Contrast and the justification of effort

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When humans are asked to evaluate rewards or outcomes that follow unpleasant (e.g., high-effort) events, they often assign higher value to that reward. This phenomenon has been referred to as *cognitive dissonance* or *justification of effort*. There is now evidence that a similar phenomenon can be found in nonhuman animals. When demonstrated in animals, however, it has been attributed to contrast between the unpleasant high effort and the conditioned stimulus for food. In the present experiment, we asked whether an analogous effect could be found in humans under conditions similar to those found in animals. Adult humans were trained to discriminate between shapes that followed a high-effort versus a low-effort response. In test, participants were found to prefer shapes that followed the high-effort response in training. These results suggest the possibility that contrast effects of the sort extensively studied in animals may play a role in cognitive dissonance and other related phenomena in humans.

If humans have to work hard to obtain one reward but work less hard to obtain another reward (of equal objective value), one reward may be preferred over the other. For example, if a student received an A in organic chemistry (a presumably difficult course), would he or she value that grade more than an A in a course called "An Introduction to Golf" (physical education)?

According to cognitive dissonance theory (Festinger, 1957), humans should try to reduce the dissonance produced by the fact that the outcome from high effort is not better than that from low effort. They can attempt to justify their added effort (Aronson & Mills, 1959) by giving greater value to the outcome that follows greater effort than to the outcome that follows lesser effort. Because it is difficult to assure that different reinforcers have equal objective value, one can ask whether Stimulus X, which is followed by reinforcement and is preceded by a high-effort response, is preferred over Stimulus Y, which is followed by the same reinforcement but is preceded by a low-effort response. If this question were asked about behavior in a nonsocial context, it is not clear what result one would expect.

Traditional reinforcement theories suggest that the value of a stimulus should depend on its consequents (Hull, 1943), but such theories are generally silent on how antecedents affect stimulus value. Thus, variations in the effort required to obtain the stimulus would not be expected to affect its value. Alternatively, however, it is possible that a backward association may develop between the stimulus and the preceding effort (see Spetch, Wilkie, & Pinel, 1981). If this were the case, one might predict that a preference would develop for the stimulus that followed the lesser effort. In a similar vein, trials involving less effort may be perceived to occur in an eas-

ier context (Bouton, 1993) or they may be considered "better" trials, and one might expect conditioned stimuli occurring on those trials to be preferred over those occurring on high-effort trials.

A third possibility is that the value of each stimulus is judged relative to the effort required to obtain it. More specifically, if one has just expended great effort to obtain a stimulus associated with reinforcement, viewed from the perspective of one's somewhat aversive state, the value of that stimulus may be judged to be relatively greater than the value of a similar stimulus, viewed from the perspective of a less aversive state. One could interpret such an effect as a form of *contrast* (see Flaherty, 1996) or a form of *relief* (Church, LoLordo, Overmier, Solomon, & Turner, 1966). If this were the case, one might expect a preference to develop for the stimulus that follows greater effort. But as noted earlier, such a result would also be consistent with cognitive dissonance theory (Festinger, 1957).

For example, Aronson and Mills (1959) found that women who experienced a severe initiation to join a group rated the group more positively than did those who experienced a mild initiation. Others have proposed mechanisms besides cognitive dissonance to account for these results, such as the greater desire for affiliation when under stress (Schachter, 1959) and more recently, the greater need for affiliation during any initiation, independent of severity (Lodewijkx & Syroito, 2001). However, it is also possible that participants in such studies may have assumed (not inappropriately) that groups that are difficult to join (or that have an unpleasant initiation) have membership advantages over those that are easy to join. Thus, humans may come to assume that unpleasant or difficult tasks (especially in the context of more pleasant or easier alternatives) *will* result in greater rewards.

