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The stimulus control of a response system in the absence of awareness.

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THE STIMULUS CONTROL OF A RESPONSE SYSTEM IN THE ABSENCE OF AWARENESS

A Dissertation Presented

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TABLE OF CONTENTS

	page
List of Tables	v
List of Illustrations	vi
Chapter I	1
Chapter II	18
Chapter III	25
Chapter IV	50
References	58
Appendix	64

LIST OF TABLES

page

Table 1 The Experimental Groups and Associated Schedule of Reinforcement for the Discrimination Phase of the Experiment.................................. 20

Table 2 Individual S+ and S- Response Rates for Each Subject in the Experiment.......................... 29

Table 3 Mean S+, S- Differences for the Discrimination Groups.................................. 31

Table 4 Mean S+ Rates During Last Twenty Minutes of the Discrimination Phase............................ 34

Table 5 Mean SVs for the Group Generalization Gradients.. 42

Table 6 Terminal Response Rates for the Extinction and Generalization Phases of the Experiment........... 48

LIST OF ILLUSTRATIONS

Figure 1 Stimulus Continuum.......................... 13

Figure 2 Mean Eyeblink and Buttonpress Gradients for Groups EBD52, EBD54 and EBS5..................... 37

Figure 3 Mean Eyeblink and Buttonpress Gradients for Groups BD52 and BS5.............................. 38

Figure 4 Mean Eyeblink and Buttonpress Gradients for Groups ED52 and ES5.............................. 39

Figure 5 Mean Eyeblink and Buttonpress Generalization Gradients for Group EBD25........................... 40

CHAPTER I

General Introduction

The concept of consciousness has enjoyed a prominent position throughout the evolution of psychology being focal to several theorists and manifesting itself in some form in virtually all areas of psychology. For the Experimental Analysis of Behavior, the consideration of the functions and origins of consciousness, as well as its interactions with other behaviors has resulted in a proliferating body of literature, mostly theoretical, but increasingly empirical. Indeed, one of the more distinguishing features of radical behaviorism has been its view with regard to consciousness.

Behaviorism and Consciousness (Awareness)

For radical behaviorists (e.g. Day, 1969; Skinner,1953) consciousness is synonymous with "awareness" or ability to verbalize, by an individual, some aspect of the public or private environment. Such a definition rules out, on *a priori* grounds, consciousness in non-verbal organisms, human or otherwise. The nominal stimulus which the verbal behavior describes may arise from an individual's own behavior (self-awareness) or it may not.

Classically, many psychologists (particularly "phenomenologists") have been concerned primarily with "conscious content" or, more specifically, what happens when a person examines and describes his "sensations" and "images", (e.g. Sperling, 1967). Such psychologists have employed a restricted definition of consciousness, implying it is nothing more than introspection. For the behaviorist, awareness of such private events constitutes only a small portion of consciousness, and is not any qualitatively unique form of behavior, although the private nature of most sensations may make their analysis more difficult. Verbal behavior, both public and private, as behavior, of which consciousness or awareness is a part, is assumed to be subject to the same natural principles as are all other behaviors, and the same methodology should apply to its investigation as apply to analyses of non-verbal behavior.

Thus, the goal of an experimental analysis of consciousness is an investigation of the controlling variables of consciousness and it eschews the awarding of any non-physical status to consciousness.

A behavioristic interpretation of consciousness is best contrasted with a mentalistic view, in which consciousness is treated as an entity and clearly something "more than" behavior. Consider the following interpretation by Sperling (1967):

"One can know the <u>content of consciousness</u> (italics added) only insofar as they are expressed by his behavior, particularly his verbal behavior ..... However, one must admit that a person who is unable to speak or act may retain consciousness. The critical aspect of the contents of consciousness is that they normally are capable of being verbalized or acted upon."

For the mentalists, then, the "contents" of consciousness can be comprehended by an external source only by examination of behavior (particularly verbal behavior), but there is "something more" to consciousness than can be understood by an exhaustive examination of public and private behavior. The logical conclusion is that an analysis of all the behavior of an organism would never result in an understanding of the "contents" of consciousness. Therefore, a distinction must be made by the mentalist between the behavior from which consciousness is inferred and consciousness itself.

Since, for the behaviorist, consciousness is a form of verbal behavior, and verbal behavior arises from the interaction of organism and environment, consciousness is therefore controlled in the same fashion as other behaviors. For Skinner (1963) "we learn to see (become aware of) what we are seeing (doing or sensing) only because a verbal community arranges for us to do so." Therefore consciousness is not considered as an inherent capacity or entity, rather its origin rests in the reinforcing practice of a <u>verbal</u> community, and it is nothing more than learned verbal behavior.

Functions of Consciousness

The functions that consciousness serves with regard to the totality of an individual's behavior still represents an unresolved empirical question for the radical behaviorist philosophy. Casual observation reveals that consciousness , and verbal behavior in general, appears to be a very well-differentiated set of responses in that it extensively modulates many other behaviors;it is unclear in what way, however.

With regard to the function served by consciousness, a clear demarcation exists between radical behaviorists and some forms of mentalism particularly,those of some phenomenologists and cognitive psychologists who believe that consciousness is an innate, necessary, antecedent of most all learned human behavior. Therefore, for these latter psychologists, the investigation of consciousess becomes a major goal of psychology, (i.e. the cognitive orientation holds that in most situations subjects first "formulate" hypotheses about experiments and then respond accordingly). As Levine (1963) has said: "The hypothesis, rather than the specific choice response on a particular trial is regarded as the dependent variable, i.e. as the unit of behavior affected by reinforcement."

For mentalists, the variables which are presumed by operant conditioners to modulate experimental performance (e.g. reinforcement) do so only because the subject is conscious or aware of the variables. Thus, for most all responses, if the subject is not aware, it is presumed that he cannot be conditioned.

Within the context of this philosophical difference between behaviorists and cognitive psychologists, admittedly one which does not avail itself of any conclusive proof and is recognizably only a difference of relative emphasis, several experiments have been conducted within the last fifteen years.

Learning and Awareness

While keeping in mind that any relationship between consciousness and other behavior represents reinforcement practices and not innate "capacities", several psychologists, operating within the framework of the Experimental Analysis of Behavior have empirically examined the relationships between awareness and operant performance in typical laboratory settings, with particular attention devoted to examination of whether control over selected behaviors could be developed in the absence of awareness of the part of the subject.

The initial, and simplest, studies of learning without awareness involved social situations in which experimenters attempted to reinforce certain verbal utterances by subjects during interviews (e.g. Greenspoon, 1955; Taffel, 1955). Following a period in which there was no response-reinforcement contingency, reinforcement was made contingent on, for example, emission of plural nouns. The verbal operant (plural nouns) was found to increase in probability of occurrence. Post-experimental questions, asking the subject if he knew the response-reinforcement relation, indicated no awareness. This effect has been replicated often.

Examples of responses successfully modified include expressions of opinion (Verplanck, 1955), attitude changes (Scott, 1957), verbal vigor in behavioral therapy (Ullman, Krasner, and Eckmann, 1961), and positive self-references (Harmatz, 1967). Examples of successful reinforcers include the word "good" (Greenspoon, 1955), body shifts (Wickes, 1956), money (Salzinger, 1959), and attitudinal statements similar to those of the subject (Golightly and Byrne, 1964). See Kanfer (1968), Williams (1964), or Krasner (1971) for reviews.

Several cognitive investigators have argued that subjects become aware of the response-reinforcement contingency in such studies and claim therefore that reinforcement is serving an informational function in the formation of hypotheses by subjects; these hypotheses, then, are the true source of control. Speilberger and de Nike (1966) presented evidence that most of their subjects became aware of the response-reinforcement contingency in their verbal conditioning study. Within an individual subject, there was a noticeable quantitative increase in the frequency of reinforced responses when he became aware of the contingency. Subjects who never became aware showed only small conditioning effects. Awareness was assessed by interviewing each subject at various points in each session to determine if he understood anything about the experiment. Similarly, Dulany (1962, 1968) using a procedure similar to Speilberger and de Nike (1966) in which subjects wrote down their "thoughts about the experiment" every few minutes during the experiment, was able to divide his subjects into three groups: (1) those aware of what the response-reinforcement contingency was, (2) those aware that their behavior was being manipulated, but not exactly how and (3) those unaware of anything at all. The first group showed a striking learning effect, the second a lesser one, and the third, virtually none. Dulany (1968) has proposed that the assessment of awareness is a very difficult problem. Frequently subjects may give reports which are false; they may be embarrassed to admit they were fooled. They may pretend not to be aware to please the experimenter, etc. He proposes a detailed questioning procedure in which more general questions give way to more specific questions about the experiment as the best that can be done at present.

