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AN EXPERIMENTAL IMPLEMENTATION OF A RULE GOVERNED RESPONSE

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El propósito de la presente investigación fue el de investigar una instancia de conducta gobernada por las reglas (Skinner, 1969).

Una respuesta gobernada por la regla fue puesta bajo control experimental y se observó el efecto del reforzamiento positivo sobre el uso de la regla. Al sujeto se le pidió que oprimiera una tecla y la soltara a su propio paso o que la oprimiera y la sostuviera por un intervalo aproximado de 10 segundos. La primera respuesta comprendía la modalidad de respuesta de la "operante libre" y la segunda fué la modalidad de respuesta gobernada por la regla. La regla estipulaba que el sujeto podía elevar su probabilidad de obtener puntos al usar este segundo modo.

Se construyó un aparato para permitir la emisión de cada modalidad de respuesta y el registro del número de respuestas. Esta información se usó por el experimentador para reforzar diferencialmente las respuestas del sujeto y para computar la tasa de respuestas. Cada modalidad fue controlada por un estímulo discriminativo diferente y había un tercer estímulo discriminativo que permitía la selección de cualquiera de las modalidades de respuesta. La cantidad de reforzamiento se incrementaba o decrementaba en la modalidad de respuesta gobernada por la regla y se mantuvo constante para la modalidad de respuesta de la operante libre.

Los hallazgos fueron: (a) Fue posible construir una regla que controla una respuesta específica; (b) fue posible producir una respuesta que se emitía solo en presencia de un estímulo discriminativo específico. La respuesta tenía una topografía específica y una tasa de respuesta derivable de la regla; (c) el reforzamiento afectó el uso de la respuesta gobernada por la regla; y (d) la modalidad de la regla fue utilizada en los niveles de reforzamiento más altos y la modalidad de operante libre se utilizó en los niveles más bajos.

The purpose of the present research was to investigate an instance of rule-governed behavior as discussed by Skinner (1969). A rule-governed response was brought under experimental control and the effect of positive reinforcement on the S's *use of the rule was assessed. The* S *was asked to either press a key and release it at his own pace or to press it and hold it for an estimated interval of ten seconds. The former response comprised the free-operant response mode and the later was the rule-governed response mode. The rule stated that the* S *could raise his probability of obtaining reinforcement by using this mode.*

An apparatus was built to allow the emission of each response mode and the recording of the number of responses. This information was used differentially by E *to reinforce the* S's *responses and to compute the response rate. Each mode was*

controlled by a different discriminative stimulus and there was a third discriminative stimulus that allowed the selection of either response mode. Amount of reinforcement was increased or decreased for the rule-governed response mode and kept constant for the free-operant response mode.

The findings were: (a) It was possible to construct a rule which controls a specific response; (b) It was possible to produce a response that was emitted only in the presence of a specific discriminative stimulus. The response had a specific topography and a response rate derivable from the rule; (c) Reinforcement did affect the use of rule-governed responses; and (d) The rule was followed at higher reinforcement levels and the free-operant response mode was used at lower reinforcement levels.

Skinner (1969) discussed behavior in terms of its controlling agencies: (a) contingencies, and (b) rules. He analyzed contingency-shaped behavior and rule-governed behavior rather throughly in theoretical terms, although little research has been done to carry on this analysis to the laboratory. This is particularly true for rule-governed behavior which is the focus of the present research.

Fernández (1970) in an unpublished doctoral dissertation, derived the following criteria for identification of rule-governed behavior in addition to those stated by Skinner (1969):

> a) high probability of response under the contingencies specified by the rule; b) verbalization of the contingencies; c) transfer to situations in which all the elements involved, except the rule that ties them together, are changed; d) insensitivity to changes in schedule of reinforcement; and e) possible provision of latency data (p.99).

The main purpose of this research was to implement a rule governed response in an experimental setting according to Skinner's criteria. For that reason the broad category of behaviors that Skinner described as rule-governed had to be restricted in this study to a single rule-governed response (RGR). To this end three problems were considered: a) the definition or description of a rule; b) the definition of the response governed by the rule; and c) the actual implementation of the rule-governed response (RGR) in such a way as to comply with the rule and the response definitions.

