Cognitive control of emotional distraction – valence-specific or general?

Elisa Straub, Andrea Kiesel, David Dignath

Department of Psychology, University of Freiburg

Accepted for publication in *Cognition and Emotion*

Correspondence

Elisa Straub

Department of Psychology, Cognition, Action, and Sustainability

Engelbergerstr. 41, 79085 Freiburg, Germany

Email: elisa.straub@psychologie.uni-freiburg.de

Abstract

Emotional information captures attention due to privileged processing. Consequently, performance in cognitive tasks declines (i.e., emotional distraction, ED). Therefore, shielding current goals from ED is essential for adaptive goal-directed- behavior. It has been shown that ED is reduced when participants recruit cognitive control before or after the presentation of an emotional negative distractor. Following up on this, we asked first, whether cognitive control of ED is negative-valence-specific or valence-general. A *valence-general-account* predicts that control shields against distracting influence of emotion, irrespective of the specific valence. In contrast, a *negative-valence-specific-account* predicts that control interacts with the valence and ED is reduced for negative stimuli only. Second, we asked whether this effect of ED differs between control modes operating on different time scales (i.e., *proactively* or *reactively*). To test this, we manipulated emotional distractor valence (positive/high-arousal; negative/high-arousal; neutral/low-arousal) and assessed how control interacts with ED. Results showed that ED was reduced for negative and positive valent stimuli when control was triggered before (i.e., *proactive control*, n_{Exp1}=141, between-subject-design) and after (*reactive control*, n_{Exp2}=37, within-subject-design) the emotional stimuli. Accordingly, control blocks off high-arousing emotional distractors from interfering with goal-directed-actions, irrespective of their valence (i.e., *valence-general-account*) and for both, *proactive* and *reactive* control modes.

Keywords: cognitive control, cognitive conflict, affect, valence

Emotional information captures attention due to privileged processing (Pessoa, McKenna, Gutierrez, & Ungerleider, 2002). While emotional-priority is beneficial in some situations (e.g., foraging or detecting predators, see Öhman, Flykt, & Esteves, 2001), it comes at the costs of increased distractibility in other situations. For instance, research on emotional distraction (ED) has demonstrated that task-irrelevant emotional stimuli impair performance (i.e., larger reaction times and more errors) in cognitive tasks, such as color discrimination tasks (Cohen, Henik, & Moyal, 2012) or stop signal tasks (Verbruggen & De Houwer, 2007). Shielding current goals from emotional distraction seems therefore essential for adaptive goal-directed behavior. This shielding function requires cognitive control processes that suppress interference from irrelevant information and adjust attention according to task-relevant goals (Miller & Cohen, 2001).

In the lab, cognitive control processes are often investigated in response-interference tasks that activate two opposing response options. In the flanker task, for example, participants are required to identify a relevant target stimulus (e.g., an arrow at the center of the screen) while ignoring task-irrelevant flanking stimuli (e.g., arrows surrounding the center arrow). Flanker stimuli can either be congruent (e.g., pointing in the same direction) or incongruent (e.g., pointing in the opposite direction) with the target. Incongruent trials trigger a conflict between responses evoked by the target and the flanker, making participants' responses slower and more error prone compared to congruent trials. This difference between congruent and incongruent trials has been termed congruency effect.

According to an influential theory (i.e., conflict monitoring theory, Botvinick, Braver, Barch, Carter, & Cohen, 2001) conflict induces control processes by providing internal feedback signals that trigger an upregulation of control which alleviates subsequent conflict. Therefore, congruency effects in trials following incongruent trials relative to congruent trials is often reduced (Gratton, Coles, & Donchin, 1992). It has been supposed that control can operate on different time scales. For instance, according to a dual mechanisms framework

(Braver, 2012), control operates either in a late-corrective, *reactive* control mode or in a more *proactive* control mode. Empirically, this is supported by studies showing that *conflict-triggered control adaptation* can be observed for *reactive* control that influences the most recent events more heavily and allows control during conflict (i.e., within a trial, see Scherbaum, Fischer, Dshemuchadse, & Goschke, 2011), but also for *proactive* control which operates on a longer time-scale following conflict (i.e., across trials, see Gratton et al., 1992). Studying these two distinct operating modes of control in interaction with ED is especially interesting given the assumption by Braver (2012) that affect-related traits and states (i.e., reward sensitivity, see Jimura, Locke & Braver, 2012 or anxiety, see Savine, Beck, Edwards, Chiew, 2010) may influence the preference of one control mode above another (Braver 2012).

Interaction of cognitive control and emotional valence

Although emotional and cognitive processing have been previously thought of as two distinct processing streams, more recent research suggests a close coupling between both (Inzlicht, Bartholow, & Hirsh, 2015; Pessoa et al., 2002). A particularly instructive example for this interplay between cognition and emotion comes from studies by Cohen and colleagues (2012, 2015a, 2015b) demonstrating that congruency effects in incongruent trials were reduced following negative valent stimuli (Cohen, Henik, & Moyal, 2012; see also Cohen, Moyal, & Henik, 2015b) and conflict-triggered control adaptation reduced ED in another task (Cohen, Henik, & Moyal, 2012; Cohen, Mor & Henik, 2015a). So far, these studies induced ED by presenting negative pictures. However, according to dimensional models of affect, affective states consist of two dimensions: arousal and valence (Barrett & Russell, 1999). While arousal refers to activation and mobilization processes, valence is described as a hedonic feeling of pleasantness or unpleasantness. Based on this distinction, it remains unclear whether cognitive control shunts any emotional information from distracting ongoing task processing or whether this effect is specific to negative valence.

More specifically, a valence-general account predicts that cognitive control shields against the distracting influence of arousal, irrespective of the valance of an event. Supporting this account, Walsh and colleagues recently observed that rewards lead to an overall reduced ED from both, positive and negative valent stimuli (Walsh, Carmel, Harper, & Grimshaw, 2018). Furthermore, theoretical models that aim to explain conflict-triggered control adaptation have attributed this effect to arousal as a trigger for increased control (Verguts & Notebaert, 2009). Empirically, this reasoning is supported by studies showing that conflict triggers increased arousal and that arousal - experimentally manipulated via vagus nerve stimulation - boosts conflict-triggered control adaptation (Fischer, Ventura-Bort, Hamm, & Weymar, 2018).

In contrast, a *negative-valence-specific account* predicts that cognitive control interacts with the specific hedonic value (i.e., negative) of an emotional event. In line with this reasoning, high load displays reduced ED from pictures of negative valence, but not from pictures of positive valence (Gupta, Hur, & Lavie, 2016). Theoretically, the *negative-valence-specific account* is further supported by models that attribute the conflict-triggered control adaptation effect to the negative valence of conflict (Dreisbach & Fischer, 2015; Inzlicht et al., 2015). Indeed, evidence suggests that conflict is experienced as negative (Dreisbach & Fischer, 2012; Fritz & Dreisbach, 2015) and motivationally aversive (Dignath & Eder, 2015; Dignath, Kiesel, & Eder, 2015; Dignath et al., in press) and that this affective quality of conflict acts as the driving force for conflict-triggered control adaptation (Fröber, Stürmer, Frömer, & Dreisbach, 2017; see also Dignath et al., in press)

In this study, we investigated conflict-triggered control of ED induced by both, positive and negative stimuli. Following previous research, we tested proactive and reactive control of ED.

The present study

To disentangle a *valence-general* and a *negative-valence-specific account,* the present study systematically manipulated the valence (positive, high arousal; negative, high arousal; and neutral, low arousal) of emotional distractors (pictures) and assessed how cognitive control (instigated by the flanker task) interacts with ED.

