Affect and action : contrasting conscious and nonconscious processes

Rotteveel, M.

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CHAPTER 5

LOADING WORKING MEMORY INTERFERES WITH AFFECT INCONGRUENT MOVEMENTS*

It is proposed in many emotion theories that action tendencies are core processes of emotion. In different empirical studies stronger influences of affect were obtained with decreased than with full consciousness. In this study action tendencies were investigated as a function of consciousness that was varied with a manipulation of attention (see Merikle & Joordens, 1997). With divided attention (i.e., working memory load) it was more difficult for participants to withdraw from their affect congruent action tendencies than with focused attention, as was demonstrated, specifically, in their execution (i.e., movement time) of affect specific movement.

Emotions may have the adaptive function of preparing for direct action without deliberation (Darwin, 1872/1998, Lang, Bradley, & Cuthbert, 1990). It is proposed that action tendencies could be organized in two affective motivational systems that enable approach and avoidance behavior (Bargh, 1997; Cacioppo, Priester, & Berntson, 1993; Lang et al., 1990). It is suggested by Chen and Bargh (1999) and Neumann and Strack (2000 a) that action tendencies are probably part of an adaptive system that operates largely independent of consciousness. Chen and Bargh even further proposed that less conscious involvement in affective responding could lead to stronger and more widespread effects of affect (as in Bargh, Chaiken, Govender, & Pratto, 1996; Fulcher & Hammerl, 2001; Murphy & Zajonc, 1993; Stapel, Koomen, & Ruys, 2002; Chapter 2). Chen and Bargh performed two experiments in which instruction (explicit versus implicit affective evaluation) was varied. Chen and Bargh predicted not explicitly, however, that with implicit affective evaluation (Experiment 2) stronger action tendencies should be found than with explicit affective evaluation (Experiment 3). The results of both experiments were, therefore, not compared directly and there were also no clear indications of stronger action tendencies with an implicit than with an explicit affective evaluation. We suggest that with

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another manipulation of consciousness this pattern of results could be obtained.

In the first experiment of Chen and Bargh (1999), participants in one group were instructed to push the response lever away from them if the stimulus word presented on a given trial was negative and to pull the lever toward them if the stimulus was positive (i.e., explicit congruent instruction). The remaining participants received the opposite instruction (i.e., explicit incongruent instruction). Participants were faster when pulling the lever with positive words than when pushing the lever away. With negatively valenced words, on the other hand, the lever was pushed faster than pulled. Chen and Bargh concluded that affect-congruent movements were performed faster than affect-incongruent movements. A comparable pattern of results was obtained (Chen & Bargh, Experiment 2) when participants were instructed only to push or pull the lever on the mere presentation (i.e., implicit instruction) of the affectively valenced words.

In Chapter 4 (Experiment 1) the pattern of results that was obtained by Chen and Bargh (1999, Experiment 1, see also Solarz, 1960) was replicated for emotional facial expressions but in a different experimental set-up. Instead of lever-movement participants were instructed to press a home button and to move only their arm within a stand towards a button below (as in pushing) or above (as in pulling) according to instructions. Two aspects could be differentiated in this way that contribute differentially to overall reaction time (as in Solarz): initiation time (RT) and movement time (MT), respectively. This differentiation of overall reaction time could be helpful because reaction time is not a unitary measure (see Welford, 1968). Initiation time reflects more a central decision making process and the generation of action, whereas movement time reflects execution and control of action and the magnitude of, for instance, the neuro-muscular response (Fitts, 1954; Welford, 1968).

