Control of Pain Motivation by Cognitive Dissonance

Abstract. *Responses by humans to painful electric shocks are significantly modified at subjective, behavioral, and physiological levels by verbal manipulations of degree of choice and justification for further exposure to the aversive stimuli. Pain perception, learning, and galvanic skin resistance are altered under these conditions of "cognitive dissonance," as they are by reductions in voltage intensity.*

Research on the "placebo problem" amply demonstrates that perception of pain may be influenced by psychological factors. One thorough survey (*1*) revealed that in nearly 100 independent studies of 29 different symptoms and sicknesses pain-reduction was achieved in an average of 27 percent of over 4500 cases of all types. In some studies the incidence of pain-reduction was as high as 75 percent, and in some a placebo was as effective as morphine.

While there is no clear understanding of the dynamics of a positive placebo reaction, the evidence suggests that experience of pain and other (aversive) motivational states may be influenced considerably by cognitive factors. Moreover, expectancies concerning future events (that is, that the "drug" will work and pain will be alleviated) can alter both psychological and physiological processes, thereby effecting changes in the way in which avoidance of pain motivates the individual.

This report describes one theoretical approach to the problem of control of motivational states by means of cognitive processes and an experimental study derived from this model which specifies several cognitive variables crucial in mediating pain-reduction.

Festinger's theory of cognitive dissonance (*2*) assumes a basic tendency toward consistency of cognitions about oneself and about the environment. When two or more relevant cognitive elements (or sets) are in a psychologically inconsistent relation dissonance is created. For example, the cognition, "I believe cigarette smoking causes cancer," and the cognition, "I am voluntarily continuing to smoke cigarettes," are dissonant if the person does not want to get cancer. Dissonance can arise from one's awareness that he is behaving in ways which do not follow from his beliefs, opinions, values, or motives and can be defined as a tension state which motivates behavior; behavior which is followed by a reduction in dissonance is reinforced.

Our present concern is application of this theory to a situation in which a person is induced to commit himself voluntarily to a state of deprivation or to an aversive stimulus. If a person has knowledge of unpleasantness of the situation and of his freedom to choose to avoid it, his agreeing to endure more of the situation is dissonant. Although such a commitment obviously requires some coercive force, in order for dissonance to be aroused it is necessary for the person to maintain his perception of having choice to do otherwise (and thus of having responsibility for consequences of the decision). The greater the coercive force exerted (in the form of justification, reward, or punishment), the more consistent will be the "discrepant" behavioral commitment, and the less the dissonance. The magnitude of dissonance, therefore, will be a function of the proportion of cognitions which are inconsistent with commitment and those which support the decision (*3*). Attempts to reduce dissonance will be in the nature of redefining the situation by adding new cognitions or modifying existing ones. When it is difficult to deny the reality of one's behavioral commitment, a more likely dissonance-reducing behavior should be modification of one's cognitions about the drive state. For example, if one "feels" less thirsty or hungry, commitment to further deprivation of water or food would be less dissonant. The total process of dissonance-reduction may lead to an alteration of both the cognitive and noncognitive components of any motivational state and thus the drive itself may be functionally lowered. If so, then various consummatory and physiological behaviors correlated with that motive, as well as subjective and instrumental reactions to it, should decrease.

To test these derivations from dissonance theory, we employed an experimental paradigm in which 80 male undergraduate subjects were tested individually in a two-phase experiment. After their thresholds for painful shock had been determined and they had learned a practice list of words without shock, subjects had to learn a list of nine words by the serial-anticipation method while being given two unavoidable painful shocks per trial until they reached the criterion (two successive errorless trials). The list was composed of sets of semantically similar words (*4*) so that under conditions of shock-induced high drive it took more trials to memorize the list because generalization rather than discrimination was facilitated.

Table 1. Mean perceived pain in relation to actual level of physical shock. An arbitrary scale of pain intensity was used to designate the perceived pain, and the numerical values were reported by the subjects. Scale values: 0, not painful; 20, slightly painful; 40, moderately painful; 60, very painful; 80, extremely painful; and 100, tremendously painful. The number of subjects in each group is shown in parentheses.