Several other investigators (e.g. Hirsh, 1957; Philbrick and Postman, 1955; Sassenrath, 1962; Krasner, 1958), however, using detailed assessments of awareness involving verbal report found evidence of conditioning without awareness although it was smaller than conditioning with awareness.

Rosenfeld and Baer (1969) reversed the role of experimenter and subject in a verbal conditioning experiment. The interviewer was instructed to reinforce with statements of "mm-hmm", chin-rubbing of the interviewee. In reality, the interviewee was the experimenter and he was reinforcing certain verbal prompts (e.g. "ready") by the interviewer. Detailed probing throughout the duration of the experiment revealed the interviewer was not aware of the role reversal or that his behavior was being shaped. Despite the lack of awareness, most subjects showed a profound increase in the frequency with which reinforced prompts were emitted. In a subsequent study, Rosenfeld and Baer (1970) used the same logic. The interviewer, however, was really talking, via intercom, to a tape recorder. The interviewer was instructed to reinforce fluent pronunciation. In reality, certain verbal prompts were followed by fluent pronunciations on the tape. The interviewer thinking that "shaping" fluencies meant that he was a good "experimenter" was reinforced by fluencies. All interviewers increased in some way, their rate of reinforced prompts, even though they never realized that the prompts were being conditioned.

Recently Keehn (e.g. Keehn, Lloyd, Hobbs, and Johnson, 1965) has developed a technique for the control of awareness. Subjects are instructed that they are to press a lever in such a way as to maximize their point total (which can be exchanged for money). In reality, eyeblinks are monitored via a one-way mirror, and are reinforced according to some schedule; no contingencies, then, are really in effect for lever presses. Keehn, Lloyd, Hobbs and Johnson (1965) found that eyeblinking came under the control of the reinforcing stimulus (was conditioned) despite the fact that the subjects never indicated awareness of the fact during post-experimental questionning. The rate and pattern of behavior that was emitted by the subjects was highly similar in nature to that obtained from non-human subjects under the control of the same schedules. Unfortunately, an extensive analysis of any covariations in lever pressing as a function of eyeblink performance were not presented, nor was an extensive assessment of awareness done.

Several investigators have examined response systems whose stimulus feedback is not discriminated by the subjects (e.g. Hefferline and Keenan, 1963; Hefferline, Keenan and Hartford, 1959; Sasmoor, 1966). In such experiments, subjects are fitted with electrodes which they believe are measuring their ability to relax. Thumb contractions, not visible to the subjects, are then reinforced operantly. The contractions eventually come under the control of the reinforcement, displaying patterning similar to that of non-conscious organisms. Detailed subject questionning reveals no awareness.

A study using a dichotic listening situation in which subjects are presented with information simultaneously in both ears suggest a method for controlling awareness. Subjects are required to monitor and repeat a message in one ear while another message is presented to the other ear. Konecni and Slamecka (1972) reinforced certain word classes contained within a message presented to the non-monitored ear by following them with the word "good". In a post- experimental interview,subjects were asked to free-associate lists of words. Unaware subjects emitted a much higher frequency of words from the reinforced word classes compared to a control group which had received random reinforcement during training.

In summarizing the "learning without awareness" literature, it appears that for some subjects in some experiments (e.g. Spielberger and de Nike, 1966; Dulany, 1966) learning does not occur without awareness. Nontheless, the major finding of learning in the absence of awareness in a substantial number of studies (e.g. Rosenfeld and Baer, 1969) does indicate that awareness is not a <u>necessary</u> condition for learning although it may control the amount and rate of acquisition of a response.

A major aspect of the learning without awareness literature is that it focuses on the control exerted by reinforcing stimulus. A more cogent analysis might also investigate whether control by the discriminative stimulus can be developed without awareness.

<u>Discrimination and Generalization</u>

In the simplest case of the most commonly used free-operant discrimination paradigm, the subject is presented two alternating stimuli. In the presence of one stimulus (S+) responses are reinforced according to some schedule; typically variable-interval (VI) schedules are used, although any other schedule may be employed. (In a variable-interval schedule reinforcements are delivered for the first response after the completion of some interval of time; the interval varies from one reinforcement to the next. A VI schedule is specified in terms of the average interval between reinforcements, thus a VI 30-sec schedule indicates that, on the average, reinforcements were programmed 30 seconds apart.) In the presence of the other stimulus (S-), responses are never reinforced, i.e. extinction (EXT) is programmed. Following the successful adquisition of a discrimination, subjects emit the greater majority of their responses during S+.

Generalization testing frequently follows discrimin - ation training. In a typical generalization test each of several stimuli from a particular physical dimension are presented randomly in succession and the number of responses emitted in the presence of each stimulus is recorded.

During generalization EXT is typically scheduled. A frequency plot of the number of responses emitted in the presence of each stimulus yields a function called a generalization gradient. The extent to which variations in the stimulus result in changes in response rate is evidence of the degree of stimulus control exerted over the response system by the physical dimension.

Figure 1, taken from Terrace (1966) illustrates a generalization gradient for a hypothetical dimension, gradient 1 representing no stimulus control and gradient 2 representing maximum control.

Hanson (1959) analyzed the effect of discrimination training on the shape of the generalization gradient, using pigeons as subjects. Relative to groups receiving single stimulus (SS) training instead of receiving discrimination training, (only S+ was presented, never S-), groups receiving discrimination training showed: (1) a steep gradient, particularly in the region of S-, (2) a displacement of the mode (peak) of the gradient beyond the S+ in a direction away from the S- (peak shift) and (3) an inverse relationship between the amount of mode displacement and the difference between S+ and S-. These three findings have been widely replicated with pigeons (e.g. Terrace, 1966) and rats (e.g. Pierrel and Sherman, 1962).

Human Discrimination Performance

All systematic studies of human operant discrimination performance have employed discrete trial situations in which a stimulus is briefly presented and the subject either makes

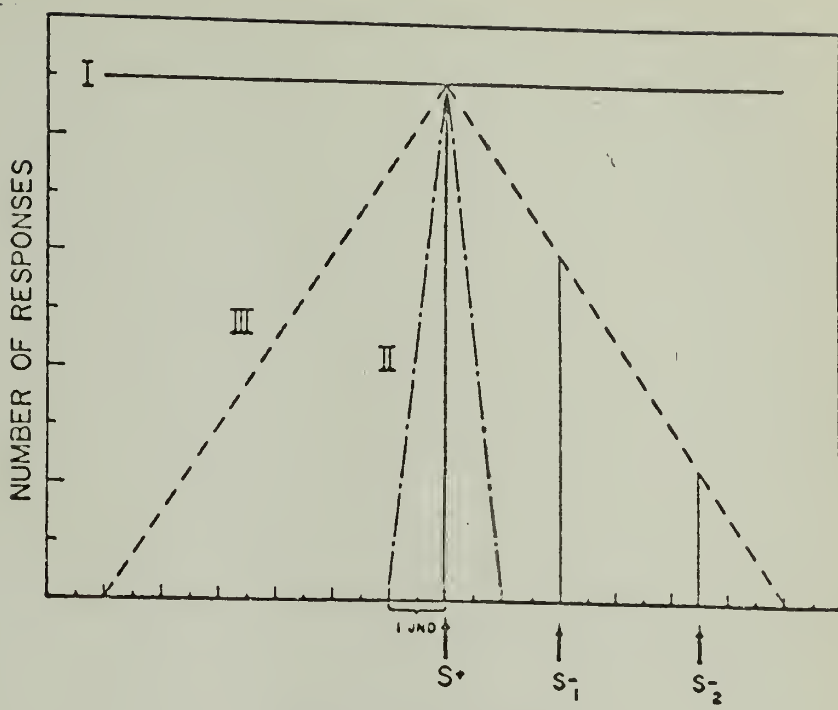

Figure 9. Hypothetical generalization gradients. Gradient I represents no stimulus control. Gradient II represents the maximum possible stimulus control. Gradient III represents an intermediate amount of stimulus control.

a response to it or does not. No studies have used a free-operant procedure in which subjects were unrestrained in the number of responses they could emit in the presence of each stimulus, as is usually the case with non-human species. The results of human studies have both confirmed and disconfirmed the findings with non-human subjects.