Chen and Bargh (1999) suggested that with less conscious affective information processing stronger and more widespread effects of affect could be obtained than with fully conscious affective information processing. This position is based (see Chen & Bargh, 1999, p.216), amongst others, on the findings of Bargh, Chaiken, Govender, & Pratto (1996) and Murphy and Zajonc (1993). Murphy and Zajonc showed (but see also Fulcher & Hammerl, 2001; Murphy, Monahan, & Zajonc, 1995; see also Chapters 2 and 3) that preceding affective facial expressions (i.e., primes) in less conscious conditions biased affective evaluations congruently of target Chinese ideographs. In fully conscious conditions, in which participants were instructed to ignore the prime, in contrast, less or even incongruent affective priming effects were obtained. It was suggested by Murphy and Zajonc that this pattern of results was probably characteristic for affective information processing because for priming on non-affective dimensions (e.g., gender and symmetry) with comparable instructions the reversed pattern of results was obtained. This theoretical position is, however, not clearly underlined by Chen and Barghs' results. Although, the results of both experiments were not compared directly it seems that instruction of lever movement was even of less influence with an implicit (Experiment 2) than with an explicit (Experiment 1) affective evaluation instruction. It seems, therefore, that the stronger influence of affect with decreased than with full consciousness is not reflected in action tendencies.

In Chen and Bargh's second experiment (1999) participants were instructed to respond only (i.e., push or pull) to the mere presence of clearly visible affectively valenced words. It could not be excluded that some participants evaluated the valenced words consciously (for a comparable conceptualization see Bargh, Chaiken, Raymond, & Hymes, 1996 and Chapter4). The participants could have sought for a reason for the presence of affective words because unlike the first experiment (i.e., explicit affective evaluation) consciousness was only occupied with the presence/absence distinction. It could, therefore, not be excluded that the assumed implicit affective evaluation was contaminated by explicit affective evaluation. Such an explanation could account for the apparent smaller effects of instruction (i.e., congruent versus incongruent lever movement) in Chen and Bargh's second than in their first experiment. It seems, therefore, that accidental affective evaluation should be prevented when consciousness is manipulated. Consciousness could be manipulated, for instance, by means of stimulus duration (see Murphy & Zajonc, 1993). Target presentation duration and, therefore, latencies between the resulting explicit and implicit affective evaluation conditions would then be probably incomparable. Another and probably more suitable manipulation of consciousness that is also comparable to presentation duration (see Merikle & Joorden, 1997) seems the manipulation of attention. The advantage of this manipulation is a constant target presentation time and consequently more comparable latencies between conditions.

Merikle and Joordens (1997) proposed that manipulations of attention and of stimulus quality (i.e., in terms of presentation duration and masking) have parallel effects on consciousness. They obtained equivalent effects of both manipulations with false recognition, exclusion failure and a variant of the Stroop-task. To achieve less conscious processing, attention was diverted away from the stimulus that was presented as long as in fully conscious conditions. Monitoring a sequence of auditory digits for three consecutive odd digits served to divide attention and disrupted prime processing similarly as visual masking. In the present experiment consciousness was manipulated by means of a comparable manipulation of attention (see also Chapter 3). Attention was varied by concurrently loading working memory (see Mulligan and Stone, 1999), which was presented as the primary task.

Participants were instructed that the experiment was about memory for digit-letter strings under dual-task conditions. Working memory was loaded in divided attention trials with digit-letter-strings as in Mulligan and Stone (1999) and Chapter 3. With divided attention participants had to reproduce after their categorization of the facial expression the digit-letter string that was presented just before the facial expression. With focused attention participants could focus on the affective categorization task and only six hyphens were presented just before the facial expressions. Participants had to categorize angry and happy facial expressions as positively or negatively valenced by means of the same stand used in Chapter 4 with two levels of instruction (i.e., congruent and incongruent) that also were varied within participants. We expected that in both attention conditions effects of instruction (i.e., congruent versus incongruent) would be obtained for initiation time as in Chen and Bargh (1999), Solarz (1960), and Chapter 4 (Experiment 1 & 3). Congruent responses should overall be faster initiated than incongruent responses. It was expected, moreover, that with divided attention instruction would have a stronger influence than with focused attention.

Method

Participants

Forty-eight first-year female undergraduate psychology students (average age 20.95 year, *SD*=1.94) from the University of Amsterdam participated in exchange for partial fulfillment of course requirements. All participants had normal or corrected-to-normal vision and were right-handed and they all gave informed consent. The experiment was announced as "Memory and Affect".

Design

The evaluation task had a 2 (Instruction: congruent, vs. incongruent forearm movement) x 2 (Target-valence: positive vs. negative emotional expressions) x 2 (Attention: focused vs. divided) within-participants factorial design.

