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COGNITIVE DISSONANCE AND AFFECT AN INITIAL TEST OF A CONNECTIONIST ACCOUNT

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In their connectionist model of cognitive dissonance, Van Overwalle & Jordens (2002) put forward the hypothesis that positive affect increases behaviour-induced attitudes, while negative affect decreases attitudes. In this article, this hypothesised role of affect was tested for two well-known paradigms in the cognitive dissonance literature: free choice and induced compliance. For the free-choice paradigm, we replicated the findings in the difficult-high choice condition of Shultz, Léveillé and Lepper (1999) and additionally induced negative mood. As predicted, negative mood resulted in a more negative attitude compared to no mood induction. For the induced compliance paradigm, we replicated the Linder, Cooper & Jones (1967) dissonance and reinforcement findings and additionally induced opposite mood in the no-choice (reinforcement) conditions. Specifically, we induced positive mood in the low reward condition and negative mood in the high reward condition. Again as predicted, positive mood increased the attitude and negative mood decreased the attitude, resulting in an elimination of the reinforcement effect.

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Festinger (1957) defined cognitive dissonance as an aversive state produced by inconsistent cognitions that people have about oneself, others or the environment. The tension or arousal produced by this cognitive discrepancy motivates people to reduce dissonance through behavioural change or cognitive restructuring such as attitude change. Several revisions and advancements of cognitive dissonance theory proposed during the last decades emphasised different affective aspects of this dissonant arousal state (for an overview, see Harmon-Jones & Mills, 1999). One of these theoretical revisions, inspired by the self-perception theory of Bem (1967), was the attributional account proposed by Cooper and Fazio (1984). They suggested that the causal interpretation of the discrepant behaviour motivates dissonance reduction. If a person makes an internal attribution for the aversive consequences of the behaviour, then dissonance arousal will motivate attitude change.

Conversely, if the behaviour is attributed to situational factors, no dissonance is experienced and as a consequence, no attitude change is observed.

Although there is some evidence that undifferentiated arousal plays a role in cognitive dissonance (e.g., Cooper, Zanna & Taves, 1978; Croyle & Cooper, 1983; Elkin & Leippe, 1986; Pittman, 1975; Zanna & Cooper, 1974), more recent research stressed the mediating role of negative affect in dissonance reduction (e.g., Elliot & Devine, 1994; Harmon-Jones, 2000, 2001; Losch & Cacioppo, 1990; see also Higgins, Rhodewalt & Zanna, 1979; Zanna, Higgins & Taves, 1976). For example, Elliot and Devine (1994) and Harmon-Jones (2000) found that participants reported more psychological discomfort (i.e., felt uncomfortable, uneasy, bothered) and general negative affect after they had just committed themselves to engage in discrepant behaviour, such as writing a counterattitudinal essay, and that affect returned to baseline-levels after changing their attitudes.

Most recently, Van Overwalle and Jordens (2002) proposed an adaptive connectionist model of dissonance that implemented a great deal of Cooper and Fazio's (1984) attributional perspective, but provided a more independent role for negative affective experiences. This connectionist model presents a major improvement over an earlier connectionist constraint-satisfaction model (Shultz & Lepper, 1996) that did not allow for learning and permanent attitude changes. Moreover, Van Overwalle and Jordens' (2002) connectionist model makes some testable novel predictions concerning the role of affect that are unique to the model. Testing some of these affect predictions is the goal of the present research.

In this article we will explore one of the most well-known dissonance paradigms —induced compliance. In this paradigm, participants are induced to act in a way that is contrary to their initial attitude and are given sufficient or insufficient external justification for doing so (e.g., high or low monetary reward). For example, in the first induced-compliance experiment conducted by Festinger and Carlsmith (1959), participants were given $20 or $1 to convince an allegedly peer student (actually a confederate) that the boring tasks in the experiment were enjoyable. According to cognitive dissonance theory (Festinger, 1957), people would experience more dissonance arousal in the $1-conditition than in the $20-condition since the low reward insufficiently justifies the discrepant behaviour. Consequently, they would attempt to reduce this dissonance arousal by changing their attitudes in the direction of the lie. As predicted, participants in the $1-conditition had more favorable attitudes toward the boring tasks compared to participants in the $20-condition. Thus, the original dissonance theory predicts a *negative* relationship between the amount of reward and the amount of attitude change.

A totally opposite perspective was taken by reinforcement theory, which assumed that the higher the reward people receive for their discrepant behav-

iour, the more they change their attitudes in line with that behaviour. Thus, reinforcement theory predicts a *positive* relationship between the level of reward and the amount of attitude change (e.g., Janis & Gilmore, 1965). However, under certain conditions, both reinforcement and dissonance effects can be obtained (Calder, Ross, & Insko, 1973; Linder, Cooper, & Jones, 1967). For instance, in the classical study by Linder, Cooper, and Jones (1967), dissonance was induced by asking participants to write a forceful counterattitudinal essay in return for a low or high monetary reward. More crucially, some participants were free to choose to comply with this request while others were given no choice. In the high-choice conditions, the classic dissonance effect was obtained, that is, participants changed their attitudes more in the low-reward condition compared to the high-reward condition. However, in the no-choice conditions, the reinforcement effect was observed. Participants favored the advocated position more in the high-reward condition than in the low-reward condition.

While the occurrence of the dissonance effect under high choice is accounted for by several cognitive dissonance theories, and the occurrence of the reinforcement effect under low choice by reinforcement theory, each of these theoretical approaches stands in isolation and little attempts have been made to reconcile them. An important advancement of the connectionist model by Van Overwalle and Jordens (2002) is its integration of the dissonance and reinforcement effects by assuming a more crucial role of affect in producing the reinforcement effect. Before describing this integration in more detail, we will first present the basic features of the connectionist model and then discuss the connectionist implementation of the concept of cognitive dissonance.

A Connectionist Approach

Inspired by the increasing success of connectionism in cognitive psychology, connectionism has gradually pervaded social psychology during the last decade. Connectionist models offer a new perspective on diverse social psychological phenomena, including causal attribution (Van Overwalle, 1998; Read & Montoya, 1999), person impression (Smith & DeCoster, 1998; Van Overwalle & Labiouse, 2003), group impression and biases (Kashima, Woolcock, & Kashima, 2000; Van Rooy, Van Overwalle, Vanhoomissen, Labiouse, & French, 2003), attitude formation and change (Van Overwalle & Siebler, 2005) and many other social judgments (for a review, see Read & Miller, 1998). A key difference with earlier models is that the connectionist architecture and processing mechanisms are modeled after the neurological properties of the brain. Concepts are represented by (a set of) nodes (representing neurons) linked to each other by connections (representing synaps-

es), which are adjusted as new information is provided by the environment. This allows a view of the mind as an adaptive learning mechanism that develops an accurate mental representation of the world.

