

Dissonance Arousal: Physiological Evidence

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Two experiments were conducted to determine whether cognitive dissonance is accompanied by physiological arousal. In Experiment 1, a standard induced compliance paradigm was replicated and was found to produce the expected pattern of attitude change. In Experiment 2, physiological recordings were obtained within the same paradigm. Subjects who wrote counterattitudinal essays under high-choice conditions displayed significantly more nonspecific skin conductance responses than other subjects, but they did not change their attitudes. The results are interpreted as support for viewing dissonance as an arousal process. The results are also interpreted as indicating that the subjects misattributed their arousal to the physiological recording device. The significance of the findings for dissonance theory, misattribution phenomena, and social psychophysiological research methods is discussed.

In his theory of cognitive dissonance, Festinger (1957) stated that an individual who holds inconsistent cognitions experiences a "psychologically uncomfortable" (p. 3) tension state which that person is motivated to alleviate. A large body of evidence (see Wicklund & Brehm, 1976, for a review) has supported Festinger's claim that counterattitudinal behavior may lead to the arousal of dissonance and a subsequent change in attitudes. Linder, Cooper, and Jones (1967) further demonstrated that such attitude change occurs only when the individual perceives that the attitude-discrepant behavior has been freely performed. Whether such attitude change is motivated by a desire to reduce negative arousal has been a major issue in dissonance research (Cooper, Zanna, & Taves, 1978; Fazio & Cooper, 1983; Higgins, Rhodewalt, & Zanna, 1979). The current research explores the possibility that dissonance arousal is accompanied by actual physiological arousal.

Previous investigations of the possible arousal properties of dissonance have employed both direct (psychophysiological) and indirect research techniques. Research em-

ploying an indirect approach has generally applied one of two models of emotion to the dissonance process. Following Festinger's original emphasis on the drive aspects of dissonance, research by Waterman (1967; Waterman & Katkin, 1967), Cottrell (Cottrell & Wack, 1967), and others demonstrated that dissonance indeed displays some drivelike qualities. Pallak and Pittman (1972), for example, demonstrated that dissonance induction led to dominant responding on a Stroop Color-Word Interference Test. Research examining dissonance arousal within the energizing-drive framework has been summarized by Kiesler and Pallak (1976). In general, this body of research provides only suggestive evidence that dissonance processes are associated with the generation and reduction of arousal.

A second model of emotion was utilized by Cooper and his associates (see Fazio & Cooper, 1983, for a review), who examined dissonance arousal within the framework of Schachter and Singer's (1962) two-factor theory of emotion. In 1974, Zanna and Cooper reported that subjects who were administered a placebo they believed was arousing did not change their attitudes following counterattitudinal behavior. Similar studies employing the induced compliance paradigm (e.g. Cooper, Fazio, & Rhodewalt, 1978; Fazio, Zanna, & Cooper, 1977) have supported the conclusion that the misattribution of arousal to an external source attenuates the attitude change produced by dissonance.

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More direct evidence that arousal is necessary for attitude change within the induced compliance paradigm was provided by a study conducted by Cooper, Zanna, and Taves (1978), which employed real drugs as well as placebos. In their study, subjects wrote counterattitudinal essays after ingesting a sedative, a placebo, or an amphetamine. As usual, subjects were given either very much or very little freedom regarding their decision to write the essay. All subjects were told that they had been given a placebo. The investigators found that attitude change in the high-choice conditions was increased by the amphetamine and attenuated by the sedative. Perhaps most interesting, however, were the data obtained from subjects in the low-choice-amphetamine condition. Even though these subjects had written their essays under low-choice rather than high-choice conditions, they nevertheless changed their attitudes in the direction of the essay. The Cooper, Zanna, and Taves study thus suggested that cognitive dissonance is accompanied by physiological arousal by demonstrating that the effects of an amphetamine can mimic the effects produced by dissonance. Furthermore, the magnitude of attitude changes under high-choice conditions depended on the level of pharmacologically induced arousal.

What is still needed is direct measurement of physiological arousal within the induced compliance paradigm. The current research sought to accomplish this by obtaining psychophysiological recordings throughout a replicated dissonance experiment. It was predicted that a relatively heightened level of autonomic arousal would be manifested by subjects who freely chose to perform counterattitudinal behaviors.