In a first experiment, we investigated proactive conflict-triggered control adaptation. Therefore, we presented in each trial 1.) a flanker stimulus 2.) an emotional or neutral picture and 3.) a color patch that had to be discriminated by participants. Cognitive control was induced before the emotional stimuli and manipulated in the flanker task by the level of congruency (incongruent vs. congruent), ED was manipulated by presenting pictures of different valence (negative vs. neutral and positive vs. neutral) and ED was assessed in reaction times (RTs) of the color-discrimination task (control [flanker] > valence > color-discrimination).

In a second experiment, we investigated reactive conflict-triggered control adaptation. Therefore, we presented in each trial 1.) an emotional or neutral picture and 2.) a flanker stimulus. Cognitive control was induced after the emotional stimuli (valence > control [flanker]). As explained above in more detail, a *valence-general account* predicts that conflict reduces ED induced by negative *and* positive compared to neutral pictures. In contrast, a *negative-valence-specific account* predicts that conflict reduces ED induced by negative (compared to neutral) pictures only.

Experiment 1

Methods

Raw individual data and analysis scripts can be found on the Open Science Framework (https://osf.io/xk3tc/).

Participants

A total of 141 participants completed the study at the University of Freiburg, Germany. Power analyses using G*Power (Faul, Erdfelder, Lang, & Buchner, 2007) suggested a sample size of N = 70 per group to detect a medium effect (with $\alpha = .05$ and $1-\beta = .9$) for the between-groups comparison between ED for positive and negative valence, based on previous research using a similar design and reporting larger effect sizes than assumed here (i.e., Cohen et al., 2012). All participants reported normal or corrected-to-normal vision and were compensated with either course credit or money. Because different exclusion criteria for participants were reported in the literature (e.g., Cohen et al. 2012, 2015a, see also 2015b), we decided to use the same criteria as used in our lab. We excluded participants with (i) random responses (error rate above 50%) and (ii) participants with an error rate above 3SDs from the remaining sample. Please note that these outlier criteria are more conservative compared to previous work. Data of two participants were excluded due to random responses and another five participants were excluded as their error rate exceeded the remaining sample's error rates by 3 SDs. Hence, we analyzed data of 134 participants (6 left-handed, 91 female, M_{age} = 24.70 years).

Apparatus, Procedure and Stimuli

The experiment was programmed and presented with e-Prime software 2.0, E-Studio (version: 2.0.10.252; Schneider, Eschmann, & Zuccolotto, 2002). Responses were collected with standard German QWERTZ- keyboard. For the flanker task and the color-discrimination task, we used stimuli from Cohen and colleagues (Cohen et al., 2012). After providing informed consent, participants were instructed to complete two alternating tasks with a picture presented between the tasks (see Figure 1). They were asked to respond as quickly and as accurately as possible. Each trial started with a fixation cross, subtending 0.48° of visual angle [1] in width and height presented for 1000 ms at the center of the screen, followed by a congruent (50 % of all trials) or incongruent arrow version (50 % of all trials) of the Eriksen flanker task. One arrow subtended 0.67 ° (width) × 0.38 ° (height) of visual angle. In the flanker task, participants were to indicate the direction of the target arrow by pressing one of two previously assigned keys (i.e., a-key for the target arrow pointing to the left and l-key for the target arrow pointing to the right). The arrows remained on the screen for 1000 ms or until a response was registered. Then, an emotional (50 % of all trials) or a neutral (50 % of all trials) picture was presented for 100

[1] Visual angles were calculated from a viewing distance of 60 cm

ms, followed by a blank screen presented for 50 ms. Picture stimuli were subtended 11.99° (width) × 9.05° (height) of visual angle. In the color-discrimination task, participants were to indicate by keypress whether a square, presented at the center of the screen for 1000 ms was blue (RGB = 0; 0; 254) or green (RGB = 0; 128; 0). The square subtended 4.89° of visual angle in width and height. Stimulus-to-key-mapping for the color-discrimination task (i.e., n-key or v-key) was counterbalanced across participants.

Participants started with a training session of 16 trials, in which they were given accuracy feedback for both, the flanker and the color-discrimination tasks. The experimental session comprised 768 trials in total, divided into four blocks with self-paced rests after 192 trials. "In each block, the combination of left or right arrow target (2), left or right flanker stimuli (2), and emotional or neutral picture stimuli (2) was presented equally frequent. Congruent and incongruent flanker tasks were followed by the same proportion of neutral and emotional pictures. For one group of participants emotional pictures consisted of pictures from the subcategory „sadness", for another group of participants emotional pictures consisted of pictures from the subcategory „fear", for another group of participants emotional pictures consisted of pictures from the subcategory „achievement", for another group of participants emotional pictures consisted of pictures from the subcategory „erotic".

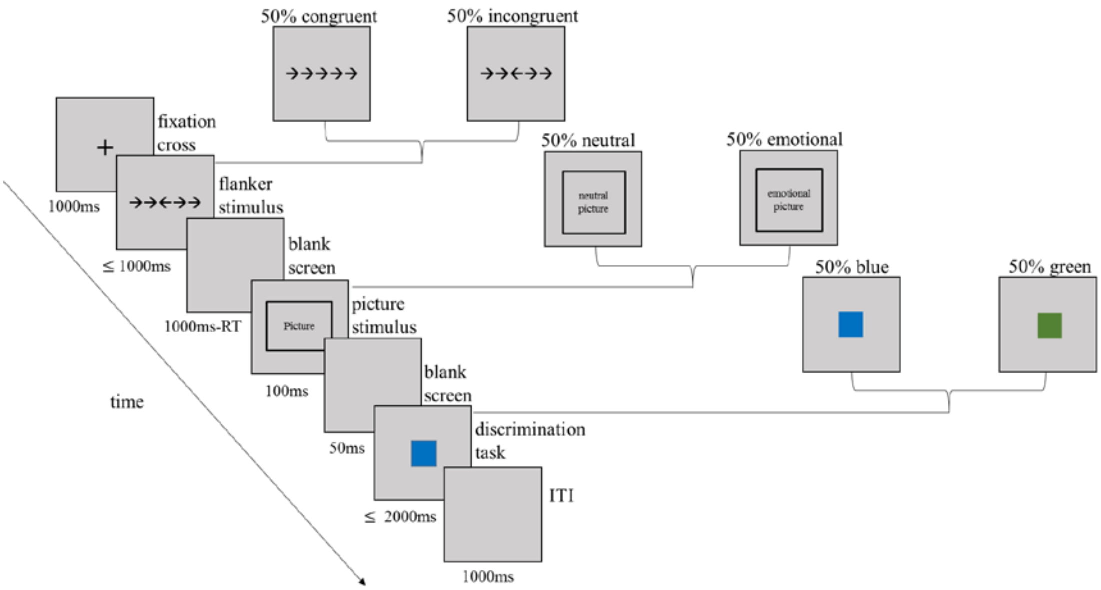

Figure 1. Example trial sequence. All stimuli were displayed against a gray background.

