

Section *III*

Attitudes and Persuasion

10

Action-Based Model of Dissonance *On Cognitive Conflict and Attitude Change*

EDDIE HARMON-JONES

Texas A&M University

DAVID M. AMODIO

New York University

CINDY HARMON-JONES

Texas A&M University

Cognitive dissonance theory (Festinger, 1957) and its research have led to an increased understanding of attitude change processes. In this chapter, we review Festinger's original theory, review some revisions of the theory, and then describe a more recent conceptualization of dissonance, the *action-based model*. The action-based model begins with the assumption that many perceptions and cognitions automatically activate action tendencies. This assumption is consistent with several perspectives, such as William James's (1890) ideomotor conception, Gibson's (1966, 1979) ecological approach to perception, and subsequent elaborations of these basic ideas (Berkowitz, 1984; Dijksterhuis & Bargh, 2001; Fiske, 1992; McArthur & Baron, 1983; Smith & Semin, 2004). The action-based model goes further to suggest that when these "cognitions" with action implications come into conflict, a negative affective state is aroused, referred to as *dissonance*. Our model posits that dissonance affect is aroused because conflicting action-based cognitions have the potential to interfere with effective action. The organism is motivated to reduce this negative affect and ultimately reduce the "cognitive inconsistency" in order

to behave effectively. This way of conceptualizing dissonance processes addresses many problems with past theories concerned with dissonance, and it suggests a framework for integrating an array of other nondissonance theories and research.

OVERVIEW OF THE THEORY OF COGNITIVE DISSONANCE

The original theory of cognitive dissonance predicted that when an individual holds two or more elements of knowledge that are relevant to each other but inconsistent with one another, a state of discomfort is created. This unpleasant state is referred to as “dissonance.” According to the theory, the magnitude of dissonance in relation to a cognition can be formulated as equal to $D / D + C$, where D is the sum of cognitions dissonant with a particular cognition and C is the sum of cognitions consonant with that same particular cognition, with each cognition weighted for importance.

According to the original theory, dissonance motivates individuals to engage in psychological work in an effort to reduce the inconsistency between cognitions. So, if a dieter consumed a fattening meal, he would likely be in a state of dissonance. Assuming that the commitment to the diet is not as strong as the enjoyment of the food (at this moment), the theory would predict that he will reduce dissonance by adding consonant cognitions (e.g., “the meal was the best I have had in years”), subtracting dissonant cognitions (e.g., “I don’t really need to be on a diet”), increasing the importance of consonant cognitions (e.g., “sensory pleasures are very important”), or decreasing the importance of dissonant cognitions (e.g., “diets are unimportant”).

Researchers have most often measured dissonance reduction with attitude change. Attitude change in response to a state of dissonance is expected to be in the direction of the cognition that is most resistant to change. In laboratory tests of the theory, knowledge about recent behavior is usually assumed to be the cognition most resistant to change, perhaps because of the local focus on the situation (Ledgerwood & Trope, this volume). If one has recently performed a behavior, it is usually difficult to convince oneself that the behavior did not occur. Thus, attitudes often change to become more consistent with a recent behavioral commitment.

ALTERNATIVE THEORETICAL EXPLANATIONS

Beginning in the mid-1960s, researchers began to propose alternative explanations for dissonance effects. Whereas the original theory focused on an inconsistency between cognitions, these theories invoked higher-order, more complex processes, and changed the focus from inconsistency to the individual’s self-concept and the individual’s concern with harming others.

Self-Consistency

In self-consistency theory, Aronson (1969, 1999) proposed that dissonance only occurs when a person acts in a way that violates his or her self-concept, that is,

when a person performs a behavior inconsistent with his or her self-view. Because most persons view themselves in a positive light, such that they are competent, rational, and moral, dissonance is experienced when a person behaves in an incompetent, irrational, or immoral way. One of the primary predictions derived from this revision is that high self-esteem individuals should respond with more dissonance reduction than low self-esteem individuals, because dissonance experiments induce individuals to act in ways discrepant from a positive self-view. Studies testing this prediction have produced mixed results: some showed that high self-esteem individuals showed greater attitude change, some showed that low self-esteem individuals showed greater attitude change, and some found no differences between self-esteem groups (see Stone, 2003, for review).

Self-Affirmation

Steele (1988) proposed that individuals possess a motive to maintain an overall self-image of moral and adaptive adequacy. He stated that dissonance-induced attitude change occurs because dissonance threatens this positive self-image. Steele proposed that instead of a motivation to reduce inconsistency, individuals are motivated to affirm the integrity of the self or maintain a “perception of global integrity, that is, of overall moral and adaptive adequacy” (Steele, Spencer, & Lynch, 1993, p. 885; see Sherman & Cohen, 2006, for a recent review). However, Simon, Greenberg, and Brehm (1995) presented evidence supporting Festinger’s original theory over self-affirmation theory; they found that simply activating non-self-relevant but important concepts caused the same attitude effects as self-affirmations, and that self-affirmations caused individuals to reduce the importance of the dissonant cognitions. Other evidence has been presented that is difficult to interpret in self-affirmation theory terms, such as evidence suggesting that self-affirmations relevant to the recent dissonant act increase rather than decrease dissonance-related attitude change (Aronson, Cohen, & Nail, 1999).

Self-Standards Model

Stone and Cooper’s (2003) self-standards model of dissonance posited that the self is multidimensional and that the accessibility of different aspects of the self determines how and whether a particular behavior leads to the state of cognitive dissonance (see also Cooper, this volume).

The self models of dissonance also have difficulty explaining the dissonance effects produced in rats (Lawrence & Festinger, 1962), as rats are believed to lack self-conceptions of morality, rationality, and competence. Four-year-old humans and capuchin monkeys, who also lack the complex self-concepts required by self models of dissonance, engage in dissonance reduction (Egan, Santos, & Bloom, 2007). Although self aspects appear to moderate dissonance processes, they are not necessary to cause dissonance (Harmon-Jones, 2000d; Stone & Cooper, 2003). In terms of the original theory, self-related cognitions would be expected to affect the magnitude of dissonance, because cognitions related to the self are often impor-

tant to an adult human. Thus, results derived from the self models are compatible with the original theory, but the self models are unable to explain basic dissonance motivation effects concerning discrepancies that do not involve the self.

Aversive Consequences

Cooper and Fazio (1984) proposed that dissonance was not due to an inconsistency between the individual's cognitions, but rather to feeling personally responsible for producing an aversive consequence. According to the original theory of cognitive dissonance, the production of aversive consequences would be expected to increase the amount of dissonance produced because an aversive consequence in itself may be an important dissonant cognition, or it may strengthen one's behavioral commitment (see Harmon-Jones, 1999). However, the original theory would deny that an aversive consequence is *necessary* to produce dissonance.