Previous Research on Physiological Parameters

The notion that cognitive dissonance may be accompanied by some kind of physiological arousal is not a new one. An intriguing study utilizing an alternate paradigm of dissonance research—free choice—was conducted by Gerard (1967). The interpretation of this study, however, is problematic. Subjects rank ordered 12 paintings according to preference before being given the opportunity to choose a print of one of them as a gift from the experimenter.

For subjects in the dissonance condition, the choice was a difficult one; they had to choose between their third and fourth rankings. Other subjects were presented with a choice between the third- and eighth-ranked paintings. Dissonance theory predicts that postdecisional regret will be experienced by individuals who select one of two similarly valued alternatives. Dissonance reduction is said to occur when an increase in the judged value of the chosen alternative and/or a decrease in the judged value of the foregone alternative occurs. In the Gerard study, a plethysmograph was used to monitor each subject's pulse amplitude. Gerard hypothesized that the stress of postdecisional dissonance would be manifested by a decrease in pulse amplitude (indicating a constriction of blood vessels). Although the predicted differences on the pulse amplitude measure were obtained, evidence of a dissonance process was weak; a statistically significant spreading of reassessed preferences was not displayed by subjects in the dissonance condition. Furthermore, six of the seven subjects whose data were eliminated from the analysis were in the dissonance condition. These subjects had displayed choice inversions; that is, they selected prints of paintings that previously had been rated as the less preferred of the two paintings offered. As the investigator noted, a self-selection bias is apparent (Gerard, 1967, p. 99).

Previous attempts to correlate the dissonance state within the induced compliance paradigm with physiological variables have been fraught with methodological flaws (see Fazio & Cooper, 1983, for a thorough review). In unpublished experiments by Buck (1970) and Gleason and Katkin (Note 1), electrodermal activity and heart rate were recorded in contexts that employed unconventional procedures for inducing or manipulating dissonance. Buck manipulated dissonance by varying the intensity of shocks that subjects (under high-choice conditions) were required to deliver to an innocent victim. As predicted, subjects who delivered intense shocks showed the greatest increase in skin conductance. No differences, however, were found on any of the relevant attitude measures.

Unlike the Buck study, Gleason and Katkin (Note 1) found differences between dissonant- and consonant-condition subjects on heart rate

and skin conductance measures. In their study, subjects were instructed to engage in proattitudinal or counterattitudinal thought. Although attitude change was manifested by subjects in the dissonance condition, it is not clear that factors known to be crucial for dissonance arousal, including decision freedom, were present. A third unpublished study (Quanty & Becker, Note 2) found that a manipulation of decision freedom alone could produce differences in electrodermal activity, but no independent evidence was provided that dissonance processes were at work.

McMillen and Geiselman (1974) attempted to find some relationship between electroencephalogram alpha wave activity and exposure to a dissonance manipulation used by Freedman (1963). Some subjects (high-justification condition) were told that their participation in an anticipated experiment would be valuable, whereas others (low-justification condition) were told that their data would be superfluous. The investigators hypothesized that since high alpha activity is associated with relaxation, subjects exposed to the supposedly dissonance-arousing conditions of low justification would show less alpha activity than other subjects. This prediction was confirmed. Unlike the Freedman study, however, no measures of relevant attitudes toward the boring experimental task were taken. In addition, decision freedom was neither measured nor manipulated.

In sum, the results of the studies described above are not inconsistent with the notion that dissonance may be accompanied by some changes in physiological activity. Two main flaws are apparent, however, throughout this research. First, standard dissonance manipulations were typically not employed. Neither Gleason and Katkin nor McMillen and Geiselman, for example, seem to have provided the conditions necessary to produce cognitive dissonance. Second, in most of the studies, no independent evidence was provided that the procedures employed were effective in producing cognitive dissonance. The latter criticism is particularly relevant to the studies conducted by Gerard, Quanty and Becker, and Buck. The strategy employed in the current study, then, was to employ an experimental paradigm that had demonstrated dissonance-

inducing qualities within the relevant subject population.