The connectionist framework also proposes a novel view on encoding, storage and retrieval of information in the brain. Long-term memory is represented in the model by encoding the stored knowledge in the connection weights, while short-term memory is represented by patterns of activation of nodes in the network. A particular advantage of adaptive connectionist models is that they are dynamic, that is, they allow not only activation to spread in the network, but they also adjust the weight of the connections after novel information is processed. Because these weight adjustments occur at a low cognitive level without the need for a supervisory control system, learning and changing social knowledge occurs largely outside awareness, and only the output of this process is communicated to consciousness.

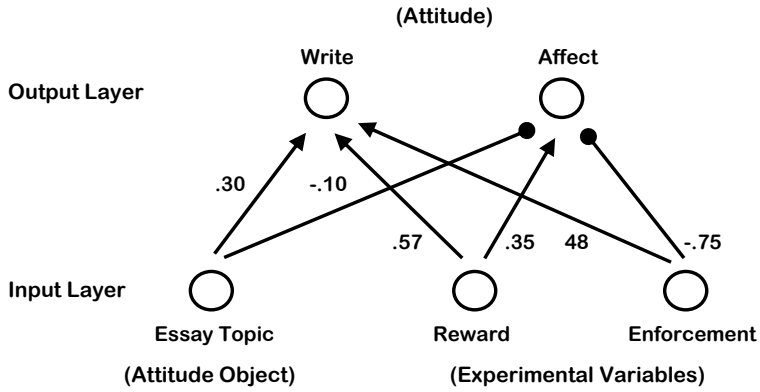
A Connectionist Model of Cognitive Dissonance

The model of cognitive dissonance developed by Van Overwalle and Jordens (2002) adopts not only the three-component view on attitudes as consisting of beliefs, evaluations and behavioural tendencies (Katz & Stotland, 1959; Rosenberg & Hovland, 1960), it also incorporates earlier attributional accounts of cognitive dissonance (Cooper & Fazio, 1984). It concurs with Cooper and Fazio's (1984) attributional model that people's attempts causally to understand and justify their dissonant behaviour and emotions are at the root of the creation and reduction of dissonance arousal. However, the model departs from Cooper and Fazio (1984) in several important respects. Van Overwalle and Jordens (2002) view the attributions to the attitude object as central instead as of attributions of one's responsibility; they emphasise the role of affect during dissonance and neglect undifferentiated arousal; and they focus on unexpected outcomes rather than unwanted outcomes.

Attitudes

Van Overwalle and Jordens (2002) employed a feedforward network in which a layer of input nodes is connected to a layer of output nodes via adjustable connections (Figure 1; see also McClelland & Rumelhart, 1988; Van Overwalle, 1998). The input nodes represent the causal factors available in the situation, such as the attitude object (e.g., the essay topic) and situational pressures (e.g., enforcement, reward) imposed by the experimenter. The output nodes represent the behavioural and affective outcomes or responses. The attributional underpinning of cognitive dissonance is implemented in the model as the forward spreading of activation from the input to

Figure 1.
A feedforward connectionist implementation of an induced-compliance experiment (Linder, Cooper & Jones, 1967).
Positive connections are indicated with an arrow and negative connections with a circled endpoint; these connections result from prior learning before the experimental manipulation of cognitive dissonance (taken from Van Overwalle & Jordens, 2002, Table 3.3). Writing = writing a counter-attitudinal essay. The topic→writing and topic→affect connections constitute the attitude, and their weights determine the attitude strength.



#Trials	Variables present	Topic	Reward	Force	Write	Affect
	Pre-experimental history					
20	counter-attitudinal topic (T)	1	0	0	0	0
10	T + low payment (20% €)	1	.2	0	1	0
10	T + high payment (€)	1	1	0	1	0
10	T + forced (F)	1	0	1	1	-1
5	T + 20% € + F	1	.2	1	1	-1
5	T + € + F	1	1	1	1	0
	Experimental conditions					
	Choice					
1	Low Payment: T + 20% €	1	.2	0	1	0
1	High Payment: T + €	1	1	0	1	0
	No choice					
1	Low Payment: T + 20% € + F	1	.2	1	1	-1
1	High Payment: T + € + F	1	1	1	1	0

Table reflecting a simplified simulation history of the relationships between input and output variables during prior learning (top panel) and during each of the experimental conditions (bottom panel); Cell entries are the activation of the nodes. #Trials = number of trials (taken from Overwalle & Jordens, 2002, Table 2.3).

the output nodes (hence, the name *feedforward*), so that the input causes or produces the behavioural and affective responses.

Generally, an attitude is revealed in approach or avoidance behaviour towards the attitude object and in experiences of positive or negative affect with respect to the attitude object. This is implemented in the model through the connections that link the attitude object with the behavioural and affective responses, that is, the topic→writing and topic→affect connections. If these connections are positive on average, this indicates a positive attitude. Conversely, if these connections are negative on average, this indicates a negative attitude. To illustrate, in Experiment 1, participants' attitude towards an attractive poster was demonstrated in part by an (evaluative) liking scale as well as by their (behavioural) choice to take the poster home. Similarly, in Experiment 2, the attitude towards the essay was influenced in part by participants' (behavioural) willingness to write the essay as well as by their (evaluative) rating of the topic. Having the topic→affect and topic→writing as separate attitude components fits the common observation that changes in the evaluative component of an attitude do not necessarily lead to behavioural change.

Attitude Change

As noted earlier, the weights of the connections in the network are adaptive, shaped by learning experiences. This is implemented in the model on the basis of an error-driven learning algorithm, called the *delta algorithm,* which has been applied in many connectionist models in social cognition (e.g., Read & Montoya, 1999; Smith & DeCoster, 1998; Van Overwalle, 1998; Van Rooy et al., 2003). Figure 1 illustrates the status of the network after a simulation phase mimicking prior social learning, using a simplified learning history (top panel of the simulation table, for full details see also Van Overwalle & Jordens, 2002). Briefly put, the network learns that although people would not write a counterattitudinal topic without extraneous inducement, with additional situational pressures such as force and reward, they are often quite willing to do so.

In particular, in the simulation reported by Van Overwalle and Jordens (2002), there were 20 trials in which the counter-attitudinal topic was *not* paired with writing it. The presence of an input or output variable is simulated by activating the corresponding node (activation = 1.0), and the absence of a variable is simulated by leaving the corresponding unit inactive (activation = 0.0). Thus, the "topic" input node was active 20 times while the "writing" output node was not, and as we will explain shortly, this leads to weaker topic→writing connections. However, the additional presence of some external pressure (force or payment) was simulated 40 times overall, followed by effectively writing the essay. Hence, the input and output nodes

were both activated, and this leads to stronger topic→writing connections. By having more trials overall in which the essay topic was written, these simulations lead to a positive topic→writing connection. Importantly, when writing was enforced and payment was absent or low, this was followed by negative affect (see next section). Consequently, the topic→affect connection is slightly negative. The direction and weight of the other connections result from the same simulation history and delta learning algorithm.

