THE QUARTERLY JOURNAL OF EXPERIMENTAL PSYCHOLOGY, 1995, *48B* (2), 142–157

Human Reactions to Uncontrollable Outcomes: Further Evidence for Superstitions Rather Than Helplessness

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Recent research has shown superstitious behaviour and illusion of control in human subjects exposed to the negative reinforcement conditions that are traditionally assumed to lead to the opposite outcome (i.e. learned helplessness). The experiments reported in this paper test the generality of these effects in two different tasks and under different conditions of percentage (75% vs. 25%) and distribution (random vs. last-trials) of negative reinforcement (escape from uncontrollable noise). All three experiments obtained superstitious behaviour and illusion of control and question the generality of learned helplessness as a consequence of exposing humans to uncontrollable outcomes.

Exposure to uncontrollable outcomes is generally associated with a learned helplessness *effect*. This effect was initially studied by Overmier and Seligman (1967), who observed that dogs that had been exposed to uncontrollable shocks failed to escape shock in the shuttlebox 24 hours later, and by Seligman and Maier (1967), who observed that uncontrollability of reinforcement (shock termination) was a critical factor leading to that effect. The learned helplessness *theory* of Abramson, Seligman, and Teasdale (1978) became very popular in human research, and many instances of human dysfunctions are frequently interpreted in this framework. This theory posits (1) that when subjects are trying to obtain a desired event and this event occurs independently of their behaviour (i.e. with the same probability whether they respond or not), they learn that they have no control over the outcome and become passive; and (2) that if some other conditions are present, subjects may generate expectations that reinforcement will remain uncontrollable in the future, and generalize passive behaviour and other deficits to different tasks and situations.

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This research was supported by grant PB91–0288 from the Dirección General de Investigación Científica y Técnica (Spain). I thank Ralph R. Miller and J. Bruce Overmier for insightful comments and helpful suggestions on previous drafts of this paper.

There is, however, a set of observations indicating that subjects exposed to uncontrollable outcomes may behave in the opposite way and may not realize that they lack control over the outcomes. Inspired by Skinner's "superstition in the pigeon" paper (1948), many experiments have provided evidence demonstrating the tendency of human subjects exposed to non-contingent outcomes to behave as if they were controlling the outcome and maintain non-functional patterns of behaviour (e.g. Bruner & Revusky, 1961; Catania & Cutts, 1963; Wright, 1962). Similarly, at the judgement level, experiments on the illusion of control have shown that humans tend to believe that they have control over non-contingent reward (Alloy & Abramson, 1979; Langer, 1975; Wortman, 1975). Thus, how can subjects become helpless if they do not detect response–reinforcement independence?

The contradiction between these areas was noted some time ago (Schwartz, 1981a, 1981b). If subjects behave superstitiously and believe that they are controlling the outcome, learned helplessness cannot take place[1] (i.e. the causal chain postulated by learned helplessness theory would be broken at its very first step, which is perception of response–outcome independence). However, systematic investigations of this problem have not been conducted, and learned helplessness, superstitious behaviour, and illusion of control have remained as independent research areas.

There are at least two procedural differences that could be responsible for those contradictory results. The first concerns the type of uncontrollable reinforcement used in each tradition. Most experiments in superstition and illusion of control have used positive reinforcement (food for animals, and points or money for humans), whereas most experiments in learned helplessness have used negative reinforcement (escape from shock for animals, escape from noise for humans). If this factor were critical, both theories would need to be modified to include reinforcer specificity.

The second concerns a methodological problem that arose when the animal learned helplessness design was applied to human research. The *triadic* design was proposed in the animal literature in order to ensure that controllability versus uncontrollability of reinforcement was the only difference between groups (Maier & Seligman, 1976). In this design, one of the controls (escape group) is exposed to escapable shock. The experimental (yoked) subjects receive the same number, duration, intensity, and pattern of shocks, but shock termination is independent of the behaviour of yoked subjects and depends only on the ability of their counterpart escape subjects to terminate the shock. An additional control group receives no exposure to the shock. That is, escape and yoked groups are exposed to identical aversive stimulation and identical reinforcement conditions, but reinforcement (defined as shock termination) is uncontrollable for the experimental (yoked) group. Unfortunately, however, when this design was applied to human research (Hiroto & Seligman, 1975), uncontrollability of reinforcement (noise