Mean shock (volts)	Perceived pain (values on arbitrary scale)		
	Part 1 of expt.*	Part 2 of expt.*	Difference
	Lo-Dis group (20)		
38.0	49.4	47.6	−1.8
	Hi-Dis group (20)		
49.5	46.0	36.8	−9.2
	Hi-Mod control group (15)		
44.6	46.0		
22.0		19.8	−26.2
	Hi-Hi control group (15)		
44.3	50.2	47.3	−2.9

* Part 1, precommitment, took place before the subject chose to continue the experiment; part 2, postcommitment, after the choice had been made.

Three groups of subjects were not given a choice of continuing to a second part of the experiment, which was the same as the first except for a list of matched words. For one of these no-choice control groups shock was maintained at a high level in both parts of the experiment (Hi-Hi); for the second group it was lowered to a moderate level (Hi-Mod), while the third group received low shock throughout the study, and this group was used only as a specific control for effects of shock level on learning (Lo-Lo).

As subjects in the dissonance conditions were preparing to leave after the first part of the experiment (since they had been led to expect that the experiment was complete), they were asked to volunteer (explicitly given a choice) for the second part, a comparable experiment. Two levels of dissonance were created by giving half of these subjects (Lo-Dis) various justifications for engaging in discrepant behavior in terms of its importance to the experimenter, to science, the subject, the space program, and so forth. On the other hand, subjects in the Hi-Dis condition were given minimum justification before making their choice; in fact, verbal manipulation was designed specifically to deny a subject the possibility of generating justifications like those provided for the Lo-Dis subjects. This was done to increase the likelihood that cognitive reevaluations would be in terms of aversiveness of the shock and not in terms of extrinsic value of participation. There was not a differential attrition (self-selected dropout) rate in the two dissonance groups. In both parts of the experiment the following dependent measures were obtained: a subjective estimate of painfulness of a sample of the shock to be given, learning performance, and galvanic skin resistance to the shocks.

Control subjects (not given a choice) are treated comparably to subjects in standard laboratory studies of motivation, and their behavior should be primarily under control of physical intensity of the shock. Similarly, Lo-Dis subjects, having been provided with cognitions which are consistent with their choice, have little need for generating a psychological reinterpretation of shock-induced motive. For these subjects also there should be a close correspondence between stimulus intensity and reactivity. On the other hand, Hi-Dis subjects must engage in a psychological process (not necessarily conscious) of reevaluating painfulness of the shock. If they do so effectively, they reduce the dissonance occasioned by commitment to more shock. Thus, they should behave similarly to the Hi-Mod subjects for whom shock voltage has been physically reduced.

Assessment of experimental manipulations, by means of a questionnaire after the experiments, revealed that we had been successful in creating the impression that dissonance groups had considerable choice in committing themselves to the second painful situation, while controls perceived that they had little choice ($p < .01$). Also, only the Lo-Dis group perceived that the importance of the "second experiment" was significantly greater than the first ($p < .05$). Therefore, the choice and justification conditions necessary for testing the dissonance theory hypothesis had been satisfied.

Table 1 presents data for subjective evaluation of painfulness of the sample shock in each part of the experiment. The Lo-Dis group, like the control group with high shock throughout, shows only a minor decrement due to adaptation. The control group, shifted from a high to a moderate level of shock, shows a corresponding shift in perception of pain and one that is quite veridical. Our attention centers upon the Hi-Dis group, which reports that the same high level of shock is less painful after commitment to more shock. The Hi-Mod group differs from all others by $p < .01$, while the Hi-Dis differs from the Hi-Hi and Lo-Dis groups by $p < .10$.

