Noncontingent reinforcement and certainty

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This study describes a method of continually sampling levels of certainty during the decision making process. Ss participating in this study were presented with the task of dividing series of photographic slides into two groups. Each time a S would make a choice (select which group he thought the picture belonged in), he was told whether he was right or wrong by a green or a red light flashing, based on a predetermined random sequence in which the probability of being right was either 0.3, 0.5, or 0.8. At the same time that the S made his choice he indicated the certainty of that choice by pressing one of several switches, each one corresponding to one of five certainty levels ranging from "don't know" to "positive" (absolute certainty). Ss' certainty varied positively with probability of reinforcement, and appeared to be independent of stimulus type. "Responsiveness" was defined as how closely the S's certainty tracked the continually occurring changes in reinforcement, and was also found to vary positively with the reinforcement probability.

Man continuously makes hypotheses about his environment. These hypotheses lead to decisions, which lead to behavior, which, in turn, provoke feedback from the environment. Certainty regarding decisions should be related to whether the feedback is positive or negative. This study attempts to test this hypothesis experimentally using the technique of noncontingent reinforcement, in which the reinforcement sequence is independent of S's response.

Bavelas (personal communication), and Wright (1962) have previously studied certainty in Ss who were subjected to noncontingent reinforcement; however, in their studies a continuous recording of Ss' level of certainty was not obtained—the degree of certainty was inferred from the response pattern, extinction times, etc.

Method. The Ss were unpaid volunteers (seven females, four males, ages ranged between 20 and 30, all had some college education). Their occupations were: one housewife, one chemist, one psychiatric resident, two secretaries, two undergraduate college students, two lab technicians, one medical student, and one intern.

The equipment was designed so that the reinforcement could be controlled either automatically by a predetermined, random sequence, or manually by the E. Stimuli were 35 mm colored slides projected on a white screen by a Nikkormatt "Autofocus" slide projector.

Fig. 1.

Fig. 2.

The Ss were seated in front of the switch panel, an 8 x 10 x 3 in. black bakelite box. On this box were mounted ten toggle switches in two vertical rows (see Fig. 1) labeled "A" and "B." The five switches in each row represented the certainty variable and were labeled as follows: bottom most, "don't know"; middle switch, "probably right"; top most, "positive." Two reinforcement lights, one red and one green, were placed between the two rows.

A strip recorder simultaneously recorded three variables: (1) the level of certainty (in discrete steps of one through five); (2) the actual decision the S made, that is the "group"; (3) the reinforcement schedule.

Each S was told that he would be looking at several series of slides projected on the screen in front of him, that each series of slides would consist of two groups (Group A and Group B), and that his task would be to learn which slide belonged to which group. He would indicate his choice by pressing a switch in either Row A or Row B on the switch panel, and would find out whether his choice was right or wrong by a flashing light (green = right, red = wrong). He would also indicate the level of certainty of his choice by selecting the switch (in either Row A or Row B) corresponding to the level of certainty he subjectively experienced while making that choice.

Before the actual testing procedure began, each S underwent a training procedure to insure comprehension of the instructions, and understanding of the apparatus and the procedure.

The S was then told that actual testing would begin, that he would not be able to ask further questions, or receive assistance, and that more difficult sequences of slides would be shown. He was told that six sequences of 30 slides each would be presented, each having a different "code." Before each sequence began, a slide reading "new code" was presented. A brief review of the criteria for indicating certainty levels was also conducted before each sequence began.

During the actual testing each S was presented with six sequences of photographic slides. Reinforcement was noncontingent in a predetermined random sequence for each probability level, and the reinforcement levels for the six sequences were: 0.8, 0.5, 0.3, 0.3, 0.5, and 0.8, in that order. The possibility that different types of visual stimuli would provoke different responses in the same S was studied by presenting each S with two sets of stimuli: one which was highly abstract, with no obvious verbal or emotional content, and one which had significant, verbal and/or emotional content. These two sets were: (1) abstract, colored geometrical forms, and (2) photographs of street signs of San Francisco, both of which were randomly arranged. Of the six sequences of 30 slides, three were of street signs and three were of geometrical forms. The sequence format was:

0.8 0.5 0.3 0.3 0.5 0.8
forms signs forms signs forms signs

Results. The following variables and relationships were measured: (1) the average level of certainty during the latter part (the last 10 slides) of each sequence, (2) the relationship between (1) and the reinforcement probabilities of that specific sequence,

Fig. 3.

(3) "responsiveness," a term that reflected how closely the S's certainty tracked the continually occurring changes in reinforcement.

The mean of the certainty levels of the last 10 trials in each sequence for each S was calculated using a 1 to 5 scale, where 1 = guessing or uncertainty, and 5 = absolute certainty. These individual means were then averaged so that the average level of certainty for the entire group of Ss for each particular sequence was obtained. A rise in certainty level correlated with higher reinforcement probabilities (see Fig. 2), and can definitely be considered significant ($p < .01$) as determined by analysis of variance. Although there was some difference in the certainty-reinforcement level curve when signs were used as stimuli rather

than geometric forms, this difference was not statistically significant. There was also no interaction between sequence of a particular run and level of certainty or any other significant interaction.

How the S's level of certainty changed as a function of the reinforcement schedule was designated as responsiveness. Responsiveness was measured for each of the six runs. The criteria for this function were set as follows: if after receiving a reinforcement, the certainty level changed in the expected direction (rose if the reinforcement was positive, fell if it was negative) the amount of change was recorded as a positive number. If the change was not in the expected direction it was recorded as a negative number. No change in certainty level, whether preceded by a positive or a negative reinforcement, was recorded as zero. The sum of all numbers recorded for each run was then computed. A highly significant difference ($p < .01$) among probability levels (using analysis of variance) was found (see Fig. 3). There were no significant interactions between the two types of stimuli (forms and signs), and no other interactive components (such as time sequencing of stimuli) were detected.

Discussion. This study confirms the intuitive notion that certainty regarding decisions is related to whether feedback is positive or negative, and provides an experimental model in which the effects of confirmation and falsification on certainty can be studied. This could be an interesting paradigm in studying delusions and paranoid conditions, a possibility which is currently under investigation by the authors.

REFERENCES

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NOTE

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