Research Article

ILLUSION OF CONTROL: Detecting Response-Outcome Independence in Analytic but Not in Naturalistic Conditions

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Abstract—*Experiments in which subjects are asked to analytically assess response-outcome relationships have frequently yielded accurate judgments of response-outcome independence, but more naturalistically set experiments in which subjects are instructed to obtain the outcome have frequently yielded illusions of control. The present research tested the hypothesis that a differential probability of responding,* p(R), *between these two traditions could be at the basis of these different results. Subjects received response-independent outcomes and were instructed either to obtain the outcome (naturalistic condition) or to behave scientifically in order to find out how much control over the outcome was possible (analytic condition). Subjects in the naturalistic condition tended to respond at almost every opportunity and developed a strong illusion of control. Subjects in the analytic condition maintained their* p(R) *at a point close to .5 and made accurate judgments of control. The illusion of control observed in the naturalistic condition appears to be a collateral effect of a high tendency to respond in subjects who are trying to obtain an outcome; this tendency to respond prevents them from learning that the outcome would have occurred with the same probability if they had not responded.*

A question of interest for many researchers has been whether subjects exposed to uncontrollable outcomes realize that they have no control, or behave superstitiously in the belief that they are controlling the outcome. Quite amazingly, there exist data to support each of those opposite possibilities. Some researchers have shown that humans are able to detect independence between responses (R) and outcomes (O) with considerable accuracy (e.g., Allan & Jenkins, 1980, 1983; Shanks, 1987; Shanks & Dickinson, 1987, 1991; Wasserman, 1990; Wasserman, Elek, Chatlosh, & Baker, 1993); others have shown that humans tend toward superstitious behavior and have an illusion of control (e.g., Alloy & Abramson, 1979; Alloy & Clements, 1992; Langer, 1975; Matute, 1994, 1995; Wortman, 1975; Wright, 1962). The purpose of this research was to find a basis for this discrepancy.

In both sets of experiments, the outcome occurs with the same probability whether or not the subject responds, that is, $p(O|R) = p(O|noR)$, which corresponds to response-outcome independence. However, a common denominator of the experiments that have reported accurate judgments of response-outcome independence is that they were concerned with what humans are capable of perceiving under ideal conditions. I refer to this as the analytic tradition because it is characterized by instructing subjects to behave scientifically and to assess the response-outcome relationship. That is, subjects are instructed (a) that the outcome might be uncontrollable, (b) that their goal is to assess the degree of control that they have, and (c) that the best strategy to assess control is to respond only on about 50% of the trials so that they can be equally exposed to $p(O|R)$ and $p(O|noR)$ (e.g., Chatlosh, Neunaber, & Wasserman, 1985; Shanks, 1987; Shanks, Pearson, & Dickinson, 1989; Wasserman, Chatlosh, & Neunaber, 1983; Wasserman & Neunaber, 1986). In contrast, experiments reporting superstitious behavior and illusion of control have been generally more concerned with what humans perceive in naturalistic settings when instructed to obtain the outcome (e.g., Langer, 1975; Matute, 1994, 1995; Wright, 1962). Thus, apparently, humans have the capacity to detect response-outcome independence under ideal analytic conditions, but tend to biased judgments of control under naturalistic conditions. The question is why.

A potentially important difference between these two traditions is that whereas subjects in the analytic condition commonly respond on 50% (or fewer) of the trials, a strategy that allows them to learn whether their response affects the outcome's occurrence (see, e.g., Shanks & Dickinson, 1987; Wasserman, 1990), this "scientific" behavior and opportunity do not seem to occur spontaneously in the naturalistic conditions in which subjects are trying to obtain a desired outcome and this outcome actually occurs. For example, I (Matute, 1995) observed that most subjects exposed to a naturalistic condition (escape from noise) responded at every opportunity. Thus, their probability of responding, $p(R)$ was 1. This behavior allowed subjects to escape the noise in all trials when the outcome was response-contingent. However, when the outcome (noise termination) was noncontingent, the high $p(R)$ seemingly favored the development of an illusion of control because, for most subjects, the outcome necessarily occurred in the presence of responding. In other words, subjects responding with a $p(R)$ of 1 had no opportunity to learn that the (noncontingent) outcome would have occurred with the same probability if they had not responded.