The aversive consequences revision has been challenged by experiments that have found dissonance-related attitude change and negative affect to occur when individuals engage in counterattitudinal behaviors that do not produce aversive consequences (Harmon-Jones, 2000c; Harmon-Jones et al., 1996). McGregor, Newby-Clark, and Zanna (1999) also summarized research showing that attitudinal ambivalence research has provided evidence of dissonance-related negative affect in the absence of feeling personally responsible for producing negative consequences.

Nevertheless, some important questions regarding the basic mechanism underlying dissonance effects remained: Why does cognitive inconsistency evoke the negative motivational state? Why does this state motivate attitude change? Festinger (1957) posited no answers to these questions, but the action-based model of dissonance does (Harmon-Jones, 1999).

ACTION-BASED MODEL OF DISSONANCE: WHY DO DISSONANCE PROCESSES OCCUR?

The action-based model concurs with theorizing in other areas of psychology in proposing that perceptions and cognitions can serve as action tendencies (Berkowitz, 1984; Dijksterhuis & Bargh, 2001; Fiske, 1992; Gibson, 1979; James, 1890; McArthur & Baron, 1983; Smith & Semin, 2004). The action-based model further proposes that *dissonance between cognitions evokes a negative affective state because it has the potential to interfere with effective and unconflicted action*. In essence, discrepant cognitions create problems for the individual when those cognitions have conflicting action tendencies. Dissonance reduction brings cognitions into line with behavioral commitments, and serves the function of facilitating the execution of effective and unconflicted action (see also Jones & Gerard, 1967).

The action-based model proposes both a proximal and a distal motivation for the existence of dissonance processes. The proximal motive for reducing dissonance is to reduce or eliminate the negative emotion of dissonance. The distal motivation is the need for effective and unconflicted action.

After an individual makes a difficult decision, psychological processing should assist with the execution of the decision. The tendency of participants in dissonance research to view the chosen alternative more favorably and the rejected alternative more negatively after a decision may help the individual to follow through, to effectively carry out the actions that follow from the decision.

As an example, consider an important, effortful behavioral decision, such as beginning an exercise program. In this situation, the “actions” implied by the decision are the exercise behaviors. The benefits of exercise, from better-fitting clothes to improved long-term health, constitute consonant cognitions. The drawbacks of exercise, including the time commitment and muscle soreness, constitute dissonant cognitions. Dissonance affect comes from the conflict between the consonant and dissonant cognitions, and this unpleasant affect motivates the individual to decrease the discrepancy by bringing the cognitions in line with the behavioral commitment. The better an individual is able to reduce the number and importance of dissonant cognitions and increase the number and importance of consonant cognitions, the more likely it is that he or she will faithfully perform the actions required by the exercise program over the long-term and reap its benefits. From the action-based model perspective, what is important is not so much the discrepancy between the cognitions themselves, but rather the discrepancy between the cognitions’ action tendencies. Cognitions consonant with the decision impel one to exercise, while cognitions dissonant from the decision have the opposite effect. Reducing the discrepancy by increasing consonant cognitions and/or decreasing dissonant cognitions would be expected to reduce negative affect. More importantly in our view, discrepancy reduction would also be expected to facilitate more effectively engaging in the exercise program.

As we review later, the action-based model is supported by neurophysiological research that demonstrates that dissonance arousal is associated with neural activations involved in the detection of response conflict and negative affect, whereas dissonance reduction is associated with neural activations involved with approach motivation. Other models of dissonance do not make these predictions and often instead propose that dissonance reduction is a self-protective process that should be associated with defensive motivation.

The action-based model views dissonance processes as adaptive. Of course, adaptive, functional psychological processes that are beneficial in most circumstances may not be beneficial in all circumstances. Occasionally, dissonance reduction may cause persons to maintain a prolonged commitment to a harmful chosen course of action, when it would be better to disengage. By adaptive, we mean that the process benefits the organism most of the time.

In addition, we must distinguish between dissonance motivation and dissonance reduction. The action-based model, like the original theory, proposes that cognitive discrepancy produces negative affect, and that the negative affect motivates attitude change (for review, see Forgas, this volume). However, it is possible to continue to maintain conflicting attitudes (although negative affect may persist). Furthermore, there are some situations in which individuals do disengage from harmful chosen courses of action, even though they may experience high levels of negative affect in the process.

TESTS OF THE ACTION-BASED MODEL

Action-Orientation and Spreading of Alternatives

According to the action-based model of dissonance, the postdecisional state is similar to an action-oriented state (Beckmann & Irle, 1985; Gollwitzer, 1990; Kuhl, 1984), where the individual is in a mode of “getting things done.” Once a decision is made, an organism should be motivationally tuned toward enacting the decision and behaving effectively with regard to it. An implemental or action-oriented mind-set is one in which plans are made to effectively execute behaviors associated with the decision (Gollwitzer & Bayer, 1999). We suggest that this implemental or action-oriented state is similar to an approach motivational state. When a person is in an action-oriented state, implementation of decisions is enhanced (Gollwitzer & Sheeran, 2006). We suggest that these action-oriented states are similar to Jones and Gerard’s (1967) concept of an unequivocal behavior orientation. Jones and Gerard’s (1967) unequivocal behavior orientation was posited to be an adaptive strategy that forced the individuals to bring their relevant cognitions into harmony with each other. The unequivocal behavior orientation “represents a commitment to action in the face of uncertainty. Such a commitment involves the risks of acting inappropriately, but such risks are assumed to be less grave on the average than the risks of hesitant or conflicted action” (p. 185). Jones and Gerard further posited, “When the time comes to act, the great advantage of having a set of coherent internally consistent dispositions is that the individual is not forced to listen to the babble of competing inner forces” (p. 181).

The action-oriented state that follows decision-making is proposed to be equivalent to the state in which dissonance motivation operates and discrepancy reduction occurs (Harmon-Jones & Harmon-Jones, 2002). Thus, experimentally manipulating the degree of action-orientation experienced following a decision should affect the degree of discrepancy reduction. In one experiment, participants were asked to make either an easy decision or a difficult decision. Participants then completed a neutral questionnaire that asked them to list seven things they did in a typical day, or they completed an action-oriented questionnaire that asked them to list seven things they could do to perform well on the exercise they had chosen. Participants then reevaluated the exercises. Participants who made a difficult decision in the action-oriented condition demonstrated a greater increase in preference for the chosen over the rejected exercise (i.e., spreading of alternatives) than participants in the other three conditions.

In a second experiment, we replicated the results of the first experiment using a different manipulation of action-orientation (Harmon-Jones & Harmon-Jones, 2002). In this experiment, action-orientation was induced by asking participants to think about a project or goal that they intended to accomplish, and to list the steps they intended to use to successfully follow through with their decision (Gollwitzer, 1990). Two comparison conditions were also included, one in which participants wrote about a neutral, ordinary day and one in which participants wrote about an unresolved problem. Participants first made a difficult decision between two equally attractive research studies in which they could participate.

Following the decision, participants completed the action-orientation manipulation, and then rerated their attitudes toward the research studies. Participants in the action-orientation condition engaged in more spreading of alternatives than did participants in the comparison conditions. This study provided stronger support for the action-based model because, in this case, the action-orientation induction was unrelated to the decision in the experiment.