Two different reaction times were measured: the initiation time in which participants released the home button (RT), and the movement time (MT) needed for reaching the response button. Outliers were excluded from instruction conditions per participant (i.e., congruent or incongruent) on the basis of the 2.5 SD criterion. Reaction times that deviated more than 2.5 SD from the average of that instruction condition were excluded from the analysis. Incorrect responses were also excluded from the reaction time analyses. The number of incorrect responses also served as a dependent variable.

Material and apparatus

Forty-eight pictures with emotional expressions from Ekman and Friesen (1976) and Matsumoto and Ekman (1988) served as targets and were presented twice (series 1 & 2). The affective stimulus material was divided over two series (series A and B) of twenty-four trials. Of each series, there were two versions (i.e., A1 and A2; B1 and B2). Each series contained 6 happy expressions of male models, 6 happy expressions of female models, 6 angry expressions of male models, and 6 angry expressions of female models. Affective stimuli used in divided attention trials in series A1 and A2, were subsequently used in focused attention trials in series B1 and B2, and vice versa. The order of trials within the series was randomised. Instruction (i.e., the congruent or incongruent arm movement) was changed halfway the experiment, which was after the first two series. Twenty-four participants started with the congruent movement instruction, the other twenty-four participants started with the incongruent movement instruction. The order of the four series was balanced over participants, with the restriction that the affective stimulus material was repeated only after the change in instruction.

Each series was preceded by six practice trials containing pictures that were not part of the experimental set. Each trial started with the projection of a black fixation point for 500 ms. Subsequently a digit-letters string (i.e., divided attention) or a string of hyphens (i.e., focused attention) was projected for 3500 ms directly followed by the target that was projected for 100 ms. Participants were allowed to categorize the facial expression for 1500 ms after which a question mark (i.e., cue for string-reproduction) was projected for 500 ms. During and after (6400 ms) this cue participants were instructed to reproduce verbally the digit-letter string or nothing. All stimuli were projected on the screen from the back by means of a threeway-projection-tachistoscope with three digital data projectors (Hitachi CPX 955) that were fitted with LCD-shutters (Displaytech LV2500-AC). Three data-projectors as well as the LCD shutters were controlled by the application 'Beam' (inhouse software) with a Pentium II 400 MHz computer.

In divided attention trials participants were instructed to maintain six digits and letters (divided attention) or nothing (focused attention) in working memory. Strings consisted of digits (1-9) and letters (B, C, D, F, G, H, J, K, L) that were combined in each string according to three rules: every string started with a digit, digits and letters were alternated, and digits and letters were not repeated within a string. Participants were instructed to reproduce the string verbally after their affective categorization of the valenced target. Responses were recorded during the experiment and scored afterwards. Proportion of correct string reproduction performance was calculated for each participant and each experimental condition, separately.

Affective ratings could be given by means of three one-button boxes that were fixed on a vertical stand. Participants were seated to the left of the stand and operated it with their right hand. The home-button (fixed in the middle) had to be pressed loosely with the back of the right hand as long as no response was given (resting position). The home button was positioned for each participant individually, so that the angle between the arm and upper-arm was 110 degrees for all participants in the resting position. In this way both muscles (biceps and triceps) were equally tensed when pressing the home button. The response-buttons were positioned perpendicularly above and below the home button (at a distance of 10.3 cm) in such a manner that participants could only make the instructed flexion (as in pulling)- or extension (as in pushing) movements with their arm.

Procedure

Participants were instructed that the experiment was about memory for digit-letter strings under dual-task conditions. They received either a congruent (i.e., flexion of the forearm for positive stimuli and extension of the forearm for negative stimuli) or an incongruent (i.e., flexion of the forearm for negative stimuli and extension of the forearm for positive stimuli) instruction with regard to the targets (i.e., facial expressions). Preceding the first two series of experimental trials, six practice trials were presented. Subsequently, the third and fourth series of trials were presented that were also preceded by six practice trials. The experiment was concluded with an exit-interview in which participants were asked about their strategies and ideas about the experiment and about the ease and/or difficulty of the forearm movements.