By distinguishing between analytic and naturalistic traditions, I do not imply that analytic processing is constrained to the laboratory. However, analytic behavior ($p[R]$ close to .5) is frequently far from optimal in terms of maximizing reinforcers. For example, Wasserman et al. (1983) reported two experiments in which the subjects showed accurate judgments, but in which, regardless of whether the actual contingency was −1, 0, or 1, the subjects' $p(R)$ remained relatively constant around the .5 (or lower) level even after 240 trials. This scientific behavior, although optimal with respect to the subjects' analytic goals of

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assessing control in those experiments, is nonoptimal for maximizing outcomes. In subsequent studies, Wasserman and his colleagues (Chatlosh et al., 1985) were able to obtain contingency-sensitive behavior by using instructions similar to those in the analytic condition but encouraging subjects to maximize outcomes as well. In those studies, variations in p(R) obtained through differential instructions did not affect subjects' judgments of control, contrary to the hypothesis advanced in this article. However, Chatlosh et al. acknowledged that p(R)s were still far from optimal (i.e., too low) in terms of maximizing reinforcement. Possibly, these relatively low p(R)s allowed the subjects to make accurate judgments but at the cost of losing reinforcers. Moreover, the subjects' p(R)s in the noncontingent conditions were never higher than .5. Thus, the range of p(R)s studied in those experiments was not as large as the one that is here hypothesized to differentiate analytic versus naturalistic conditions.

Similarly, Shanks and Dickinson (1991, Experiment 1) observed low and constant p(R)s as well as accurate judgments in a group instructed to assess control, and observed higher p(R)s in a group instructed to maximize outcomes. Moreover, they used a response cost to prevent the tendency to overrespond in this latter group. As Shanks and Dickinson acknowledged, the natural performance strategy for maximizing reinforcement probably differs from that for identifying contingencies. Unfortunately, however, the group maximizing outcomes was not tested for judgments of control. Thus, that study, although using naturalistic versus analytic instructions, does not provide evidence on whether different p(R)s resulting from different instructions affect perceived control.

The way in which p(R) could influence the judgments of control has been elaborated elegantly by several researchers (e.g., Allan, 1993; Gibbon, Berryman, & Thompson, 1974; Skinner, 1985), but as Gibbon et al. noted, p(R) is one variable that is usually outside the experimenter's control, and there is no definite evidence on the effects of manipulating this variable. Allan and Jenkins (1983, Experiment 3) provided some indirect evidence on the potential influence of p(R). In that experiment, subjects saw a joystick moving on a computer's monitor; a dot moving or not moving was the potential effect of the movements of the joystick. Allan and Jenkins reported that the illusion that the joystick controlled the dot in noncontingent conditions was higher if the joystick moved with a probability of .7 than if it moved with a probability of .5. If the different probabilities of the movements of the joystick are seen as instances of different p(R)s, then Allan and Jenkins's experiment is consistent with the hypothesis that p(R) influences judgments. However, subjects in that experiment were mere observers of the movements of the joystick. That is, the subjects' p(R) was not a variable, and this result, though suggestive, does not provide direct evidence on p(R).

Taken together, these studies provide indirect support for the hypothesis that subjects tend to a very high p(R) in naturalistic settings and suggest that p(R) has an influence on judgments of control (i.e., accurate judgments occur when p[R] approaches .5), but do not allow us to conclude that this variable is responsible for the differential judgments obtained in the analytic and naturalistic conditions. The research reported here tested directly the hypothesis that analytic versus naturalistic instructions (i.e., differential goals on the part of the subject) yield differential p(R)s, and that these differential p(R)s are responsible for the discrepant judgments of control obtained in naturalistic and analytic conditions.

METHOD

Subjects

Thirty-two undergraduate students from Deusto University volunteered for the experiment. Subjects were randomly assigned to one of four groups in a 2 × 2 factorial design.

Procedure

Subjects were tested individually using a personal computer. All subjects were exposed to uncontrollable outcomes. Half of the subjects were instructed to obtain the outcome (naturalistic condition), and the other half were instructed to respond on 50% of the trials and to assess control over the outcome (analytic condition). The outcome was termination of aversive noise (escape) for half of the subjects in each condition and was a more neutral event (a beep) for the other half of the subjects. These different outcomes were used to test whether the hedonic properties of the outcome (with termination of aversive noise being possibly a more powerful reinforcer than presentation of a beep sound) would modulate the influence of naturalistic versus analytic instructions.