Rules as defined by Skinner are discriminative stimuli (S^D) extracted from the contingencies either directly or indirectly. These are verbal statements and are generally public. Rules, as defined in the present research, are verbal statements specifying the occasion and the consequences contingent upon the emission of a particular type of response.

A rule-governed response as defined in the present research is one that obeys the specifications of the rule regarding the situation when and where it should be followed (i.e. the formal response occurs in schedule in the situation as specified), has a specific topography, and produces a response rate derivable from the rule.

In order to implement a rule-governed response a task was needed which would offer at least another alternative mode of response clearly contrastable with the behavior generated by the rule. A rule was chosen that would produce a sharp difference in response rate between different response modes in order to assess if S was following the rule or behaving under other circumstances. The S^D utilized allowed S to select different response modes. Under these circumstances one of the S^D's was the verbal statement. The physical (visual) S^D's were stimuli

conditioned to the rule (verbal statement). Thus a complete specification of the rule linked a verbal S^D with a physical S^D, described the response and the consequences.

Summing up, the aim of the present research was: (a) to construct a verbal statement specifying an S^D in whose presence a specific response should be emitted and followed by a certain amount of positive reinforcement, (b) to produce a response that is emitted only in the presence of a specific discriminative stimulus, has a specific topography, and has response rate clearly different from the operant level, and (c) to investigate how amount of reinforcement, as defined by number of points, affects a rule-governed response.

Method

Subjects

Two female and six male volunteer students of an Introductory Psychology course at The University of Puerto Rico in Mayaguez served as *S*s.

Apparatus

The apparatus consisted of two plastic boxes interconnected electrically. The subject's box (Box 1) contained a "cointosser circuit" with a key for the *S*'s responses and two lights, a YES light and a NO light. The experimenter's box (Box 2) contained a digital response counter plus three switches that are referred to as A, B, and C. None of the above switches set anything into operation. They were simply to be set up as S^D,s with respect to *S*'s response.

The apparatus was constructed to allow the following operations: (a) to record the number of responses produced under either response mode; (b) to provide three S^D's (switches A, B, and C), which controlled the different response modes; (c) and to provide visual feedback to the *S* (YES or NO lights) which served to compute the amount of reinforcement to be delivered. The cointosser circuit functioned as a random variable that controlled the appearance of the YES or NO light.

Experimental Procedure

The *S* was seated on one side of a small desk facing *E*. Box 1 was placed in front of *S* and Box 2 was put to one side of *E*. *E* also had a stop watch, legal pad and plastic tokens. The experimental design is described in what follows.

1. *Phase A.* In this initial phase *S* was asked to press the key at his own rate and he was told that he would receive one point (token) for every YES light that appeared on his box. Switch A (on E's box) was the S^D used in this phase. Switch A was described as putting into operation schedule A, which was to pay *S* according to a random variable (every YES light of a cointosser circuit). *E* counted *S*'s responses for several response intervals (1 minute) and in between intervals *E* could count the amount of points *S* had made and pay him with plastic tokens. The number of response intervals given to any *S* was variable. The general criterion was that the response rate should be *stable* (i.e. a range not greater than 2 responses) in at least three subsequent intervals. Phase A then consisted of various response intervals using switch A as the S^D for the free operant response mode paying *S* 1 point for every YES he obtained. The *E* wrote down every YES *S* reported while controlling the time of the intervals with the stop watch. The total number of responses emitted during each interval was recorded by the digital counter. Following each interval *E* counted the amount of YES lights *S* had obtained and paid *S* with plastic tokens. A response interval of 60 seconds was chosen. It was found in the

exploratory study that shorter time periods were not practical for either *S* or *E* and that longer intervals produced fatigue and boredom in *S*. The number of responses and the amount of points earned were registered for each interval. The preceding comprised the baseline data for switch A.