We have just seen that connections grow stronger when the input and output nodes are both activated, and negative when only the input is activated. How exactly does the delta algorithm adjust these weights? The general principle is that the delta algorithm attempts to bring the internal predictions of the system as closely as possible in line with the information it receives from the outside environment, by reducing any errors between the internal prediction and outside information. Based on the existing connections (which are typically zero to begin with), new incoming information leads to the activation of the causal nodes at the input layer, which is then automatically spread to the outcome nodes at the output layer in proportion to the connection weights. When the activation of an outcome node at the output layer is underestimated, the delta error is positive and the learning algorithm increases the weights of the connections involved to adjust for that error. In contrast, when an outcome is overestimated, the delta error is negative, and the weights of the connections are decreased. Thus, when an input node is active and the output node is not, given a positive connection between the nodes, this leads to an overestimation of the (zero) activation of the output node, and the weights are decreased. When the activation of the output node is negative (as in the case of negative affect), the weights are further decreased. In contrast, when both the input and output nodes are active, this leads to an underestimation of the (full) activation of the output node, and the weights are increased.

Dissonance

The concept of cognitive dissonance in the connectionist model is represented as the error between the predicted outcome based on the internally generated activation (driven by the activation received from the attitude object and contextual variables at the input layer) and the actual responses (observed behaviour and affect at the output layer). This conceptualisation of cognitive dissonance is in line with Festinger's (1957) view that cognition maps reality and that dissonance can arise when people receive information that disconfirms their cognitions or expectations (Festinger, Riecken & Schachter, 1956). As Festinger (1957) stated: "*the reality which impinges on a person will exert pressures in the direction of bringing the appropriate cognitive elements into correspondence with that reality*" (p. 11, original italics).

It is this error or discrepancy that the delta algorithm attempts to minimise during a dissonance experiment. Underestimation of the willingness to write the essay as requested by the experimenter results in a positive error and increase of the connections. As can be seen in Figure 1 (Choice conditions in the simulation table), if little situational constraints are present such a low payment, the only connection that can increase substantially is the topic_writing connection, which leads to (behavioural) attitude change. Conversely, if substantial situational inducements are present such as high payment, their activation sufficiently predicts the discrepant behaviour and little error is left, leading to little weight change. This mechanism is responsible for the typical dissonance effects given high choice. It hypothesises that attitude change under these conditions is brought about mainly by changing the behavioural disposition to engage in discrepant behaviour. Van Overwalle and Jordens (2002) describe the connectionist simulation of induced compliance (Figure 1) with full details on how the simulation was conducted, and also provide connectionist simulations on other well-known dissonance paradigms, including prohibition (Freedman, 1965), initiation (Gerard & Mathewson, 1966) and free choice (Schultz et al., 1999).

Affect and Attitude Change

However, a different mechanism is responsible for the effects of reinforcement under conditions of no choice. As noted earlier, several studies (e.g., Linder, Cooper & Jones, 1967) demonstrated that given little choice, attitude change is large given high as opposed to little reward. To explain this revered effect within the connectionist network, recall that an attitude is determined by both the behavioural and affective responses at the output layer, that is, by an average of the topic→writing and topic→affect connections. The novel hypothesis put forward by Van Overwalle and Jordens (2002) is that reinforcement given no choice is driven by substantial changes in affect rather than behaviour. They reasoned that the combination of two experimental constrains like lack of choice and low reward would result in increasingly negative affect. This negative affect is implemented in the network by a negative activation (= -1) of the affect node, and this negative activation neutralises the positive activation representing the execution of the discrepant behaviour (see No Choice – Low Payment condition in the simulation table of Figure 1). Thus, the negative activation reflecting negative affect and the positive activation reflecting the discrepant behaviour cancel each other out. This leaves little error in the system, and hence results in minimal adjustments in the topic→output connections and little attitude change in conditions of low reward. Thus, the attitude is changed little because the negative affect undercuts the discrepant behavioural tendencies. Phenomeno-

logically, people may experience the situation of double experimental constraints as so uncomfortable that this provides a sort of an excuse (e.g., "I feel so bad that I do not deserve further blame"), leaving little discrepancy and attitude change. In contrast, when a high reward is given, the activation of the affect node remains positive and – like in the previous section – the behavioural topic→writing connection undergoes an increase to minimise the delta error. Taken together, these two mechanisms create less attitude change given low reward in comparison with high reward, mimicking the reinforcement effect (for a more detailed discussion of the simulation, see Van Overwalle & Jordens, 2002).

Predictions

To summarise, the inclusion of affective responses in the connectionist model generates novel predictions on the role of affect in dissonance reduction. Van Overwalle and Jordens (2002) predicted that positive affect will increase dissonance reduction and attitude change, whereas negative affect will decrease dissonance reduction and attitude change. Although this affect hypothesis may seem at odds with ample evidence showing that cognitive dissonance is associated with negative affect, it is not. Prior dissonance studies explored how dissonance influences affective experiences, such as the build-up of negative affect before dissonance resolution and the return to base-line levels after dissonance reduction (Elliot & Devine, 1994; Harmon-Jones, 2000, 2001; Losch & Cacioppo, 1990). In contrast, in the present investigation, we explore the reverse causal direction, that is, how induced affect may influence dissonance reduction. This is similar to research dealing with the impact of induced mood on social judgments, and which is driven by theoretical approaches such as affect priming (Bower, 1981; Isen, 1984) and affect-as-information (Schwarz & Clore, 1983; Schwarz, 1990). Our predictions are largely consistent with the predictions and findings of these models. A substantial amount of evidence has shown that induced positive mood results in more positive judgments compared to a neutral mood state, while induced negative mood produces more negative judgments (for an overview, see Forgas, 2001). In a sense, the connectionist affect hypothesis is an extension of these mood-congruent findings in the domain of cognitive dissonance, in that positive mood is expected to result in more positive judgments of the attitude object while negative mood is expected to result in more negative judgments.

We tested the affect hypothesis of Van Overwalle and Jordens (2002) in two dissonance paradigms, free-choice and induced compliance. In the first experiment, we investigated the effect of induced mood in the free-choice

paradigm (Brehm, 1956; Shultz et al., 1999). Because we were also interested in the effects of mood under low choice, and in order to test our affect hypothesis in another paradigm, we also explored the effect of mood in the no-choice conditions of the induced-compliance paradigm (Linder et al., 1967). In both studies, in addition to attitude change, we also measured several specific affects in order to explore how they were associated with greater dissonance and attitude change.

Experiment 1: Free-Choice Paradigm

To obtain evidence for the role of affect in cognitive dissonance under conditions of high choice, we first turn to the free-choice paradigm. In this paradigm, participants are invited to choose freely between different objects that differ in attractiveness. According to cognitive dissonance theory (Festinger, 1957), people experience dissonance arousal following a choice because they are confronted with the negative aspects of the chosen alternative and with the positive aspects of the rejected alternative. This arousal can be reduced by increasing the attractiveness of the chosen alternative and by decreasing the attractiveness of the rejected alternative. This results in an increased difference between the evaluation of the chosen and rejected alternative, denoted as *spread of alternatives*.