Subjects in the naturalistic-escape group were exposed to 50 trials of aversive 3000-Hz, 90-dB (A scale) noise and were told that their task was to escape the noise by pressing or not pressing the space bar of the computer keyboard during the first second of noise. Reinforcement was defined as noise terminating right after that first second. On nonreinforced trials, noise duration was 5 s. The noise terminated at 1 s on 75% of the trials in which the subject responded and on 75% of the trials in which the subject did not respond. That is, $p(O|R) = p(O|noR) = .75$. This high-outcome schedule was used because it usually produces a higher illusion of control than lower outcome schedules in naturalistic settings (e.g., Alloy & Abramson, 1979; Matute, 1995; Wright, 1962; but see also Wasserman et al., 1983, 1993, for an absence of this effect in analytic settings). Mean intertrial interval was 7.5 s (range: 3–12 s). Subjects in the analytic-escape group were exposed to identical treatment but were encouraged to respond on 50% of the trials to assess control over termination of the noise. (Actual instructions for both groups are given in the appendix.)

Subjects in the beep groups were told that they would hear a beep and they would have 1 s to make the beep repeat (naturalistic-beep group) or to decide whether to respond to assess control of the beep repetitions (analytic-beep group). The beep was 75 dB (A scale) and was repeated on 75% of the trials in which the subjects responded and on 75% of the trials in which the subjects did not respond. When presented, the second beep occurred 1 s after the initiation of the first beep.

One dependent variable was subjects' p(R), defined as the number of trials that included at least one active response divided by the total number of trials. The other dependent variable was the judgment of control. After the last trial, all subjects answered a question regarding the degree of control that they had perceived (see appendix). The scale for responding ranged from −100 to +100. Positive numbers indicated a positive contingency, negative numbers indicated a negative contingency, and 0 indicated a perception of response-outcome independence.

RESULTS

High $p(R)$ and illusion of control developed in the naturalistic conditions whether subjects were trying to obtain termination of the noise or repetition of the beep. In contrast, subjects investigating their degree of control (analytic groups) maintained their $p(R)$ at a point close to .5 and accurately reported response-outcome independence.

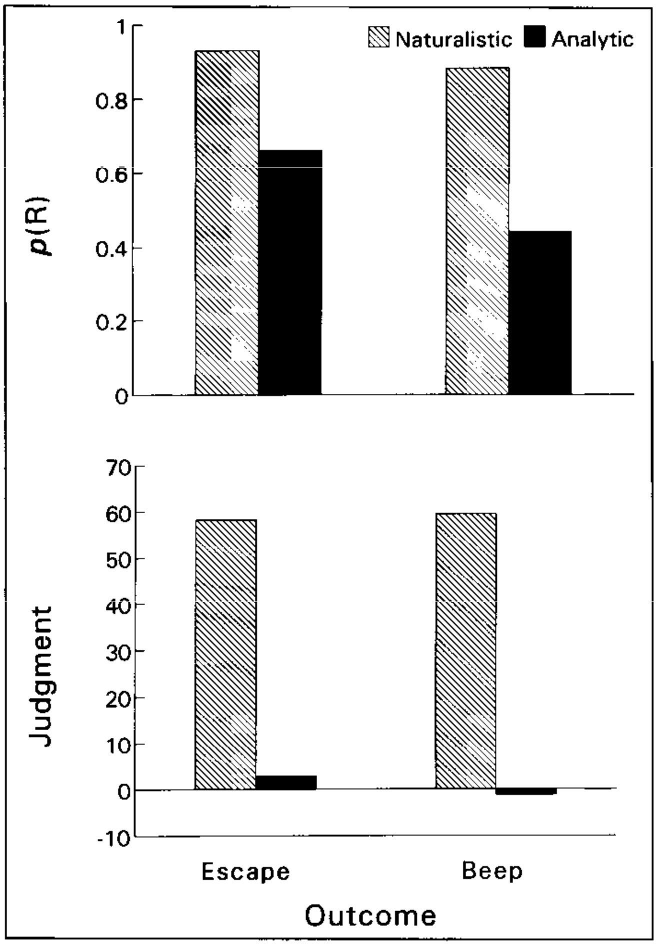

Fig. 1. Mean probability of responding ($p[R]$; top panel) and mean judgment of control (bottom panel) for the four experimental conditions. Judgments were assessed using a scale that ranged from −100 to +100, with positive and negative numbers representing perception of positive and negative contingency, respectively, and 0 indicating an accurate perception of response-outcome independence.