Selection of Physiological Measures

The history of physiological measures in social psychology has not been an illustrious one, although phenomena such as electrodermal activity (e.g., galvanic skin response) have been measured frequently although, at times, haphazardly (see Schwartz & Shapiro, 1973, and Cacioppo & Petty, 1983, for reviews). Nevertheless, recent advances in psychophysiological measurement technique have been considerable (cf. Venables & Christie, 1980), and this is particularly true in the case of measures of sympathetic arousal (Masling, Price, Goldband, & Katkin, 1981). Burch and Greiner (1960) were the first investigators to demonstrate a monotonic relationship between pharmacologically manipulated arousal and frequency of spontaneous, or nonspecific, electrodermal responses. The measurement of nonspecific electrodermal activity as an index of autonomic arousal relatively free of artifact has since gained wide support among psychophysiologicals (Edelberg & Muller, 1978; Katkin, 1975; Szpiller & Epstein, 1976; see Masling et al., 1981, for a brief review). For these reasons, the primary measure of autonomic arousal selected for use in this study was the frequency of nonspecific skin conductance responses (SCRs). To have a more general measure of bodily activation, heart rate was also selected. Both heart rate and electrodermal activity can be recorded with minimum discomfort for the subject, and it was thought that this would allow a closer replication of a typical induced compliance paradigm.

Selection of Research Design

Since the misattribution of dissonance arousal to an external source can attenuate attitude change, and since earlier studies have failed to find attitude change when physiological measurements were taken, it is possible that the mere act of taking physiological measurements eliminates the attitude change that would otherwise be produced by cognitive dissonance. To avoid the ambiguities of previous research, it was critical in this study to obtain

independent evidence that the dissonance manipulations employed were effective and that lacking the presence of recording devices, they would produce attitude change.

Therefore, two experiments were conducted. In the first experiment, the same induced compliance procedure that was to be used in the psychophysiological experiment was tested for its effectiveness in producing dissonance-induced attitude change. In the second experiment, the identical induced compliance procedure was employed while subjects' skin conductance responses and heart rates were recorded. Both experiments manipulated decision freedom and the consistency between the subjects' original attitudes and the opinions advocated in the essay. Thus, in both experiments, subjects were assigned to one of three experimental conditions, high-choice counterattitudinal essay, high-choice consonant essay, and low-choice counterattitudinal essay. A consonant essay group was included to test whether decision freedom was physiologically arousing.

Experiment 1

Method

Subjects. Thirty male undergraduates enrolled at Princeton University participated in the study. All subjects had previously completed a 10-item attitudes questionnaire distributed in campus dormitories by a female research assistant 1-3 weeks prior to the experiment. The critical item asked respondents the extent to which they agreed or disagreed with the statement, "Alcohol use should be totally banned from the Princeton campus and eating clubs." Respondents who indicated disagreement by marking the 31-point scale to the right of the midpoint were contacted by telephone and recruited for the study. Subjects were paid \$2.50 for their participation in the experiment.

Procedure. Subjects were randomly assigned to one of the three experimental conditions: high-choice counterattitudinal essay, high-choice consonant essay, and low-choice counterattitudinal essay. When the subject arrived at the laboratory, the male experimenter explained that the university and local government were jointly examining an issue that had become a problem in the community—the enforcement of the new legal drinking age. The experimenter continued:

A survey of arguments on this issue has been suggested by a committee here on campus—the Committee on Campus-Borough Relations. The committee is currently discussing the use of alcohol by students on campus and in the eating clubs. Ever since the state of New Jersey raised the legal drinking age to nineteen, it has

been difficult for the university to maintain a consistent policy toward student alcohol use. A proposal to completely ban the use of alcohol by students on campus has been presented to the committee. Before making a recommendation, however, the committee would like to gather arguments on both sides of the issue. We have found that a good way of doing this is simply to ask people to list all the arguments they can think of that support a particular side of the issue.

Subjects in the two counterattitudinal essay conditions were asked to write strong and forceful arguments in support of the alcohol ban. Subjects in the consonant essay condition were asked to write arguments against the alcohol ban. All subjects were told that their arguments would be immediately forwarded to the Committee on Campus-Borough Relations.

Choice manipulation. Subjects in the high-choice conditions were given further information about the survey. The experimenter said:

Because this survey is part of a research project, we want to remind you that your participation is completely voluntary. We would appreciate your help, but we do want to let you know that it's completely up to you.