Brehm (1956) conducted the first free-choice study to demonstrate this post-decisional spreading of alternatives. Participants had to rate the desirability of eight articles (e.g., desk lamp, a radio, a coffeemaker) and were then offered a choice between the exposed articles as payment for their participation. Dissonance was manipulated by offering participants a difficult choice (i.e., a choice between two objects that were about equally high in desirability) or an easy choice (i.e., a choice between two objects that were not close in desirability). After the choice, participants liked the chosen alternative more and the rejected alternative less than before the choice. Moreover, the spread of alternatives was greater in the difficult-choice condition than in the easy-choice condition, consistent with the assumption of cognitive dissonance theory that more dissonance arousal is experienced given a difficult choice. These findings were replicated and extended in a recent study by Shultz et al. (1999).

In their connectionist model, Van Overwalle and Jordens (2002) explained these findings by increased positive affect following choice and increased negative affect following rejection. They hypothesised that under a difficult-choice condition, the chosen object would generate positive affect while the rejected object would generate a neutral affective state (see Van Overwalle & Jordens, 2002, Table 2.5). If this hypothesis is correct, mood manipulations

should also influence dissonance reduction in this paradigm (Brehm, 1956; Shultz et al., 1999). Specifically, a positive mood should result in a more positive attitude and a negative mood should result in a more negative attitude. Thus, there should be a main effect of mood. Because the simulations of Van Overwalle and Jordens (2002, Table 2.5) suggest that mood is relatively positive in most conditions (after all, participants had the chance to get a poster for free), we suspected that there was less variability available for positive mood induction as it might quickly result in ceiling effects. Therefore, we induced only negative mood.

Our prediction was that, compared to no mood induction, inducing negative mood would lead to a negative main effect reducing the favorability of both the chosen and the rejected alternatives. These predictions of decreased attitude change are counter to what prior models would predict. They would predict that a negative mood induction would increase dissonance-related distress and so produce even more attitude change. Given that a difficult choice typically shows the greatest dissonance and spread of alternative (Brehm, 1956), we explored our hypothesis under this condition.

Method

Participants

A total of 56 introductory psychology students (50 female and 6 male) at the Vrije Universiteit Brussel participated in the study. They received extra credit for their participation. One half of the participants was randomly assigned to Shultz et al.'s (1999) difficult/high-choice condition without mood induction, while the other half were assigned to the same difficult/high-choice condition with negative mood. Two participants in the mood condition was offered a wrong choice between two posters by the experimenter and were therefore replaced by two novel participants. In addition, one subject mistakenly took one of the offered posters for the other and was omitted, resulting in a total of 53 participants. There were 27 participants (23 female and 4 male) in the no-mood condition and 26 participants (24 female and 2 male) in the mood condition.

Procedure

The procedure was closely modeled after the recent free-choice study by Shultz at al. (1999). The experiment was presented as a study of how people choose between alternatives. The experiment was run in individual sessions.

Initial Evaluation. The objects of choice were eight posters: four paintings (of a sunflower field, a view of St. Tropez, "Fragment 2" by Kandinsky, a detail from Michelangelo's "The creation of Adam" of the Sistine chapel) and four photographs (of a canoeist, an oasis, city skyline, and a romantic

view of a lighthouse). Each poster was displayed on a board and the order of presentation was randomised for each session. The experimenter asked the participants first if they already owned any of the posters. If so, the poster was replaced by another. The participants then rated the likeability of each poster on a 14-point scale (1 = *strongly dislike* and 14 = *strongly like*).

Choice of Posters. The posters were evaluated a second time in order to select two posters that were close to one another in their initial evaluation. Participants were asked to rank the posters according to their preference by assigning a number between –7 and +7 to each poster, with the highest number representing the most preferred poster. The two posters with the highest rankings on this ranking scale, with exception of those posters with a ranking of +6 or above to avoid ceiling effects in the final evaluation (see below), were selected and offered to the participant by the experimenter. The experimenter explained that the posters were a gift of a shop and that the participants were allowed to take home one of the two posters that were offered. They were told that their choices were irreversible.

Mood Induction. After participants made their choice, negative mood was induced by giving negative bogus feedback about an earlier ostensibly unrelated performance test conducted before the main dissonance experiment. Several pilot studies had indicated that this mood manipulation was the most effective in our student population in comparison with other standard mood procedures (e.g., emotion-eliciting movies, remembering positive versus negative life events, etc.). Participants in the condition without mood did not participate at this earlier performance test.

During the performance test, upon arrival at the lab, participants were told that data were collected for a colleague who was busy conducting other experiments. The experimenter explained that the purpose of the task was to detect logical relationships between the elements of a figure. The task consisted of 12 problems with an increasing degree of difficulty and the correct solution had to be selected from the presented alternatives. An example was provided to be sure that the participants understood the instructions. There was no time limit. Participants then completed 12 items of the 'Standard Progressive Matrices' test of intelligence (Raven, 1958; in the positive-mood condition, 12 items of set D were administered, while in the negative-mood condition items D5-D12 and E6-E9 were administered). Items of varying difficulty were given to increase the credibility of the feedback manipulation.

During the main dissonance experiment, negative mood was manipulated by providing feedback on this earlier performance task after participants made their choices of the posters. The feedback was given after rather than before their choices, in order to ensure that the mood manipulation (a) would not be contaminated by any mood effects of the experimental choice task and (b) would persist long enough till the final attitude rating. The negative per-

formance feedback was given as follows:

> The task you performed is an intelligence test and is a good predictor for academic success. I corrected your answers and you have a test score of 4/12, which is a very low score. Actually, this is the lowest score we had in the experiment till now. I am surprised since in my opinion the test was straightforward. I wonder if you have been working seriously on it?