Neural Activity Underlying Dissonance and Dissonance Reduction

The action-based model of cognitive dissonance is consistent with recent models of self-regulation, and it provides an important theoretical framework for placing neural processes in the context of motivated cognition.

Dissonance Arousal, Conflict Monitoring, and the Anterior Cingulate Cortex According to the action-based model, dissonance is aroused by the activation of cognitions that interfere with goal-driven behavior. Although few studies have directly examined the process of dissonance arousal in the brain, much attention has been given to questions of how the brain processes response conflicts on tasks such as the color-naming Stroop (1935) task. For example, when completing the color-naming Stroop task, one's goal is to identify the ink color of a word stimulus, regardless of the word's meaning. However, the processing of word meaning is typically automatic, and when a word's meaning is incongruent with one's goal to judge the word's color, such as when the word *red* is presented in blue ink, there is conflict between the intended and the automatic response tendencies. In studies examining neural activity during the Stroop task, anterior cingulate cortex activity is greater during incongruent trials than congruent trials (Carter et al., 1998). Similar findings have been observed using other response-conflict tasks, such as the Eriksen flanker's task (Eriksen & Eriksen, 1974; Gehring, Goss, Coles, Meyer, & Donchin, 1993), and the Go/No-Go task (Botvinick, Nystrom, Fissel, Carter, & Cohen, 1999; Keihl, Liddle, & Hopfinger, 2001). Researchers have interpreted these findings as evidence that the anterior cingulate cortex plays a role in monitoring action tendencies for potential conflicts, so that other mechanisms may be engaged to override the unwanted tendency and to promote an effective goal-directed response (Botvinick, Braver, Barch, Carter, & Cohen, 2001). Thus, conflict monitoring represents the first component of a dual-process model of cognitive control, whereby the need for control is initially detected.

Recently, we have suggested that the anterior cingulate cortex, and its associated role in conflict monitoring, corresponds well to the process of dissonance arousal (Harmon-Jones, 2004). The conflict-monitoring account is consistent with the action-based model of dissonance, because it too focuses on conflicts between action tendencies. Amodio et al. (2004) integrated the conflict-monitoring framework with social psychological theories of self-regulation by examining conflict between automatic stereotyping tendencies and participants' goals to respond without prejudice. In this study, anterior cingulate cortex activity was monitored using an event-related potential measure referred to as the "error-related negativity" component (Gehring et al., 1993; van Veen & Carter, 2006). When participants—who

reported low-prejudice attitudes—accidentally made responses that reflected the application of racial stereotypes, thus constituting a clear response conflict, the anterior cingulate cortex was activated. By comparison, anterior cingulate cortex activity was lower on other trial types that did not elicit conflicting actions.

In subsequent research, Amodio, Devine, and Harmon-Jones (2008) demonstrated that heightened anterior cingulate cortex activity associated with racially biased responses was only observed for participants with strong personal motivations to respond without prejudice. Participants without personal motivations (i.e., high-prejudice participants) did not show enhanced anterior cingulate cortex activity when their responses reflected the application of stereotypes. Thus, when participants made responses that were dissonant with their attitude-based intentions, anterior cingulate cortex activity was high. Furthermore, participants with stronger anterior cingulate cortex activity to dissonant responses were more likely to engage in controlled behavior (slower, more careful responding). These studies provided evidence for the role of the anterior cingulate cortex, and its associated conflict monitoring function, as a critical process underlying dissonance arousal and the control of action. This line of research demonstrated that high-level conflicts, the type with which dissonance theory has been most concerned, also activate the anterior cingulate cortex.

Response conflict tasks used in studies of the anterior cingulate cortex have also been found to cause increases in skin conductance, which indexes sympathetic nervous system arousal (Hajcak, McDonald, & Simons, 2003, 2004), and measures of negative affect such as the startle eyeblink response (Hajcak & Foti, 2008). Situations that typically evoke cognitive dissonance also cause increased skin conductance (Elkin & Leippe, 1986; Harmon-Jones et al., 1996; Losch & Cacioppo, 1990) and negative affect (Elliot & Devine, 1994; Harmon-Jones, 2000c; Zanna & Cooper, 1974). Taken together, these studies suggest that the anterior cingulate cortex is associated with the negative affective state of dissonance and involved in initiating dissonance-reducing action. These results showing that dissonance is associated with increased anterior cingulate cortex activation was derived from the action-based model, which suggests that dissonance results from the need for effective and unconflicted action (distal motive). This anterior cingulate cortex prediction could be viewed as compatible with the original theory of dissonance but is unlikely compatible with other versions of dissonance because of their focus on high-level self-consistencies or other non-consistency-oriented motivations (e.g., aversive consequences, self-affirmation).

Dissonance Reduction and the Prefrontal Cortex The arousal of negative affect by cognitive discrepancy drives efforts to reduce the dissonant state. The process of cognitive discrepancy reduction can occur rapidly (e.g., essay writing; Rabbie, Brehm, & Cohen, 1959). According to the action-based model, the process of discrepancy-reduction engages approach-oriented motivational processes, as the individual works to successfully implement the new commitment. Only the action-based model makes the prediction that discrepancy reduction following commitment to action involves approach motivational processes, which the model views as part of the distal motive of effecting unconflicted behavior. Other

models of dissonance propose that dissonance reduction is motivated by a need to protect the self-image. Thus, these other models would not propose that dissonance reduction involves approach motivation, or that dissonance reduction would involve brain regions associated with translating intentions into effective action.

Recent neurocognitive models of control posit that the prefrontal cortex governs the implementation of a controlled response following the detection of conflict by the anterior cingulate cortex (Botvinick et al., 2001; Miller & Cohen, 2001). That is, as discrepancy-related activity in the anterior cingulate cortex rises, anterior cingulate cortex-to-prefrontal cortex communication increases. The prefrontal cortex plays a critical role in responding to the discrepancy by amplifying an intended response tendency to override the unintended tendency (Kerns et al., 2004). The action-based model suggests that whereas the anterior cingulate cortex is associated with dissonance arousal, regions of the prefrontal cortex are critical for dissonance reduction. The dissociation between the neural processes related to dissonance arousal and discrepancy reduction supports the idea that these two processes reflect the operation of independent underlying mechanisms. However, neurocognitive models do not clearly specify which regions of the prefrontal cortex contribute to different aspects of discrepancy reduction and action control, and they are silent on the role of motivation in the process of control.

Converging evidence from studies using a range of methods suggests that prefrontal cortex activity is lateralized on the basis of motivational direction, with the left frontal region being involved in approach motivational processes (“going toward”), and the right frontal region being involved in inhibitory or withdrawal motivational processes (“going away”). For instance, damage to the left frontal lobe causes depressive symptoms, with stronger depressive symptoms among patients with damage closer to the frontal pole (e.g., Robinson & Downhill, 1995). Given that depression relates to impaired approach-related processes, damage to brain regions involved in approach motivation would lead to depression.