One way of reducing the likelihood that the experimental scenario elicits assumptions (based on past experience) about the differential magnitude of rewards is to

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ask whether similar effects can be found with nonhuman animals in nonsocial contexts. Clement, Feltus, Kaiser, and Zentall (2000) conducted such a study to determine the effect of prior effort on the value of the reward that followed. In their experiment, pigeons were trained on two simultaneous color discriminations. Presentation of each discrimination required the pigeon to first peck a white light. On half of the trials, a single peck to the white light turned it off and turned on one of the discriminations (e.g., responses to red were followed by food [S+], whereas responses to yellow were not [S-]). On the remaining trials, 20 pecks were required to the same white light to produce a different color discrimination (e.g., responses to green were followed by food [S+], whereas responses to blue were not [S-]). Following acquisition of the two discriminations, the pigeons were tested for their preference between the two positive (S+) stimuli¹ (i.e., red vs. green). Clement et al. found that the pigeons chose the S+ that had required 20 pecks to produce, by a 2-to-1 margin over the S+ that had required 1 peck to produce (see also Clement & Zentall, 2002). If such a result had been found with humans, it would likely be explained as an example of *cognitive dissonance* (i.e., rewards following less pleasant tasks are given greater value).

Clement et al. (2000) proposed that the effect obtained in their study might be attributed to contrast between the conditions at the end of the initial link (1 vs. 20 pecks) and the appearance of a discriminative stimulus that signaled reinforcement. In the example given, because the 20-peck requirement that resulted in the green stimulus should have been more aversive to the pigeon than was the single-peck requirement that resulted in the red stimulus, the appearance of the green stimulus may have been judged as a relatively greater improvement than the appearance of the red stimulus. Thus, preference for the green stimulus may have been the result of a within-trial contrast effect.

If within-trial contrast of the kind reported by Clement et al. (2000) is implicated in the cognitive dissonance phenomenon found in humans, one might be able to show similar contrast effects under conditions similar to those reported for pigeons. In the present experiment, we asked whether humans would show a preference similar to that shown by pigeons for a positive stimulus that was preceded by greater as opposed to lesser effort.

METHOD

Participants

Thirty-two undergraduates (7 males and 25 females) at the University of Kentucky volunteered to participate. All participants were enrolled in an introductory psychology class and received course credit in exchange for their participation.

Apparatus

All participants were trained and tested with a program created in Macromedia Authorware software run on a personal computer (Dell Inspiron 3000).

Procedure

All participants attended individual half-hour experimental sessions. The participants were told that they were participating in an experiment exploring perceptual ability and memory for shapes. They were also told that they would have to produce pairs of shapes by clicking a mouse (sometimes repeatedly) and that they had to determine which shape of each pair was correct. They were then given access to a computer mouse and allowed to start the program.

Although in the original study with pigeons, 20 responses were used in the high-effort condition, we were not sure that 20 responses would be sufficiently aversive for adult humans. Thus, the participants were trained in one of two ($n = 16$) high-effort conditions, either 20 responses or 30 responses (i.e., fixed ratio; FR 20 or FR 30). Discriminative stimuli that followed high and low effort were counterbalanced over participants (see Figure 1 for the stimuli used for two counterbalancing groups, A and B).

Training. Each trial began with the presentation of a blue rectangle. The participants produced a pair of discriminative stimuli by clicking on the rectangle either once (FR 1) or several times (FR 20 or FR 30, depending on the condition). The participants chose between the shapes by clicking once on the chosen shape. When they selected the S+, the word *correct* appeared. When they selected the S-, the word *wrong* appeared. Each low-effort response was followed by one of two discriminations (which alternated randomly over low-effort trials). Similarly, each high-effort response was followed by one of two discriminations, randomly alternated. Training consisted of blocks of 8 trials (2 trials containing each pair of discriminative stimuli, randomly presented, 1 each with the S+ on the left and right). Once the participants had completed a block with 100% accuracy, they proceeded to the testing phase of the experiment.