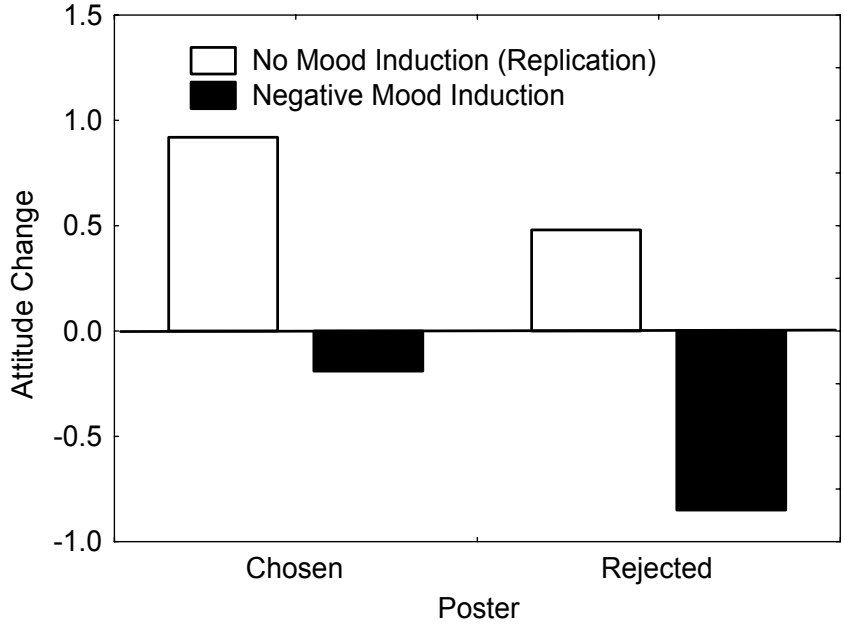
Dependent measures

Affect Measures. Affect was measured using emotion items from the Discomfort scale developed by Elliot and Devine (1994) and several attribution-related emotion items (e.g., guilt, gratefulness, pride) developed by Van Overwalle, Mervielde and De Schuyter (1995). Participants were asked to indicate on a 7-point scale the extent to which each emotion best characterised their current affective experience (1 = *not at all*; 7 = *very much*). We composed several affect indices from these items. General affect indices included Positive Affect (*happy*, *glad*, *pleasant*; Cronbach's alpha = .86); Negative Affect (*irritated*, *dissatisfied*, *angry*, *disappointed*, *frustrated*; alpha = .89); and Discomfort (*uneasy*, *uncomfortable*, *unpleasant*, *bothered* and *worried*; alpha = .83). Specific affect indices included negative emotions of Hopelessness (*hopeless* and *desperate*; alpha = .68), Shame (*ashamed* and *inferior*; alpha = .69) and Guilt (*guilt*, *regret*, and *self-blame*; alpha = .92); and positive emotions of Gratitude (*grateful*, *appreciative* and *trustworthy*; alpha = .43), Pride (*proud* and '*fier*', a Dutch synonym for pride; alpha = .36), and Hope (*optimistic*, *eager* and *determined*; alpha = .65). The positive emotions were included for similarity with Experiment 2 and their lower reliability are of little concern, as we are mainly interested in negative affect here.

Final Evaluation. The participants evaluated all posters again on the same 14-point likeability scale as the initial evaluation. In order to minimise demand effects of consistency in the response patterns, the experimenter explained that since participants were now more familiar with the posters, it was possible that their evaluations might have changed. In addition, the order of the presentation of the posters was different from the first evaluation, as well as the layout of the questionnaire.

A few weeks after the experiment was over, participants received a written debriefing, according to the procedure of Mills (1976).

Figure 2.
Attitude change as function of mood induction in the difficult/high choice condition of the free-choice experiment (Experiment 1).



Results

Attitude Change

Change scores were computed separately for the chosen and rejected poster as the difference between the final evaluation and the initial evaluation. The scores were analysed with an ANOVA with Mood (negative mood versus no mood) as a between-subjects factor and Poster (chosen versus rejected) as a within-subjects factor. As predicted, the analysis showed a main effect of Mood, $F(1, 51) = 9.41$, $p < .01$. As can be seen in Figure 2, the chosen and rejected posters were both liked less in the negative mood condition ($M = -0.52$) compared to the no-mood condition ($M = 0.70$). Neither the effect of Poster nor of its interaction with Mood were significant, Fs$(1, 51) < 2.13$. The lack of a significant main effect for Poster was confirmed by contrast analyses indicating that, in the two mood conditions, the change score of the chosen poster did not differ significantly from the change score of the rejected poster. Although inconsistent with our expectations, there is an alternative way to analyse whether or not change took place, consistent with Brehm's original (1956) analysis. In this analysis, one verifies

whether the means for the chosen and rejected posters differ significantly from the theoretical mean of 0, which represents no change in evaluation (Brehm, 1956; Shultz et al., 1999).

We first verified whether the no-mood condition replicated the predicted attitude change. The change score for the chosen poster (M = 0.92) differed significantly from no change, $t(26) = 3.11$, $p < .01$ (one-tailed), indicating that the chosen poster was liked more after choice than before. The change scores for the rejected poster (M = 0.48) were not significantly different from zero. Although Shultz et al. (1999) reported a decreased attractiveness of the rejected alternative, increased liking for the chosen poster in this experiment is an alternative way of reducing dissonance (see also Brehm, 1956).

We then tested the effect of negative mood. After negative mood was induced, the positive attitude change for the chosen poster in the no-mood condition was now eliminated (M = -0.19), $t(25) = 0.53$, *ns*. On the other hand, the negligible change for the rejected poster in the no-mood condition, now turned negative (M = -0.85) and significantly differed from zero, $t(25) = 1.73$, $p < .05$ (one-tailed). Taken together, the poster was liked more in the no-mood condition but not after negative mood, whereas the rejected poster was liked less after negative mood but not when no mood was induced. This pattern of attitude change is consistent with our prediction.

Reported Affect

We again compared the mood with the no mood condition. As expected, after negative mood induction, participants reported higher levels of Negative Affect (M = 3.28) compared to no mood induction (M = 1.41), $t(51) = 7.28$, $p < .0001$, more Discomfort (M = 3.38 vs. 1.81), $t(51) = 6.29$, $p < .0001$, and less Positive Affect (M = 3.84 vs. 4.57), $t(50) = 2.97$, $p < .01$. With respect to specific emotions, after negative mood induction, participants experienced more Guilt (M = 2.43) compared to no mood induction (M = 1.55), more Shame (M = 2.88 vs. 1.35), more Hopelessness (M = 2.46 vs. 1.48), and less Hope (M = 3.82 vs. 4.32), all ts(51) = 2.03-4.69, ps < .05. Taken together, these results indicate that experiences of negative affectivity generally increased after negative mood induction.

Discussion

The results of this free-choice experiment lend support for the hypothesis that affect influences dissonance reduction and attitude change. As predicted, the chosen and rejected posters were rated more unfavorably after negative mood induction. Specifically, when no mood was induced, the chosen poster was rated more favorably after choice while the attractiveness of the rejected poster did not change reliably. In contrast, when negative mood was

induced, the chosen poster was no longer rated more favorably after choice, while the rejected poster was rated reliably less favorably.

However, there are many alternative explanations for our results. For one thing, the results are consistent with an attributional explanation of cognitive dissonance. Given that the negative mood experienced by the participants was blatantly due to the performance feedback on the previous task, this should facilitate misattributing the source of their dissonance arousal to that task, and hence lead to less attitude change in favor of the posters (Zanna & Cooper, 1974). It is also possible that the induction of negative mood may have changed the overall level of the evaluation, consistent with affect priming (Bower, 1981; Isen, 1984) and affect-as-information theories (Schwarz & Clore, 1983; Schwarz, 1990). As noted earlier, a vast amount of evidence has shown that the induction of negative mood produces more negative judgments (for an overview, see Forgas, 2001). To provide more direct and unique evidence for the connectionist approach to cognitive dissonance, we now turn to another experiment where mood is hypothesised to have more specific effects.