The $p(R)$ data are depicted in the top panel of Figure 1. A 2 (outcome) × 2 (instructions) analysis of variance on subjects' $p(R)$ yielded a main effect for instructions, $F(1, 28) = 23.23$, $p < .01$; a marginally significant effect for outcome, $F(1, 28) = 3.31$, $p = .08$; and no interaction. This result confirms that $p(R)$ is affected more by the instructed goals of the subject than by the objective properties of the outcome (at least with the mild outcomes used in this experiment). Both the noise termination and the beep repetition seemed to function as reinforcers or as neutral events depending on whether subjects had been instructed to obtain the outcome or to assess control over it. Planned comparisons showed that for both outcome conditions, subjects receiving naturalistic instructions were more active than subjects receiving analytic instructions, $F(1, 28) = 6.62$, $p < .05$, for the escape condition and $F(1, 28) = 17.6$, $p < .01$, for the beep condition.

The judgmental data are depicted in the bottom panel of Figure 1. A 2 (outcome) × 2 (instructions) analysis of variance on subjects' judgments yielded a main effect for instructions, $F(1, 28) = 9.29$, $p < .01$, and no other main effect or interaction ($ps > .50$). Planned comparisons confirmed that for both outcome conditions, subjects in the naturalistic condition reported higher judgments of control (i.e., illusion) than subjects in the analytic condition (who reported an accurate judgment of response-outcome independence), $F(1, 28) = 4.22$, $p < .05$, for the escape condition and $F(1, 28) = 5.08$, $p < .05$, for the beep condition.

Finally, subjects' $p(R)$s and judgments of control were found to be positively correlated, $r = .70$, $p < .001$. In general, subjects responding at high rates reported the highest positive judgments of control, and subjects responding in about 50% of the trials accurately detected response-outcome independence.

DISCUSSION

This single factorial experiment replicated both (a) experiments showing that humans can detect response-outcome independence accurately (e.g., Shanks & Dickinson, 1987; Wasserman, 1990) and (b) experiments showing that humans develop superstition and illusion of control (e.g., Langer, 1975; Matute, 1994, 1995; Wright, 1962) by simply varying the goal-setting instructions. The subjects' $p(R)$, which followed from naturalistic versus analytic instructions, appeared to be a critical determinant of whether subjects detected response-outcome independence. Thus, the different judgments obtained by different research traditions appear to reflect different (analytic vs. naturalistic) research orientations that imply different goals and strategies on the part of the subject.

Subjects maintained their $p(R)$ at a point close to .5 and made accurate judgments of response-outcome independence when their goal was to find out how much control over the outcome was possible (analytic conditions). In contrast, subjects who were trying to maximize the outcome (naturalistic conditions) tended to a very high $p(R)$, and many of them did not even test for $p(O|noR)$. Consequently, the outcome most frequently occurred in the presence (rather than absence) of responding. When this happens, responses apparently are perceived as reinforced (despite the outcome being "objectively" independent of responding), thus increasing on the next trial the probability of a response (rather than a nonresponse), which itself is again apt to be reinforced. Thus, p(R) effectively modifies the environmental relation to which the subject is exposed (see Gibbon et al., 1974; Skinner, 1985, for further discussion). In this view, the illusion of control appears to be simply a collateral effect of a high p(R) in naturalistic settings in which subjects are trying to obtain an outcome.