Picture Stimuli

Stimuli used as emotional distractors were photographs of either negative or positive valence. For explorative purposes, we were also interested in how specific emotions within the same valence category (e.g., sadness and fear) might influence the interaction between cognitive control and ED. While Cohen and colleagues used sad pictures (Cohen et al., 2015a), research suggests that effects of emotion on attention can be particularly strong for fear-related stimuli (Vuilleumier, Armony, Driver, & Dolan, 2001; Öhman et al., 2001). Similarly, for positive stimuli it has been argued that erotic stimuli have a strong appetitive motivation compared to arousal matched sport achievement pictures (Schupp et al., 2004; see also Anderson, 2005, Most, Smith, Cooter, Levy, & Zald, 2007). Negative valence was represented by two picture sets, each comprising 12 pictures: 35 participants viewed emotional pictures with fear-inducing content and 37 participants viewed pictures with sad content. Positive valence was also represented by two picture sets, each comprising 12 pictures: 38 participants viewed erotic pictures and 31 viewed pictures depicting scenes of achievement. Pictures of the categories sad, fear and achievement were selected from the International Affective Picture System (IAPS; Lang, 2005). Pictures with erotic content were taken from the Nencki Affective Picture System (NAPS; Marchewka, Żurawski, Jednoróg, & Grabowska, 2014)[2]. Databases provide separate ratings for female and male, ranging from 1 – excited/aroused to 9 – relaxed/unaroused to explain arousal and ranging from 1 – very negative emotions, to 9 – very positive emotions to explain valence. Negative stimuli used in our experiment corresponded to mean arousal and mean valence ratings of 6.20 (SD = 0.74) and 1.95 (SD = 0.67), respectively. For positive stimuli, mean arousal and mean valence ratings were 5.95 (SD = 0.80) and 7.21 (SD = 0.51),

[2] We decided to take erotic content pictures from NAPS, because pilot testing showed that our participants considered the erotic pictures from the IAPS as less erotic than indicated by the ratings and more funny due to the ‘retro look’ of older pictures.

respectively. Difference between positive and negative valent stimuli was not significant in arousal (t(46) = 1.141, p = .260, d = .324) but in valence (t(46) = -30. 469, p < .001, d = 8.788). For neutral pictures, mean arousal and mean valence ratings were 3.48 (SD = 0.40) and 4.91 (SD = 0.49), respectively. See appendix for the slide numbers.

Data Analysis

Exploratory analyses showed that the four subcategories of emotion (i.e., fear, sad, achievement, erotic) did not influence the critical interaction between ED and conflict. Therefore, data for the main analysis were collapsed across the two valence categories of emotion and analyzed according to their valence (i.e., negative vs. positive; see supplement for exploratory analysis).

Mean RTs and error rates were calculated for congruent and incongruent flanker tasks and color-discrimination tasks. Data of the flanker task were analyzed using t-tests for paired sample. Data of the color-discrimination task were analyzed with a three-way Analysis of Variance (ANOVA) with the within-subject factors *conflict* (incongruent vs. congruent) and *distraction* (emotional vs. neutral) and the between-subject factor *valence context* (positive vs. negative). RTs and error rates in the flanker task and the color-discrimination task served as dependent variables.

Additionally, relevant null effects were further scrutinized by Bayes Factors (BFs) using JASP (Jarosz & Wiley, 2014). The Bayes approach offers a way to compare the likelihood of the data considered under both, the null and the alternative hypothesis via calculation of the BF_{01}. This gives an index of how strong the data is in favor of the null-hypothesis (see Jarosz & Wiley, 2014 for an overview of different terminology). In the present study, the null-hypothesis assumes that the modulation of ED by congruency (CE) is not larger for negative stimuli compared to positive stimuli: CE x ED (negative) $\ngtr$ CE x ED (positive). The alternative-hypothesis assumes that the modulation of ED by congruency is larger for negative stimuli compared to positive stimuli: CE x ED (negative) > CE x ED (positive). BF_{01} greater than 3 or

BF_{01} lower than 1/3 will be considered evidence for one hypothesis over the other. Bayesian analysis requires a prior probability distribution (i.e., prior) for the model parameters. The prior can be determined from information of previous experiments. We used the default setting of JASP Bayesian *t*-test as prior which consists of a Cauchy distribution (a t-distribution with a single degree of freedom) with its parameter set to r = 0.707.

Results and Discussion

All trials in which participants committed an error in the flanker or the color-discrimination task were excluded (5.7 % and 7.1 % of responses in the flanker task and color-discrimination task, respectively). Furthermore, RTs that deviate more than 3 SDs for each participant and for each condition (i.e., each cell of the ANOVA) were removed from RT analyses (1.8 % responses in the flanker and color-discrimination tasks, respectively).

Flanker task

Reaction times

The typical congruency effect was observed with faster responses in congruent trials (*M* = 444 ms, SD = 52) compared to incongruent trials (*M* = 510 ms, SD = 54), *t*(133) = 39.666, *p* <. 001, *d* = 1.26.

Error Rates

Analogous analysis was performed on error rates. Congruency effect was significant, *t*(133) = 17.209, *p* <.001, *d* = 1.57, indicating more error trials on tasks with incongruent conditions (*M* = 9.0 %, SD = 5 %) compared to congruent flankers (*M* = 2.5 %, SD = 3 %).

Color-discrimination task

Reaction times

Results of the three-way ANOVA with *conflict*×*distraction* as within-subject factors and *valence context* as between-subject factor showed a significant main effect of *conflict*, *F*(1,132) = 11.088, *p* = .001, η_p^2 =.077, demonstrating faster responses in the color-discrimination task in trials with congruent (*M* = 510 ms, SE = 7 ms) compared to incongruent flanker stimuli (*M* = 513 ms , SE = 7 ms). Data revealed ED, demonstrated in a significant main effect of *distraction*, $F(1,132) = 10.841$, $p <. 001$, $\eta_p^2 = .076$, indicating prolonged RTs after emotional (*M* = 513 ms , SE = 7 ms) compared to neutral stimuli (*M* = 509 ms, SE = 7 ms). Importantly, results yielded a significant interaction of *conflict*×*distraction*, $F(1,132) = 4.863$, $p = .029$, $\eta_p^2 = .036$ [3]. As expected, ED was reduced following incongruent flanker tasks (*M* = 3 ms, SE = 2 ms) compared to congruent flanker tasks (*M* = 6 ms, SE = 2 ms). No other two-way interaction reached significance, *conflict*×*valence context*, $F(1,132) = 0.290$, $p = .591$ $\eta_p^2 = .002$; *distraction*×*valence context*, $F(1,132) = 1.545$, $p = .216$, $\eta_p^2 = .012$. The three-way interaction between *conflict*×*distraction*×*valence context* was not significant, $F(1,132) = .728$, $p = .395$, $\eta_p^2 = .005$.

Closer inspection of data showed that ED is smaller in positive (Δ = 3 ms, SE = 2 ms) compared to negative stimuli (Δ = 6 ms, SE = 2 ms). Furthermore, conflict in the flanker task reduced ED even more for positive stimuli (Δ = 5 ms, SE = 2 ms) than for negative stimuli (Δ = 2 ms, SE = 2 ms; see Figure 2). Please note that this pattern of results is opposite to the prediction of the *negative-valence context-specific* hypothesis (which predicted increased cognitive control for negative distraction compared to positive distraction).

[3] Please note that effect sizes for main and interaction effects were small compared to the ones reported in previous literature with related paradigms (Cohen et al., 2012, Experiment 2)

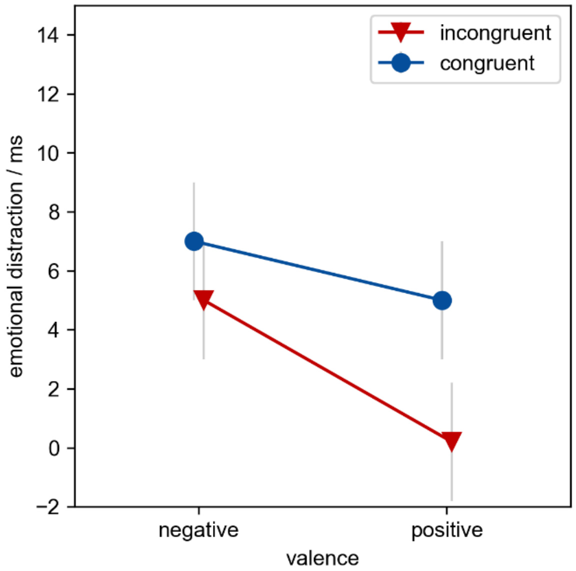

Figure 2. Interaction between conflict and ED [ms] for trials with stimuli of negative and positive valence. Error bars show standard errors.