[1] It could be argued that subjects may develop superstition and "helplessness" deficits at the same time because superstitious subjects may develop passive—or other—patterns of behaviour that interfere with the response required for the test task. That effect, however, would support a superstition—competing response—account (Bracewell & Black, 1974; Glazer & Weiss, 1976a, 1976b) rather than learned helplessness theory, because the effect would not be mediated by the learning of response–outcome independence (Abramson et al., 1978; Maier, 1989), but by the adventitious learning of the contingency (Herrnstein, 1966; Skinner, 1948).

termination in the human case) was confounded with *failure feedback*. That is, following Hiroto and Seligman's seminal paper (1975), most experiments in the human instrumental tradition have induced subjects to terminate aversive noise, but have exposed "yoked" subjects to (a) uncontrollable noise, and (b) failure feedback (in each trial, when the noise stops, subjects are told that their response was not correct and that the noise terminated automatically). Thus, even though learned helplessness theory (Abramson et al., 1978) states clearly that uncontrollability, rather than failure, is responsible for the impairment effect, human experiments do not provide support for this theory because the two variables are confounded. In consequence, results in the human tradition have frequently been interpreted as supporting alternative theories in terms of failure (see Buchwald, Coyne, & Cole, 1978; Coyne, Metalsky, & Lavelle, 1980; Frankel & Snyder, 1978), rather than helplessness. Overall, the failure feedback manipulation raises serious questions concerning the empirical validity of human learned helplessness because demonstrations of human helplessness in the absence of failure feedback have not yet been reported[2] (see Matute, 1994, for further discussion).

In a recent experiment, I tested for both superstition and learned helplessness under negative reinforcement conditions (Matute, 1994). When the failure feedback manipulation was not used and yoked subjects were just exposed to the uncontrollable noise condition supposedly leading to learned helplessness, they did not display any learned helplessness deficits. Instead, most of them developed superstitious patterns of escape behaviour and did not learn that reinforcement (noise termination) was independent of responding. An "impairment" effect (frequently interpreted as learned helplessness) was found only in a group of subjects that was exposed to the failure feedback condition. The data replicated well-established superstition and illusion-of-control effects but under the negative reinforcement conditions that have generally been assumed to lead to the opposite outcome—that is, learned helplessness—and suggested that previous experiments apparently supporting learned helplessness in humans could be explained by alternative theories of failure, or even extinction due to the continuous failure to get the desired event, rather than learned helplessness.

However, the superstition and illusion-of-control effects found by Matute (1994) could be an artifact of the use of a yoked procedure. In the triadic design, subjects in the escape group are learning to terminate aversive stimulation (the noise), and thus the patterns of noise that they produce include a very quick offset of noise once they reach criterion (i.e. most trials are reinforced after criterion). Thus, the reinforcement pattern that the yoked subjects receive also includes this "last-trials" distribution that has the pattern of

[2] In addition to the instrumental induction procedure, researchers have frequently used a second type of induction procedure called the *Cognitive* pretreatment (Hiroto & Seligman, 1975). This procedure is generally accepted as one of the two major ways to induce learned helplessness in humans. However, it does not provide uncontrollable reinforcement. In each of several cognitive problems, responses are reinforced on a random 50% schedule, but reinforcement never occurs in the absence of responding. Reinforcement is thus controllable on a VR–2 schedule. Failure feedback is then provided at the end of each problem (i.e. subjects are told that their final answers are all incorrect). Kofta and Sedek (1989) were able to demonstrate an "impairment" effect after elimination of the failure feedback component of this procedure. But they also noted that the effect was not mediated by the learning of response–outcome independence. Rather, they explained it in terms of the confusing experience to which subjects were exposed (Sedek & Kofta, 1990).

someone who is learning to terminate the noise. Superstitious behaviour and illusion of control could be favoured by this last-trials distribution of reinforcement. More natural uncontrollable conditions are likely to follow a random distribution, and it might be more difficult for subjects to develop and maintain superstitious patterns of repetitive behaviour when exposed to natural (random) uncontrollable outcomes than when exposed to the artificial last-trials distribution produced by the yoked procedure.

Another potential problem of the yoked procedure is that, since the aversive stimulus is of very short duration on most trials, yoked subjects ordinarily receive a very high percentage of reinforced trials (in that the aversive stimulus terminates very shortly after a response). It has been shown that, at least under positive reinforcement conditions, a high percentage of reinforcement favours the illusion of control (Alloy & Abramson, 1979). Therefore, it is possible that the high percentage of negative reinforcement created by the yoked procedure also favoured the illusion of control.