Testing. The participants were told that they were entering a new phase of the experiment that would not involve feedback. Testing consisted of two blocks of 8 trials, randomly presented. As in training, on half of the test trials the participants had to click on the rectangle once, and on the other half of the trials the participants had to click either 20 or 30 times. The participants then received a choice between the high-effort S+ and the low-effort S+ (on half of the trials) or the high-effort S- and the low-effort S- (on the remaining trials), without feedback.

Posttest. After testing, the participants completed a questionnaire that asked them to rank the shapes in order of preference with the values 1 (*most preferred*) through 8 (*least preferred*). The participants were also asked how they had decided which shape to choose during testing. This question was asked to help determine whether the participants were aware that their choice was guided by the initial events on training trials.

RESULTS

Training

The acquisition criterion for each trial type (high vs. low effort) was 100% accuracy on all 4 trials within a training block. A 2×2 mixed factor analysis of variance (ANOVA) was conducted on the average number of trials to criterion with associated effort (high FR 20 or FR 30 vs. low FR 1) and degree of high effort (FR 20 vs. FR 30) as factors. The ANOVA revealed a significant main effect of degree of high effort [$F(1,30) = 4.88, p < .05$], with participants in the FR 30 high-effort condition ($M = 26.5, SEM = 4.70$) reaching criterion significantly faster than those in the FR 20 high-effort condition ($M = 38.75, SEM = 4.12$). However, there was no effect of effort ($F < 1$), nor was there a significant interaction [$F(1,30) = 2.55, p = .12$; see Table 1].

Figure 1. Discriminative stimuli (S+ and S-) used in the two counterbalancing conditions following high-effort and low-effort responses.

Testing: Choice of Stimuli Associated With High Versus Low Effort

Choice of the high-effort S+. To determine whether mean choice of the high-effort S+ was significantly different from chance (50%), a single-sample *t* test was conducted on the overall choice of the high-effort S+ stimuli on test trials. The analysis indicated that choice of the high-effort S+ (65.2%, *SEM* = 7.23) was significantly different from chance [$t(31) = 2.98, p < .05$], indicating that the S+ stimuli presented on the high-effort trials were chosen more than were the S+ stimuli presented on the low-effort trials. A one-way ANOVA performed on the data indicated that choice of the high-effort S+ was not dependent on the degree of high effort ($F < 1$). To determine whether the initial event on test trials affected choice of the S+ stimuli on test trials, a mixed factor ANOVA was conducted, with initial event (high vs. low effort on test trials) and degree of high effort (FR 20 vs. FR 30, associated with the test stimuli during training) as factors. No significant main effects

were found (both $F_s < 1$), nor was there a significant interaction [$F(1,30) = 3.44, p = .07$].

Choice of the high-effort S-. To determine whether mean choice of the high-effort S- was significantly different from chance (50%), a single-sample *t* test was conducted on the overall choice of the high-effort S- stimuli on test trials. The analysis indicated that choice of the high-effort S- stimuli (50.4%, *SEM* = 7.03) was not significantly different from chance ($t < 1$).

A one-way ANOVA performed on the S- choice data indicated that the choice of the high-effort S- stimuli was not dependent on the degree of high effort ($F < 1$). To determine whether the initial event on test trials affected choice of the S- stimuli on test trials, a mixed factor ANOVA was conducted with initial event (high vs. low effort on test trials) and degree of high effort (FR 20 vs. FR 30) as factors. No significant main effects or interaction was found (all $F_s < 1$).

Testing: Posttest Questionnaire

Preference ranking of shapes. To assess preference for shapes that had followed high versus low effort in training, a mean ranking for high-effort shapes and low-effort shapes was calculated by averaging the individual ranking of each shape obtained in the posttest questionnaire, pooling over degree of high effort.