Much research assessing electroencephalographic (EEG) activity has similarly found that increased left frontal cortical activation relates to state and trait approach motivation (Amodio et al., 2007; Amodio, Master, et al. 2008; Harmon-Jones & Allen, 1997, 1998; Harmon-Jones, 2003, 2004). Source localization of frontal asymmetry has demonstrated that it reflects activity in the dorsal prefrontal cortex (Pizzagalli, Sherwood, Henriques, & Davidson, 2005). For instance, research has related greater left frontal activity to the state engagement in approach-related responses (Amodio et al., 2007; Harmon-Jones & Sigelman, 2001) and to the accessibility of approach-related goals (Amodio, Shah, Sigelman, Brazy, & Harmon-Jones, 2004). In addition, fMRI studies have observed greater left prefrontal cortex activity during the retrieval of approach-related action words (Bunge, 2004; Petersen, Fox, Posner, Mintun, & Raichle, 1988). These findings suggest that the left prefrontal cortex is involved in the implementation of intended action and the formation (and restructuring) of goals to guide future action. They are also congruent with the action-based model’s position that the discrepancy reduction process serves to promote goal-directed behavior through the restructuring of goal-relevant attitudes.

Considered as a whole, research on left prefrontal cortex function suggests that it is involved in approach motivational processes aimed at resolving inconsistency (MacDonald, Cohen, Stenger, & Carter, 2000; van Veen & Carter, 2006). Next, we describe a set of studies that have examined the role of left prefrontal cortex activity and approach motivation as they relate directly to the resolution of dissonance-arousing discrepancies. The prediction of the action-based model is that commitment to a chosen course of action should lead to an enhancement in relative left frontal cortical activity, which in turn should be associated with attitude change in support of the chosen course of action.

Induced Compliance and Relative Left Frontal Cortical Activation In an experiment by Harmon-Jones, Gerdjikov, and Harmon-Jones (2008), participants were randomly assigned to a low- versus high-choice condition in an induced compliance paradigm. Immediately after starting to write the counterattitudinal essay (regarding a tuition increase at their university), participants' EEG activity was recorded. After essay completion, attitudes were assessed. Participants in the high-choice condition evidenced greater relative left frontal activation than individuals in the low-choice condition (Harmon-Jones, Gerdjikov, et al., 2008). Moreover, participants in the high-choice condition evidenced attitudes to be more consistent with the behavior than participants in the low-choice condition.

Neurofeedback of Relative Left Frontal Cortical Activity and Free Choice In the previous experiment, when the psychological process (commitment to a chosen course of action) was manipulated and the proposed physiological substrate was measured (left frontal cortical activation), commitment to a chosen course of action increased relative left frontal cortical activation (Harmon-Jones, Gerdjikov, et al., 2008). To provide stronger causal inferences regarding the role of the left frontal cortical region in following through with the commitment (discrepancy reduction), it is important to manipulate the physiology (or proposed mediator) and measure the psychological outcome (Sigall & Mills, 1998; Spencer, Zanna, & Fong, 2005). Therefore, we conducted another experiment in which relative left frontal cortical activation was manipulated after dissonance was aroused to test whether a manipulated increase in relative left frontal cortical activation would increase dissonance reduction (attitude change).

To manipulate relative left frontal cortical activity, we used neurofeedback training of EEG. Neurofeedback presents the participant with real-time feedback on brainwave activity. If brainwave activity over a particular cortical region changes in the direction desired by the experiment, then the participant is given "reward" feedback; if brainwave activity does not change in the desired direction, either negative feedback or no feedback is given. Rewards can be as simple as the presentation of a tone that informs the participant that brain activity has changed in the desired way. Neurofeedback-induced changes result from operant conditioning, and these changes in EEG often occur without awareness of how the brain activity changes occurred (Kamiya, 1979; Kotchoubey, Kübler, Strehl, Flor, & Birbaumer, 2002; Siniatchkin, Kropp, & Gerber, 2000).

AU: Added second author since there are two Harmon-Jones et al. (2008) citations in refs. list. I assume you're referring to this one?

In past research, neurofeedback was effective at decreasing but not increasing relative left frontal activity after only 3 days of training. The decrease in relative left frontal activity brought about with this brief neurofeedback training caused less approach-related emotional responses (Allen, Harmon-Jones, & Cavender, 2001). Based on these past results, we predicted that a decreased left frontal condition would be more successful at changing brain activity than an increased left frontal condition.

Most importantly, we predicted that a decrease in relative left frontal activity would lead to a decrease in discrepancy reduction as measured by spreading of alternatives. To test these predictions, we used the decision paradigm developed by Brehm (1956). First, participants were randomly assigned to increase or decrease relative left frontal activation during two days of neurofeedback training. Then, on the third day, immediately following a difficult decision, participants received neurofeedback training in the same direction as the previous two days. Finally, attitudinal spreading of alternatives was assessed. In support of predictions, neurofeedback training caused a reduction in relative left frontal cortical activity, which caused an elimination of the familiar spreading of alternatives effect (Harmon-Jones, Harmon-Jones, Fearn, Sigelman, & Johnson, 2008). This experiment's manipulation of relative left frontal cortical activity, a presumed mediator of the effect of commitment on discrepancy reduction, provides strong support for the role of relative left frontal activity in discrepancy reduction processes.

Action-Oriented Mind-set and Relative Left Frontal Cortical Activation A follow-up experiment (Harmon-Jones, Harmon-Jones, et al., 2008, Experiment 2) was designed to conceptually replicate the previous experiment. In this experiment, we manipulated action-oriented mental processing following a difficult decision. We expected to replicate past research in which the action-oriented mind-set increased discrepancy reduction following a decision (Harmon-Jones & Harmon-Jones, 2002). Secondly, we expected the action-oriented mind-set would increase relative left frontal cortical activity. Finally, we expected this increase in left frontal cortical activity would relate to discrepancy reduction, as assessed by spreading of alternatives.

To further extend past research, we included a condition to manipulate positive affect that was low in approach motivation (i.e., participants wrote about a time when something happened that caused them to feel very good about themselves but was not the result of their own actions). This was done to distinguish between the effects of positive affect and of approach motivation on spreading of alternatives. Past research suggested that action-oriented mind-sets increase positive affect (Taylor & Gollwitzer, 1995), but we do not predict that positive affect, itself, causes increased left frontal cortical activity or an increase in spreading of alternatives.

Results revealed that the action-oriented mind-set increased relative left frontal cortical activity and spreading of alternatives, as compared to a neutral condition and a positive affect/low-approach motivation condition. These results provide a conceptual replication of the past results by using a different operationalization of action-oriented motivational processing. Both experiments revealed that the hypothesized increase in action-oriented processing was manifested in increased

relative left frontal cortical activity. Moreover, both studies revealed that relative left frontal activation correlated positively with spreading of alternatives. This correlation occurred across both conditions within the neurofeedback experiment and within the action-oriented mind-set condition of the second experiment.