2. *Phase B.* Switch B was introduced in this phase. Switch B was the S^D used to produce a rule-governed response mode. The rule-governed response consisted of pressing the key and sustaining it for approximately 10 seconds and then releasing it. The *S* was told that by doing this he would obtain more YES lights than NO lights. The *S* was also instructed to estimate his ten seconds. The phase consisted of various response intervals during which *S* would only use this response mode. after each interval he was paid the amount of points he had obtained (YES lights) and here also *S* received one point for every YES. The number of response intervals was also variable, depending on how soon the baseline would stabilize. This procedure provided the baseline for switch B.

3. *Phase C.* The S^D for this phase was switch C. This switch was said to put into operation either schedule A or B, depending on which mode *S* chose to respond to (free-operant response mode or the ten second delayed response). This switch was included in the procedure to provide *S* with an optional selection of either response mode. The *S* was given various response intervals in this phase and was paid one point for every YES he obtained. It is important to point out here that *S* was instructed to use only one of the response modes during a given interval, he could change response modes from interval to interval but not within an interval. The *E* computed the points *S* made paid him and proceeded to the next interval. The payment for this phase was one point for each YES. This phase provided the baseline data for switch C.

4. *Ascending Phase.* The purpose of this phase was gradually to raise the amount of reinforcement for the rule-governed response mode while maintaining the amount of reinforcement for the free-operant response mode constant at amount 1. Switch B and switch C were serially used in this phase. Switch B was turned on and *S* was told that his responses would be counted for an interval on this switch (using the rule-governed response mode) and that he would receive two points for every YES. In this case, he would receive two points for every YES he made using the rule-governed response and one point for every YES if he used the free-operant mode. In this way *S* was differentially reinforced for using the rule -governed response mode. The *E* used the initial response rates (baselines) provided by phases A, B, and C to see which response mode *S* was using and to decide which pay *S* was to receive. The ascending phase consisted therefore of differentially reinforcing *S* for the use of the rule-governed response mode and then permitting him to select either mode with its corresponding pay. The amount of reinforcement was raised from two to ten points progressively. Between each of the response intervals *E* would add up *S*'s points and pay him the amount he had earned. When *S* reached amount of reinforcement ten the following phase was implemented.

5. *Descending Phase. S* was told that switch C was the only switch in operation and that now the amount of points would descend progressively from nine points to one point. At each interval *E* instructed *S* as to the value of both response modes and he was told to choose whichever response mode he wanted to use. At amount of reinforcement nine he was told that the rule-governed response mode would pay him nine points for every YES. This was done at each subsequent response interval. Again in this phase *E* paid *S* according to the number of responses he produced and compared each amount with the baseline data collected in phases A and B to determine *S*'s response mode.

6. *Reversion to A.* This condition was not given to all of the *S*s. It was implemented only in those cases where there was some doubt on the part of *E* as to the initial baseline rate for switch A, specially in those cases where the response rates were losing or gaining higher rates. A very short number of response intervals on switch A were taken at this point in this case. The amount of reinforcement for these intervals was one.

7. *Variable Phase.* This phase was added to the procedure to ascertain whether or not the above progressive orders of reinforcement were determining the level at which *S*s would adopt or abandon the rule-governed response mode. It seemed that by implementing a variable (disordered) presentation of points there might be some difference as to the point at which *S* would change his response mode. In this phase *S* was instructed to select from a box a piece of paper containing a number from one to ten. This number would then be the amount of reinforcement he was to receive for the RGR mode in the subsequent response interval. The reinforcement value for the free-operant mode remained one. Switch C was used for this phase. This procedure was followed for the ten numbers.

Response Rate and Amount of Reinforcement.

Response rate (number of responses /60 seconds) was the dependent variable. Response rate (r.r.) was also the main indicator for deciding that the rule was being followed and for differentially reinforcing the response mode when operating under switch C. In the exploratory study the amount of reinforcement was raised from one to 30 and it was found that the r.r. was quite constant after ten. Therefore, it was decided that the reinforcement level from one to ten sufficed to produce a rulegoverned response. A cumulative record was kept in order to assess the changes in baseline rate throughout the different stages of the experimental design.

Results

Figures 1, 2, and 3 show cumulative records of response baselines of subjects 1, 2, and 3 respectively.