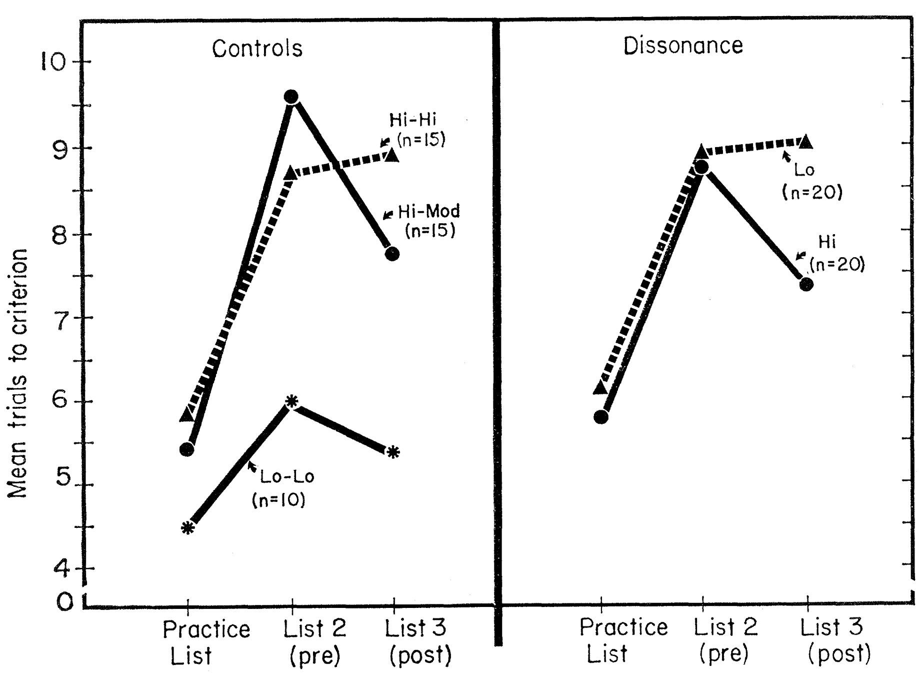

Fig. 1. Mean number of trials to reach criterion in a serial-anticipation learning task (the greater the number, the poorer the learning).

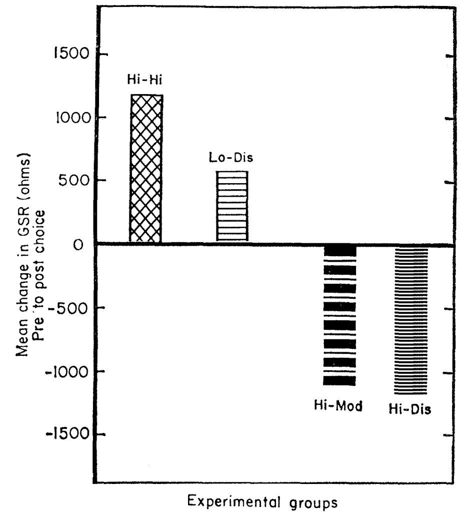

Fig. 2. Mean difference in galvanic skin response (GSR), expressed in ohms, from the first three shocks in word-list 2 (precommitment) to the first three shocks in word-list 3 (postcommitment). (Negative values indicate a reduction in GSR, while positive ones indicate an increase.)

Thus we have the predicted trend of dissonance influencing verbalization: many of the subjects said the shock "doesn't hurt so much." But did it really hurt less, or were they only role-playing? If there had in fact been a change in pain motive itself, then there should be a measurable effect upon learning behavior which is less amenable to conscious distortion and directly influenced by differences in strength of the shock stimulus which induces the pain motive.

Figure 1 reveals that for the three control groups the number of trials required to reach criterion is a function of the level of shock intensity; learning is poorer when shock level is higher and improves when shock level is reduced. These findings are reflected in kind by curves for dissonance groups which perform identically on the practice and premanipulation word lists. From this comparable base line, the groups diverge after commitment: the Lo-Dis group responds exactly like the Hi-Hi control, while the Hi-Dis group improves its performance in the same way as the Hi-Mod control group, in which shock is physically reduced by over 20 volts. These differences are statistically significant even when any initial differences in learning performance prior to commitment are covaried out (Hi-Dis versus Lo-Dis: $t = 2.38$, $p = .01$; control groups: $t = 2.03$, $p = .05$) (*5*).

These average group effects are not due to a few extreme subjects since

70 percent of the Hi-Dis group and 60 percent of the Hi-Mod group improve, while for the Lo-Dis and Hi-Hi groups there is improvement by only 40 percent and 33 percent, respectively. This effect is revealed in statistically significant fashion on a number of different analyses of the learning performance. Thus we have been able to bring the learning performance of Hi-Dis subjects under a similar degree of control with verbal-cognitive manipulations, as has been possible with the Hi-Mod group by use of variations in shock intensity.