This interpretation can be quantified by BFs that indicate evidence for the null-hypothesis that the modulation of conflict-induced by negative stimuli is not larger compared to modulation of conflict induced by positive stimuli, CE x ED (negative) ≯ CE x ED (positive). The alternative hypothesis assumes that the modulation of conflict induced by negative stimuli is larger compared to the modulation of conflict induced by positive stimuli, CE x ED (negative) > CE x ED (positive). The resulting BF_{01} of 9.31 can be considered as evidence in favor of the null-hypothesis that control of ED is not specific for negative stimuli.

Error Rates

Analogous analysis was performed on error rates. Results revealed a significant main effect of conflict, $F(1,132) = 10.385$, $p = .002$, $\eta_p^2 = .073$, demonstrating more errors in the color-discrimination task in trials with preceding congruent (M = 7.4 %, SE = 1 %) compared to incongruent flanker stimuli (M = 6.9 %, SE = 1 %). Main effect of *distraction* was not significant, $F(1,132) = .042$, p =. 838, $\eta_p^2 = .000$. No other two-way interaction reached significance, *conflict*×*distraction*, $F(1,132) = 2.669$, $p = .105$, $\eta_p^2 = .020$, *conflict*×*valence context*, $F(1,132) = .304$, $p = .582$ $\eta_p^2 = .002$; *distraction*×*valence context*, $F(1,132) = .019$, p =

.892, η_p^2 = .000. The three-way interaction between *conflict*×*distraction*×*valence context* was not significant, $F(1,132) = .084$, $p = .772$, η_p^2 = .001.

Experiment 2

Experiment 2 had three purposes: First, we wanted to replicate the results of the previous study in a within-design that avoids any differences in baseline performance or mood between groups of participants. Therefore, picture valence was manipulated within-subjects. Second, we wanted to generalize our findings to a task design that taps into reactive conflict-triggered control adaptation, because this design has been most often reported in the literature (Cohen et al., 2012, 2015b). Consequently, we dropped the color-discrimination task and presented affective stimuli intermixed with flanker stimuli only. To assess the influence of ED on reactive control, we analyzed how the valence of pictures influenced performance in the flanker task (valence > control [flanker]). Third, previous research suggested that affective stimuli affect female and male participants differently (cf. Lykins, Meana, & Strauss, 2008). Therefore, we selected new affective stimuli according to gender-specific ratings and presented gender-specific stimulus-sets to female and male participants respectively. Usage of gender sensitive stimuli, in particular when using erotic stimuli, is common practice in emotion research (e.g., Most, Smith, Cooter, Levy & Zaldo, 2007; Lykins, Meana, & Strauss, 2008). It is important to note that achieving such gender specific adaptations of the experiment also leads to the limitation that valence and arousal values of the pictures provided to both gender groups were not exactly the same, but slightly differ from one another.

Methods

Pre-registration, raw individual data and analysis scripts can be found on the Open Science Framework (https://osf.io/chnzt/).

Participants

A total of 37 participants completed the study at the University of Freiburg, Germany. Previous research that investigates negative vs. neutral pictures observed effect sizes ranging from *dz* = 0.84 (see Cohen et al., 2012, Experiment 1) to *dz* = 1.47 (see Cohen et al., 2011, Experiment 1). Power analyses using G*Power suggested a minimum sample size of N = 17 to detect an effect of *dz* = 0.84 (with $\alpha = .05$ and $1-\beta = .9$) for the within-groups comparison between ED for positive and negative valence. All participants reported normal or corrected-to-normal vision and were compensated with either course credit or money. No data was excluded due to random responses, data of two participants was excluded as their error rate exceeded the sample's error rates by 3 SDs. Hence, we analyzed data of 35 participants (2 left-handed, 20 female, M_{age} = 27.05 years).

Apparatus, Procedure and Stimuli

Apparatus and procedure were identical to Experiment 1 despite the following changes: (i) Flanker tasks were presented after the picture stimuli. Therefore, ED was investigated in flanker tasks, not discrimination tasks and participants only completed one task type throughout the experiment. (ii) In the Flanker task, distractor stimuli (i.e., arrows surrounding the center) appeared 150 ms before the target arrow and the task remained on the screen for 2000 ms or until a response was registered. (iii) Picture valence was manipulated blockwise. In each block, half of the picture stimuli (n=20) were affective (either positive or negative) and half of the stimuli (n=20) were neutral. The order of the negative/neutral and positive/neutral blocks was sequential with the condition of the first block counterbalanced across participants. (iv). In total, there are sixteen blocks each including 40 trials appearing in randomized order with self-paced rests after each block.

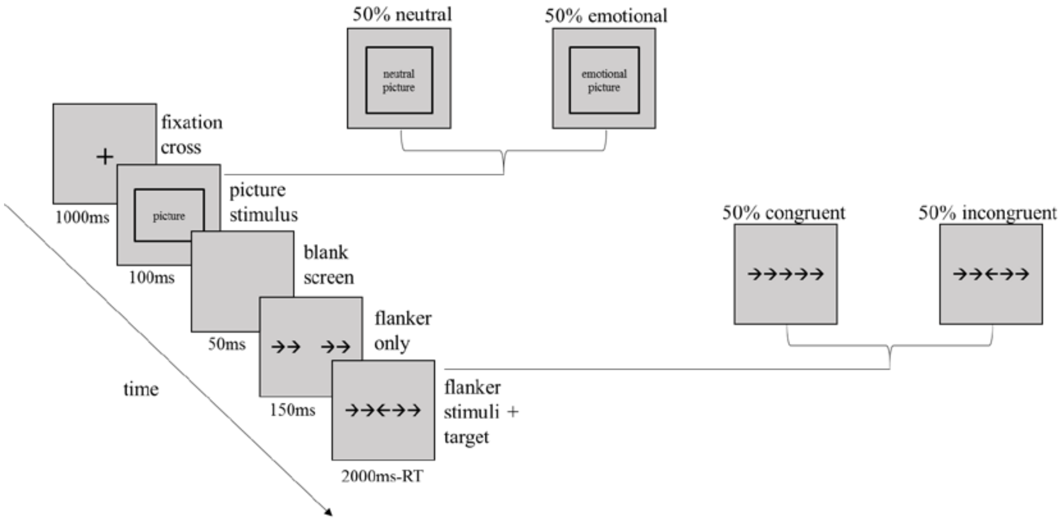

Figure 3. Example trial sequence. All stimuli were displayed against a gray background.

Picture Stimuli

Emotional distractor stimuli comprise photographs of either negative, positive or neutral valence taken from NAPS. The database provides separate ratings for women and men. We used three individual sets of pictures (i.e., 20 positive, 20 negative and 20 neutral) for female and three individual sets (i.e., 20 positive, 20 negative and 20 neutral) for male participants. According to the database, mean arousal and valence ratings of negative stimuli used in our experiment corresponded to M = 5.85, SD = 0.24 (female), M = 6.09, SD = 0.25 (male) and M = 3.29, SD = 0.55 (female), M = 2.91, SD = 0.40 (male), respectively. For positive stimuli, mean arousal and mean valence ratings were M = 5.39, SD = 0.27 (female), M = 5.77, SD = 0.35 (male) and M = 6.70, SD = 0.60 (female), M = 7.02, SD = 0.35 (male), respectively. For neutral pictures, mean arousal and mean valence ratings were M = 4.21, SD = 0.10 (female), 5.7, SD = 0.41 (male) and M = 5.53, SD = 0.31 (female) M = 3.8, SD = 0.25 (male), respectively. See appendix for the slide numbers.