Experiment 2: Induced Compliance Paradigm

The previous experiment provided supportive evidence for our hypothesis under conditions of high choice. The aim of the present experiment is to test the affect hypothesis under conditions of low choice in a replication and extension of the classical study by Linder et al. (1967). This study is of particular interest because it allows the connectionist model of Van Overwalle and Jordens (2002) to unify the opposing effects of dissonance and reinforcement in a single theory. Recall that in the Linder et al. experiment, participants wrote a forceful counterattitudinal essay under conditions of choice or no choice, and low or high reward. The results revealed the classical dissonance effect in the choice conditions, that is, participants changed their attitudes more in the low-reward condition compared to the high-reward condition, whereas the reinforcement effect was observed in the no-choice conditions, resulting in an interaction between reward and choice.

Our main goal was to put the affect hypothesis to test in the no-choice conditions by attempting to eliminate the reinforcement effect. The reason why we focus on the reinforcement effect is that, under conditions of high choice, dissonance reduction is assumed to be determined mainly by external justifications of choice, not by affect. In contrast, under conditions of no choice, affect is assumed to play a crucial role in the reinforcement effect. As noted earlier, Van Overwalle and Jordens (2002, Table 2.3) suggested that the reinforcement effect depends on opposite affects. Under low reward, the situa-

tion is assumed to be particularly unpleasant (because there are two aversive constraints rather than one – lack of choice and low reward), and this negative effect is assumed to lead to less attitude change in comparison with the high reward condition.

To test this affective explanation of the reinforcement effect, we replicated the Linder et al. (1967) paradigm and added two novel mood conditions to the no-choice conditions. This resulted in low and high-reward conditions under manipulations of high-choice, no-choice and no-choice with mood, or six conditions overall. Comparison of the choice and no-choice conditions will allow us to test simply whether the interaction between dissonance and reinforcement reported by Linder et al. (1967) works. Of more importance is the comparison between no-mood and mood induction under conditions of no-choice. Recall that in the connectionist model, mood determines attitudes in the same direction. Hence, we induced positive mood in the low-reward condition (which would be experienced as very unpleasant) in order to increase attitude change, and we induced negative mood in the high-reward condition (which would be experienced as more pleasant) to decrease attitude change.

Our hypothesis is that by inducing mood states opposite to the experienced affect as assumed by Van Overwalle and Jordens (2002), we will counteract the affective feelings normally experienced during cognitive dissonance and so eliminate the reinforcement effect. These predictions are counter to what prior models predict. They would predict that positive mood would alleviate dissonance-related distress and so decrease attitude change, while negative mood would exacerbate distress and increase attitude change. Thus, earlier models would predict a strengthening of the reinforcement effect rather than an elimination.

Method

Participants

A few weeks before the beginning of the experiment, two hundred first-year psychology students at the Vrije Universiteit Brussel, completed an opinion questionnaire about societal and academic issues as part of a course requirement. They indicated on a 15-point scale (1 = *strongly disagree* to 15 = *strongly agree*) their attitude to the issue 'The university credit system should be abolished', embedded in the survey. Ninety-one participants (72 females and 19 males) who were strongly opposed to the abolishing of university credit system (circled 1 on the scale) were selected for participation in the study. They were randomly assigned to the conditions (15 or 16 participants per condition). Six of the original participants in the high-choice conditions were replaced because they refused to write the counterat-

titudinal essay. This exclusion is a requirement for this paradigm, because participants who do not comply are not expected to experience any cognitive dissonance.

Procedure

In a variation of the procedure by Linder et al. (1967), the expectation of a reward was manipulated by announcing one week before the experiment that participation in the study would be rewarded with €2.50 (all payments were in Belgian francs, but are converted here for convenience). The actual reward, however, was lower or higher than expected. This manipulation of expectation was necessitated because several pilot studies indicated that without it, any level of reward was typically received with pleasure in our student population, washing out dissonance in all conditions. This was presumably due to cultural differences because in Belgium, university education is strongly subsidised and almost free (the enrolment fees are typically less than 10% of what is required in the U.S.). The amount of the actual reward given in the low- and high-reward conditions was determined by pretesting.

The remainder of the procedure was closely modeled after Linder et al. (1967). Cognitive dissonance was induced by giving participants a low or high choice for writing the counterattitudinal essay on abolishing the current examination credit system. Participants received the following instructions:

> The purpose of this study is to investigate students' opinions on several academic and social topics. The psychology department conducts the study in collaboration with a commercial research bureau. More specifically, they are interested in the opinions of students concerning the topic of the abolishing the university credit system. We want to collect as many arguments as possible pro or contra the issue of abolishing the current university credit system. Past research has shown that one of the best ways to get arguments on both sides of the issue is to ask people to write an essay favoring only one side of the issue. Since enough arguments against abolishing of credit system are already sampled, we now need arguments in favor of abolishing the university credit system. Thus, we ask you to write a forceful essay in support of abolishing the university credit system. Afterwards, the commercial research bureau will analyse the essays and report the findings.

After receiving these general instructions, the amount of reward and choice was manipulated between participants.

Reward Manipulation. The experimenter reminded the participants of the reward of €2.50 given by the commercial research bureau, as previously announced. However, they would actually receive a lower (€0.25) or higher reward (€10) than expected. All participants were told that the reason for this discrepancy was that the research bureau had decided to decrease (low-

reward condition) or increase (high-reward condition) the monetary reward for participation.

Choice Manipulation. The experimenter told the participants in the high-choice condition that the decision to write favorable arguments was entirely their own. Participants in the no-choice condition were informed that they were randomly assigned to write favorable arguments. In the high-choice condition, the experimenter told the participants that:

> The research bureau has decided to reduce (increase) the payment to €0.25 (€10). I would like to stress again that the decision to write the essay is up to you.

In the no-choice condition, participants were told:

> Thus, since you are randomly assigned to this task, you have to write a forceful essay favoring the abolishing of credit system. Oh yes, I almost forgot to tell you that the research bureau has decided to reduce (increase) the payment to €0.25 (€10).

All participants were paid before they started to write the essay. They were given approximately 15 minutes to compose their essay.

Mood Induction. In the mood conditions, positive and negative mood was induced in a similar way as in Experiment 1, by giving bogus feedback about an earlier ostensibly unrelated performance test. After finishing the essay, positive performance feedback was provided given low-reward and negative feedback was provided given high-reward. The negative feedback was identical to Experiment 1. The positive feedback was given as follows:

You have a test score of 10/12. This is a very high score. It corresponds to the 90th percentile, which means that 90% of the population has a score lower or similar to yours. Only 10% of the population obtains a higher score.