The experimenter then handed the subject a consent form that stated:

I understand the nature of the task I am being asked to perform. I am aware that my list of arguments is intended for use by the Princeton University Joint Committee on Campus-Borough Relations. I further understand that I will be paid \$2.50, regardless of whether or not I write, and allow release of, my list of arguments.

The subject was asked to sign and date the form and check one of two boxes to indicate whether he allowed his arguments to be released to the committee.

Subjects in the low-choice condition were merely told to begin writing the list of arguments when the experimenter gave the signal.

At the conclusion of the essay, the experimenter obtained each subject's attitude with a 1-item question identical to the question asked on the dormitory survey 1-3 weeks before. The appearance and format of the questionnaire were modified to lessen the likelihood that subjects would draw any connection between it and the dormitory survey. Subjects were also asked to rate the amount of choice they had regarding the decision to write or not write the essay. This item read, "How free did you feel to decline to write the essay?" This measure served as a manipulation check of the choice variable. To minimize their possible concerns with managing their impressions to the experimenter, subjects were asked to insert the consent form, essay, and their responses to these questions into an envelope addressed to the Committee on Campus-Borough Relations. The experimenter then announced that the experiment was over, and the subject was thoroughly debriefed.

Results

Choice manipulation check. Subjects were asked to rate their decision freedom on the

essay task on a 31-point scale, with higher numbers indicating greater freedom to decline writing the essay. Planned comparisons of mean responses on the choice measure revealed no difference between the two high-choice conditions, $F(1, 27) < 1$, and a significant difference between the two high-choice conditions ($M = 21.0$, counterattitudinal essay; $M = 21.8$, consonant essay) and the low-choice condition ($M = 9.9$), $F(1, 27) = 50.17, p < .01$.

Attitude measures. There were no differences among the three experimental groups on the attitude premeasure, $F(2, 27) < 1$. Pre-measure means were 23.1, high-choice counterattitudinal essay; 22.0 high-choice consonant essay; and 22.1 low-choice counterattitudinal essay.

An attitude change score for each subject was obtained by calculating the difference between dormitory survey prescores and attitude scores on the postessay measure. Mean attitude change scores from each of the three experimental conditions are shown in the first column of Table 1. Change is scored in the direction of the position advocated in the essay. The difference between the two nondissonance cells was not significant, $F(2, 27) < 1$, although these conditions differed significantly from the high-choice counterattitudinal essay condition, $F(1, 27) = 38.86, p < .01$, as indicated by a priori orthogonal contrasts. As predicted, subjects in the high-choice counterattitudinal essay (cognitive dissonance) condition showed more attitude change than subjects in the other two conditions.

Experiment 2

The first experiment demonstrated that the attitude issue selected and the procedure used

were effective in producing dissonance-induced attitude change. The second experiment obtained physiological recordings within the same procedure, with subjects drawn from the same population. Although the two experiments were not run concurrently, they were started and completed during the same semester.

Method

Subjects. Thirty male undergraduates who had completed the dormitory attitude survey participated. One subject was excused from completing the experiment because of illness. As in Experiment 1, all subjects had indicated disagreement with the proposed alcohol ban. These subjects were contacted by telephone and were offered \$2.50 for participation in an experiment examining the impact of simple mental and physical tasks on heart rate and electrical activity of the skin. Subjects were told that the study was being conducted by the physiology division of the psychology department.

Apparatus. Subjects were individually tested in a quiet room in which temperature was maintained between 21° and 23° centigrade. A Grass Model 7 polygraph recorded all physiological responses. Skin resistance was measured using a Grass Model 7P1F preamplifier. A constant current of 10 μ A was passed through Beckman Ag/AgCl electrodes filled with .05 M NaCl electrolyte (Johnson & Johnson's K-Y Jelly). Recording was bipolar, with electrodes attached to masked areas on the medial phalanx of the index and second fingers of the subject's nonpreferred hand.

Heart rate was recorded through a Grass Model 7P4DF preamplifier. Stainless steel plate electrodes were attached in Limb Lead II or III configuration, with the wrist electrode adjacent to the subject's nonpreferred hand. Beckman hypoallergenic electrode cream was used as the electrolyte.