Thomas and Mitchell (1962) gave three groups of subjects SS training with different colored lights, e.g. yellowish-green, bluish-green (wavelength dimension), and interspersed a generalization test periodically. The generalization gradients, while not sharp,when analyzed over time showed a gradual progression toward a peak at the primary colors (e.g. blue, yellow, etc.) indicating that subjects were labelling the stimulus and responding accordingly. Corroborative evidence was obtained from a study by Thomas and DeCapito (1966), who required subjects to label an ambiguous stimulus (bluish-green light). Following SS training subjects labelling the stimulus as "green" eventually came to show non-sharp generalization gradients with peaks in the green portion of the wavelength spectrum, those subjects labelling the stimulus as "blue" showed gradients peaked in the blue region. A group that did not label the stimuli demonstrated peaks midway between the two.

Doll and Thomas (1967) gave different groups of subjects wavelength discrimination training in which the

S+,S- difference differed for the groups. Interestingly, compared to the SS control all discrimination groups showed peak shift, but the magnitude of peak shift varied directly, rather than inversely, with the S+,S- difference.

Thomas and Jones (1962) gave different groups of subjects different series of stimulus values (SV's) during generalization testing along a wavelength continuum. For one group the same number of SV's in the generalization test were located above the S+ as below it. For the other group the test SV's were asymmetrically distributed around the S+. Subjects in the symmetrical test group showed a peak of responding near the S+, while subjects receiving the asymmetrical test series showed a peak toward the center of the test series. This latter tendency of a shift of the mode of generalization gradients towards the center of the test series has been reported elsewhere (Helson and Avant, 1967) and is called the "central tendency effect".

Thomas, Svinicki and Vogt (1973) gave subjects discrimination training along a brightness continuum, and found that, relative to a SS control group, area shift[1] was obtained when the S+ was a more intense stimulus than the S-, but not when the S- was a less intense stimulus than the S+.

[1] Area shift is a combined measure of peak shift and steepening of the generalization gradient in that the area under the gradient is affected by both shifts of mode and steepening where the modal stimulus value is not.

When area shift was obtained, its magnitude varied directly as a function of the S+, S- difference. They interpreted the results,as well as the Thomas and Jones (1962) results in terms of adaptation-level (AL) theory (Helson, 1964). They reasoned that in generalization testing there was a tendency to shift the mode of responding toward the "AL" of the test series. If the AL of the test series, which is empirically determined by having the subjects rate which SV of a series is the "medium" SV (i.e. in a series of stimuli differing in brightness, that SV which was rated "medium" brightness) happened to be the central stimulus, then the central tendency effect would be observed; if the AL were beyond the S+ in a direction away from the S- area shift would be obtained. Thomas et.al. (1973) confirmed this prediction by selecting SV's for the S+ and S- which were "above" the empirically determined AL for their SV's. Under these circumstances, area shift was obtained even when the S+ was a less intense SV than the S-, thus area shift depended on the AL of the stimuli.

In summarizing the results of human operant discrimination studies, it appears as though certain of the non-human findings apply, e.g. area shift can be obtained. However, the typical findings appear to occur only under certain circumstances, and are not as general as might be hoped.

Purpose

Since all demonstrations of stimulus control of the responding of human subjects have used discrete-trial situations, it would be interesting to determine if similar types of control could be developed with free-operant schedules of reinforcement.

Further, since all demonstrations of learning without awareness have concentrated on the role of reinforcing stimuli, it would be helpful to investigate whether stimulus control could be developed in the absence of awareness.

With the above considerations in mind, the purpose of the present investigation were the following: (1) to determine whether "typical" generalization gradients could be obtained (stimulus control developed) for human subjects in a free-operant situation, and (2) to investigate whether stimulus control could be developed over a response system in the absence of awareness by the subject, and if so whether it would differ from the type obtained using a response system, which the subject was aware was being manipulated.

CHAPTER II

Method

Subjects

Twenty high school and college students served as subjects receiving either money or credit towards their grade in a psychology course as compensation.

Apparatus

The apparatus consisted of a masonite paneled relay rack containing five buttons, 1.27 cm x 1.27 cm, spaced 1.27 cm apart and located at chest level to the subject. The leftmost button was transilluminated white and operative during the experiment, other buttons were neither operative nor lighted. A force of 200 g operating through a distance of 10 mm defined an effective button press. A six digit add-subtract counter was centered 20.32 cm above the buttons. Two standard jewel lights flanked the counter on either side at a distance of 3.08 cm. A set of Pioneer eight ohm headphones which contained the auditory stimuli for the experiment were fitted to and worn by the subject throughout the experiment. The ten different intensities of white noise used in the experiment, and their codes are as follows:

Code	Intensity in decibels
SV1	40
SV2	47
SV3	54
SV4	59
SV5	64
SV6	69
SV7	73
SV8	78
SV9	82
SV10	86

The wall directly behind the apparatus contained a wall-length one-way mirror which permitted the experimenter to observe and record (by pressing a button) the eyeblinking of the subject. All equipment was controlled by standard electromechanical programming equipment located in an adjacent room

Procedure

Subjects were randomly assigned to one of nine different experimental groups. All groups received two experimental sessions each consisting of a forty minute session. The discrimination phase lasted the entire forty minute duration of the first session and the first twenty minutes of the second session. Immediately following the twentieth minute of the second session, the generalization phase started and lasted for the final twenty minutes. Between the first and second session, subjects were permitted a five minute rest period.

Groups differed according to the contingencies imposed upon them during the discrimination phase of the experiment. For the three subjects in group EBD52, (reinforcement contingent for Eyeblinking and Buttonpressing, Discrimination training programmed, S+ = SV5, and S- = SV2, i.e. EBD52) two stimuli alternated at one minute intervals. In the presence of SV5 (S+), eyeblinks were reinforced according to a VI 30-sec schedule, and button presses were reinforced according to an independent VI 30-sec schedule. Eyeblinking

Table 1

The Experimental Groups and Associated Schedule of Reinforcement for the Discrimination Phase of the Experiment

Group	Number of Subjects	S+ value	S- value	Schedule: Eyeblink S+	Eyeblink S-	Buttonpress S+	Buttonpress S-
EBD 52	3	SV5	SV2	VI 30-sec	EXT	VI 30-sec	EXT
EBS 5	3	SV5	---*	VI 30-sec	---	VI 30-sec	---
EBD 54	2	SV5	SV4	VI 30-sec	EXT	VI 30-sec	EXT
BD 52	2	SV5	SV2	X**	X	VI 30-sec	EXT
BS 5	2	SV5	---	X	X	VI 30-sec	---
ED 52	2	SV5	SV2	VI 30-sec	EXT	X	X
ES 5	2	SV5	---	VI 30-sec	---	X	X
EBD 25	2	SV2	SV5	VI 30-sec	EXT	VI 30-sec	EXT

*---=never received S-

**X = responses recorded, but no contingencies programmed and buttonpressing were placed on EXT in the presence of SV2 (S-).

For the three subjects of group EBS5,(reinforcement contingent for Eyeblinking and Buttonpressing, Single stimulus training programmed,and S+ = SV5,i.e. EBS5), only one stimulus was presented during the discrimination phase, SV5 (S+). In the presence of SV5 both eyeblinks and buttonpresses were reinforced according to independent VI 30-sec schedules. Thus group EBS5 served as a SS "control group" vis a vis EBD52 in that the former never received an S-.

For the two subjects in group EBD54,(reinforcement contingent for Eyeblinking and Buttonpressing, Discrimination training programmed, S+ = SV5, and S- = SV4,i.e. EBD54), the parameters were identical those of group EBD52, except that S- was SV4.