The purpose of this research was to explore the generality of superstition and illusion-of-control effects in humans exposed to uncontrollable noise under different conditions of negative reinforcement. Subjects were induced to try to terminate aversive noise. However, reinforcement (defined as shortly terminated noise) was pre-programmed and occurred, in all cases, independently of responding. Experimental conditions differed in the percentage (75% vs. 25%) and distribution (random vs. last-trials pattern) of reinforcement. An additional group was not exposed to the training phase. Finally, all five groups were exposed to a controllable helplessness generalization test task.

EXPERIMENT 1

Method

Subjects

One hundred undergraduate students volunteered for the experiment. Subjects had not participated in any related experiment. Subjects were administered the Beck Depression Inventory (BDI) (Spanish adaptation by Conde, Esteban, & Useros, 1976) just before the experiment and were immediately assigned to one of five groups. One-way analysis of variance (ANOVA) showed that groups were homogeneous in their BDI scores prior to treatment ($p > 0.50$).

Apparatus

The experiment was conducted using an IBM personal computer, and subjects were run individually in a room measuring about 250 × 200 cm. The experimenter left the room as soon as subjects had read and understood the instructions.

Procedure

Training. Control subjects were not exposed to the training phase. All other subjects received 40 trials of an uncontrollable 3000-Hz tone and were induced to find a numerical cue to stop it. This task replicated the task used by Matute (1994), but the design was different. Tone duration was 5 sec on non-reinforced trials and 1 sec on reinforced trials. In all cases, tone termination was independent of subject's behaviour and was preprogrammed according to the following schedules for each condition:

(a) Group 75–L: Subjects received non-contingent reinforcement (short tones) on the last 75% of trials (i.e. the last 30 tones terminated in just 1 sec); (b) Group 25–L: Subjects received non-contingent reinforcement on the last 25% of trials (last 10 trials); (c) Group 75–R: Subjects received non-contingent reinforcement on a randomly distributed 75% of the trials; and (d) Group 25–R: Subjects received non-contingent reinforcement on a randomly distributed 25% of the trials.

Instructions were as follows:

> From now on, imagine that numbers 1, 2, and 3 are the only keys in the keyboard.
>
> From time to time, a loud tone will come on for a while. Try to find the way to stop it. You may either type a number or do nothing. If your response is a number, it can have 1 or 2 digits, but the same digit cannot appear in it twice. For example, some possible numbers could be 2, 21, 13, 1 . . . But 11, 22, and 33 are not valid.
>
> While the tone is on, you may try several responses. Tones have a maximum duration time of 5 seconds. Try to stop as many tones as possible and as rapidly as possible. Press enter when ready to start.

Assessment of Superstition and Judgements of Control. It is not obvious which responses should be classified as superstitious. Therefore, superstitious *behaviour* was restrictively defined as a pattern of escape behaviour that was repetitive from the *n*th to the last trial. This definition is probably too restrictive and may lead to missing interesting data because complex, non-easily identifiable patterns of superstitious behaviour have been frequently reported in the superstition literature (e.g. Wright, 1962; Yellott, 1969). Therefore, another dependent variable, superstitious *belief*, was also included. Superstitious belief was defined as subjects stating that they have found a response to stop the tone. Subjects were asked:

> What was the way to stop the noise?

This question was asked through the computer screen upon termination of the training phase, and subjects had a maximum of one line to type in their answers. The degree of *certainty* with which subjects believed that they had learned a response to stop the tones was also assessed. The next display asked the subjects:

> How certain are you about that? (please type a number between 0 and 100).

A distinction was also made at the *judgement of control* level between the number of tones subjects believed they had terminated and the number of tones that they believed to be terminable. The following questions were asked, one display at a time, upon termination of the test phase:

> During the first task . . . (1) Approximately, which percentage of the tones were you able to terminate? (2) Which percentage of the tones was "terminable"? (in other words, which percentage could you have terminated if you had made the best of the task?).

Helplessness Generalization Test Phase. The generalization test phase was signalled by the following phrase being displayed at the middle of the screen:

> For the next task, instructions are still the same. Press "enter" when ready to start".

Control subjects were now given the instructions that the other groups received during the previous phase. All five groups were exposed to 20 trials of a controllable escape test task. The correct numerical response was randomized across subjects but the same randomization was used in each group of subjects. Criterion trial, defined as the first trial in which all the remaining tones were

escaped, mean escape latency, and number of failures to escape were measured during this phase (see Hiroto & Seligman, 1975).