Biases in contingency judgments have been explained in several different ways (e.g., Alloy & Tabachnik, 1984; Crocker, 1981; Skinner, 1985). Perhaps the most popular view is the one that explains the illusion of control as a means to protect self-esteem (e.g., Alloy & Abramson, 1979; Alloy & Clements, 1992). According to this hypothesis, conditions in which subjects are more personally involved should lead to stronger illusions of control. This prediction has received experimental support. For example, Alloy and Abramson found that nondepressed subjects showed a stronger illusion of control than depressed subjects and that subjects who received monetary reward showed a stronger illusion of control than those who were not rewarded. However, this explanation is not necessarily antithetical to an explanation in terms of p(R). Although Alloy and Abramson used instructions that were similar to the analytic instructions in this research, they did not report their subjects' p(R)s. As noted by Skinner (1985), it is quite likely that differences in p(R) between those subjects (nondepressed subjects are generally more responsive than depressed subjects; subjects receiving monetary reward are generally more responsive than subjects receiving no reward) were at the basis of their different judgments. Depressed subjects and subjects receiving no money probably received a greater exposure to p(O|noR), and this exposure allowed them to make more accurate judgments. Thus, the differential exposure to the environmental contingencies (mediated by subjects' p[R]) could provide a more parsimonious and more direct explanation of the illusion of control (see Allan, 1993; Skinner, 1985, for further discussion on how the response-outcome pairings may produce both accurate judgments and illusions of control depending on p[R]).

Finally, one may ask why subjects in the present (and previous) naturalistic conditions responded at such a high rate and did not test for the effect of nonresponding through reduction of p(R). In natural escape or reward conditions, refraining from testing opposite response alternatives once one of them appears to work likely has adaptive value. Organisms cannot afford losing reinforcers by reducing their p(R) simply to test whether reinforcement would have occurred with the same probability if they had not responded. The resulting illusion of control is possibly something that organisms can afford, except under conditions such as an absence of reinforcement (extinction), high response cost, severe punishment, fatigue (from a very large number of trials or high-effort responses), or an analytic goal (manipulated in this experiment through instructions). But these conditions reduce p(R), and, hence, the likelihood of an illusion of control is reduced as well.

These speculations aside, the present research demonstrates that the difference in response probability generated by different instructions used in the naturalistic and analytic traditions results in different judgments of control.

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APPENDIX: INSTRUCTIONS

The naturalistic-escape group was given the following instructions, in Spanish, on the computer screen:

From time to time, you will hear a loud noise. Your task is to find the way to stop it by using the space bar. It is also possible that the correct response might be doing nothing.

As soon as the noise begins, you will have 1 second to stop it (anything you may do after that first second will not influence the noise). Try to stop as many noises as possible and do so as rapidly as possible. (If you are not able to stop them, they will stop automatically after 5 seconds.)

The analytic-escape group was given the following instructions:

From time to time you will hear a loud 5-second noise. Your task is to find out whether or not it is possible to stop it in just 1 second. It is possible that noise duration is preprogrammed, or, by contrast, it is possible that you have some or total control over its termination. Thus, try to find out whether noise termination depends on your responses or on any other cause.

Your response possibilities are:

A) Press the space bar

B) Do nothing

However, you only have the first second of noise to decide what to do and act. Anything you may do after the first second will not influence the noise. (If the noise does not stop after that first second, it will last for its whole 5-second duration.)

Because your task is to find out the degree of control that you have over noise termination, the best strategy that you can use is to press the bar on about 50% of the trials, and to not press it on the other half of the trials. Thus,

—If you notice that the noise stops only when you press the space bar, it means that you have 100% control over noise termination by pressing the bar.

—If you notice that the noise stops only when you do not press the bar, it means that you have also 100% control over noise termination by refraining from pressing the bar.

—But if you notice that the noise stops with the same probability regardless of whether you press or not, it means that you have no control at all (0%) over noise termination. Noise termination is probably preprogrammed.

—Finally, it may also happen that your degree of control is any intermediate value between 0 and 100% (e.g., 30%, 74%, 50% . . .).

Remember, press the space bar on about 50 % of the trials only. This way you will find out whether or not pressing the bar makes any difference.

Instructions for the naturalistic- and analytic-beep groups were modified from the naturalistic- and analytic-escape groups, respectively, by making appropriate substitutions, such as replacing "noise termination" with "beep repetition."

The instructions for the postexperimental question read as follows for the two escape groups (the question used for the beep groups was modified accordingly):

Now we would like to know your personal opinion about the degree of control that you had over noise termination while you were performing the task. To answer this question, please give a number between −100 and 100. 100 indicates that noises always stopped if you pressed the bar; −100 indicates that noises always stopped if you refrained from pressing the bar; 0 indicates that pressing or not pressing the bar was irrelevant (it had no effect on noise termination). You can also give any positive number (if it was better to press the bar), or any negative number (if it was better to refrain from pressing).

Which degree of control did you have over noise termination?