The two subjects of group BD52,(reinforcement contingent for Buttonpressing, Discrimination training programmed, S+ =SV5, and S- = SV2, i.e. BD52) received identical parameters to those of group EBD52 except that no reinforcement was programmed for eyeblinking although eyeblinks were recorded by the experimenter.

The two subjects of group BS5,(reinforcement contingent for Buttonpressing, Single stimulus training programmed, S+ = SV5, i.e. BS5) served as a SS control for group BD52, i.e. no S- was presented to them, only the S+.

For the two subjects of group ED52, (reinforcement contingent for Eyeblinking, Discrimination training programmed S+ = SV5, and S- = SV2, i.e. ED52) the parameters were identical to those of group EBD52 except that no reinforcements were in effect for buttonpressing, although buttonpresses were recorded.

The two subjects in group ES5, (reinforcement contingent for Eyeblinking, Single stimulus training programmed, S+ = SV5, i.e. ES5) were a control group for group ED52 in that S- was never presented.

For the two subjects of group EBD25, (reinforcement contingent for Eyeblinking, and Buttonpressing, Discrimination training programmed, S+ = SV2 and S- = SV5, i.e. EBD25) parameters were identical to those of group EBD52 except that the S+ was SV2 and the S- was SV5.

For group R (two subjects), the parameters were similar to those of group EBD52. For one subject during SV5 a VI 30-sec schedule was programmed for eyeblinking and EXT was in effect for buttonpressing, while during SV2, EXT was effective for eyeblinking and a VI 30-sec schedule reinforced buttonpressing. For a second subject, the contingencies were reversed for each stimulus, i.e. during SV2 a VI 30-sec schedule reinforced buttonpressing and EXT was in effect for eyeblinking, etc.

Table 1 details the parameters of the discrimination phrase for all groups (except group R).

Reinforcements consisted of 12 point additions to the counter which were delivered at the rate of 10 per second. Coincident with the point additions, the green light to the left of the counter flashed as a signal.

During the discrimination phase, whenever a VI 30-sec or EXT schedule was programmed for a response system (and not when "no contingency" was programmed) a random 10% of all non-reinforced responses resulted in a one point loss on the counter. Such a contingency had been found to stabilize response rates in previous studies with the present apparatus. The red light flashed as the point was deducted.

During the generalization phase, all subjects received two randomized blocks of the ten test stimuli. Each stimulus was presented singly, for a one minute duration. During the generalization phase, no contingencies were in effect for either buttonpressing or eyeblinking.

For three randomly selected subjects (in different groups) another observer independently recorded eyeblinks to provide a measure of interobserver reliability. After the experimental sessions, subjects filled out an "awareness" questionnaire (Appendix A) designed to discover, by moving from more general to more specific questions, the extent of any knowledge the subjects had about the "real" experimental contingencies. (Questions 4 and 5 were omitted for SS subjects).

The following instructions were read to each subject at the start of the experiment. Note that subjects were not instructed about any eyeblinking contingency, i.e. they were led to think that only buttonpressing affected the counter score.

Your goal in this experiment is to maximize your point score on the counter in front of you. You will increase the counter total by adopting some strategy of pressing the lighted button in front of you. Sometimes when you are not pressing appropriately, a point will be deducted from the counter. Sometimes point additions and losses will immediately follow a buttonpress and sometimes they will be delayed. When points are added, the green light to the left of the counter will flash as a signal. When a point is deducted from the counter, the red light to the right of the counter will flash as the point is deducted. Try to maximize your point score by adopting a strategy which permits you to gain as many points and to avoid losing as many points as possible. Sometimes when your strategy has been particularly poor, the counter will step below zero and read all nine's; this is bad and you should try to keep the counter reading above zero as much as possible. You are to wear these headphones while you press. They will contain noises that will help you to maximize your point score. When the light on the button comes on, the session will have started and when it goes off, the session will have ended and I will come and get you.

CHAPTER III

Results

Assessment of Awareness

In order to ascertain whether the eyeblinking response system was, in fact, a response system which the subject did not realize was being manipulated, an analysis of responses to the awareness questionnaire was conducted.

To question 1 ("What do you think this experiment is really about?"), 14 of the 20 subjects replied with a statement such as "I don't know." etc. All subjects were vague in their statements and said nothing indicating awareness of the real contingencies (e.g. ".... it seemed more like guesswork ... something to do with logical thinking or something like that "-S215).

To question 2 ("What sorts of things did you do in order to maximize your point score....?) there was considerable variance in the answers, but most reflected the theme of trying to establish some pattern (e.g. "....I just pushed the buttons in different patterns" - S216). Answers to question 3 (" What sorts of rules did you follow... what was your strategy.... did you use the noises in the headphones....?") were similar to question 2.

To question 4 (" Did you notice that you only gained points when the loud noise was on....") and question 5 ("Did you notice that you never gained points when the dim noise was on...?"), received only by discrimination groups (and reversed for group EBD25), all subjects answered yes.

When asked to guess the "other" behavior being manipulated (Questions 6 and 7), nine subjects declined while the others gave vague answers (e.g. "what you are doing while you are sitting here"-S232, or "looking away from the buttons" - S223).

Question 8 asked subjects to rank six behaviors according to their certainty that they were being monitored, even though they felt they might be guessing. The mean ranking given to eyeblinking (1 = most confident, 6 = least confident) was 4.8.

The final question admitted that eyeblinking was being monitored. All subjects responded in the negative when asked if they knew this.

In summarizing the results of the questionnaires, it appears certain that all subjects were unaware that eyeblinking was being monitored or had anything to do with their point totals. Additionally, while subjects knew that buttonpressing was in someway related to their point total, they were never able to specify a rule which in any way approximated the programmed experimental contingencies. Thus, it is warranted to distinguish buttonpressing as a "conscious" response system and eyeblinking as an "unconscious" response system, in the subsequent analysis.

Reliability of Measurement of Eyeblinking

In the present study, eyeblinking was recorded by the experimenter who depressed a button everytime the subject blinked. Since the assessment of eyeblinking involved the use of a human intermediary, some measure of his reliability in assessing responses should be determined. Such a provision was allowed by having a second observer measure eyeblinking, along with the experimenter for a randomly selected set of 3 subjects (i.e. 6 sessions) S218, S220, and S207.

Reliability was assessed by counting the number of observed eyeblinks which fell within 1.5 seconds of each other. A ratio was formed between the number of agreements for both observers and the combined total number of agreements for both observers. This ratio was multiplied by 100 to get a percentage score (100% equals maximum agreement). The percentage of agreements thus obtained for these three subjects conjointly observed was 61%, 94% and 96%. The mean inter-observer reliability of 83% represented a high degree of reliability. The lowest reliability index (61%) was recorded for the first subject conjointly observed and the low value obtained, no doubt, indicated the inexperience of the second observer.

Nonetheless, the high overall reliability indicates that the measurement of eyeblinking was "accurate" and that the experimenter was not "biasing" the results in any way.

Discrimination Phase

Table 2 contains the S+ and S- response rates for individual subjects for both eyeblinking and buttonpressing, during both sessions of the discrimination phase, and provide the basis for the following analyses.

Level of Discrimination - Since a major purpose of this experiment was to investigate whether or not stimulus control could be developed for both a conscious and an unconscious response system, an analysis of the response rates to the S+ and S- was conducted in order to comprehend the extent to which subjects came under the control of the S+ and S-, (the discriminative stimuli). For the five discrimination groups - (EBD52, EBD54, EBD25, BD52, ED52) the S- response was subtracted from the S+ response rate as measured during the first twenty minutes of session 2 (the last twenty minutes of the discrimination phase); the larger the difference the greater the level of discrimination. Table 3 contains the group means for each response system . Analysis of data of Table 3 showed that groups EBD52, (eyeblinking: $t=4.28$, $p<.05$; buttonpressing: $t=3.43$, $p<.05$), EBD54 (eyeblinking: $t=20.21$, $p<.025$; buttonpressing: $t=42.38$, $p<.01$) , and EBD25 (eyeblinking: $t=6.31$, $p<.05$; buttonpressing: $t=6.54$, $p<.05$) all showed a significant degree of discrimination, i.e.the S+, S- difference differed significantly from zero.