Results and Discussion

Superstitious Behaviour and Beliefs. Superstitious *behaviour*, defined as repetitive behaviour from the *n*th trial to the last one, was observed mostly in Group 75–L (10 subjects), but also in Group 25–L (5 subjects). In the two random groups, some subjects seemed to tend towards superstitious responding over several trials, but their response patterns then returned to an apparently random pattern. Other subjects developed complex patterns that could not be clearly categorized as superstitious behaviour, but their superstitious *beliefs* were made explicit when they were asked about the way to stop the tone. Table 1 shows the number of subjects that reported a superstitious belief (i.e. they reported a "correct" way to terminate the noise), as well as the summary means for the other variables measured in this experiment during the training and test phases. Most subjects (77.5%) believed that they had found a numerical response to stop the tones. Only one out of the 80 subjects exposed to this phase realized that there was not a response to stop the tones. The remaining subjects reported that they were not able to specify the way in which they were terminating the tones, but they believed they had terminated some—or many—tones.

In addition to the above data, subjects' *certainty* in believing that they had found the correct response to stop the tone was analysed. A 2 (random vs. last-trials distribution) × 2 (75% vs. 25% of reinforcement) ANOVA of certainty of superstitious beliefs yielded a main effect for reinforcement distribution, $F(1, 75) = 20.27$, $p < 0.01$, but no other main effects or interactions. Subjects receiving reinforcement in a last-trials distribution were significantly more superstitious, as reflected by their certainty about the correct key, than subjects receiving random patterns of reinforcement. One subject did not answer this question.

Judgements of Control and Controllability. Identical 2 × 2 ANOVAs were performed for each of the judgemental questions. Regarding the illusion of control (i.e. percentage of tones that subjects believed they had terminated), all four groups showed illusion of control, but contrary to the above superstition data, the illusion of control analysis yielded a main effect for percentage of reinforcement, $F(1, 67) = 28.17$, $p < 0.01$, but no other main effects or interactions. Nine subjects did not answer this question. Subjects receiving 75% reinforced trials (i.e. short tones) judged that they had exerted significantly more control over noise termination than did subjects receiving 25%.

However, regarding the judgement of the programmed controllability of the task, no significant main effects or interactions were found (all ps > 0.05). All four groups perceived the task as highly controllable.

In summary, no evidence of learned helplessness was found during training. Instead, the opposite, superstition and illusion-of-control effects, occurred to different degrees in all four experimental groups.

TABLE 1
Mean Values for Dependent Variables Measured during Training and Test Phases, by Group, for Experiment 1

Variable	*Group*				
	75–L	*25–L*	*75–R*	*25–R*	*Control*
Training Phase					
Number of subjects reporting superstitious beliefs (out of 20)	18	16	17	11	—
Number of subjects reporting response–Rft independence (out of 20)	—	1	—	—	—
Certainty of superstitious beliefs (for superstitious subjects)	68.44 (7.46)	56.56 (9.72)	32.41 (7.00)	26.00 (8.17)	—
Illusion of control	49 (4.29)	28.75 (4.08)	53.32 (6.74)	22.2 (3.64)	—
Illusion of controllability	88.25 (4.81)	86.87 (6.09)	93.00 (2.47)	97.22 (2.15)	—
Test Phase					
Criterion trial	10.3 (1.49)	11.95 (1.51)	13.20 (1.59)	13.5 (1.48)	15.6 (1.16)
Number of correct escape Rs	12.20 (1.47)	11.45 (1.74)	10.20 (1.82)	10.40 (1.59)	8.75 (5.48)
Mean escape latency	2.49 (0.34)	2.62 (0.36)	2.85 (0.40)	2.85 (0.34)	3.72 (0.23)

Note: R = response; standard errors are given in parentheses.

Helplessness Generalization Effects. Because subjects did not detect response–outcome independence during the training phase, learned helplessness effects should not be expected in the generalization test phase. In fact, Table 1 shows that all four groups exposed to uncontrollability performed slightly better than did the naive control group in this phase. One-way analyses of variance for each of the dependent variables showed that these differences were nonsignificant (all $ps > 0.10$).

EXPERIMENT 2

Experiment 1 replicated previous data showing that humans exposed to uncontrollable noise do not necessarily perceive uncontrollability and develop learned helplessness, as is usually assumed. Rather, subjects may show the opposite tendency towards illusion of control and superstitious behaviour, which, in turn, prevents the development of learned helplessness. It also extended previous data by showing that certainty of superstitious belief in the context of trying to find a numerical key to stop the noise is favoured by a

last-trials distribution of reinforcement. Additionally, consistent with previous research on illusion of control with positive reinforcement (Alloy & Abramson, 1979), the degree of illusion of control also increased with the percentage of negative non-contingent reinforcement.