Results

Seventeen participants mentioned the greater ease of performing congruent movements than incongruent movements. Only two participants mentioned greater ease of performing incongruent movements than congruent movements. Twenty-five participants volunteered that, overall, the extension movement was performed more easily than flexion, whereas, ten participants found that flexion of the forearm was performed more easily. Participants subjectively reported to be well able to evaluate the affective meaning of the pictures.

For initiation time 1.71 % outliers were removed in the focused attention congruent condition, 1.22 % in the focused attention incongruent condition, 1.97 % in the divided attention congruent condition, and 2.05 % in the divided attention incongruent condition. For movement time 2.95 % outliers were excluded from analysis in the focused attention congruent condition, 3.19 % in the focused attention incongruent condition, 3.35 % in the divided attention congruent condition, and 3.77 % from the divided attention incongruent condition. There were less incorrect responses in the focused congruent instruction condition (5.73 %) than in the incongruent (7.38 %) instruction condition. There were less incorrect responses in the divided congruent instruction condition (8.77 %) than in the incongruent (11.11 %) instruction condition. The difference between levels of attention (proportion incorrect Focused: M=0.07, SD=0.009; Divided: M=0.104, SD=0.012) proved to be reliable in a 2 (Atention) x 2 (Instruction) x 2 (Target-valence) analysis of variance (ANOVA), $F(1,47)=17.10$, $p<0.0001$. Participants also made slightly more incorrect responses in incongruent (M=0.096, SD=0.013) than in congruent conditions (M=0.076, SD=0.012) but this main effect was only marginally significant ($F(1,47)=2.29$, $0.10<p<0.15$). Interestingly, more incorrect responses were made with angry facial expressions (M=0.096, SD=0.011) than with happy facial expressions (M=0.076, SD=0.011), $F(1,47)=4.48$, $p<0.05$. This main effect of affective valence was, moreover, qualified by a two-way interaction of affective valence and instruction, $F(1,47)=7.67$, $p<0.01$. The influence of instruction appeared to be stronger with angry faces (Congruent: M=0.073, SD=0.011; Incongruent: M=0.119, SD=0.015) than with happy faces (congruent: M=0.082, SD=0.014; incongruent: M=0.073, SD=0.013).

Participants were overall faster (see also Table 1) to release the home (RT) button in congruent (M=655.01, SD=116.52) than in incongruent (M=705.53, SD=132.42) conditions as was evidenced by a main effect of instruction in a 2 (Attention) x 2 (Instruction) x 2 (Target-valence) ANOVA, $F(1,47)=30.76$, $p<0.0001$. The participants released the home button also faster in focused attention conditions (M=640.41, SD=110.92) than in divided attention conditions (M=720.14, SD=130.00), $F(1,47)=57.67$, $p<0.0001$. The interaction, however, between attention and instruction proved to be non-significant, $F(1, 47)<1$, n.s. Positively valenced targets were faster (M=673. 01, SD=127.80) categorized than negatively (M=687.53, SD=127.03) valenced targets, $F(1,47)=5.28$, $p<0.05$. This main effect was qualified by a two-way interaction between target valence and instruction, $F(1,47)=4.51$, $p<0.05$. The influence of instruction was less with positively valenced targets (Congruent: M=652.08, SD=119.59; Incongruent: M=693.94, SD=131.15, $V(47)=5$, $p<0.01$) than with negatively valenced (Congruent: M=657.94, SD=113.61; Incongruent: M=717.13, SD=133.01, $V(47)=7.4$, $p<0.01$) targets. No further main or interaction effects were found in this analysis.

Table 1. *Mean (SD) Reaction Times for the Home Button (RT).*

	Congruent	Incongruent
Focused		
Positive	613.14	651.52
	(104.29)	(116.83)
Negative	622.10	674.88
	(101.82)	(110.88)
Divided		
Positive	691.02	736.37
	(121.71)	(131.52)
Negative	693.78	759.37
	(113.95)	(140.24)

Table 2. *Mean (SD) Movement Times (MT).*

	Congruent	Incongruent
Focused		
Positive	188.02	186.36
	(65.59)	(64.78)
Negative	170.32	200.66
	(51.02)	(82.04)
Divided		
Positive	204.55	208.67
	(60.70)	(67.30)
Negative	182.62	229.53
	(60.55)	(68.10)