TABLE 2a

Individual S+ and S- Response Rates
For Each Subject in the Experiment

Group	Subject Number		Rates (responses/min) Session 1		Rates (responses/min) Session 2	
			S+	S-	S+	S-
	S200	E	27.10	7.05	31.00	9.10
		B	17.75	2.40	25.50	1.80
EBD 52	S219	E	8.45	5.30	24.10	7.30
		B	13.15	15.90	39.20	2.50
	S222	E	8.25	8.50	24.90	12.50
		B	11:25	6.40	29.50	8.10
	S206	E	30.75	-----*	39.00	-----
		B	37.25	-----	41.20	-----
EBS 5	S218	E	31.25	-----	31.90	-----
		B	32.55	-----	42.50	-----
	S223	E	16.40	-----	29.10	-----
		B	21.45	-----	62.50	-----
	S205	E	21.25	6.15	28.70	9.40
ED 52		B	16.40	11.15	14.80	10.20
	S215	E	19.75	15.50	24.30	8.40
		B	20.75	17.05	14.20	9.30
	S216	E	16.25	-----	31.50	-----
ES 5		B	11.70	-----	19.70	-----
	S221	E	14.75	-----	19.50	-----
		B	16.25	-----	16.30	-----

*----= S- not received
E= eyeblink
B = buttonpress

TABLE 2b

Individual S+ and S- Response Rates
For Each Subject in the Experiment

Group	Subject Number		Rates (responses/min) Session 1		Rates (responses/min) Session 2	
			S+	S-	S+	S-
BD 52	S217	E[a]	7.35	6.80	9.70	12.70
		B	17.55	14.75	48.50	2.10
	S220	E	14.55	16.40	12.80	16.30
		B	34.70	3.90	42.90	2.30
BS 5	S208	E	11.50	-----*	17.50	-----
		B	29.90	-----	27.50	-----
	S207	E	8.85	-----	14.20	-----
		B	17.05	-----	17.40	-----
EBD 25	S231	E	20.50	9.75	22.10	16.30
		B	28.80	14.75	29.10	16.30
	S232	E	8.75	5.55	15.50	10.30
		B	16.05	5.75	19.90	2.80
EBD 54	S225	E	15.75	9.90	27.60	11.20
		B	21.25	11.35	34.50	13.50
	S226	E	17.10	13.75	31.50	13.80
		B	16.00	14.00	27.40	6.80
Group R	S235	E	8.75	8.20	15.70	12.20
		B	10.70	9.90	15.50	10.00
	S236	E	10.85	8.65	19.50	16.70
		B	15.75	7.10	21.50	13.50

*---- = S- not received

(a) E = eyeblink
B = buttonpress

TABLE 3

Mean S+, S- Differences for the Discrimination Groups

Group	Eyeblink Mean Difference	Buttonpress Mean Difference
EBD52	17.0	27.2
ED52	17.6	4.7
BD52	-3.2	43.5
EBD25	5.5	14.9
EBD54	17.0	20.8

Group EBD52 also showed a significant discrimination for both response systems (eyeblink: t=9.11, p<.05; buttonpressing: t= 23.75, p<.025). Group BD52 showed only a discrimination for buttonpressing (t=11.21, p<.05), the response system for which a discrimination schedule was in effect.

The failure to obtain a substantial S+,S- difference in group R resulted in their omission from the following analyses. Thus all discrimination groups (except group R) showed some sort of differential responding in the presence of the two stimuli, either for one or both response systems.

Group and Response System Differences in Level of Discrimination - A major purpose of this study was to investigate differences among conscious and unconscious response systems with regard to the development of discriminative behavior and stimulus control. Therefore, the data of Table 3 were subjected to an analysis of variance (5x2 mixed factorial design) to determine if there were group and/or response system differences in the level of discrimination attained.

The results indicate that:(1) the groups differed significantly from each other, F(4,6) = 4.69, p<.05 (i.e. the different groups attained different degrees of discrimination), (2) the degree of discrimination did not differ as a function of whether it was for eyeblinking or buttonpressing, and (3)the groups effect interacted significantly with the type of response system, F (4,6) =

4.97, $p < .05$.

Analysis of S+ Rates- An analysis of S+ rates provided data on the origins of the different levels of discrimination attained by the groups, i.e. it could be that all groups attained similar S- rates, and differed in their S+ rates; or it could be that S+ rates were similar for all groups and that differences in S- rates accounted for the different levels of discrimination; or it could be a combination of both.

The S+ rates during the first twenty minutes of session 2 (the last twenty minutes of the discrimination phase) were calculated for each subject for both eyeblinking and buttonpressing. The group means are presented for both the discrimination groups and their SS controls (groups EBS5, ES5, BS5) in Table 4. An overall analysis of variance was conducted on the data of Table 4 (8x2 mixed factorial design). The results indicated that: (1) the groups did not differ from each other in their S+ rates, and (2) the rates of eyeblinking and buttonpressing in the presence of S+ did not differ. Therefore, different levels of discrimination reflect differences in S- response rates, since all groups attain roughly equivalent S+ rates.

Since research indicates that the level of attained discrimination may vary as a function of the physical distance between S+ and S-, (e.g. Hanson, 1959) groups EBD54 and EBD52 were compared for both response systems.

TABLE 4

Mean S+ Rates During Last Twenty Minutes of the Discrimination Phase

Group	Eyeblink Mean S+ Rate	Buttonpress Mean S+ Rate
EBD52	20.6	31.4
EBS 5	33.3	48.7
ED52	26.5	14.5
ES5	25.5	18.0
BD52	11.2	45.7
BS 5	15.8	22.4
ED52	18.7	24.5
ES5	29.5	30.4

No significant differences were found with the stimulus differences used in the present study. When the S+ and S- were far apart (S+ = SV5, S-=SV2 for group EBD52), the level of discrimination attained was not different than when the S+ and S- were close together (S+ = SV5, S-= SV4 for group EBD54).

Group EB25 vs. EBD52 - Since previous studies with human subjects (e.g. Thomas et.al. 1973) have indicated that the level of discrimination as well as the degree of stimulus control varies as a function of whether the S+ is more or less intense than S-, group EBD52, (for which the S+ = SV2, and S-=SV5) was compared with group EBD52 (for which the S+ was SV5 and the S- was SV2). No difference in level of discrimination was found for either response system, indicating that the discrimination was just as good when S+ was more intense than S- as when the S- was more intense than S+.

Group ED52 vs. Group BD52 - Since in group ED52, there was no contingency between buttonpressing and reinforcement (only for eyeblinking) and in group BD52 the opposite was the case, blink rates and buttonpress rates for the two were compared in order to investigate, as any reinforcement theory might predict, whether the levels of discrimination attained were different for a response system when reinforcement was programmed for it, as opposed to when it was not.

Comparing the eyeblinking discrimination level of the two groups indicated that the discrimination was better for group ED52, $F(1,6) = 17.41$, $p < .01$. For the buttonpress response system, the discrimination was better for group BD52, $F(1,6) = 6.31$, $p < .05$. These comparisons indicate that when differential reinforcement was contingent for a response system, the level of discrimination attained was higher than when differential reinforcement was not programmed for a response system.

Generalization Phase

Figures 2,3,4, and 5 contain the group generalization gradients for both eyeblinking and buttonpressing, each panel in a figure representing a group. Visual inspection of the graients indicates clearly that for all gradients response rate varied as a function of SV. More detailed analysis of the shape of the gradients will be considered subsequently.