However, the superstition data found in Experiment 1 and in previous research in our laboratory, as well as the last-trials effect on it, could be task-specific. That is, subjects in these experiments performed a cognitive task consisting of finding a numerical response to stop the noise. This task contrasts with the simpler, more traditional instrumental task consisting of pressing or not pressing a single response key (Hiroto & Seligman, 1975). The numerical-response task was presented as a learning task, and it probably could induce a greater degree of superstitious behaviour, especially with the last-trials distribution, than the simpler task typical of learned helplessness experiments involving just one response key. Presumably, the traditional press/not-press task could induce a more accurate perception of non-contingency and consequently a learned helplessness effect, rather than superstitious behaviour and illusion of control. The purpose of Experiment 2 was to test the generality of illusion of control versus learned helplessness using a more traditional triadic design and a single response key.

Method

Subjects

Thirty undergraduate students volunteered for the experiment. They had not participated in any related experiment. Subjects were randomly assigned to the escape, yoked, or control conditions. One-way ANOVA showed that groups were homogeneous in their BDI scores prior to treatment ($p > 0.50$).

Procedure

The following instructions were presented to the escape and yoked groups through the computer screen:

> From time to time you will hear a loud tone. Your task is to find the way to stop it. You may either press the F1 key or do nothing. Try to stop as many tones as possible. If you are not able to terminate the tones, they will stop automatically after 5 sec. Press "enter" when ready to start.

Subjects received 40 trials of a 3000-Hz tone with a maximum duration time of 5 sec. Escape subjects could terminate the tone by pressing the response key four times (see Horoto & Seligman, 1975). Noise termination in the yoked group was independent of responding and was preprogrammed according to the noise patterns produced by their counterpart escape subjects. Control subjects were not exposed to this phase and read magazines for an equivalent period of time.

Because subjects in this experiment were left with just two response possibilities (i.e. press/not press), superstitious *behaviour*—defined in Experiment 1 as repetitive responses or pattern of responses—was not directly assessed in the present experiment. Instead, it seemed more interesting to assess subjects' *probability of responding*, P(R), defined as the number of trials in which subject gives at least one active response, divided by the total number of trials. Superstitious *beliefs* and their associated certainty rating, as well as the *judgements* of control and controllability, were assessed in the

same way as in Experiment 1. The helplessness generalization test phase was identical to that of Experiment 1.

Results and Discussion

Superstition. This experiment replicated the basic findings of Experiment 1. Summary means are presented in Table 2. During the training phase, 7 out of the 10 subjects in the yoked group developed the superstitious belief that they had found a way to stop the noise. This superstitious response was maintaining the F1 key pressed down, or pressing the F1 key any number of times, or even refraining from pressing the F1 key (see Footnote 1). Only two subjects in the yoked group concluded that tone termination was independent of responding. The remaining subject answered that he did not know what the correct response was. One-way ANOVA on the certainty of "correct" response was performed for all subjects reporting that they had found a key to stop the noise (N = 10 in the escape group; N = 7 in the yoked group). Mean certainty of correct response was not significantly different between the escape and yoked groups, $F(1, 15) = 2.21$, $p > 0.10$.

Another variable that supported a superstitious account of this experiment was the subjects' probability of responding, P(R), during the training phase. Although the mean P(R) of the whole yoked group differed from the mean P(R) of the escape-group, $F(1, 18) = 6.30$, $p < 0.05$, average P(R) was quite high in the yoked group, and it seems that most subjects avoided testing other alternatives once they had a response that appeared to be correlated with noise termination. The high P(R) of most yoked subjects, together with the reinforcement percentage and distribution implicit in a yoked procedure, leads to an adventitious response–reinforcement contingency that subjects perceive as real. Escape subjects, as well as most yoked subjects, did not test—and did not experience—the probability of the outcome occurring in the absence of responding, P(O | no R).

Judgements of Control and Controllability. Yoked subjects showed illusion of control and of task controllability during the training phase (see Table 2). There was a significant difference in the judgement of control when the whole yoked group was compared to the escape group, $F(1, 17) = 5.52$, $p < 0.05$ (one subject did not answer this question). However, the judgement of control of the superstitious yoked subjects ($M = 63.0$, $SE = 10.69$) did not differ significantly from the judgement of escape subjects ($p > 0.10$). (Note that the actual control was 100% for escape subjects and 0% for yoked subjects). Finally, escape and yoked groups did not differ significantly in their judgement of task controllability ($p > 0.10$). Both groups perceived the task as highly controllable.