Data Analysis

A three-way-repeated measures ANOVA was conducted with the within-subject factors *distraction* (emotional vs. neutral) × *conflict* (incongruent vs. congruent) × *valence context* (positive vs. negative). Relevant null-effects were further scrutinized by BFs using JASP

(Jarosz & Wiley, 2014). As we were not interested in gender-specific differences, data were collapsed across gender.

Results and Discussion

All trials in which participants committed an error in the flanker task were excluded (2.7 %). Furthermore, RTs that deviate more than 3 SDs for each participant and for each condition (i.e., each cell of the ANOVA) were removed from RT analyses (1.7 % responses in the flanker tasks).

Flanker task

Reaction times

Results of the three-way ANOVA with *conflict*×*distraction*×*valence context* demonstrate a significant main effect of *distraction*, $F(1,34) = 16.163$, $p <.001$, $\eta_p^2 =.322$, indicating prolonged RTs in flanker tasks following emotional pictures (*M* = 414 ms , SE = 9 ms) compared to neutral pictures (*M* = 407 ms , SE = 8 ms) and a significant main effect of *conflict* $F(1,34) = 725.330$, $p <. 001$, $\eta_p^2 = .955$ with faster responses in congruent trials (*M* = 376 ms, SD = 52) compared to incongruent trials (*M* = 445 ms, SD = 52). Main effect of *valence context* was not significant, $F(1,34) = 3.646$, $p = .065$, $\eta_p^2 = .097$. Importantly, results yielded a significant interaction of *conflict*×*distraction*, $F(1,34) = 10.599$, $p = .003$, $\eta_p^2 = .097$. Replicating previous work (Cohen et al., 2012), congruency effect was reduced in flanker trials following emotional pictures (*M* = 66 ms, SE = 3 ms) compared to following neutral pictures (*M* = 73 ms, SE = 3 ms) [4]. More specifically, ED was present in congruent trials demonstrated in significantly slower RTs for congruent trials following emotional pictures (*M* = 381 ms, SD = 56) than for congruent trials following neutral pictures (*M* = 371 ms, SD = 48 ms), $t(34) = 4.462$, $p <.001$, $d = .192$. This difference was diminished in incongruent trials following emotional pictures (*M* = 447 ms, SD

[4] Please note that effect sizes for main and interaction effects were small compared to the ones reported in previous literature with related paradigms (Cohen et al., 2012, Experiment 1)

= 52) for incongruent trials following neutral pictures (*M* = 444 ms, SD = 52), *t*(34) = 1.848, *p* <.073, *d* = .058. No other two-way interaction of the ANOVA reached significance, *conflict*×*valence context*, *F*(1,34) = .194, *p* = .662, η_p^2 = .006, *distraction*×*valence context*, *F*(1,34) = 1.200, *p* = .281, η_p^2 = .034. The three-way interaction between *conflict*×*distraction*×*valence context* was significant, *F*(1,34) = 4.213, *p* = .048, η_p^2 = .110. Closer inspection of data showed that ED is larger in positive (Δ = 8 ms, SE = 3 ms) compared to negative stimuli (Δ = 5 ms, SE = 1 ms). Both, ED induced by negative and by positive pictures show the same pattern of results, that is larger ED in congruent (negative: *M* = 7 ms, SE = 2 ms; positive: *M* = 13 ms, SE = 4 ms) compared to incongruent trials (negative: *M* = 3 ms, SE = 1 ms; positive: *M* = 2 ms, SE = 2 ms, see Figure 4). Follow-up ANOVAs showed that the influence of control on ED was larger for positive stimuli (Δ = 11 ms, SE = 3 ms, *F*(1,34) = 12.050, *p* = .001, η_p^2 = .262) relative to negative stimuli (Δ = 3 ms, SE = 3 ms, *F*(1,34) = 1.574, *p* = 0.218, η_p^2 = .044). This finding was surprising and not predicted by any of the accounts tested. However, the direction of the effect speaks clearly against a *negative-valence-specific account* due to the fact that modulation of ED was even larger when ED is induced by positive compared to negative pictures.

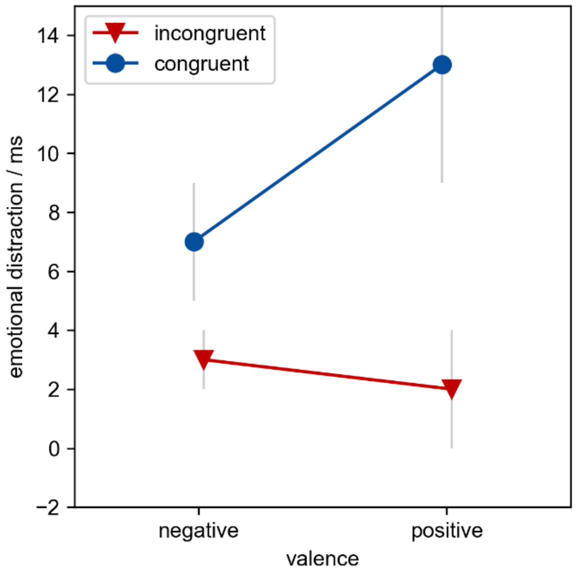

Figure 4. Interaction between conflict and ED [ms] for trials with stimuli of negative and positive valence. Error bars show standard errors.

This interpretation can be quantified by BFs that indicate evidence for the null-hypothesis. CE x ED (negative) ≯CE x ED (positive) [alternative hypothesis, CE x ED (negative) > CE x ED (positive)]. The resulting BF_{01} of 15.42 can be considered as evidence in favor for the null-hypothesis that control of ED is not specific for negative stimuli.

Error Rates

Analogous analysis was performed on error rates. Results revealed a significant main effect of *distraction* was also significant, $F(1,34) = 4.964$, $p = .003$, $\eta_p^2 = .127$, demonstrating more errors in flanker trials following emotional pictures (*M* = 3.1 %, SE = 1 %) compared to trials following neutral pictures (*M* = 2.3 %, SE = 1 %). Main effect of *conflict*, $F(1,34) = 26.591$, $p < .001$, $\eta_p^2 = .439$, demonstrating more errors in in incongruent (*M* = 4.9 %, SE = 1 %) compared to congruent flanker trials (*M* = 0.5 %, SE = 1 %). Main effect of *valence context* was not significant, $F(1,34) = 2.516$, $p = .122$, $\eta_p^2 = .069$. No other two-way interaction reached significance, *conflict*×*distraction*, $F(1,34) = 3.174$, $p = .084$, $\eta_p^2 = .085$, *conflict*×*valence context*, $F(1,34) = .248$, $p = .622$, $\eta_p^2 = .007$, *distraction*×*valence context*, $F(1,34) = .048$, $p = .828$, $\eta_p^2 = .001$. The three-way interaction between *conflict*×*distraction*×*valence context* was not significant, $F(1,132) = .039$, $p = .844$, $\eta_p^2 = .001$.

General Discussion

The purpose of the study was to test whether conflict-triggered control adaptations interact with emotional distraction in general or whether this control is specific to the negative valence of emotional distractors. Furthermore, we asked whether ED differs between control modes that operate on different time scales. Therefore, we systematically manipulated the valence (positive, high arousal; negative, high arousal; and neutral, low arousal) of emotional distractors (pictures) and assessed how control (instigated by the flanker task) interacts with ED when induced before and after the emotional stimuli. According to our theoretical analysis, a *valence-general account* predicts that cognitive control shields against the distracting influence of arousal, irrespective of the valance of emotional distractor stimuli. In contrast, a *negative-*

valence-specific account predicts that cognitive control interacts with the specific hedonic value of emotional distractor stimuli and conflict reduces ED from negative pictures only.