In order to jointly evaluate whether there was any peak shift and steepening of the generalization gradient, the area under the gradient was determined by taking each subject's individual gradient and computing the number of responses for each SV. For each subject a grouped frequency distribution was thus obtained and a mean for each distribution was then calculated to permit comparison. The higher the value for the mean, the greated was the percentage of a subject's responses made to the louder stimuli, i.e. the higher SV's (see Thomas et.al. 1973 for a discussion

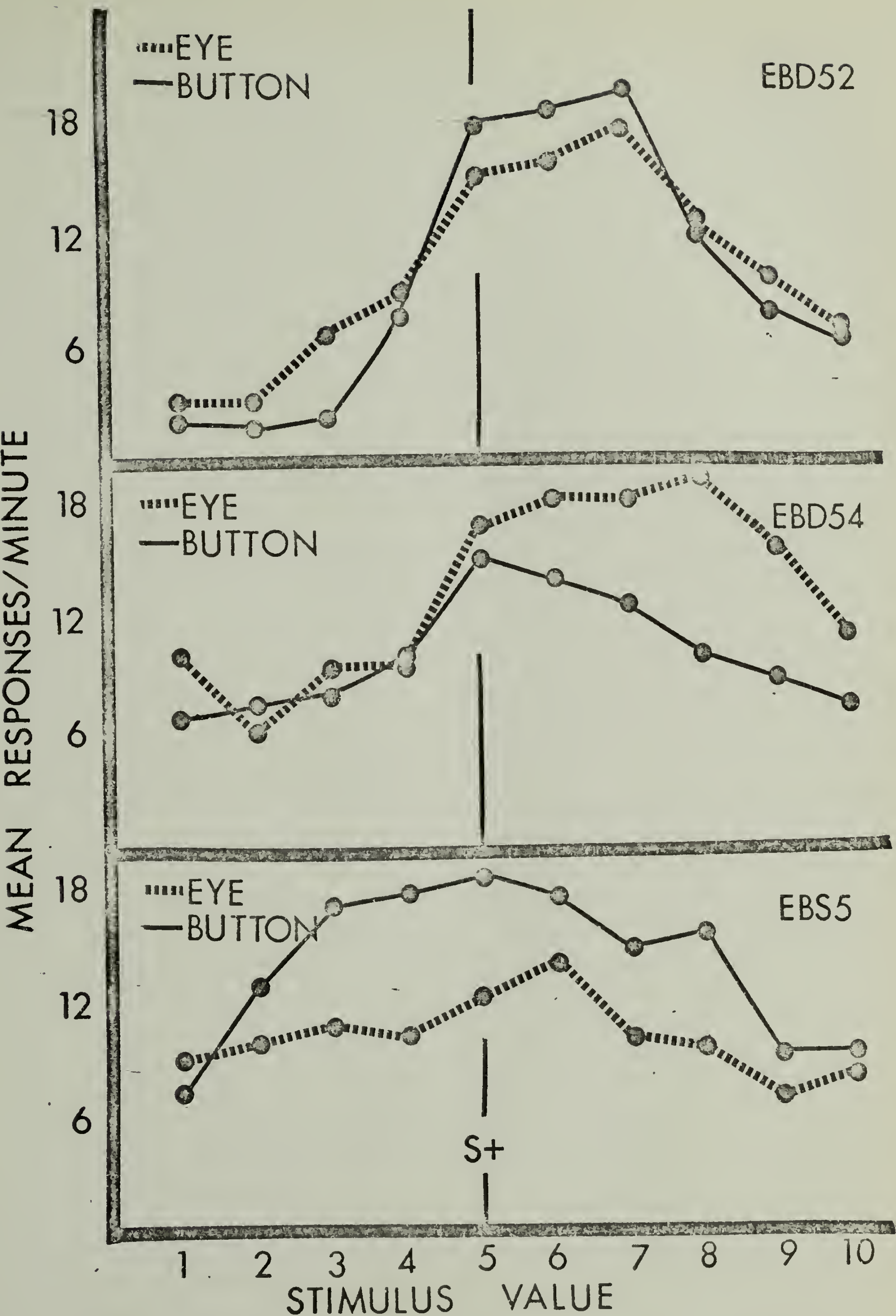

Fig.2. Mean eyeblink and buttonpress gradients for groups EBD52, EBD54 and EBS5.

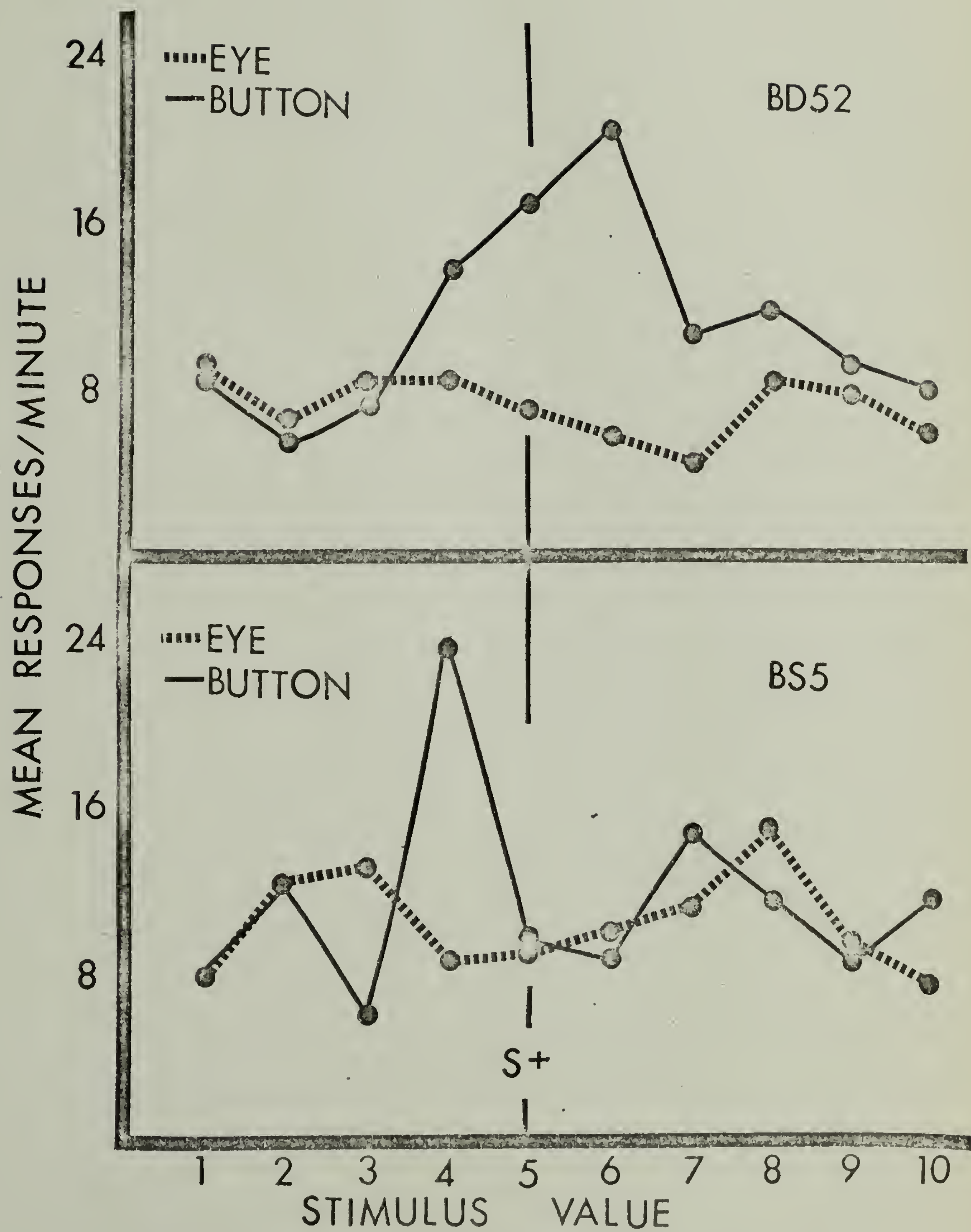

Fig.3. Mean eyeblink and buttonpress gradients for groups BD52, and BS5.