In summary, yoked subjects did not develop learned helplessness during this task. On the contrary, they perceived the task as controllable, responded at a high rate, and thought that they were controlling noise termination.

Helplessness Generalization Effects. No learned helplessness effects were observed during the generalization test phase. In fact, yoked subjects performed slightly better than did the naive control group in this task. One-way ANOVAs were conducted for each of the test task variables. All three groups were homogeneous in their mean criterion trial, number of failures to escape, and mean escape latency (all ps > 0.1).

TABLE 2
Mean Values for Dependent Variables Measured During Training and Test Phases, by Group, for Experiment 2

	Group		
Variable	*Escape*	*Yoked*	*Control*
Training Phase			
Number of subjects reporting superstitious (yoked) or correct beliefs (escape) (out of 10)	10	7	—
Number of subjects reporting response–Rfi independence (out of 10)	—	2	—
Certainty of superstitions (yoked) or correct beliefs (escape) (for subjects reporting a "correct" R)	78.2 (7.45)	62.14 (7.22)	—
Probability of responding	1.00 (0.00)	0.86 (0.05)	— —
Judgement of control	80.25 (6.70)	50.0 (12.25)	—
Judgement of controllability	98.5 (1.50)	87.0 (10.11)	—
Test Phase			
Criterion trial	9.70 (1.80)	10.50 (2.37)	13.60 (2.49)
Number of correct escape Rs	14.50 (1.35)	13.20 (1.89)	12.20 (2.12)
Mean escape latency	2.27 (0.31)	2.66 (0.45)	3.05 (0.44)

Note: R = response; standard errors are given in parentheses.

EXPERIMENT 3

Experiment 2 replicated and generalized previous data by showing that humans tend towards superstitious behaviour and illusion of control also when a more traditional triadic design and just one response key are used.

But the question that led to Experiment 1 can also be applied to Experiment 2—that is, results of Experiment 2 could be an artifact of the yoked procedure that has the collateral effect of enhancing superstitious behaviour and illusion of control by distributing most reinforcers in the last trials. Therefore, Experiment 3 replicated the conditions of Experiment 1 (random vs. last-trials distribution; 25% vs. 75% of reinforcement) under the simpler press/not-press task used in Experiment 2.

Method

Subjects. Seventy-five undergraduate students volunteered for the experiment. They had not participated in any related experiment. They were randomly assigned to one of five equal-sized groups. One-way ANOVA showed that the groups were homogeneous in their BDI scores prior to treatment ($p > 0.50$).

Procedure. Conditions were identical to Experiment 1: 75–L, 25–L, 75–R, 25–R, and control. The training task was the simpler press/not-press task used in Experiment 2. All other details are constant throughout the three experiments.

Results and Discussion

Summary means for this experiment are given in Table 3.

Superstition. As in Experiments 1 and 2, most subjects (75%) believed that they had found a response to stop the tone. Also as in the previous experiments, most of the non-superstitious subjects who stated no specific "correct" response for tone termination believed that they had terminated some—or many—tones, but did not know how. Only 5 out of the 60 experimental subjects realized that there was not a response to stop the tone.

A 2 (random vs. last-trials distribution) × 2 (75 vs. 25 percentage of reinforcement) ANOVA of certainty of superstitious beliefs yielded no significant main effects or interactions ($ps > 0.1$). The reduction of certainty in superstitious beliefs that was observed with random reinforcement distribution in the numerical-response task used in Experiment 1 did not take place with the simpler press/not-press task used in the present experiment.

Data concerning probability of responding replicated the results from Experiment 2. All four groups exposed to uncontrollability tended toward a higher P(R) than would be expected for subjects learning that outcomes are response-independent. Average P(R) was 0.80, and no main effects or interactions were found for this variable ($ps > 0.1$).

Judgements of Control and Controllability. Based on the number of tones that subjects believed they had terminated, all four experimental groups showed illusion of control. Consistent with the results of Experiment 1, a main effect was found for percentage of reinforcement, $F(1, 51) = 9.79$, $p < 0.01$, but no other main effects or interactions were found. Five subjects did not answer this question. Subjects receiving 75% reinforcement judged that they had exerted more control over noise termination than did subjects receiving 25%.

Regarding the judgement of the programmed controllability of the task, no significant main effects or interactions were found (all $ps > 0.50$). As in Experiments 1 and 2, all four groups rated the task as highly controllable (see Table 3).