Next we turn to physiological data to determine whether changes noted above in cognitions and learning extend to the noncognitive component of pain. Figure 2 presents mean galvanic skin resistance (GSR) data for each of the four main groups, subtracting a subject's GSR to each of the first three shocks in list 2 from each of the first three shocks in list 3. These results clearly parallel those obtained at each of the other two levels of analysis. The control group given high shock throughout shows an increase in physiological responsiveness to shocks, while, as expected, lowering the shock for the Hi-Mod group produces a decrement in GSR. What is dramatic, however, is the fact that the Lo-Dis group again mirrors the Hi-Hi control, while the Hi-Dis group behaves physiologically as if shocks (of constant intensity) did not hurt as much after commitment as they had before ($F = 3.05$, $p < .05$; Hi-Dis versus Lo-Dis: $t = 2.00$, $p < 05$; control groups: $t = 2.24$, $p < .05$). These differences remain significant even after covarying changes in basal skin resistance.

Evidence has been presented which appears to validate the position derived from the theory of cognitive dissonance that voluntary commitment for minimal justification to a behavior which is discrepant with a motivational state can effectively limit the impact of that motive upon behavior. Recent studies in our laboratory and elsewhere (*6*) lead us to believe that this motivational control is demonstrable across a wide range of primary and socially acquired drives.

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5. Data analyzed by IBM program BMDO6V; general linear hypothesis with contrasts.
6. This research was financed by an NSF grant (GS-226) to New York University (P. Zimbardo, principal investigator) and represents part of a larger project initiated by A. R. Cohen before his recent death. A fuller report of this study is in preparation and will appear as a monograph published by Scott, Foresman and Company, Chicago.

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Phenylketonuria in Rats: Reversibility of Behavorial Deficit

Abstract. *Phenylketonuria was induced in hooded rats by the conventional procedure of feeding excessive quantities of* L*-phenylalanine after weaning. Although this procedure reliably induced large, dose-dependent deficits in performance on a water maze, the behavioral deficits were completely eliminated after cessation of phenylalanine loading. These results cast doubt on the assumption that this animal preparation adequately simulates the irreversible intellectual impairments found in the child with late-detected phenylketonuria.*

Most laboratory investigations of phenylketonuria (PKU) have used an experimental animal preparation which has been more or less tacitly assumed to be an analog of human PKU in most important respects (*1*). One common procedure for producing this PKU preparation has been to administer excessive quantities of phenylalanine, of related compounds, or of both to weanling or older rats to simulate certain biochemical signs of PKU—mainly, elevated concentrations of phenylalanine in plasma and excessive excretion of phenylketones in urine. Although there is somewhat general agreement that this preparation provides an adequate model of PKU for biochemical studies, there is considerable disagreement about whether it also simulates the principal behavioral effect of PKU, that is, the irreversible and usually profound mental retardation seen in the child who has a late stage of untreated PKU (*1, 2*).

Recently several researchers have investigated the permanence of behavioral effects of phenylalanine loading begun during fetal or neonatal life (*3*). The net result of these experiments is equivocal. Our experiment was designed to determine whether a permanent behavioral deficit could be demonstrated in the weanling rat—the preparation most likely to be used by other investigators because of the obvious technical convenience of phenylalanine administration in the diet. Although it must be acknowledged that this preparation is less likely to sustain a permanent PKU-related behavioral deficit because of its relatively advanced stage of development, we considered the experiment important because of a singular omission in the growing body of literature on this problem: No one has adequately established in the same or related experiments both (i) that there are detrimental behavioral effects of PKU in animals (to establish the sensitivity of the behavioral test) and (ii) that these behavioral effects are eliminated after cessation of phenylalanine administration.

Our previous research has shown that rats fed phenylalanine-enriched diet (P-diet) from weaning perform less well than controls in a multiple-unit, water–T-maze learning task (*4*). A more recent and extensive experiment with pair-fed, littermate controls (*5*), concerned with the direct and interactive effects of dose of phenylalanine (3-, 5-, and 7-percent P-diets) and duration of administration (10, 25, 40, 55, and 70 postweaning days), revealed that P-diets induce deficits in maze performance which are directly related to dosage, regardless of sex or duration of administration (see *5*).

Although these experiments demonstrated large, reliable, and dose-dependent behavioral effects of chronic dietary administration of excessive phenylalanine, they did not answer the question of whether the behavioral deficits resulted merely from acute reactions to excessive phenylalanine or its related metabolites—an effect which should subside when feeding of P-diet is stopped. Accordingly, the present experiment was designed primarily to test the permanence of the behavioral deficit induced by P-diet administration begun at weaning.

A second goal of this experiment was to determine if P-diet administration during any one, or any combination of the first three 10-day intervals after weaning (20 to 29, 30 to 39, and