S 1's response rate for A was 1.00, for schedule B, 17, and for C, 1.34. This *S* did not follow the rule until amount of reinforcement ten in phase C. The descending and variable phases show a steady high rate of responding with the only low rate at variable phase reinforcement level ten.

S 2, presented the following r.r., respectively for switches A, B, and C: .81, .39 and .76. This *S* began using the rule at the beginning of phase C. The ascending phase shows a low and high pattern up to amount of reinforcement 4; where the r.r. declined until amount three of the descending phase. *S* continued using the rule until amount 1 of the variable phase.

S, 3, baseline r.r.,s were as follows: 1.13, .10 and 1.42. This *S*'s r.r. for phase B were extremely low therefore *E* raised the amount of reinforcement during the ascending phase from 10 to 35 by increments of 5 and *S* used the rule schedule at amounts 30 and 35. During the descending phase *S* followed the rule until level 32, *E* then introduced an interval of switch B at each level and *S* followed the rule until level 29 where he abandoned it. A small phase of reversion (A) was introduced that produced and extremely high r.r. (3.67). During variable phase (30-21) *S* used the rule at levels 26, 29, 30 and 28.

In general the baseline was sensitive to amount of reinforcement. There was a functional relation between the rule-governed response and the drop in the r.r.. There is an obvious decline in the rate of responding during the ascending phase as

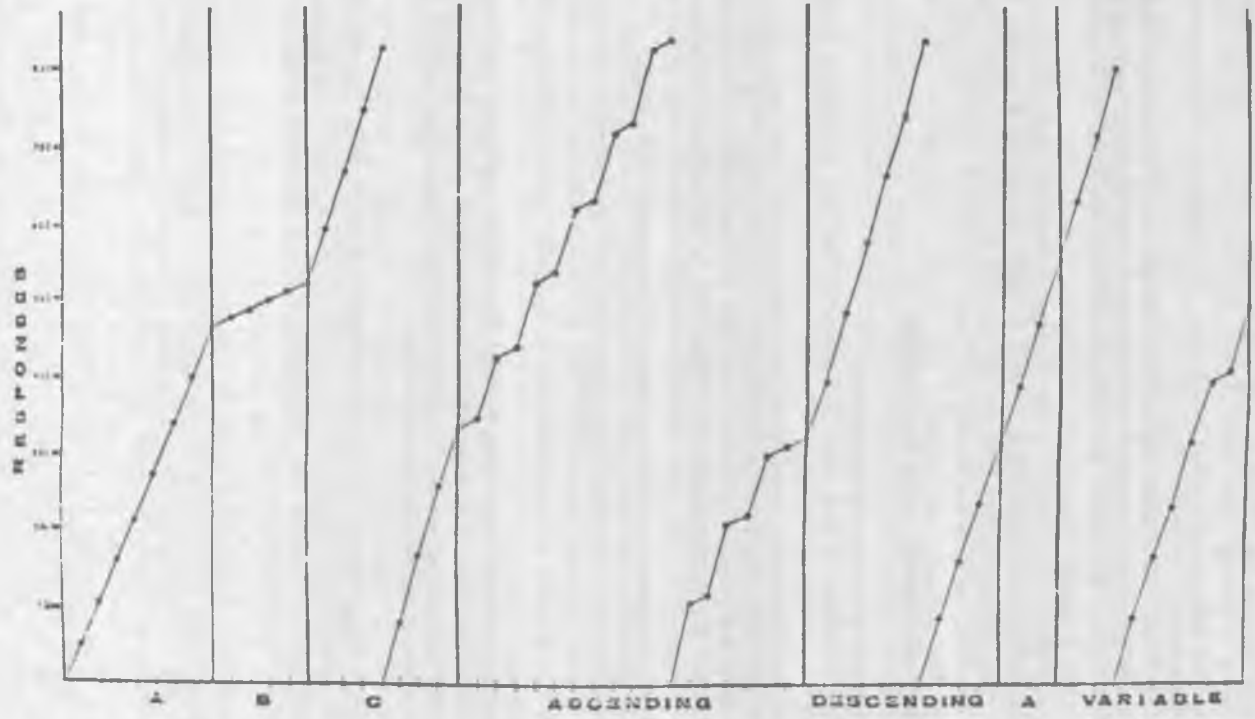

Figure 1. Cumulative record of responses of *S*1. The effect of different amounts of reinforcement on a rule-governed response in different experimental conditions.