Left Prefrontal Cortex Activity and Approach Motivation Following Prejudice-Related Discrepancy Discrepancies between one's attitude and behavior are often investigated in the context of intergroup relations. For example, most White Americans today believe it is wrong to discriminate on the basis of race. But at the same time, most White Americans show evidence of automatically activated tendencies to express racial stereotypes and negative evaluations. Thus, in intergroup situations, people are often confronted with a discrepancy between their nonprejudiced beliefs and their implicit tendencies to express prejudice. This phenomenon clearly represents a case of cognitive dissonance.

To examine the roles of left prefrontal cortex activity and approach motivation in the context of prejudice, we preselected White American participants who reported holding low-prejudice attitudes in an earlier testing session (Amodio, Devine, & Harmon-Jones, 2007). Participants were told that we would examine their neural responses as they viewed pictures of White, Black, and Asian faces. Following this task, participants were given bogus feedback indicating that their neural activity revealed a strong negative emotional response toward Black faces, compared with White and Asian faces. This feedback was highly discrepant with participants' nonprejudiced beliefs and, as expected, aroused strong feelings of guilt on a self-report measure (beyond changes in other emotions), and participants were not immediately given an opportunity to engage in behavior that might reduce their guilt. Participants also showed a decrease in left frontal cortical activity compared with baseline levels, and the degree of this decrease was correlated with their experience of guilt. This pattern suggested that the initial arousal of guilt-related dissonance was associated with a reduction in approach-motivation tendencies. Although this study was not designed to measure changes in anterior cingulate cortex activity, the decrease in left-sided prefrontal cortex activity is consistent with the idea that dissonance arousal is associated with a reduction in approach motivation accompanied by an increase in behavioral inhibition (e.g., Amodio, Master, et al., 2008).

The effects of left frontal activity and approach motivation were examined in the second part of the study. After the guilt manipulation, participants were told that the study was completed, but that in the time remaining in the session, they could help us by judging some stimuli ostensibly to be used in a future experiment. Here, we provided an opportunity to reduce their discrepancy-related guilt. We told participants that we wanted their feedback on different magazine articles that we might have participants in a future study read. Participants read the headlines of a series of different articles. Some headlines referred to articles associated with reducing prejudice (e.g., "Improving Your Interracial Interactions"). Others were filler headlines that were unrelated to intergroup relations (e.g., "Five Steps to a Healthier Lifestyle"). Participants viewed each title for 6 seconds while their EEGs were recorded. After viewing each title, they rated their personal desire to

read the article. We found that participants who reported stronger guilty affect in response to the bogus feedback indicating their prejudiced response—an index of dissonance arousal—reported significantly stronger desire to read articles related to reducing prejudice. Induction-related feelings of guilt were unrelated to participants' desire to read the filler articles. Furthermore, stronger desire to read prejudice reduction articles was associated with greater left-sided prefrontal cortex activity, consistent with the idea that discrepancy reduction involves the engagement of approach-related action (i.e., associated with egalitarian behavior), which involves activity of the left prefrontal cortex. Hence, these results supported the action-based model of dissonance in the context of prejudice and feelings of guilt.

CONSIDERING THE ACTION-BASED MODEL AND OTHER MODES OF DISSONANCE REDUCTION

Would a change in action orientation and/or relative left frontal cortical activity affect discrepancy reduction in other dissonance-evoking situations? We would expect left frontal cortical activity to affect dissonance processes when dissonance is aroused by a strong commitment to behavior, which is what typically occurs in the induced compliance and free choice paradigms (e.g., Beauvois & Joule, 1996; Brehm & Cohen, 1962). In such situations, we predict that individuals are motivated to follow through with their behavioral commitment and to change their attitudes to be consistent with their behavior (Stone et al., 1997). However, in some induced compliance situations, individuals may reduce dissonance by means other than attitude change, perhaps because their commitment is not sufficiently strong (Gilbert & Ebert, 2002) or because their original attitude is highly resistant to change (Simon et al., 1995). In other dissonance paradigms, we would predict relative left frontal activation to relate to dissonance reduction to the extent that dissonance is likely to be reduced via approach motivational processes, such as changing one's attitudes to be more supportive of the recent behavioral commitment.

Changing one's cognitions to bring them in alignment with each other is one way of reducing the negative emotion of dissonance. This is the method of reducing dissonance most often measured in research. However, this is not the only way a person can deal with the emotive state of dissonance. It is also possible to trivialize the dissonant cognitions (Simon et al., 1995) or engage in reality-escaping behaviors such as drinking alcohol to reduce the negative dissonance state and the motivation to engage in discrepancy reduction (Steele, Southwick, & Critchlow, 1981). The action-based model would predict that reducing dissonance by means other than attitude change would be more likely when action was not greatly needed or when the action implications of the cognitions were low.

It is also possible to experience dissonance and not reduce it. The negative emotion of dissonance provides motivation to change one's cognitions, but this motivation may not always lead to such changes. In this situation, the cognitive discrepancy would still be present, but the negative affect would remain elevated, as seen when individuals with important cognitive discrepancies suffer low self-esteem (Major & Townsend, this volume). The action-based model predicts

that if an individual experiences dissonance but does not reduce it, the effectiveness of his or her behavior related to the commitment would be hampered. The effectiveness of behavior could be hampered by hindering pursuit and acquisition of an immediate goal, or it may be hampered in more diffuse ways. These and other ways of dealing with cognitive discrepancies, and with the negative emotion of dissonance, need to be considered in future research.

The action-based model does not make the claim that dissonance reduction always occurs in the direction of a decision. Sometimes a person makes a decision, and the evidence is overwhelming that the wrong decision has been made. This information would arouse dissonance. When a person realizes that he/she has made a mistake, his/her original decision is no longer the cognition most resistant to change. Consider Leon, who chose to attend one university over another. After beginning the first semester, Leon might realize that the university he chose is completely unsuitable for him. He will likely not be able to reduce the dissonance associated with his decision; rather, the negative emotion of dissonance would likely increase. At some point, as dissonant cognitions continue to increase, he may choose to reverse his decision and look for a different university (Festinger, 1957, reports the results of such an experiment). Like the original theory of dissonance, the action-based model predicts that the direction of attitude change will be in the direction of the cognition that is most resistant to change.

CONCLUSION

The action-based model assumes that dissonance processes operate because they are functional, that is, most often useful for the organism. However, the action-based model does not claim that dissonance reduction is always functional. We think of dissonance processes as being similar to other functional, motivated behaviors such as eating. Eating is necessary for the survival of the organism; however, disordered eating can be harmful. Similarly, dissonance reduction often benefits persons by assisting them in acting on their decisions without being hampered by excess regret or conflict. However, if a person makes a poor decision and then reduces the dissonance associated with the decision, he/she will persist in acting on the decision when it might be advantageous to disengage. The action-based model proposes that dissonance reduction, while not always functional, is functional more often than not. In the majority of cases, it is advantageous for persons to reduce dissonance, and act effectively on their decisions. The dissonance-reduction mechanism functions to override continued psychological conflict that would potentially interfere with effective action.