Dependent Measures

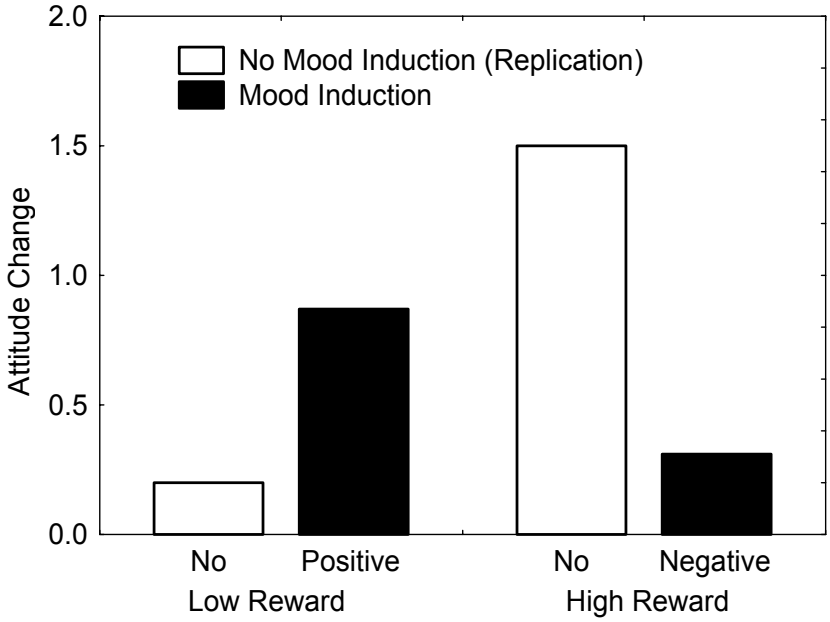
Affect Measures. The affect questionnaire as well as the affect indices were the same as in Experiment 1. Unlike Experiment 1, however, all the indices including those of positive affect, now showed reasonable reliability: General affect (Cronbach's alpha = .86); Negative Affect (alpha = .82); Discomfort (alpha = .81), Gratitude (alpha = .66), Pride (alpha = .85), Hope (alpha = .80), Hopelessness (alpha = .67), Shame (alpha = .64) and Guilt (alpha = .72).

Attitude Measure. Participants' attitudes toward abolishing the credit system were assessed by the same item from the initial attitude measurement, but now embedded in a different opinion questionnaire. Participants were

asked to indicate their attitude on a 15-point scale (1 = *strongly disagree* and 15 = *strongly agree*).

Manipulation Checks. At the end of the experiment, participants completed a questionnaire assessing the efficacy of the choice, reward and feedback manipulation. They indicated how much freedom they experienced ("How much freedom did you have to write or not to write the essay?") on 15-point scale (1 = *no freedom at all* and 15 = *a great deal of freedom*). They also indicated on a 15-point scale how large the received reward was (1 = *very small* and 15 = *very large)*. Furthermore, the manipulated discrepancy between the expected and actual reward ("Did the experimenter gave you a larger or a smaller reward than expected?") was measured on a 15-point scale (1 = *smaller reward* and 15 = *larger reward*). Additionally, participants in the mood conditions were asked how well they performed on the intelligence test according to the experimenter (1 = *very bad* and 15 = *very good*). Finally, participants were examined for suspicion by asking their idea about the purpose of the study. After completing this questionnaire, participants were thoroughly debriefed according to the procedure of Mills (1976) and were given the expected reward of €2.50, after which they were dismissed.

Figure 3.
Attitude change as function of mood induction in the no-choice conditions of the induced-compliance experiment (Experiment 2).



Results

Manipulation Checks

The manipulation checks of choice and reward in the conditions without mood induction showed that they were all effective. Participants in the high-choice conditions reported that they had more freedom to write the essay (M = 14.43) than participants in the no-choice conditions (M = 8.13), $F(1, 56) = 50.50$, $p < .0001$. Furthermore, participants in the high-reward condition reported that they received a higher reward (M = 13.60) than participants in the low-reward condition (M = 4.13), $F(1, 56) = 241.28$, $p < .0001$. In addition, participants reported that they received a higher reward than expected (M = 14.70) in the high-reward condition and a lower reward than expected in the low-reward condition (M = 2.53), $F(1, 56) = 604.78$, $p < .0001$.

The manipulation of performance feedback in the mood conditions was also effective as demonstrated by participants' performance on the intelligence test. As expected, participants in the positive-mood condition rated the performance feedback communicated by the experimenter as more positive (M = 13.07) compared to participants in the negative-mood condition (M = 1.06), $F(1, 29) = 1083.09$, $p < .0001$.

Attitude Change

Before proceeding to the critical test of our hypothesis, we first want to ascertain that the dissonance and reinforcement effects of Linder et al. (1967) were successfully replicated. Therefore, the means of the replication conditions were subjected to a 2 (Choice) x 2 (Reward) between-subjects analysis of variance (ANOVA). Inspection of the data revealed two outliers (attitude change of more than 9 scale points or 4 standard deviations [= 2.17]), one in the high-choice condition with high reward and one in the no-choice condition with high reward. After removing these two outliers (resulting in 58 participants), as expected, the interaction between Choice and Reward was significant, $F(54) = 5.61$, $p < .05$. Consistent with the predicted dissonance effect, participants in the high-choice conditions favored the counterattitudinal position in the essay marginally more after a low reward (M = 1.33) than after a high reward (M = 0.36), $t(27) = 1.43$, $p = .08$ (one-tailed). In contrast, in line with the predicted reinforcement effect, participants in the no-choice conditions favored the essay position significantly less after a low reward (M = 0.20) than after a high reward (M = 1.50), $t(27) = 1.92$, $p < .05$ (one-tailed).

We now turn to the hypothesised role of affect in the production of the reinforcement effect by focusing on the no-choice conditions. The affect hypothesis predicts that positive mood induction will increase attitude change and that negative mood induction will decrease attitude change. To test this, we directly compared the mood versus no-mood conditions, keep-

ing constant the level of reward. Thus, within the low reward conditions, we compared *positive* mood induction with no mood induction, and within the high reward conditions, we compared *negative* mood induction with no mood induction. As can be seen in Figure 3, as expected, participants changed their attitude more after positive mood induction in the low-reward condition ($M = 0.87$ versus 0.20 in the no-mood condition), $t(28) = 1.97$, $p < .05$ (one-tailed) and less after negative mood induction in the high-reward condition ($M = 0.31$ versus 1.50 in the no-mood condition), $t(28) = 1.76$, $p < .05$ (one-tailed). We also made the prediction that the reinforcement effect would be eliminated after inducing these opposite mood states. In line with our prediction, Figure 3 shows that the reinforcement effect became non-significant after mood induction. A direct comparison between the positive-mood condition ($M = 0.87$) and the negative-mood condition ($M = 0.31$) revealed even a marginal trend in the direction of a reversed reinforcement effect, $t(29) = 1.54$, $p = .07$ (one-tailed).