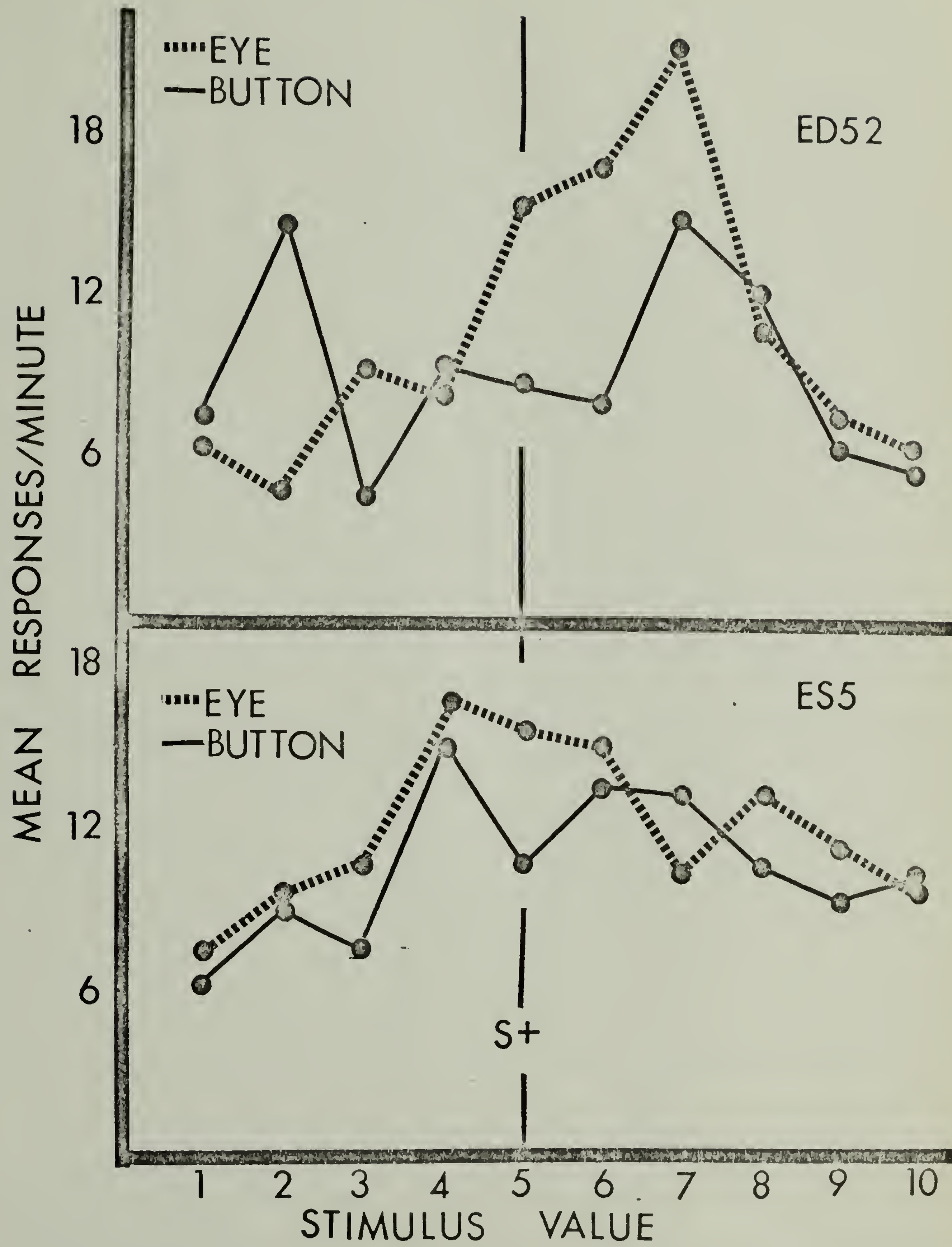

Fig.4. Mean eyeblink and buttonpress gradients for groups ED52 and ES5.

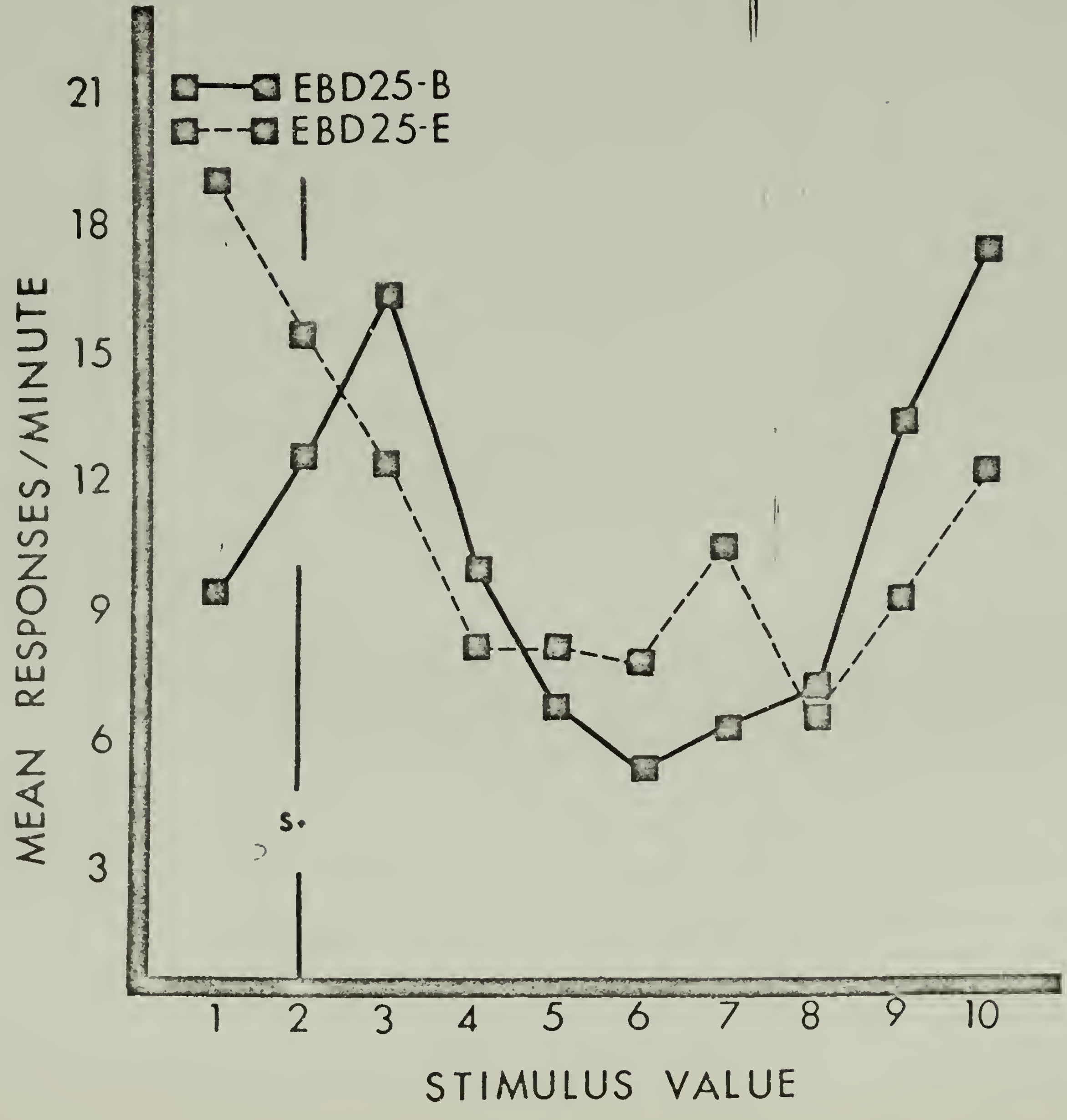

Fig.5. Mean eyeblink and buttonpress generalization gradients for group EBD25.

of this precedure). Table 5 contains the group mean values thereby obtained for both buttonpressing and eyeblinking. Group EBD25 was excluded since the S+ and S- were reversed; additional features of the EBD25 gradients also prescribed separate analyses.

An overall analysis of variance was performed on the data of Table 5 (7x2 mixed factorial design). Significant groups, $F(6,9) = 6.10$, $p < .01$, and Groups x Response System interaction, $F(6,9) = 4.21$, $p < .05$ were obtained. Thus, the gradients were different for the various groups. As was the case for the discrimination data, there were no overall differences between buttonpressing and eyeblinks. More detailed analyses of the significant differences among groups with the shape of the gradient are presented in the following sections.

Group EBD52, Group EBD54 and Group EBS5 - Since a major purpose of the present study was to investigate whether stimulus control, as well as area shift, could be obtained for both eyeblinking and buttonpressing, discrimination groups EBD52 and EBD54 were considered along with their SS control, group EBS5. All groups were similar in that independent schedules were programmed for both response reinforcement systems. Figure 2 contains the gradients.