Procedure. When the subject arrived at the laboratory, the male experimenter explained that the study was concerned with the physiological correlates of various mental and physical tasks. All subjects were told that they had been assigned to the mental-task-only group and would therefore be performing only cognitive tasks. Subjects were informed that their heart rate and the electrical activity of their skin would be recorded throughout the experiment. They were assured that no shocks would be administered and that the tasks they were asked to perform were not being used to test their mental ability. The experimenter

Table 1
Mean Attitude Change and Electrodermal Activity

Condition	Mean attitude change scores (Experiment 1)	Mean adjusted frequency skin conductance responses (Experiment 2)
High-choice counterattitudinal	7.2	8.1
High-choice consonant	2.4	4.6
Low-choice counterattitudinal	2.5	5.5

Note. Attitude change is scored in the direction of the position advocated in the essay.

further pointed out that although all subjects experienced some initial uneasiness associated with the recording situation, most found that they were able to ignore the apparatus once they began working on the assigned tasks.

After the electrodes were attached and the recording commenced, the experimenter informed the subject that the first task would be an anagram-solving task. The subject was provided with a 10-item list of scrambled words and given 2 minutes to solve as many as possible. This was the first of the two filler tasks that subjects performed prior to the essay task.

After terminating the anagram task, the experimenter told the subject that a 1-minute resting measure would be taken. After 30 sec of this rest period had transpired, the experimenter casually asked the subject how he felt and pointing to the strip chart, said:

It seems that the initial tension you had from being hooked up to the recorder is gone now.

This comment was included in the procedure in an attempt to attenuate the anticipated misattribution of dissonance arousal to the recording situation.

In the second filler task, the subject was given 3 minutes to recall and write down all of his activities the day before the experiment. This was followed by a 3-minute rest period. The physiological recordings taken during this 3-minute rest period provided the subject's baseline rate of response.

At this point the subject was randomly assigned to one of the three experimental conditions: high-choice counterattitudinal essay, high-choice consonant essay, and low-choice counterattitudinal essay. The experimenter then described the essay task as follows:

The task that we will ask you to do next is an essay task. The topic for this essay has been suggested by a committee here on campus—the Committee on Campus-Borough Relations. In return for their helping us to obtain a National Science Foundation research grant, we have agreed to gather some information for them in the course of our research. The committee is currently discussing the use of alcohol by students on campus and in the eating clubs.

The experimenter continued to explain the essay task in the same manner as in Experiment 1. Subjects in the two counterattitudinal essay conditions were requested or told to write as many forceful arguments as possible in support of the proposed ban on alcohol while consonant essay subjects were asked to write arguments opposing the ban.

The procedure employed for the manipulation of choice was identical to that used in Experiment 1.

Subjects were given 3 minutes to list arguments. As in Experiment 1, the subject was asked to insert the finished list in a campus mail envelope addressed to the Committee on Campus-Borough Relations. A 3-minute rest period followed. Physiological responses recorded during this postessay rest period were the primary dependent measure.

The subject was then asked to complete a single-item questionnaire, which he was told was part of the same university-sponsored survey of attitudes concerning the proposed ban on alcohol use. The same item used on the dormitory questionnaire from 1 to 3 weeks earlier served as the attitude postmeasure.

After the subject completed the attitude postmeasure

and inserted it into the envelope, a final 3-minute rest period ensued, after which the recorder was turned off. The subject was then administered a final post-experimental questionnaire. One item asked the subject to indicate on a 9-point scale how much choice he had to write or not write the list of arguments. This item served as a manipulation check of the choice variable. The subject was thanked for his participation and thoroughly debriefed. During debriefing, no subject expressed the suspicion that the dormitory survey was part of the experiment.

Results

Choice manipulation check. As in Experiment 1, orthogonal planned comparisons of mean responses on the measure of perceived choice revealed a significant difference between the two high-choice conditions ($M = 5.80$, counterattitudinal; $M = 6.88$, consonant) and the low-choice condition ($M = 3.70$), $F(1, 26) = 6.66$, $p < .05$. The difference between the two high-choice-condition means was not significant, $F(1, 26)$, $p < 1$.