We propose that the action-based model provides an explanation of the underlying, basic motivation behind dissonance processes. The action-based model assumes that, in most cases, dissonance processes are behaviorally adaptive. Dissonance reduction primarily functions to facilitate effective action. Organisms experience discomfort when they hold conflicting cognitions because conflicting cognitions impede effective action. This new way of thinking about dissonance processes, we hope, will stimulate research on dissonance theory and assist in connecting the large body of dissonance theory evidence with other research literatures.

REFERENCES

- Allen, J. J. B., Harmon-Jones, E., & Cavender, J. (2001). Manipulation of frontal EEG asymmetry through biofeedback alters self-reported emotional responses and facial EMG. *Psychophysiology*, *38*, 685–693.
- Amodio, D. M., Devine, P. G., & Harmon-Jones, E. (2007). A dynamic model of guilt: Implications for motivation and self-regulation in the context of prejudice. *Psychological Science*, *18*, 524–530.
- Amodio, D. M., Devine, P. G., & Harmon-Jones, E. (2008). Individual differences in the regulation of intergroup bias: The role of conflict monitoring and neural signals for control. *Journal of Personality and Social Psychology*, *94*, 60–74.
- Amodio, D. M., Harmon-Jones E., Devine P. G., Curtin J. J., Hartley S., & Covert, A. (2004). Neural signals for the detection of unintentional race bias. *Psychological Science*, *15*, 88–93.
- Amodio, D. M., Master, S. L., Yee, C. M., & Taylor, S. E. (2008). Neurocognitive components of behavioral inhibition and activation systems: Implications for theories of self-regulation. *Psychophysiology*, *45*, 11–19.
- Amodio, D. M., Shah, J. Y., Sigelman, J., Brazy, P. C., & Harmon-Jones, E. (2004). Implicit regulatory focus associated with resting frontal cortical asymmetry. *Journal of Experimental Social Psychology*, *40*, 225–232.
- Aronson, E. (1969). The theory of cognitive dissonance: A current perspective. In L. Berkowitz (Ed.), *Advances in experimental social psychology* (Vol. 4, pp. 1–34). New York: Academic Press.
- Aronson, E. (1999). Dissonance, hypocrisy, and the self concept. In E. Harmon-Jones & J. Mills (Eds.), *Cognitive dissonance: Progress on a pivotal theory in social psychology* (pp. 103–126). Washington, DC: American Psychological Association.
- Aronson, J., Cohen, G., & Nail, P. R. (1999). Self-affirmation theory: An update and appraisal. In E. Harmon-Jones & J. Mills (Eds.), *Cognitive dissonance: Progress on a pivotal theory in social psychology* (pp. 127–148). Washington, DC: American Psychological Association.
- Beauvois, J. L., & Joule, R. V. (1996). *A radical dissonance theory*. London: Taylor & Francis.
- Beauvois, J. L., & Joule, R. V. (1999). A radical point of view on dissonance theory. In E. Harmon-Jones & J. Mills (Eds.), *Cognitive dissonance: Progress on a pivotal theory in social psychology* (pp. 43–70). Washington, DC: American Psychological Association.
- Beckmann, J., & Irle, M. (1985). Dissonance and action control. In J. Kuhl & J. Beckmann (Eds.), *Action control: From cognition to behavior* (pp. 129–150). Berlin, Germany: Springer-Verlag.
- Berkowitz, L. (1984). Some effects of thoughts on anti- and prosocial influences of media events: A cognitive-neoassociation analysis. *Psychological Bulletin*, *95*, 410–427.
- Botvinick, M. M., Braver, T. S., Barch, D. M., Carter, C. S., & Cohen, J. D. (2001). Conflict monitoring and cognitive control. *Psychological Review*, *108*, 624–652.
- Botvinick, M. M., Nystrom, L. E., Fissel, K., Carter, C. S., & Cohen, J. D. (1999). Conflict monitoring versus selection-for-action in anterior cingulate cortex. *Nature*, *402*, 179–181.
- Brehm, J. W. (1956). Postdecision changes in the desirability of alternatives. *Journal of Abnormal and Social Psychology*, *52*, 384–389.
- Brehm, J. W. (1999). The intensity of emotion. *Personality and Social Psychology Review*, *3*, 2–22.
- Brehm, J. W., & Cohen, A. R. (1962). *Explorations in cognitive dissonance*. New York: Wiley.

AU: Work not cited in text. Pls. add text cite or delete this ref.

AU: Not cited in text.

- Bunge, S. A. (2004). How we use rules to select actions: A review of evidence from cognitive neuroscience. *Cognitive, Affective, and Behavioral Neuroscience*, 4, 564–579.
- Carter, C. S., Braver, T. S., Barch, D. M., Botvinick, M. M., Noll, D., & Cohen, J. D. (1998). Anterior cingulate cortex, error detection, and the online monitoring of performance. *Science*, 280, 747–749.
- Cooper, J., & Fazio, R. H. (1984). A new look at dissonance theory. In L. Berkowitz (Ed.), *Advances in experimental social psychology* (Vol. 17, pp. 229–264). Orlando, FL: Academic Press.
- Cooper, J., & Worchel, S. (1970). Role of undesired consequences in arousing cognitive dissonance. *Journal of Personality and Social Psychology*, 16, 199–206.
- Dijksterhuis, A., & Bargh, J. A. (2001). The perception-behavior expressway: Automatic effects of social perception on social behavior. In M. P. Zanna (Ed.), *Advances in experimental social psychology* (Vol. 33, pp. 1–40). San Diego, CA: Academic Press.
- Egan, L. C., Santos, L. R., & Bloom, P. (2007). The origins of cognitive dissonance: Evidence from children and monkeys. *Psychological Science*, 18(11), 978–983.
- Elkin, R. A., & Leippe, M. R. (1986). Physiological arousal, dissonance, and attitude change: Evidence for a dissonance-arousal link and a “don’t remind me” effect. *Journal of Personality and Social Psychology*, 51, 55–65.
- Elliot, A. J., & Devine, P. G. (1994). On the motivation nature of cognitive dissonance: Dissonance as psychological discomfort. *Journal of Personality and Social Psychology*, 67, 382–394.
- Eriksen, B. A., & Eriksen, C. W. (1974). Effects of noise letters upon the identification of a target letter in a nonsearch task. *Perception & Psychophysics*, 16, 143–149.
- Festinger, L. (1957). *A theory of cognitive dissonance*. Stanford, CA: Stanford University Press.
- Festinger, L., & Carlsmith, J. M. (1959). Cognitive consequences of forced compliance. *Journal of Abnormal and Social Psychology*, 58, 203–210.
- Fiske, S. T. (1992). Thinking is for doing: Portraits of social cognition from daguerreotype to laserphoto. *Journal of Personality and Social Psychology*, 63, 877–889.
- Frijda, N. H. (1986). *The emotions* (Vol.). New York: Cambridge University Press.
- Gerhing, W. J., Goss, B., Coles, M. G. H., Meyer, D. E., & Donchin, E. (1993). A neural system for error detection and compensation. *Psychological Science*, 4, 385–390.
- Gibson, J. J. (1966). *The senses considered as perceptual systems*. Boston: Houghton Mifflin.
- Gibson, J. J. (1979). *The ecological approach to visual perception*. Boston: Houghton Mifflin.
- Gilbert, D. T., & Ebert, J. E. J. (2002). Decisions and revisions: The affective forecasting of changeable outcomes. *Journal of Personality and Social Psychology*, 82, 503–514.
- Gollwitzer, P. M. (1990). Action phases and mind-sets. In E. T. Higgins & R. M. Sorrentino (Eds.), *Handbook of motivation and cognition: Foundations of social behavior* (Vol. 2, pp. 53–92). New York: Guilford Press.
- Gollwitzer, P. M., & Bayer, U. (1999). Deliberative versus implemental mindsets in the control of action. In S. Chaiken & Y. Trope (Eds.), *Dual-process theories in social psychology* (pp. 403–422). New York: Guilford Press.
- Gollwitzer, P. M., & Sheeran, P. (2006). Implementation intentions and goal achievement: A meta-analysis of effects and processes. In M. P. Zanna (Ed.), *Advances in experimental social psychology* (Vol. 38, pp. 69–119). San Diego, CA: Academic Press.
- Hajcak, G., & Foti, D. (2008). Errors are aversive: Defensive motivation and the error-related negativity. *Psychological Science*, 19, 103–108.
- Hajcak, G., McDonald, N., & Simons, R. F. (2003). To err is autonomic: Error-related brain potentials, ANS activity, and posterror compensatory behavior. *Psychophysiology*, 40, 895–903.
- Hajcak, G., McDonald, N., & Simons, R. F. (2004). Error-related psychophysiology and negative affect. *Brain and Cognition*, 56, 189–197.