A 2×2 repeated measures ANOVA was conducted on the mean ranks with stimulus value (S+ vs. S-) and associated effort (high vs. low effort) as factors. Both the stimulus value and initial event main effects were significant [$F(1,31) = 23.19, p < .05$, and $F(1,31) = 9.48$,

Table 1
Mean Trials to Criterion and Standard Errors of the Means for Discriminations That Followed High-Effort and Low-Effort Responses

High FR Condition	<i>n</i>	Discrimination			
		Low Effort		High Effort	
		<i>M</i>	<i>SEM</i>	<i>M</i>	<i>SEM</i>
20	16	38.0	4.6	39.5	5.3
30	16	29.0	3.5	24.0	2.9

$p < .05$, respectively], with S+ stimuli being ranked as preferred over S- stimuli and high-effort stimuli being ranked as preferred over low-effort stimuli (see Table 2). The interaction was not significant ($F < 1$).

Testing: Awareness of Effort–Stimulus Associations

Four participants in the FR 20 high-effort condition and 5 participants in the FR 30 high-effort condition indicated on the posttest questionnaire that they were aware that they were being asked to choose between two previously reinforced and two previously nonreinforced stimuli. However, none of the participants indicated that they were aware of the correlation between effort and the discriminative stimulus pairs, and none of them reported that they had attempted to match choice of the test stimuli with high- or low-effort initial events.

DISCUSSION

The results of the present experiment are consistent with those previously obtained in justification of effort studies with humans (e.g., Aronson & Mills, 1959; Lewis, 1964). Participants in the present experiment showed a significant preference for positive stimuli that followed the presumably less pleasant high-effort response. Clement et al. (2000) suggested that within-trial contrast may explain this effect when it is found in pigeons. They suggested that contrast between the (hedonic) state of the organism at the end of the high-effort peck requirement and the appearance of the positive discriminative stimulus signaling reinforcement is responsible for the inflated value of the reinforcer. A similar sort of contrast might account for the choice behavior of humans in the present study.

Although it is assumed that the unpleasant event that produced contrast in the pigeon experiments and in the present experiment resulted from the differential effort, it is also possible that the relatively aversive event was the time needed to complete the additional required responses (Fantino & Abarca, 1985). According to Fantino and Abarca, although the *absolute* delay to reinforcement was the same for both the high-effort and low-effort S+ stimuli, the *relative* proximity of the conditioned stimuli to reinforcement (the proportion of the trial occupied by the conditioned stimuli) determines the stimulus preference. Thus, the relative reduction in delay to reinforcement signaled by the conditioned stimuli on high-effort trials may be responsible for the stimulus preference. In

support of this hypothesis, DiGian, Friedrich, and Zentall (2004) have recently shown that if a delay is inserted prior to the presentation of one pair of discriminative stimuli (in the absence of differential responding), there is a preference for the discriminative stimuli that follow the delay.

The emphasis of the delay reduction theory is somewhat different from the contrast account proposed here. According to the contrast theory, one would expect that insertion of an aversive delay (relative to no delay) prior to presentation of discriminative stimuli would result in greater contrast and thus, preference for the stimuli that follow the delay. In fact, if contrast is responsible for these effects, it follows, perhaps counterintuitively, that any relatively more aversive event will result in a preference for the outcomes that follow.

If our hypothesis is correct that the present phenomenon results from the relatively aversive effect of a prior event on the conditioned stimuli that follow, other relatively aversive events should produce similar results. We have already noted the effect of a prior relatively aversive delay (DiGian et al., 2004). More recently, we have found similar effects using food and the absence of food as the prior events (Friedrich, Clement, & Zentall, in press). Specifically, pigeons preferred a conditioned stimulus that followed the absence of food over one that followed a small amount of food. It would be of interest to see whether similar results would be obtained with human participants.