We found that ED decreased following conflict (Experiment 1, i.e., proactive control) and during conflict (Experiment 2, i.e., reactive control). These findings are in line with previous studies that showed a reduction of ED following conflict-activation (Cohen et al., 2012, 2015a) and during conflict-activation (Cohen et al., 2012, Verbruggen & De Houwer, 2007). Extending this research, we observed no difference in conflict-triggered control adaptation between negative and positive valence or even larger adaptation effects on positive valence in Experiment 2, which argues against a *valence-specific account*. Accordingly, the regulatory processes induced by cognitive conflict cannot be traced back to the specific negative valence that causes ED, but conflict-triggered control adaptation reduced ED from both, negative and positive distractor valence.

The present results rule out an alternative explanation of conflict-reduced ED. More specifically, Braem and colleagues (2017) showed that the anterior cingulate cortex response to negative pictures was reduced after a conflict compared to non-conflicting trial, suggesting that processing of conflict alleviates affective responses. With reference to the findings by Cohen and colleagues (2012; 2015a), Braem and colleagues speculated that "[…] it remains to be determined whether studies would find reduced emotional distraction [for previous incongruent flanker] when using positive pictures (as the reduced distraction reported in Cohen et al., 2011, 2012, 2015) or whether such studies would show the opposite pattern instead. The latter would suggest that the results of Cohen and colleagues (2011, 2012, 2015) could have been influenced by the aversive nature of conflict processing (Botvinick, 2007)" (Braem et al., 2017, p. 147). According to this line of reasoning, it remained unclear whether conflict-reduced ED reported by Cohen and colleagues (2012, 2015a, see also 2015b) is the result of a control process that shields processing against the distraction of emotional pictures or whether it is the consequence of repeating the same valence (in the incongruent flanker and the negative picture), which leads to reduced processing of negative pictures. The present results speak against the latter account since conflict reduced ED for both, negative and positive valence.

Surprisingly, we found that modulation of ED following conflict (Experiment 1) and during conflict (Experiment 2) was even larger for positive stimuli compared to negative stimuli. This cannot be explained by an overall difference in the size of the ED between negative and positive valence (as indicated by the non-significant differences between ED induced by negative and induced by positive stimuli, Experiment 1: *distraction*×*valence context*, $F(1,132) = 1.545$, $p = .216$, $\eta_p^2 = .012$, Experiment 2: *distraction*×*valence context*, $F(1,34) = 1.200$, $p = .281$, $\eta_p^2 = .034$). Based on research that attributes conflict-triggered control adaptation effects to the negative valence of conflict (Dreisbach & Fischer, 2015; Inzlicht et al., 2015), two post-hoc explanation appear tenable. First, research on 'hedonic contrast' suggests that evaluations of affective stimuli are not absolute but relative to evaluations of alternative stimuli (Eder & Dignath, 2014; Larsen, Norris, McGraw, Hawkley, & Cacioppo, 2009). This interpretation would suggest that negative conflict signals became even more negative against the background of a positive affective state induced by the picture (see Dreisbach, Fröber, Berger, & Fischer, 2018). Alternatively, it has been argued that the *processing* of conflict is associated with negative affect, while *resolution* of conflict (i.e., correct response to incongruent tasks) has been associated with more positive affect (Schouppe et al., 2015). This could suggest that control of conflict triggers a positive affective response which acts as a reinforcer for the currently active control set (Schouppe et al., 2015; see also Notebaert & Verguts, 2008). Possibly positive affect as induced by the pictures could have added up with the positive reinforcement signal triggered by conflict resolution and consequently facilitated control. Clearly, both of these explanations are speculative and require further testings.

While the present research conceptualized cognitive control as a shielding-against-distraction mechanism that implies increased stability, another aspect of cognitive control is flexibility (i.e., flexible working memory updating of task-relevant information, Miyake et al., 2000). A frequently used tool to investigate flexibility is task-switching because cognitive and attentional set-shifting affords flexible working memory adjustments and updating of task-relevant information (for reviews see Kiesel et al., 2010; Koch, Poljac, Müller, & Kiesel, 2018). Recent findings indicate that induction of positive affect reduces switch costs and thus are assumed to enhance cognitive flexibility (Dreisbach & Goschke, 2004; Fröber & Dreisbach, 2014; Liu & Wang, 2014; Liu & Xu, 2016; see also Chiew and Braver, 2014, for a review see Goschke, 2014). Taking into account that in a proactive control mode cognitive control influences emotional distraction that *follows* control induction, it would be interesting to investigate how cognitive control in task-switching influences subsequent emotional distraction from both, positive and negative stimuli.

Results of the previous study are also informative regarding proactive control in dual tasking (for a review see Schuch, Dignath, Steinhauser, & Janczyk, 2018). Experiment 1 comprises two different tasks: the flanker task that induced conflict and the color-discrimination task that measured ED caused by the picture. Consequently, proactive conflict-triggered control adaptation operated across tasks. A recent review revealed mixed evidence regarding the scope of conflict-triggered control adjustments (Braem, Abrahamse, Duthoo, & Notebaert, 2014). According to this review, conflict-triggered control adjustments are reflected in both, task-specific control (i.e., conflict-triggered control adaptation in the same task type that instigates conflict, e.g., Kiesel, Kunde, & Hoffmann, 2006; Notebaert & Verguts, 2008) and task-general control (i.e., conflict-triggered control adjustments in a task that differs from the task instigating the conflict, e.g., Kunde & Wühr, 2006). The present results showed that cognitive control of ED is not restricted to modulation of task-relevant processing pathways but regulates performance across tasks in a more general manner.

Summary

Taken together, in two Experiments we showed that cognitive control mechanisms that operate on different time scales (i.e., proactive and reactive) block off high arousing emotional distractors from interfering with goal-directed actions, both for negative and positive valence.

Acknowledgments

This research was supported by a grant within the Priority Program, SPP 1772 from the German Research Foundation (Deutsche Forschungsgemeinschaft, DFG), grant no DI 2126/1-1 and DI 2126/1-2 to DD. We thank our student assistants Julia Ditz, Patrik Seuling, Jessica Helm and Sari Al Salti for data collection. We are grateful to Dr. Noga Cohen for providing materials of the experimental design and to Ronja Khelifa for translating original experiment's instructions from Hebrew into English. We thank Dr. Lisa Hüther-Pape and Dr. Edita Poljac for improving the English and Lea Johannsen and Moritz Schiltenwolf for helpful discussions.

References

Anderson, A. K. (2005). Affective influences on the attentional dynamics supporting awareness. *Journal of Experimental Psychology: General*, *134*(2), 258.

Barrett, L. F., & Russell, J. A. (1999). The Structure of Current Affect: Controversies and Emerging Consensus. *Current Directions in Psychological Science, 8*(1), 10–14.

Botvinick, M. Braver, T. S., Barch, D. M., Carter, C. S., & Cohen, J. D. (2001). Conflict monitoring and cognitive control. *Psychological Review, 108*(3), 624–652.

Braem, S., Abrahamse, E. L., Duthoo, W., & Notebaert, W. (2014). What determines the specificity of conflict adaptation? A review, critical analysis, and proposed synthesis. *Frontiers in Psychology*, *5*.

Braem, S., King, J. A., Korb, F. M., Krebs, R. M., Notebaert, W., & Egner, T. (2017). The Role of Anterior Cingulate Cortex in the Affective Evaluation of Conflict. *Journal of Cognitive Neuroscience*, *29*(1), 137–149.

Braver, T. S. (2012). The variable nature of cognitive control: a dual mechanisms framework. *Trends in Cognitive Sciences*, *16*(2), 106–113.

Chiew, K. S., & Braver, T. S. (2014). Dissociable influences of reward motivation and positive emotion on cognitive control. Cognitive, Affective, & Behavioral Neuroscience, 14(2), 509-529.