Reported Affect

We tested the same mood versus no-mood comparisons as for attitude change. Concerning general affect, participants reported more Positive Affect in the positive mood condition ($M = 4.22$) than in the no-mood condition ($M = 2.53$), $t(28) = 4.25$, $p < .001$. Furthermore, participants reported marginally lower levels of Discomfort in the positive mood condition ($M = 2.81$) than in the no-mood condition ($M = 3.71$), $t(28) = 1.78$, $p = .085$. The Negative Affect index revealed no significant differences. It is interesting to note that the higher level of discomfort in the no-choice low-reward replication condition (i.e., without mood induction) is in line with the assumption by Van Overwalle and Jordens (2002) that the combination of external constraints (enforcement and low reward) produces negative affect that is responsible for the reinforcement effect.

Concerning specific emotions, comparisons revealed that after positive mood induction, participants experienced more Gratefulness ($M = 3.69$), Pride ($M = 3.23$), and Hope ($M = 4.16$) than given no mood induction ($M = 2.69$, 1.33, and 3.07 respectively), ts(28) = 2.19-4.96, ps $< .05$. Moreover, participants in the negative mood condition experienced more Shame ($M = 2.56$) than in the no-mood condition ($M = 1.61$), $t(28) = 2.32$, $p < .05$. All these results are consistent with the notion that positive mood induction generally increased positive affectivity, and that negative mood induction generally increased negative affectivity, although the main difference lies in the increase of positive affect after positive mood induction.

Discussion

This study provided further support for the affect hypothesis put forward by Van Overwalle and Jordens (2002). In particular, the present results provide the first empirical evidence for the hypothesised role of affect in the reinforcement effect. Compared to the no-mood conditions, participants who were given a low reward (and presumably felt more dejected) changed their attitude more after positive mood was induced. In contrast, participants who were given a high reward (and presumably felt happier) changed their attitude less after negative mood was induced. The inducement of these opposite mood states eliminated the typical reinforcement effect and even resulted in a reversal that approached significance.

General Discussion

This article presents an initial validation of the affect hypothesis proposed by Van Overwalle and Jordens (2002) in their connectionist model of cognitive dissonance. As predicted, compared to no-mood conditions, the attitude increased after positive mood induction and decreased after negative mood induction. In the free-choice paradigm (Experiment 1), this manipulation rendered the chosen and rejected posters less favorable after inducing negative mood. In the induced compliance paradigm (Experiment 2), this mood manipulation eliminated the reinforcement effect, by inducing positive mood in the low-reward condition and negative mood in the high-reward condition. These findings contradict earlier theories of dissonance that would predict exactly the opposite effects. Recall that these theories predict that positive mood diminishes dissonance-related experiences of discomfort and so reduces attitude change, whereas negative mood further increases discomfort and so enhances attitude change (but see e.g., Higgins, Rhodewalt & Zanna, 1979).

For strategic reasons, we manipulated only one mood state without the opposite mood state in each condition. The reason was that we expected either the most change in only one mood manipulation (Experiment 1), or that the most interesting theoretical prediction involved only one mood state, and not the other (Experiment 2). Although full mood manipulations are certainly desirable, as they are, the present studies already demonstrate limitations of current dissonance theories, and point to the important role of mood. Nevertheless, a full design might rule out some alternative explanations for the present findings that are theoretically less interesting. For instance, one might argue that inducing negative mood distracts from the dissonance manipulations, and thus washes out any dissonance reduction and attitude

change effects. For instance, telling participants that they tested low on an intelligence test might potentially have overshadowed the concerns raised by the dissonance manipulations. Likewise, it is possible that the mood manipulation was simply stronger than the reward manipulation, and so overrode the original dissonance and reinforcement effects. By demonstrating the expected positive and negative mood effects in a single study with a full design, one could eliminate such alternative explanations.

The crucial role of mood in the present studies is very much in line with recent affect-priming and affect-as-information theories which documented mood-congruent judgments in numerous studies (for an overview, see Forgas, 2001). Affect priming theory (Bower, 1981; Isen, 1984) states that mood biases occur through mood-congruent attention, encoding and retrieval of information involved in the judgmental processes. These biases were explained by the mechanism of activation spreading in an associative memory network. This is, of course, very similar to the activation spreading mechanism in the connectionist model. The affect-as-information approach (Schwarz & Clore, 1983; Schwarz, 1990) proposes an alternative mechanism of mood influence. According to this approach, affect has informational value since people ask themselves "How do I feel about it?" when they evaluate persons or objects. This is essentially the same assumption as the connectionist model, since the model includes affective responses as a crucial component of attitude change.

Concerning reported affect, we found that the induced mood evoked global positive and negative affect and discomfort, and that these affects generalised to more specific emotions such as shame, guilt, gratitude, hope, and so on. These are the first results indicating a change on specific self-related affect, as previous research focused exclusively on general negative affect in cognitive dissonance (e.g., Elliot & Devine, 1994; Harmon-Jones, 2000). However, the finding that self-related affect was changed, may indicate that our mood induction were also blows or boosts to self-esteem, suggesting affirmation of self-esteem as an alternative explanation for our results in Experiment 2 (cf. Steele, Spencer, & Lynch, 1993). However, given that in Experiment 1 no negative self-worth affects like shame or guilt were changed, this alternative is less likely as an explanation for all our mood induction effects. This alternative can be ruled out definitely if future research can demonstrate similar effects with other, more direct mood induction procedures that do not implicate self-related performance or self-worth.

Although the specific affect measures were included mainly for exploratory reasons, it is strange why different affects were changed in each experiment. There was not a single affect measure that stood out in the two experiments. One possible reason is the limited validity of self-reports of affective experiences. Especially when mood is unobtrusively induced like in the pre-

sent experiments, people may have little direct introspective access to their internal processes and affective experiences (e.g., Gasper & Clore, 2000; Nisbett & Wilson, 1977; Zajonc, 1980). Along the same line is the increasing evidence that dissonance reduction itself is an automatic process largely outside awareness. Lieberman, Ochsner, Gilbert and Schacter (2002) demonstrated that amnesic patients showed as much dissonance reduction as normal controls, although they had no memory of their behaviour that induced this dissonance.

As noted earlier, our affect hypothesis is largely consistent with the predictions of both affect-priming and affect-as-information models. These models would predict that positive affect would produce more positive judgments compared to a neutral affective state, while negative affect would result in more negative judgments. However, it is evident that these models do not take into account discrepant behaviour to determine attitudes, whereas the connectionist assumption is that approach-avoidance behaviour and positive-negative affect combined, form an attitude. Therefore, the present network approach can possibly accommodate a larger range of findings and phenomena, and future research may attempt to mine out other predictions. For example, one might attempt to measure the behavioural and affective components separately as a function of cognitive dissonance. In addition, mood induction effects can be demonstrated in other classic dissonance paradigms in interaction with other external constraints such as punishment or threat, and as noted earlier, using more direct mood manipulations. Given the breath of the connectionist approach to dissonance reduction, there is still plenty of room for further empirical exploration.

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