., Cuthbert, B. C., & Lang, P. J. (1990). Startle Reflex Modification: Emotion or Attention? *Psychophysiology, 27*(5), 513-522.

Cook, E. W., Hawk, L. W., Davis, T. L., & Stevenson, V. E. (1991). Affective individual differences and startle reflex modulation *Journal of Abnormal Psychology, 100*(1), 5-13.

Coryell,W., Scheftner, W., Keller, M., Endicott, J., Maser, J., & Klerman, G. L. (1993). The enduring psychological consequences of mania and depression. *American Journal of Psychiatry, 150,* 720-727.

Eder, A. B. (2011). Control of impulsive emotional behaviour through implementation intentions. *Cognition and Emotion, 25*(3), 478-489.

Eder, A. B., Rothermund, K., & Proctor, R. W. (2010). The prepared emotional reflex: Intentional preparation of automatic approach and avoidance tendencies as a means to regulate emotional responding. *Emotion, 10*, 593-598.

Fredrikson, M. (2007). Orienting and Defence Reactions to Phobic and Conditioned Fear Stimuli in Phobics and Normals. *Psychophysiology, 18*(4), 456-465.

Furedy, J. J., & Heslegrave, R. J. (1983). A consideration of the recent criticism of the T-wave amplitude index of myocardial sympathetic activity. *Psychophysiology, 20,* 2014-2011.

Gollwitzer, P. M., & Brandstaetter, V. (1997). Implementation intentions and effective goal pursuit. *Journal of Personality and Social Psychology, 73,* 186-199.

Graham, F. K. (1979). *Distinguishing among orienting, defence, and startle reflexes*. In H. D. Kimmel, E. H. van Olst & J. F. Orlebeke (Eds.), The orienting reflex in humans (pp. 137-167): Hillsdale, NJ Erlbaum.

Gross, J. J., Thompson, R. (2007). *Emotion Regulation: Conceptual Foundation*. In J. J. Gross (Ed.), Handbook of Emotion Regulation (pp. 3-24). New York: Guilford Press.

Gross, J. J., & Levenson, R. W. (1997). Hiding feelings: The acute effects of inhibiting negative and positive emotion. *Journal of Abnormal Psychology, 106,* 95-103.

Gruber, J., Harvey, A. G., & Johnson, S. L. (2009). Reflective and ruminative processing of positive emotional memories in bipolar disorder. *Behavioural Research Therapy, 47*(8), 697-704.

Kalisch, R., Wiech, K., Critchley, H. D., Seymour, B., O'Doherty, J. P., Oakley, D. A., & Dolan, R. J. (2005). Anxiety reduction through detachment: Subjective, physiological and neural effects. *Journal of Cognitive Neuroscience, 17,* 874-883.

Lacey, J. I., Kagan, J., Lacey, B. C., & Moss, H. A. (1963). *The visceral level: Situational determinants and behavioural correlates of autonomic response patterns.* In P. H. Knapp (Ed.), Expression of emotions in man (pp. 161-196). New York: International university press.

Lang, P. J., Bradley, M. M., & Cuthbert, B. N. (2005). *International Affective Picture System (IAPS): Instruction manual affective ratings*. Technical Report A-6, The Centre for Research in Psychophysiology, University of Florida. .

Lang, P. J., Bradley, M. M., & Cuthbert, B. N. (1997). *Motivated attention: affect, activation and action*. P. J. Lang, R. F. Simons & M. T. Balaban (Eds.), Attention and Orienting: Sensory and Motivational Processes (pp. 97-135).

Lang, P. J., Greenwald, M., Bradley, M. M., & Hamm, A. O. (1993). Looking at pictures: Evaluative, facial, visceral, and behavioral responses. *Psychophysiology, 30,* 261-273.

Marks, I. M., & Mathews, A. M. (1979). Brief standard self rating questionnaire for phobic patients. *Behavioural Research Therapy, 17,* 263-267.

Quigley, K. S., & Berntson, G. G. (1990). Autonomic origins of cardiac response to non signal stimuli in rat. *Behavioural Neuroscience,* 104, 751-752.

Schweiger Gallo, I., & Gollwitzerr, P. (2007). Implementation Intentions: Control of fear despite cognitive load. *Psichothema, 19*(2), 280-285.

Schweiger Gallo, I., McCulloch, K., Keil, A., & Rockstroh, B. (2009). Strategic automation of emotion regulation. *Journal of Personality and Social Psychology, 96*(1), 11-31.

Schweiger Gallo, I., McCulloch, K. C., & Gollwitzer, P. M. (2012). Differential effects of various types of implementation intentions on the regulation of disgust. *Social Cognition, 30*(1), 1-17.

Smith, J. C., Bradley, M. M., & Lang, P. J. (2005). State anxiety and affective physiology: Effects of sustain exposure to affective pictures. *Biological Psychology, 69*, 247-260.

Urry, H. (2009). Using Reappraisal To Regulate Unpleasant Emotional Episodes: Goals and Timing Matter. *Emotion, 9*(5), 782-797.

Veltman, J. A., & Gaillard, A. W. (1998). Physiological workload reactions to increasing levels of task difficulty. *Ergonomics, 41*(5), 656-659.

Webb, T. L., & Sheeran, P. (2007). How do implementation intentions promote goal attainment? A test of component processes. *Journal of Experimental Social Psychology, 43*, 265-268.