Cohen, N., Henik, A., & Moyal, N. (2012). Executive control attenuates emotional effects—For high reappraisers only? *Emotion*, *12*(5), 970–979.

Cohen, N., Mor, N., & Henik, A. (2015a). Linking executive control and emotional response: A training procedure to reduce rumination. *Clinical Psychological Science, 3*(1), 15–25.

Cohen, N., Moyal, N., & Henik, A. (2015b). Executive control suppresses pupillary responses to aversive stimuli. *Biological Psychology*, *112*, 1–11.

Dignath, D., & Eder, A. B. (2015). Stimulus conflict triggers behavioral avoidance. *Cognitive, Affective, & Behavioral Neuroscience*, *15*(4), 822–836.

Dignath, D., Wirth, R., Kühnhausen, J., Gawrilow, C., Kunde, W., & Kiesel, A. (in press). Motivation drives conflict adaptation. *Motivation Science*.

Dreisbach, G., & Goschke, T. (2004). How positive affect modulates cognitive control: reduced perseveration at the cost of increased distractibility. Journal of Experimental Psychology: Learning, Memory, and Cognition, 30(2), 343.

Dreisbach, G., & Fischer, R. (2015). Conflicts as Aversive Signals for Control Adaptation. *Current Directions in Psychological Science*, *24*(4), 255–260.

Dreisbach, G., Fröber, K., Berger, A., & Fischer, R. (2018). Unexpected conflict signals loom larger in a positive context: Evidence from context specific control adjustments. *Journal of Experimental Psychology: Learning, Memory, and Cognition.*

Eder, A. B., & Dignath, D. (2014). I like to get nothing: Implicit and explicit evaluation of avoided negative outcomes. *Journal of Experimental Psychology: Animal Learning and Cognition*, *40*(1), 55–62.

Fischer, R., Ventura-Bort, C., Hamm, A., & Weymar, M. (2018). Transcutaneous vagus nerve stimulation (tVNS) enhances conflict-triggered adjustment of cognitive control. *Cognitive, Affective, & Behavioral Neuroscience, 18*(4), 680–693.

Fröber, K., & Dreisbach, G. (2014). The differential influences of positive affect, random reward, and performance-contingent reward on cognitive control. Cognitive, Affective, & Behavioral Neuroscience, 14(2), 530-547.

Fröber, K., Stürmer, B., Frömer, R., & Dreisbach, G. (2017). The role of affective evaluation in conflict adaptation: An LRP study. *Brain and Cognition*, *116*, 9–16.

Goschke, T., & Bolte, A. (2014). Emotional modulation of control dilemmas: The role of positive affect, reward, and dopamine in cognitive stability and flexibility. Neuropsychologia, 62, 403-423.

Gupta, R., Hur, Y.-J., & Lavie, N. (2016). Distracted by pleasure: Effects of positive versus negative valence on emotional capture under load. *Emotion*, *16*(3), 328–337.

Inzlicht, M., Bartholow, B. D., & Hirsh, J. B. (2015). Emotional foundations of cognitive control. Trends in Cognitive Sciences, 19(3), 126–132.

Jimura, K., Locke, H. S., & Braver, T. S. (2010). Prefrontal cortex mediation of cognitive enhancement in rewarding motivational contexts. Proceedings of the National Academy of Sciences, 107(19), 8871-8876.

Kiesel, A., Kunde, W., & Hoffmann, J. (2006). Evidence for task-specific resolution of response conflict. *Psychonomic Bulletin & Review*, *13*(5), 800–806.

Kiesel, A., Steinhauser, M., Wendt, M., Falkenstein, M., Jost, K., Philipp, A. M., & Koch, I. (2010). Control and interference in task switching—A review. *Psychological bulletin*, *136*(5), 849.

Koch, I., Poljac, E., Müller, H., & Kiesel, A. (2018). Cognitive structure, flexibility, and plasticity in human multitasking - An integrative review of dual-task and task-switching research. *Psychological Bulletin*, *144,* 557-583.

Kunde, W., & Wühr, P. (2006). Sequential modulations of correspondence effects across spatial dimensions and tasks. *Memory & Cognition*, *34*(2), 356–367.

Lang, P. J. (2005). International affective picture system (IAPS): Affective ratings of pictures and instruction manual. *Technical Report*.

Larsen, J. T., Norris, C. J., McGraw, A. P., Hawkley, L. C., & Cacioppo, J. T. (2009). The evaluative space grid: A single-item measure of positivity and negativity. *Cognition and Emotion*, *23*(3), 453–480.

Lykins, A. D., Meana, M., & Strauss, G. P. (2008). Sex Differences in Visual Attention to Erotic and Non-Erotic Stimuli. *Archives of Sexual Behavior*, *37*(2), 219–228.

Marchewka, A., Żurawski, Ł., Jednoróg, K., & Grabowska, A. (2014). The Nencki Affective Picture System (NAPS): Introduction to a novel, standardized, wide-range, high-quality, realistic picture database. *Behavior Research Methods*, *46*(2), 596–610.

Miller, E. K., & Cohen, J. D. (2001). An integrative theory of prefrontal cortex function. *Annual Review of Neuroscience*, *24*(1), 167–202.

Most, S. B., Smith, S. D., Cooter, A. B., Levy, B. N., & Zald, D. H. (2007). The naked truth: Positive, arousing distractors impair rapid target perception. *Cognition & Emotion*, 21(5), 964–981.

Miyake, A., Friedman, N. P., Emerson, M. J., Witzki, A. H., Howerter, A., & Wager, T. D. (2000). The unity and diversity of executive functions and their contributions to complex “frontal lobe” tasks: A latent variable analysis. Cognitive psychology, 41(1), 49-100.

Notebaert, W., & Verguts, T. (2008). Cognitive control acts locally. *Cognition*, *106*(2), 1071–1080.

Öhman, A., Flykt, A., & Esteves, F. (2001). Emotion drives attention: detecting the snake in the grass. *Journal of Experimental Psychology: General*, *130*(3), 466.

Pessoa, L., McKenna, M., Gutierrez, E., & Ungerleider, L. G. (2002). Neural processing of emotional faces requires attention. *Proceedings of the National Academy of Sciences*, *99*(17), 11458–11463.

Savine, A. C., Beck, S. M., Edwards, B. G., Chiew, K. S., & Braver, T. S. (2010). Enhancement of cognitive control by approach and avoidance motivational states. Cognition and Emotion, 24(2), 338-356.

Scherbaum, S., Fischer, R., Dshemuchadse, M., & Goschke, T. (2011). The dynamics of cognitive control: Evidence for within-trial conflict adaptation from frequency-tagged EEG. *Psychophysiology*, 48(5), 591–600.

Schouppe, N., Braem, S., De Houwer, J., Silvetti, M., Verguts, T., Ridderinkhof, K. R., & Notebaert, W. (2015). No pain, no gain: the affective valence of congruency conditions changes following a successful response. *Cognitive, Affective, & Behavioral Neuroscience*, *15*(1), 251-261.

Schupp, H., Cuthbert, B., Bradley, M., Hillman, C., Hamm, A., & Lang, P. (2004). Brain processes in emotional perception: Motivated attention. *Cognition and Emotion*, 18(5), 593–611.

Verbruggen, F., & De Houwer, J. (2007). Do emotional stimuli interfere with response inhibition? Evidence from the stop signal paradigm. *Cognition and Emotion*, *21*(2), 391–403.

Verguts, T., & Notebaert, W. (2009). Adaptation by binding: a learning account of cognitive control. *Trends in Cognitive Sciences*, *13*(6), 252–257.

Vuilleumier, P., Armony, J. L., Driver, J., & Dolan, R. J. (2001). Effects of Attention and Emotion on Face Processing in the Human Brain: An Event-Related fMRI Study. *Neuron*, *30*(3), 829–841.