Physiological measures. Skin conductance increases of .1 micromhos or greater were counted as responses (Edelberg, 1972). Because electrodermal activity was recorded in terms of resistance, pre- and postresponse levels were converted to conductance, and response amplitude was then compared to the criterion. Responses that occurred while the subject was talking or coughing were not counted.

Heart rate in beats per minute (BPM) was manually coded from the polygraph record. All coding of physiological data was performed blind to experimental condition.

An analysis of covariance (ANCOVA) of post-essay SCR frequency was performed with the 3-minute preessay rest measure as the covariate.¹ Orthogonal planned comparisons of the ANCOVA adjusted means were performed to test the main hypotheses. This analysis revealed no significant difference between the two nondissonance (high-choice consonant and low-choice counterattitudinal) cells, $F(1, 23) = 2.84$, indicating a lack of support for

¹ Separate slopes for the covariate were estimated within each experimental condition (see Siddle & Turpin, 1980, for a discussion of the application of analysis of covariance to physiological data). Although subjects in the three conditions displayed different baseline levels of electrodermal activity, the differences between these means were not statistically significant, $F(2, 26) < 1$.

the possibility that decision freedom per se is a sufficient condition for heightened arousal. A comparison of the high-choice counterattitudinal mean with the means of the high-choice consonant and low-choice counterattitudinal cells revealed a significant effect of experimental condition, $F(1, 23) = 37.44$, $p < .01$. Subjects in the high-choice counterattitudinal essay (cognitive dissonance) condition were more aroused after writing the essay than subjects in the other two conditions. Condition means of nonspecific SCR frequency during the postessay rest period are shown in Table 1.

An ANCOVA was conducted on heart rates recorded during the second 3-minute rest period. The differences between condition means were not significant, $F(2, 23) < 1$. The adjusted mean heart rates in each of the three cells were 70.7 (high-choice counterattitudinal), 72.1 (high-choice consonant), and 70.2 (low-choice counterattitudinal). The correlation between nonspecific SCR frequency and heart rate during the second rest period was nonsignificant ($r = .20$, $p < .30$).

Attitude measures. As in Experiment 1, the attitude prescores of subjects in the three experimental groups did not differ significantly from one another $F(2, 26) = 1.13$. Planned comparisons of attitude change scores detected no significant differences across experimental conditions, all $F_s < 1$. The grand mean of the attitude change scores was .2 on the 31-point scale. The mean length of the essays (number of words) did not differ significantly among the three conditions.

Discussion

The results of the present research confirm the hypothesis that dissonance arousal is accompanied by actual physiological arousal. Subjects who freely performed behaviors inconsistent with prior attitudes were shown to display heightened electrodermal activity. Previous research (Cooper, Zanna, & Taves, 1978) had shown that sedatives can attenuate and that amphetamines can augment attitude change. But it had not been shown that counterattitudinal behavior of subjects under free-choice conditions actually produced heightened autonomic arousal. This research provides such evidence and thus caps a body of

research supporting the arousal properties of dissonance.

In the second experiment, subjects in the high-choice counterattitudinal condition did not display any overall attitude change. Since the induced compliance procedure in Experiment 2 was a replication of that used in Experiment 1, the mere presence of the physiological recording device may have played a direct role in the prevention of attitude change. It seems likely then that subjects misattributed their heightened arousal to some aspect of the physiological recording situation. This misattribution explanation is supported by a wealth of previous evidence (see Cotton, 1981, and Fazio & Cooper, 1983, for reviews), indicating that the attribution of arousal to a source other than attitude-behavior discrepancy attenuates the attitude change otherwise motivated by dissonance arousal. The subtle mentioning by the experimenter of a possible alternative source of the subject's arousal is typically sufficient to precipitate this misattribution effect. In Gonzalez and Cooper (1976), for example, an experimenter simply suggested that "new fluorescent lighting" had made some subjects "feel very tense and uncomfortable" (p. 210). This suggestion alone was sufficient to significantly attenuate attitude change.

In the present study, subjects in Experiment 2 were told that many persons found psychophysiological recording procedures anxiety arousing. This was part of the experimenter's introductory script for subjects in all three conditions and was included to counter the possible fears of subjects with no prior exposure to psychophysiological research. Ironically, these calming words may have had the unintended effect of increasing the salience of the polygraph as a possible source of arousal.