Participants moved their arm faster (see Table 2) in focused attention conditions than in divided attention conditions, as was proved by a (Attention) x 2 (Instruction) x 2 (Target-valence) ANOVA, $F(1,47)=20.23$, $p<0.0001$. Participants also moved their arms faster with congruent (M=186.38, SD=60.50) than with incongruent (M=206.30, SD=72.04) instructions, $F(1,47)=10.61$, $p<0.01$. These main effects were, as expected, qualified by a two-way interaction, $F(1,47)=4.80$, $p<0.05$. The influence of instruction was larger in divided attention conditions (Congruent: $M=193.60$, $SD=61.30$; Incongruent: $M=219.10$, $SD=68.15$) than in focused attention conditions (Congruent: $M=179.17$, $SD=59.12$; Incongruent: $M=193.51$, $SD=73.88$). Post-hoc analysis (Tukey's HSD procedure) revealed that the difference between congruent and incongruent movements was significant for divided attention ($V(47)=4.99$, $p<0.01$) but not for focused attention ($V(47)=2.80$, n.s.). The effect of attention appeared, moreover, to be significant only for incongruent movements ($V(47)=5$, $p<0.01$) and not for congruent movements ($V(47)=2.82$, n.s). As in initiation time also a two-way interaction was found between instruction and affective valence, $F(1,47)=26.88$, $p<0.0001$. For positively valenced targets no difference was obtained for instruction conditions (Congruent: $M=196.29$, $SD=63.40$; Incongruent: $M=197.51$, $SD=66.65$; $V(47)=0.28$, n.s.), whereas for negatively valenced targets arm movement was faster ($V(47)=5.41$, $p<0.01$) with a congruent ($M=176.47$, $SD=56.04$) than with an incongruent ($M=215.10$, $SD=76.40$) instruction. No further main or interaction effects were found in this analysis.

Although we did not formulate explicitly hypotheses regarding working memory performance, proportion correct reproductions (i.e., working memory performance) of the letters and digits were analyzed by means of a 2 (movement congruency) x 2 (affective valence) ANOVA. More correct reproductions were given in congruent trials ($M=0.896$, $SD=0.109$) than in incongruent trials ($M=0.867$, $SD=0.134$), $F(1,47)=4.88$, $p<0.05$. No further main or interaction effects were found in this analysis.

Discussion

Affect-congruent responses were faster initiated in both attention conditions than affect-incongruent responses, especially in response to angry faces. This result is comparable to Chen and Bargh (1999), Solarz (1960) and the findings in Chapter 4. This effect was not clearly influenced by the manipulation of attention. In contrast, level of attention (i.e., divided versus focused) proved to be of influence on instruction (i.e., congruent versus incongruent) with movement time. Affect-congruent movements were performed faster than affect-incongruent movements with divided than with focused attention. This finding may indicate that attention is a prerequisite for the control and execution of affect incongruent movements. It should be noted, however, that the overall movement time with focused attention was less than with divided attention. In other words, when attention was diverted away the effect of affective information processing on movement time was relatively rather than absolutely stronger.

The obtained general pattern of results for movement time with the manipulation of attention is comparable to the stronger suboptimal than optimal affective priming effects in the Chapters 2 and 3, Fulcher and Hammerl (2001), Murphy and Zajonc (1993), Murphy, Monahan, & Zajonc, 1995, and Stapel, Koomen, and Ruys (2002). In these studies stronger affective priming was found with decreased consciousness of the affective primes. It is even more comparable to the findings in Chapter 3 in which the same experimental manipulation was used as in the present experiment. Stronger affective priming was found with divided attention than with focused attention. Participants were instructed to ignore the affectively valenced faces (as in Murphy & Zajonc, 1993) that preceded the Japanese ideographs that had to be rated as positively or negatively valenced while attention was manipulated (i.e., divided versus focused). Stronger congruent affective priming was obtained with divided than with focused attention. It is argued in Chapter 2 (see also Murphy & Zajonc, 1993) that stronger affective priming with decreased than with full consciousness could be characteristic for affective information processing. It seems, therefore, that the pattern of results obtained in this study underpins this argument further. Not only for preferences (Fulcher & Hammerl, 2001; Murphy & Zajonc, 1993; Murphy, Monahan, & Zajonc, 1995; Stapel, Koomen, & Ruys, 2002) and facial EMG (Chapter 2) this pattern of results is established, but also for the execution of affect specific movement.