Walsh, A. T., Carmel, D., Harper, D., & Grimshaw, G. M. (2018). Motivation enhances control of positive and negative emotional distractions. *Psychonomic Bulletin & Review*, *25*(4), 1556–1562.

Appendix

Slide numbers of pictures used in Experiment 1

Data base	Slide Nr.	valence	arousal	emotion category	Slide Nr.	valence	arousal	emotion category
IAPS	2053	2.47	5.25	negative (sad)	3000	1.59	7.34	negative (fear)
	2345.1	2.26	5.50		3015	1.52	5.90	
	3300	2.74	4.55		3053	1.31	6.91	
	3225	1.82	5.95		3063	1.49	6.35	
	3001	1.62	6.64		3064	1.45	6.41	
	3005.1	1.63	6.20		3080	1.48	7.22	
	3064	1.45	6.41		3131	1.51	6.61	
	9404	3.71	4.67		3168	1.56	6.00	
	6190	3.57	5.64		3170	1.46	7.12	
	6838	2.45	5.80		3266	1.56	6.79	
	2981	2.76	5.97		9183	1.96	6.58	
	8499	7.63	6.07	positive (achievement)	2215	4.36	3.38	neutral
	8185	7.57	7.27		2221	4.39	3.07	
	8080	7.73	6.65		2273	5.41	3.52	
	8030	7.33	7.35		2280	4.22	3.77	
	8492	7.21	7.31		2377	5.19	3.50	
	8470	7.74	6.14		2396	4.91	3.34	
	8190	8.10	6.28		2435	5.84	3.94	
	8501	7.91	6.44		2441	4.64	3.62	
	8210	7.53	5.94		2446	4.7	3.79	
	2040	8.17	6.65		2480	4.77	2.66	
	8370	7.77	6.73		2487	5.2	4.05	
	8186	7.01	6.84		2499	5.34	3.08	
NAPS	017_v	6.87	5.67	positive (erotic)				
	008_h	6.85	5.45					
	024_h	6.60	5.67					
	016_v	7.05	5.20					
	015_h	6.97	5.20					
	019_v	7.12	4.95					
	023_h	6.67	5.40					
	020_h	6.65	5.27					
	002_h	6.60	5.27					
	007_h	6.65	5.20					
	009_h	6.72	5.02					
	033_v	6.62	4.87					

Slide numbers of pictures used in Experiment 2

female				male			
Database: NAPS Slide Nr.	valence	arousal	emotion category	Slide Nr.	valence	arousal	emotion category
People_039_v	2.59	6.28		People_077_v	3.08	6.50	
People_210_h	3.88	5.77		People_240_h	2.21	6.43	
People_072_v	3.07	5.86		People_216_h	2.95	6.33	
People_094_h	3.07	5.83		People_133_h	2.68	6.20	
People_120_h	3.37	5.81		People_214_h	4.24	6.12	
People_062_v	3.55	5.79		People_136_h	2.90	6.05	
People_119_h	3.20	5.76		People_142_h	2.80	5.93	
People_118_h	2.50	5.76		People_125_h	2.63	6.30	
People_087_h	3.39	5.75		People_121_h	3.06	5.84	
People_060_v	4.00	5.74	negative	People_002_v	2.84	6.16	negative
People_085_h	3.17	5.61		People_140_h	2.88	5.76	
People_083_h	3.72	5.55		People_144_h	2.94	6.18	
People_014_h	4.33	5.53		People_022_h	2.47	6.16	
People_141_h	4.11	5.44		People_010_h	3.24	6.33	
People_124_h	2.90	6.28		People_119_h	2.78	5.64	
People_136_h	2.40	6.13		People_215_h	2.81	6.06	
People_145_h	2.96	6.13		People_083_h	3.32	5.53	
People_125_h	2.72	6.03		People_147_h	3.10	6.05	
People_024_v	3.40	6.03		People_143_h	2.65	6.22	
People_010_h	3.46	6.00		People_213_v	2.69	5.94	
Opposite-sex_couple_005_h	6.40	5.60		Female_018_h	7.45	6.50	
Opposite-sex_couple_017_v	6.95	5.80		Opposite-sex_couple_025_h	7.30	6.40	
Opposite-sex_couple_024_h	6.45	5.75		Female_021_h	7.10	6.30	
Opposite-sex_couple_016_v	7.60	5.75		Female_020_v	7.35	6.20	
Male_003_v	6.25	5.00		Opposite-sex_couple_023_h	6.70	5.25	
Opposite-sex_couple_002_h	6.60	5.70		Opposite-sex_couple_005_h	6.85	6.05	
Opposite-sex_couple_019_v	7.90	5.70		Opposite-sex_couple_007_h	6.45	5.35	
Opposite-sex_couple_020_h	7.00	5.60		Female_002_h	7.40	5.85	
Opposite-sex_couple_007_h	6.85	5.05		Female_011_h	7.60	5.85	
Opposite-sex_couple_023_h	6.65	5.55	positive	Female_004_v	7.25	5.80	positive
Opposite-sex_couple_035_h	7.00	5.05		Female_017_v	7.20	5.75	
Male_016_v	5.85	5.45		Female_006_v	7.10	5.70	
Opposite-sex_couple_015_h	7.40	5.35		Female_005_v	6.25	5.60	
Male_013_v	6.25	5.30		Opposite-sex_couple_008_h	6.95	5.60	
Opposite-sex_couple_008_h	6.75	5.30		Opposite-sex_couple_024_h	6.75	5.60	
Opposite-sex_couple_048_h	6.75	5.20		Female_009_h	6.90	5.55	
Male_024_h	6.60	5.15		Female_015_v	7.30	5.55	
Opposite-sex_couple_013_h	5.25	5.15		Opposite-sex_couple_017_v	6.80	5.55	
Opposite-sex_couple_047_v	6.80	5.15		Female_013_h	6.85	5.50	
Male_023_v	6.60	5.15		Female_023_h	6.85	5.40	
Landscapes_072_h	5.66	4.03		Objects_044_v	3.05	6.19	
Landscapes_037_v	5.85	4.04		People_138_h	3.53	5.76	
Landscapes_135_h	5.39	4.09		People_149_h	3.54	5.27	
Objects_220_h	5.67	4.10		People_104_h	3.75	5.85	
Objects_043_h	5.86	4.11		Landscapes_111_h	3.83	5.67	
Objects_044_v	5.9	4.13		Objects_038_v	3.86	5.95	
Landscapes_080_h	5.18	4.14		Landscapes_042_h	3.86	5.63	
Objects_214_h	5.78	4.15		Landscapes_016_h	3.89	4.79	
Objects_297_h	5.84	4.20		Objects_237_h	3.89	5.63	
Landscapes_019_h	4.94	4.21	neutral	Objects_220_h	3.90	6.15	neutral
Objects_271_h	5.86	4.21		Landscapes_037_v	3.90	5.9	
Landscapes_016_h	5.38	4.22		Landscapes_024_v	3.94	4.53	
Landscapes_083_h	5.75	4.25		Landscapes_130_h	3.95	5.95	
Landscapes_060_h	5.15	4.30		Objects_201_v	3.95	5.86	
Objects_276_h	5.55	4.30		Landscapes_072_h	3.97	6.03	
People_148_h	5.85	4.31		Objects_249_v	4.00	5.86	
Landscapes_111_h	5.36	4.32		Objects_214_h	4.05	5.79	
People_104_h	5.09	4.34		Landscapes_083_h	4.09	5.77	
Objects_161_v	5.41	4.36		Objects_257_h	4.10	5.80	
Landscapes_091_h	5.19	4.37		Objects_219_h	4.14	5.78	