AU: Not cited in text.

AU: Not cited in text.

AU: this work is not cited in text; if it stays, please provide volume no.

- Harmon-Jones, E. (1999). Toward an understanding of the motivation underlying dissonance effects: Is the production of aversive consequences necessary to cause dissonance? In E. Harmon-Jones & J. Mills (Eds.), *Cognitive dissonance: Progress on a pivotal theory in social psychology* (pp. 71–99). Washington, DC: American Psychological Association.
- Harmon-Jones, E. (2000a). A cognitive dissonance theory perspective on the role of emotion in the maintenance and change of beliefs and attitudes. In N. H. Frijda, A. R. S. Manstead, & S. Bem (Eds.), *Emotions and beliefs* (pp. 185–211). Cambridge, England: Cambridge University Press.
- Harmon-Jones, E. (2000b). The role of affect in cognitive dissonance processes. In J. Forgas (Ed.), *Handbook of affect and social cognition* (pp. 237–255). Mahwah, NJ: Erlbaum.
- Harmon-Jones, E. (2000c). Cognitive dissonance and experienced negative affect: Evidence that dissonance increases experienced negative affect even in the absence of aversive consequences. *Personality and Social Psychology Bulletin*, *26*, 1490–1501.
- Harmon-Jones, E. (2000d). An update on dissonance theory, with a focus on the self. In A. Tesser, R. Felson, & J. Suls (Eds.), *Psychological perspectives on self and identity* (pp. 119–144). Washington, DC: American Psychological Association.
- Harmon-Jones, E. (2003). Clarifying the emotive functions of asymmetrical frontal cortical activity. *Psychophysiology*, *40*, 838–848.
- Harmon-Jones, E. (2004). Contributions from research on anger and cognitive dissonance to understanding the motivational functions of asymmetrical frontal brain activity. *Biological Psychology*, *67*, 51–76.
- Harmon-Jones, E., & Allen, J. J. B. (1997). Behavioral activation sensitivity and resting frontal EEG asymmetry: Covariation of putative indicators related to risk for mood disorders. *Journal of Abnormal Psychology*, *106*, 159–163.
- Harmon-Jones, E., & Allen, J. J. B. (1998). Anger and prefrontal brain activity: EEG asymmetry consistent with approach motivation despite negative affective valence. *Journal of Personality and Social Psychology*, *74*, 1310–1316.
- Harmon-Jones, E., Brehm, J. W., Greenberg, J., Simon, L., & Nelson, D. E. (1996). Evidence that the production of aversive consequences is not necessary to create cognitive dissonance. *Journal of Personality and Social Psychology*, *70*, 5–16.
- Harmon-Jones, E., Gerdjikov, T., & Harmon-Jones, C. (2008). The effect of induced compliance on relative left frontal cortical activity: A test of the action-based model of dissonance. *European Journal of Social Psychology*, *38*, 35–45.
- Harmon-Jones, E., & Harmon-Jones, C. (2002). Testing the action-based model of cognitive dissonance: The effect of action-orientation on post-decisional attitudes. *Personality and Social Psychology Bulletin*, *28*, 711–723.
- Harmon-Jones, E., Harmon-Jones, C., Fearn, M., Sigelman, J. D., & Johnson, P. (2008). Action orientation, relative left frontal cortical activation, and spreading of alternatives: A test of the action-based model of dissonance. *Journal of Personality and Social Psychology*, *94*, 1–15.
- Harmon-Jones, E., & Mills, J. (1999). *Cognitive dissonance: Progress on a pivotal theory in social psychology*. Washington, DC: American Psychological Association.
- Harmon-Jones, E., Peterson, H., & Vaughn, K. (2003). The dissonance-inducing effects of an inconsistency between experienced empathy and knowledge of past failures to help: Support for the action-based model of dissonance. *Basic and Applied Social Psychology*, *25*, 69–78.
- Harmon-Jones, E., & Sigelman, J. (2001). State anger and prefrontal brain activity: Evidence that insult-related relative left-prefrontal activation is associated with experienced anger and aggression. *Journal of Personality and Social Psychology*, *80*, 797–803.

AU: Not cited in text. If this ref. and the following ref. are deleted, please re-letter Harmon-Jones (2000c) as (2000a) and (2000d) as (2000b). If text cites are added, Harmon-Jones (2000) refs. will have to be re-alphabetized by title and re-lettered, here and in text.

AU: Not cited in text.

AU: Not cited in text.