Clement et al. (2000) reported that pigeons showed not only a preference for the S+ stimulus that followed greater effort but also for the S- stimulus that followed greater effort. In the present experiment, however, the results were not so clear cut. Although the participants did rank the high-effort S- stimuli as better than the low-effort S- stimuli, when given a choice between high-effort S- stimuli and low-effort S- stimuli, no significant difference was found. Clement et al. attributed the preference for the S- stimulus that followed greater effort to the transfer of value from the S+ to the S- stimuli in each discrimination (see Zentall & Clement, 2001). But other research has found no evidence for a preference for the S- stimulus that followed greater effort (Clement & Zentall, 2002; DiGian et al., 2004; Friedrich et al., in press). The degree of value transfer may depend on the physical distance between the S+ and S- stimuli in each display or on the discriminability of those stimuli (there may be less value transfer if the stimuli are highly discriminable). In the case of human participants, it is also possible that verbal labels could have been applied to the stimuli, thus making them more discriminable. Furthermore, it is possible that adult humans' extensive experience in making simultaneous discriminations has inhibited the process of transferring value from the S+ to the S- stimuli, because such a process would likely retard discrimination learning. Thus, the absence of a preference for the S- stimuli that follow greater effort may not have implications for the mechanisms responsible for the S+ preferences.

The contrast model presented here assumes that choice of the S+ stimuli that had been preceded in training by

Table 2
Mean Ranks for Low-Effort and High-Effort S+ and S- Stimuli with Standard Errors of the Means

Effort	N	Stimuli			
		S+		S-	
		M	SEM	M	SEM
High	32	3.41	0.38	4.89	0.23
Low	32	4.20	0.27	5.69	0.21

Note—Stimuli were ranked from 1 (*best*) to 8 (*worst*).

a high-effort response reflects a preference for those stimuli, as was suggested to account for similar effects found with pigeons. That is, it was assumed that food reward for pigeons is not fundamentally different from the feedback provided to humans after having made a correct response. Human participants clearly value being correct, and explicit, extrinsic rewards are not generally needed to motivate them. For this reason, we believe that a similar underlying mechanism for the preference for high-effort S+ stimuli over low-effort S+ stimuli in humans and pigeons is a reasonable assumption.

The form of contrast suggested by the present research may differ from traditional forms of contrast that have been previously studied. *Incentive contrast*, of the kind studied by Crespi (1942), involves a sudden upward or downward shift in incentive that results in an overshoot in response relative to the appropriate control condition. Perhaps methodologically closer to the present effect is *behavioral contrast* (Reynolds, 1961), which is characterized by training with two discriminative stimuli and in which a change in the schedule of reinforcement associated with one stimulus often produces a change in responding (in the opposite direction) to the other stimulus. There is evidence, however, that much of the behavioral contrast effect can be attributed to the anticipation of the leaner schedule while in the presence of the richer schedule, rather than in response to the appearance of the richer schedule after having been in the presence of the leaner schedule (Williams, 1981; Williams & Wixted, 1986). However, the present form of contrast is clearly retroactive, given that the choice of discriminative stimuli follows the differential effort.

A third form of contrast, *anticipatory contrast*, has been reported by Flaherty (1982). Flaherty found that rats would often drink less of a weak saccharin solution if they had learned that it would be followed by a strong sucrose solution. This form of contrast is different from the others in that the measure of contrast involves differential rates of the consumption of a reward. Furthermore, as with behavioral contrast, it is typically seen as an anticipatory effect rather than as a reaction to a prior manipulation.

Whether or not the form of contrast reported in the present research is different from other contrast effects, contrast appears to be a reasonable description of the data presented here, as well as those reported by Clement et al. (2000) and Clement and Zentall (2002), because it involves a comparative or relational process in which the conditions of reinforcement are not merely evaluated in an absolute sense but are judged relative to recently presented alternatives. The present study suggests that such relative evaluations may play a role in other related phenomena in humans, such as justification of effort and perhaps other cognitive dissonance effects.

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NOTE

1. The pigeons were trained with simultaneous discriminations to reduce the generalization decrement that might result when they were given a choice between the two positive conditioned stimuli on test trials.