Helplessness Generalization Effects. As in the previous experiments, perception of response–outcome independence did not take place during the training task, and consequently no learned helplessness deficits could be generalized to the controllable test task. One-way ANOVAs were conducted for each of the test task variables. All five groups were

TABLE 3
Mean Values for Dependent Variables Measured During Training and Test Phases, by Group, for Experiment 3

	Group				
Variable	*75–L*	*25–L*	*75–R*	*25–R*	*Control*
Training Phase					
Number of subjects reporting superstitious beliefs (out of 15)	12	12	13	8	—
Number of subjects reporting response–Rft independence (out of 15)	2	1	1	1	—
Certainty of superstitious beliefs (for superstitious subjects)	73.17 (9.85)	64.50 (8.41)	65.31 (9.42)	49.38 (12.19)	—
Probability of responding	0.72 (0.08)	0.83 (0.06)	0.79 (0.05)	0.88 (0.06)	—
Illusion of control	42.27 (10.04)	25.35 (6.86)	56.05 (7.68)	27.65 (4.91)	—
Illusion of controllability	87.3 (8.23)	82.32 (7.19)	77.50 (9.80)	83.65 (7.89)	—
Test Phase					
Criterion trial	13.40 (1.56)	12.40 (1.71)	15.80 (1.30)	14.93 (1.57)	17.26 (1.30)
Number of correct escape Rs	9.86 (1.64)	10.40 (1.60)	7.00 (1.81)	8.80 (1.52)	8.33 (1.62)
Mean escape latency	3.28 (0.33)	3.14 (0.35)	3.84 (0.34)	3.60 (0.29)	3.77 (0.31)

Note: R = response; standard errors given in parentheses.

homogeneous in their mean criterion trial, number of failures to escape, and mean escape latency (all $ps > 0.1$).

GENERAL DISCUSSION

The experiments reported in this paper tested the generality of superstition and illusion-of-control effects in humans exposed to uncontrollable noise under different task conditions, as well as two different conditions of percentage and distribution of negative reinforcement (noise termination). All three experiments replicated the basic superstition effect: Most subjects exposed to non-contingent negative reinforcement tended to behave superstitiously, and to believe (a) that they had found a way to stop the noise, (b) that the task was controllable, and (c) that they were controlling it. This, in turn, is incompatible with the development of learned helplessness and its generalization to the test phase.

The experiments also showed that although the certainty of superstitious belief may be affected by reinforcement distribution under the numerical-response task used in Experiment 1, the influence of this variable is not critical. Superstition and illusion-of-control effects were also observed under random reinforcement distributions (Experiment 1 and 3), and similar effects were also found when a more traditional press/not-press task was used (Experiments 2 and 3). This press/not-press task was not affected by whether reinforcers were presented during the last trials or were randomly distributed through the task (Experiment 3). Additionally, a consistent effect of percentage of reinforcement on illusion of control was found (Experiments 1 and 3). Subjects receiving 75% non-contingent negative reinforcement showed a greater illusion of control than did subjects receiving 25%. This replicated and extended previous research that had reported this effect under positive reinforcement conditions (Alloy & Abramson, 1979).

In light of these and previous data on superstitious behaviour and illusion of control, one could be tempted to conclude that uncontrollability leads to superstitious behaviour and illusion of control and that learned helplessness is a theoretical construct with little empirical support. However, two points have to be made here.

First, it is important to distinguish between learned helplessness *effect* and *theory*. The present research was concerned with learned helplessness theory and, more specifically, with the perception of response–outcome independence and found evidence that contradicted this account. Similarly, researchers studying learned helplessness in animals are also finding that the initial theoretical focus on outcome controllability was quite arbitrary and that there are many other parameters that influence the development of the learned helplessness effect in animals (see Minor, Dess, & Overmier, 1991, for a review). Nevertheless, the impairment effect is a robust empirical finding, and the absence of an impairment effect in the present experiments contrasts with the numerous demonstrations of such an effect, regardless of its interpretation. There are several variables that could be thought to be responsible for the lack of impairment effect obtained in the present research. Examples include low perceived difficulty of the task, its low importance, mild aversive stimulation, insufficient length of uncontrollable pre-exposure, lack of failure feedback, or even the fact that subjects had to respond to two questions concerning superstition after the training and before the test phase. However, except for the failure feedback manipulation, which was not used in this research, the conditions used in the present experiments did not differ from the conditions that have been used in experiments successfully reporting impairment effects in humans (e.g. Hiroto & Seligman, 1975; Matute, 1994). As noted in the Introduction, no convincing evidence distinctively supporting learned helplessness theory against alternative explanations of the effect has yet been reported with human subjects, and by and large, demonstrations of the impairment effect available in the literature seem to be more dependent on the use of failure feedback than on the exposure to response–outcome independence postulated by learned helplessness theory (see Matute, 1994, for further discussion on this point).