Is attitude change motivated by a desire to reduce negative arousal? An alternative model consistent with the current results might view autonomic arousal as one consequence of cognitive dissonance, but not as the causal mediator in a chain of events leading to dissonance-induced attitude change. Taken alone, the present study does not demonstrate that autonomic arousal is a necessary condition for attitude change following induced compliance. Such a view is supported, however, when the current evidence is combined with data pro-

vided by the Cooper, Zanna, and Taves (1978) experiment. Those investigators demonstrated that attitude change can be significantly attenuated by the effects of a sedative. In that study, high-choice subjects who had ingested 30 mg of phenobarbital (but were told that it was a placebo) showed no more attitude change than subjects who had written essays under low-choice conditions after ingesting a real placebo. Thus, Cooper et al. provided evidence that arousal is a necessary condition for attitude change following induced compliance; the current study provides evidence that cognitive dissonance does produce such arousal.

Subjects in the current study who were forced to engage in a counterattitudinal behavior displayed less autonomic arousal than subjects who did so under high-choice conditions. Control theories, for example, reactance (Brehm, 1966; Brehm & Brehm, 1981), would suggest that forcing someone to engage in a particular behavior (i.e., limiting their freedom and control) might lead to a phenomenologically aversive state. It may be that behaviors performed in an effort to regain behavioral freedom are not preceded or accompanied by heightened arousal. Although the current experiment was not designed to test reactance or control theory predictions, future research might examine the psychophysiological parameters of the reactance state.

The discovery of a physiological correlate of dissonance arousal addresses the controversy surrounding alternative explanations for attitude change in the induced-compliance paradigm (Bem, 1967; Tedeschi, Schlenker, & Bonoma, 1971). The current study raises a further challenge to those explanations that do not incorporate some notion of arousal into their theoretical framework. Furthermore, these results question the explanation provided by impression management theorists (e.g., Gaes, Kalle, & Tedeschi, 1978) for the effects of bogus pipeline assessments of attitudes following induced compliance. Gaes et al. (1978) have argued that bogus pipeline procedures attenuate self-reported attitude change because of the experimenter's explicit and convincing demonstration that the polygraph can reliably measure subjects' real attitudes. In the present study, however, the experimenter never mentioned any "lie detection" capabilities of the physiological apparatus, nor was the apparatus

ever referred to as a polygraph. The current results suggest, then, that the lack of attitude change within the bogus pipeline/induced compliance paradigm of Tedeschi and his associates may be due to reasons other than impression management concerns.

Can impression management theory account for the present results? Tedeschi et al. (1971) originally stated that their theory "avoids assumptions about unpleasant tensions" (p. 693). A recent revision of the theory (Tedeschi & Rosenfeld, 1981), however, argues that subjects in induced compliance experiments "feel uncomfortable, embarrassed, and/or socially anxious" (p. 155). The revised impression management theory does not seem to differ from dissonance theory, then, in its predictions concerning arousal. Revised impression management theory merely replaces dissonance arousal with the concept of social anxiety, and it is not yet clear how the two concepts are to be differentiated empirically.

The differences between the results obtained from the two physiological measures are also informative, given recent advances in the understanding of factors that influence autonomic responses. In his review of the psychophysiological research literature, Hassett (1978) concludes his discussion of nonspecific, or spontaneous, skin conductance responses by pointing out that recent findings are "consistent with a growing body of evidence that spontaneous activity increases under emotional stress" (p. 17). By comparison, "tonic measurements of heart rate and blood pressure give us [only] an overall picture of the body's state of mobilization" (p. 51). Since tonic heart rate is a relatively insensitive measure of psychological discomfort, it is not surprising that spontaneous electrodermal activity was found to be a uniquely robust index of what Festinger (1957) referred to as the "psychological discomfort" (p. 2) of cognitive dissonance.

The results of this research also point to a possible methodological problem in social psychophysiological research. Since the apparatus used in such research can serve as salient misattributional stimuli, investigators should be cognizant of the problems arising from the occurrence of such phenomena. Future research should be directed toward manipulating experimentally the salience of re-

ording devices as a source of arousal. Such research will both further an understanding of experimental artifact in psychophysiology and enable the simultaneous examination of physiological arousal and dissonance-induced attitude change within subjects.

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