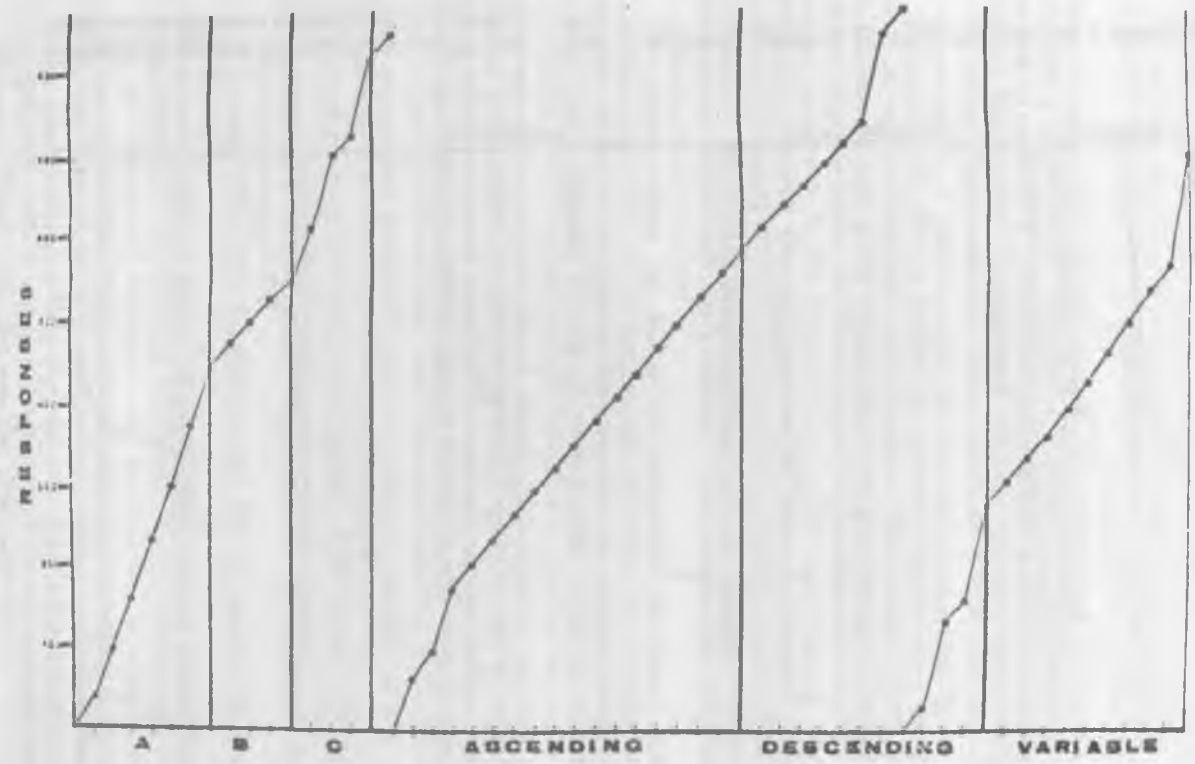

Figure 2. Cumulative record of responses of *S*5. The effect of different amounts of reinforcement on a rule-governed response in different experimental conditions.