Secondly, concluding that uncontrollable noise always leads to superstition and illusion of control and never to learned helplessness would imply that humans are incapable of detecting when reinforcers are presented independently of their responses. This radical position would face serious problems, as it is well known that not only human but also infrahuman animals are able to discriminate accurately between contingent and

non-contingent outcomes (e.g. Killeen, 1981; Shanks & Dickinson, 1987; Wasserman, 1990). Instead, I would like to conclude that the present results added evidence that superstitious behaviour and illusion-of-control effects, which were already well established under positive reinforcement conditions, do also occur under several negative reinforcement conditions traditionally assumed to lead to the opposite outcome—that is, learned helplessness. It could well be that both superstition and learned helplessness theories could be correct for different conditions of response–outcome independence, but the implication of this research is that conditions under which the learning of response–outcome independence takes place are not as general as is usually assumed, and they need to be specified.

The P(R) data of the present experiments suggest some conditions in which the perception of response–outcome independence could take place. It seems that subjects trying to obtain a desired event (noise termination in the present experiments) tend toward a high P(R), and that this P(R) is adventitiously maintained as long as a minimum rate of reinforcement occurs. This finding raises an interesting possibility concerning the degree to which the actual contingencies or non-contingencies are modified, depending on subjects' P(R). If subjects trying to obtain something choose to respond on every trial, no matter how uncontrollable reinforcement might be, it will always occur in the presence, and never in the absence, of responding (see Gibbon, Berryman, & Thompson, 1974; Skinner, 1985, for excellent discussions on this point). Under such conditions, the high tendency to respond could explain the illusion of control, because subjects are not exposed to P(O | no R), and thus they cannot learn that the outcome would have occurred with the same probability if they had not responded.

Thus, if a high P(R) could explain the illusion of control, conditions tending to reduce P(R) could favour an accurate detection of non-contingency. If this were true, some examples of conditions that could lead to perception of response–outcome independence—and thus, presumably, to learned helplessness—would be uncontrollable punishment, longer duration of training so that subjects reduce their P(R), or simply, as is frequently the case in the judgement of causality tradition, instructing the subjects to respond in about 50% of the trials (e.g. Shanks & Dickinson, 1987; Wasserman, 1990). All of these provide examples of conditions in which subjects would be exposed to P(O | no R) and could, presumably, perceive response–outcome independence. By contrast, the high tendency to respond observed in the present research was clearly at variance with the P(R) close to 0.5 needed for an accurate detection of non-contingency to take place, and with the P(R) close to zero that should be developed by subjects who have detected the non-contingency of response and outcome.

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Revised manuscript received 4 August 1994

Réactions humaines envers des conséquences incontrôlables: arguments supplémentaires en faveur de la superstition plutôt que de la détresse

Des données récentes ont décrit des comportements superstitieux et des illusions de contrôle chez des sujets humains exposés à des conditions de renforcement négatif qui, traditionnellement, sont supposées produire des effets opposés (détresse acquise). Les expériences décrites ici testent la généralité de ces effets dans deux tâches différentes, avec divers pourcentages (75% vs. 25%) et présentations (aléatoire vs. lors des derniers essais) du renforcement négatif (échappement à un bruit incontrôlable). Les trois expériences produisent des comportements superstitieux et des illusions de contrôle et questionnent la généralité de la détresse acquise comme conséquence de l'exposition de sujets humains à des conséquences incontrôlables.

Reacciones de los seres humanos a las consecuencias incontrolables: Nuevas demostraciones de superstición en vez de indefensión

En investigaciones recientes se ha observado el surgimiento de conductas supersticiosas e ilusiones de control en sujetos humanos expuestos a condiciones de refuerzo negativo que tradicionalmente han sido consideradas como generadoras del resultado contrario (es decir, indefensión aprendida). Los experimentos relatados en este artículo tratan de confirmar la generalidad de estos efectos en dos tareas diferentes y bajo distintas condiciones de porcentaje (75% frente a 25%) y distribución (aleatoria ó en los últimos ensayos) del refuerzo negativo (escape de un ruido incontrolable). En los tres experimentos se observó conducta supersticiosa e ilusión de control, poniendose en duda, por tanto, la generalidad de la indefensión aprendida en el hombre como originada por la exposición a consecuencias incontrolables.