The increased influence of instruction on movement time with divided attention could be due to relatively faster congruent movements and /or slower affect-incongruent movements. Because of the increased overall movement time with divided attention, however, it seems reasonable to assume that it is the latter. It was probably more difficult for participants to withdraw from their tendency to execute congruent movements with divided than with focused attention. This could be due to an increased influence of the emotional expressions with divided attention (see, for instance, De Fockert et al., 2001; Chapter 3) or to less capacity with divided attention to execute affect incongruent movements. With our results it is difficult to decide finally between both kinds of interpretations. The lower working memory performance with incongruent in contrast with congruent movements, however, suggests the latter. It seems, therefore, that full attention is needed to withdraw from affect-congruent movement tendencies and execute effectively affect incongruent movements.

It would be interesting to explore further the association between action tendencies and different motivational-behavioral systems. The Behavioral Inhibition System(BIS)/Behavioral Activation System (BAS) dichotomy, for instance, as proposed by Carver and White (1994), based on Gray's (1970, 1982) model of personality, would be an interesting candidate. It could be hypothesized that action tendencies as, for instance, measured with arm movement are organized within these systems. It is argued by Gray that the behavioural activation system responds to incentives-signals or reward and escape from punishment. The behavioural inhibition system responds, on the other hand, on threats-signals of punishment, non-reward, and novelty. Both systems are believed to have different neural substrates and, therefore, different influences on action. People differ in how sensitive they are to cues of reward and cues of threat. Carver and White (1994) developed a questionnaire that measures the relative BIS/BAS trait sensitivity. Asymmetry in anterior brain activity (Harmon-Jones & Allen, 1997; Sutton & Davidson, 1997) correlates, for instance, with this measure. If the BIS/BAS sensitivity is associated with action tendencies as measured with arm movement this should be reflected in specific correlations. BAS sensitive participants should show stronger effects of instructions with arm flexion, whereas BIS sensitive people should show stronger effects of instruction with arm extension. Such a finding would be intriguing because an explanation of action tendencies in terms of BIS/BAS trait sensitivity would integrate different empirical findings and could guide future research.

Instructed arm movement does not appear useful as a direct and implicit measure of affect. Implicit dependent measures of affect are of interest mainly because they can reflect affective states without accompanying consciousness. Arm movement as an affective response, however, remains possibly implicit in the sense that participants are not aware of the affective nature of their response. In this manner, arm movement may be useful to establish dissociations between conscious, but unreported, affective evaluations and reported affective judgments (e.g., preference judgments). This could be especially of interest in research where people do not want to respond overtly with their feelings (e.g., racial prejudice) but are, for instance, biased towards social desirable answers. An important advantage of such an application of action tendencies above, for instance, the Implicit Association Test (Greenwald, McGhee, & Schwartz, 1998) would be the inherent affective meaning of specific movements (i.e., flexion and extension). In the IAT, in contrast, the affective meaning is mapped on specified responses. Perhaps that is the reason the IAT reflects environmental associations as is proposed, for instance, by Karpinski and Hilton (2001, see also: Brendl, Markman, & Messner, 2001). They argue that the IAT reflects probably little of a participants (implicit) attitude but rather the affective connotation of the subject of investigation in his or her environment. Although, it is uncertain why there is a relation between the direction of arm movement and affective evaluation it evidently exists and reflects reliably a subjective affective evaluation. Instructed arm movement could, therefore, probably be useful for the measurement of unreported though experienced affective states (i.e., indirect measurement of attitudes).

In sum, we have obtained evidence for stronger influences of action tendencies with divided than with focused attention with movement time. This finding underlines the theoretical position proposed in Murphy and Zajonc (1993, see also Bargh et al., 1996 and Chen & Bargh, 1999) that experimental effects of affect increase in magnitude with decreased consciousness. We have also proposed guidelines for future research and application of instructed arm movement as a probable measure of implicit affect.