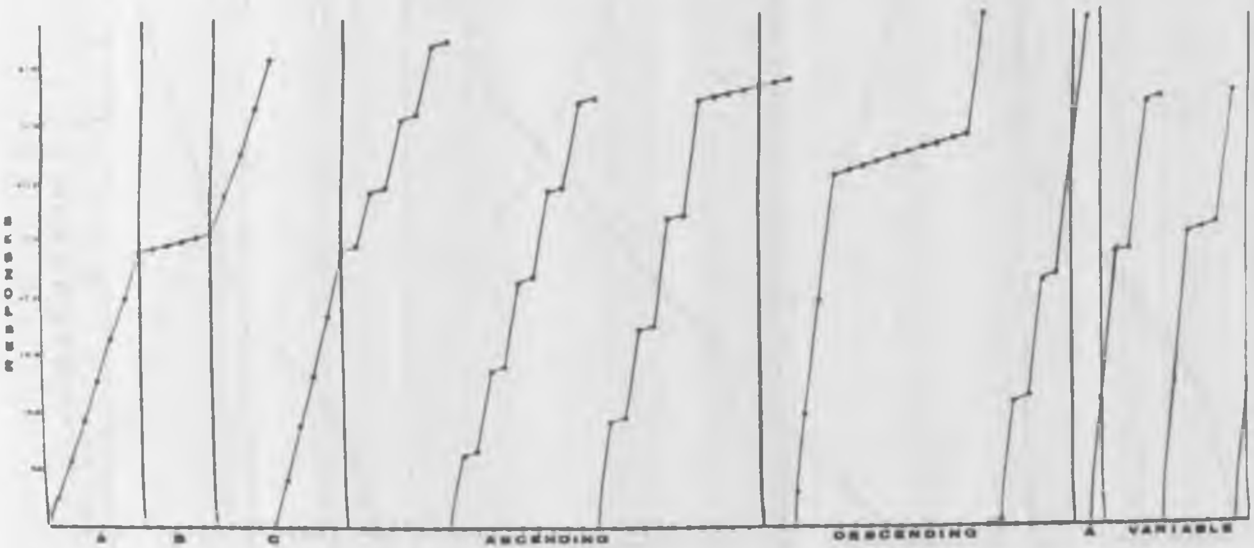

Figure 3. Cumulative record of responses of *S*8. The effect of different amounts of reinforcement on a rule-governed response in different experimental conditions.

compared with the original baseline. The descending and variable phases also show a decline although that of the variable phase is slighter. The *S*'s shift from free operant mode to the rule governed mode was discretely determined in terms of size of reinforcement increment.

Discussion

Within the scope of the present research it was shown that: (a) It was possible to construct a setting which controlled a response that was emitted only in the presence of a specific S^D, had a specific topography, and had a r.r. clearly different from the operant level. The rule was a verbal description of the most relevant parts of the setting. This is consistent whith Fernández's (1970, p.99) formulation of a "high probability of response under the contingencies specified by the rule"; (b) Reinforcement did affect a specific rule-governed response more specifically, the use of the rule was determined by the amount of reinforcement; (c) The rule would be followed as long as the reinforcement was large enough to outpay the free-operant response mode; (d) When amount of reinforcement was low the free-operant response mode was preferred; and (e) The mean response rates obtained during the ascending, descending and variable phases as compared to the baseline level seem to suggest that the rule controlled the bahavior inspite of the different conditions. It was observed that even though there was a difference between r.r.'s in both response modes there was a lowering of the response rate of the free-operant mode during the above phases.

The occasion where the rule should be followed was clearly stated in the instructions given to *S*. As the rule (as originally stated) was a verbal stimulus, the statement of the rule included a reference as to the occasion when it should be applied. The topography of RGR is likely to differ from the CSB due to the specification of the rule even though the difference may be very small or almost unnoticeable. The rule also should stipulate parameters of response (i.e., as in response differentiation or differential reinforcement of rate of responding) that should subsequently show up in the *S*'s r.r. or other response indices. In the present research the different response rates of the two modes were the basic data for evaluating whether *S*s were using one or another mode. The previous specification of the consequences contingent upon the emission of the response may be given in the instructions and these may or may not form part of the rule.

The implications of this study with reference to RGB are the following:

a) Rule-governed behavior can be implemented in the laboratory at least in a limited range as in a RGR.
b) It is possible to produce different response rates according to the specifications of the rule.
c) It is also possible to produce different topographies of response even though these differences may be subtle. Specifically, in this particular case, when *S* was on the free-operant response mode, he alternated between extension and flexion of the thumb muscles for very brief periods of time. In contrast, when the same *S* was in the RGR mode he had a position of sustained flexion of the same muscles during at least three seconds. This finding seems to lend support to Skinner's claim that response topographies for rule-governed behavior and contingency shaped behavior are usually different.

References

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