- James, W. (1950). *The principles of psychology*. New York: Dover. (Original work published 1890)
- Jones, E. E., & Gerard, H. B. (1967). *Foundations of social psychology*. New York: Wiley.
- Kamiya, J. (1979). Autoregulation of the EEG alpha rhythm: A program for the study of consciousness. In S. A. E. Peper & M. Quim (Eds.), *Mind/body integration: Essential readings in biofeedback* (pp. 289–297). New York: Plenum Press.
- Kerns, J. G., Cohen, J. D., MacDonald, A. W., Cho, R. Y., Stenger, V. A., & Carter, C. S. (2004, February 13). Anterior cingulate conflict monitoring and adjustments in control. *Science*, *303*, 1023–1026.
- Kiehl, K. A., Liddle, P. F., & Hopfinger, J. B. (2001). Error processing and the rostral anterior cingulate: An event-related fMRI study. *Psychophysiology*, *37*, 216–223.
- Kotchoubey, B., Kübler, A., Strehl, U., Flor, H., & Birbaumer, N. (2002). Can humans perceive their brain states? *Consciousness and Cognition*, *11*, 98–113.
- Kuhl, J. (1984). Volitional aspects of achievement motivation and learned helplessness: Toward a comprehensive theory of action-control. In B. A. Maher (Ed.), *Progress in experimental personality research* (Vol. 13, pp. 99–171). New York: Academic Press.
- Lawrence, D. H., & Festinger, L. (1962). *Deterrents and reinforcement*. Stanford, CA: Stanford University Press.
- Losch, M. E., & Cacioppo, J. T. (1990). Cognitive dissonance may enhance sympathetic tonus, but attitudes are changed to reduce negative affect rather than arousal. *Journal of Experimental Social Psychology*, *26*, 289–304.
- MacDonald, W. III, Cohen, J. D., & Stenger, V. A., Carter, C. S. (2000). Dissociating the role of the dorsolateral prefrontal and anterior cingulate cortex in cognitive control. *Science*, *288*, 1835–1838.
- McArthur, L. Z., & Baron, R. M. (1983). Toward an ecological theory of social perception. *Psychological Review*, *90*, 215–238.
- McGregor, I., Newby-Clark, I. R., & Zanna, M. P. (1999). “Remembering” dissonance: Simultaneous accessibility of inconsistent cognitive elements moderates epistemic discomfort. In E. Harmon-Jones & J. Mills (Eds.), *Cognitive dissonance: Progress on a pivotal theory in social psychology* (pp. 325–353). Washington, DC: American Psychological Association.
- Miller, E. K., & Cohen, J. D. (2001). An integrative theory of prefrontal cortex function. *Annual Review of Neuroscience*, *24*, 167–202.
- Petersen, S. E., Fox, P. T., Posner, M. I., Mintun, M., & Raichle, M. E. (1988). Positron emission tomographic studies of the cortical anatomy of single-word processing. *Nature*, *331*, 585–589.
- Pizzagalli, D. A., Sherwood, R. J., Henriques, J. B., & Davidson, R. J. (2005). Frontal brain asymmetry and reward responsiveness: A source-localization study. *Psychological Science*, *16*, 805–813.
- Rabbie, J. M., Brehm, J. W., & Cohen, A. R. (1959). Verbalization and reactions to cognitive dissonance. *Journal of Personality*, *27*, 407–417.
- Robinson, R. G., & Downhill, J. E. (1995). Lateralization of psychopathology in response to focal brain injury. In R. J. Davidson & K. Hugdahl (Eds.), *Brain asymmetry* (pp. 693–711). Cambridge, MA: MIT Press.
- Sherman, D. K., & Cohen, G. L. (Eds.). (2006). The psychology of self-defense: Self-affirmation theory. In M. P. Zanna (Ed.), *Advances in experimental social psychology* (Vol. 38, pp. 183–242). San Diego, CA: Academic Press.
- Sigall, H., & Mills, J. (1998). Measures of independent variables and mediators are useful in social psychology experiments: But are they necessary? *Personality and Social Psychology Review*, *2*, 218–226.
- Simon, L., Greenberg, J., & Brehm, J. W. (1995). Trivialization: The forgotten mode of dissonance reduction. *Journal of Personality and Social Psychology*, *68*, 247–260.

Note: Book-internal chapters do not appear in refs. list (per APA style).

- Siniatchkin, M., Kropp, P., & Gerber, W.-D. (2000). Neurofeedback—The significance of reinforcement and the search for an appropriate strategy for the success of self-regulation. *Applied Psychophysiology and Biofeedback*, *25*, 167–175.
- Smith, E. R., & Semin, G. R. (2004). Socially situated cognition: Cognition in its social context. In M. P. Zanna (Ed.), *Advances in experimental social psychology* (Vol. 36, pp. 53–117). San Diego, CA: Academic Press.
- Spencer, S. J., Zanna, M. P., & Fong, G. T. (2005). Establishing a causal chain: Why experiments are often more effective than mediational analyses in examining psychological processes. *Journal of Personality and Social Psychology*, *89*, 845–851.
- Steele, C. M. (1988). The psychology of self-affirmation: Sustaining the integrity of the self. In L. Berkowitz (Ed.), *Advances in experimental social psychology* (Vol. 21, pp. 261–302). San Diego, CA: Academic Press.
- Steele, C. M., Southwick, L. L., & Critchlow, B. (1981). Dissonance and alcohol: Drinking your troubles away. *Journal of Personality and Social Psychology*, *41*, 831–846.
- Steele, C. M., Spencer, S. J., & Lynch, M. (1993). Self-image resilience and dissonance: The role of affirmational resources. *Journal of Personality and Social Psychology*, *64*, 885–896.
- Stone, J. (2003). Self-consistency for low self-esteem in dissonance processes: The role of self-standards. *Personality and Social Psychology Bulletin*, *29*, 846–858.
- Stone, J., & Cooper, J. (2003). The effect of self-attribute relevance on how self-esteem moderates attitude change in dissonance processes. *Journal of Experimental Social Psychology*, *39*, 508–515.
- Stone, J., Wiegand, A. W., Cooper, J., & Aronson, E. (1997). When exemplification fails: Hypocrisy and the motive for self-integrity. *Journal of Personality and Social Psychology*, *72*, 54–65.
- Stroop, J. R. (1935). Studies of interference in serial verbal reactions. *Journal of Experimental Psychology*, *18*, 643–662.
- Taylor, S. E., & Gollwitzer, P. M. (1995). Effects of mindset on positive illusions. *Journal of Personality and Social Psychology*, *69*, 213–226.
- van Veen, V., & Carter, C. S. (2006). Conflict and cognitive control in the brain. *Current Directions in Psychological Science*, *15*, 237–240.
- van Veen, V., Krug, M. K., Schooler, J. W., & Carter, C. S. (2007). *The neurobiology of attitude change: Cognitive dissonance engages anterior cingulate conflict monitoring*. Unpublished manuscript.
- Wicklund, R. A., & Brehm, J. W. (1976). *Perspectives on cognitive dissonance*. Hillsdale, NJ: Erlbaum.
- Zanna, M. P., & Cooper, J. (1974). Dissonance and the pill: An attribution approach to studying the arousal properties of dissonance. *Journal of Personality and Social Psychology*, *29*, 703–709.

AU: Not cited in text.

AU: Not cited in text.

ACKNOWLEDGMENTS

The work in this article was supported by a National Science Foundation Grant (BCS-9910702). Correspondence concerning this article should be addressed to Eddie Harmon-Jones, Texas A&M University, Department of Psychology, 4235 TAMU, College Station, TX 77843, or via the Internet to eddiehj@gmail.com.