All gradients show evidence of stimulus control though its extent varies. Both gradients of group EBS5 are flat relative to the gradients of the discrimination

TABLE 5

Mean SVs for the Group Generalization Gradients

Group	Eyeblink Mean SV	ButtonPress Mean SV
EBD 52	6.4	7.1
EBD 54	7.5	5.5
EBS 5	5.2	4.9
BD 52	4.8	6.0
BS 5	5.1	4.5
ED 52	7.0	5.5
ES 5	4.9	4.8

groups (which are more peaked). Comparing group EBD52 with group EBS5 (see Table 5) reveals that area shift was obtained for eyeblinking, $F(1,9) = 20.41$, $p<.005$, and buttonpressing, $F(1,9) = 23.94$, $p<.001$.

Comparing the group EBD54 gradients with those of group EBS5, reveals that area shift was obtained for eyeblinking $F(1,9) = 29.65$, $p<.001$, but not for buttonpressing. Thus area shift occurred only for the unconscious response system when S- was SV4.

Since the animal literature (e.g. Hanson, 1959) indicates that the magnitude of area shift varies inversely with the physical difference between S+ and S- programmed during discrimination training, a statistical analysis was performed on the eyeblink data of groups EBD54 and EBD52. The results, $F(1,9) = 20.23$, $p<.005$ confirm the visual observation that the magnitude of area shift was greater for group EBD54.

In summary, Figure 2 demonstrates that area shift was obtained for both the conscious and unconscious response systems when the S+, S- difference during discrimination training was large (group EBD52), but was only obtained with the unconscious response system when the S+,S- difference was small (group EBD54). Additionally, the amount of area shift for the unconscious response system was found to be greater when the S+, S- difference during discrimination training was small relative to when it was large.

Group BD52 and Group BS5. - Figure 3 contains the eyeblink and buttonpress gradients for groups BD52 and BS5. Only the buttonpress gradient of group BD52 shows good stimulus control. For buttonpressing area shift occurred, $F(1,9) = 24.06, p<.001$, but for eyeblinking it did not. Thus when reinforcement was contingent on buttonpressing (Group BD52) good stimulus control, as well as area shift, ensued, and when reinforcement was not contingent for eyeblinking (Group BS5) poor stimulus control and no area shift was observed.

Group ED52 and Group ES5 - Figure 4 contains the gradients for groups ED52 and ES5. For group ES5, both gradients are reasonably flat, evidence of poor stimulus control. The variable nature of the buttonpress gradient for group ED52 is indicative of poor stimulus control, (mean SV = 5.5). Thus, poor stimulus control developed for buttonpressing when differential reinforcement was not programmed during discrimination training. The group ED52 eyeblink gradient indicates good stimulus control. Area shift was statistically significant for the eyeblink system, $F(1,9) = 34.10, p<.001$.

The finding that good stimulus control did not develop for response systems receiving no response-contingent reinforcement (i.e. the buttonpress system for group ED52 and the eyeblink system for group BD52) indicates that discrimination training results in good stimulus control over a response system only when the reinforcement is response-contingent-- the mere covariation of reinforcing events, response events, and discriminative stimuli, which occurs during S+ is not a sufficient condition for the development of stimulus control (although the discrimination data of group ED52, in which differential S+, and S- rates developed for buttonpressing indicate that under certain conditions it may be sufficient for the development of a discrimination). Additionally this selective feature of reinforcement indicates that the good stimulus control for the EBD groups (for both response systems) did not result from a covariance of the response systems (i.e. subjects blinking more because they were pressing more).

Group EBD25 - Figure 5 contains the eyeblink and buttonpress gradients for group EBD25. Close inspection indicates that the mode for the eyeblink gradient is clearly SV1 and the shape of the curve invites the extrapolation that if SVs lower than SV1 had been presented during the generalization test, a peaked gradient with marked area shift would have been obtained relative to a SS control. No such area shift is apparent with the buttonpress gradient, indeed the modal stimulus is SV3, representing a displacement toward the center of the test series. Thus with an asymmetrical test series (i.e. most of the SVs were of greater intensity than the S+ of the discrimination phase) area shift was obtained for eyeblinking.

Both gradients show an increase in response rate to SVs far removed from S+, i.e. SV9 and SV10. This finding has been reported by others (Terrace, 1966) with non-human subjects in which stimuli far removed from S+ on the side of S- are presented during generalization testing.

In combining these results with those contained in Figure 2, it appears that good stimulus control developed for both conscious and unconscious response systems following discrimination training; however, the nature of the stimulus control was different for the two response systems. For the conscious response system, the following results were obtained: (1) When the S+ was a more intense stimulus than the S-, area shift was obtained with a large S+, S- difference and disappeared when the S+, S- difference was small, (2) when the S- was a more intense stimulus than the S+, no area shift was obtained, and (3) when an asymmetrical test series was employed, the peak of the generalization gradient was displaced toward the center of the test series (central tendency effect).

For the unconscious response system, the results were: (1) area shift was obtained both when the S+ was a more intense and a less intense stimulus relative to the S-, and (2) the magnitude of the area shift increased as the S+, S- difference decreased (note that this was only tested where the S+ was more intense than the S-).

Resistance to Extinction

In an effort to gather more data about the eyeblink and the buttonpress response systems, an examination of the extinction rate for the two was conducted. For each response system, the total number of responses occurring during the last ten minutes of generalization testing (the second block of ten test stimuli) was measured and the average response rate was calculated (number of responses /10).

Table 6 contains the raw extinction data. The difference between this measure and the average response rate during the S+ of the final ten minutes of the discrimination phase was next determined. For each subject, a ratio was formed between this difference and the final ten minutes of S+ responding, thus yielding a percentage measure; the higher the ratio, the faster the rate of extinction. Although visual inspection indicates that buttonpressing extinguished more rapidly (e.g. 15 of the 18 subjects had higher buttonpress ratios relative to eyeblink ratios) the result only approached and did not attain statistical significance, $t = 2.04$, $p < .10$, two tailed; thus there were no overall differences between the response systems obtained in the present study.

<u>Group R⁻</u>

Both subjects in group R approached but failed to achieve a satisfactory level of discrimination (see Table 2) during the initial discrimination phase. While there was a tendency for the S+ rate to exceed the S- rate, the S+, S-

TABLE 6

Terminal Response Rates for the Extinction and Generalization Phases of the Experiment

Group	Subject	Terminal S+ Rate (R's/min)		Terminal Generalization Rate (R's/min)	
		Eyeblink	Buttonpress	Eyeblink	Buttonpress
	S200	31.00	25.50	9.50	5.10
EBD 52	S219	24.10	39.20	11.50	8.90
	S222	24.90	29.50	12.40	9.40
	S206	39.00	41.20	5.90	4.60
EBS 5	S218	31.90	42.50	7.10	2.10
	S223	29.10	62.50	8.30	3.20
ED 52	S205	28.70	14.80	8.50	7.20
	S215	24.30	14.20	12.30	5.60
ES 5	S216	31.50	19.70	16.60	5.10
	S221	19.50	16.30	8.00	4.90
BD 52	S217	9.70	48.50	7.00	8.30
	S220	12.80	42.90	9.40	9.60
BS 5	S208	17.50	27.50	10.30	5.40
	S207	14.20	17.40	9.40	8.40
EBD 25	S231	22.10	29.10	8.70	7.50
	S232	15.50	19.90	8.40	8.50
EBD 54	S225	27.60	34.50	9.10	5.40
	S226	31.50	27.40	12.40	6.80

difference for the second session was only 3.50 (eyeblinking) and 5.50 (buttonpressing) for S235 and 2.80 (eyeblinking) and 8.00 (buttonpressing) for S236. For S235 the generalization gradients were flat with no marked peaks for either response system. For S236 both gradients were highly variable with numerous peaks at well spaced SVs. The unstable nature of the gradients obviated both graphic presentation and statistical analysis.

CHAPTER IV

Discussion

The purpose of the present study was to determine if stimulus control of an unconscious response system could be developed, and, if so, how it might differ from the type of control developed over a conscious response system.

The results of the "awareness" questionnaire corroborate the findings of Keehn et.al. (1965) in indicating that eyeblinking, when measured by the experimenter via a one-way mirror, represents a superior "unconscious" operant. The present questionnaire embodied most of the recent suggestions regarding improvement of questionnaires (e.ğ. Dulany, 1966) in that a progressive movement from more general to specific questions was built in to ascertain the extent of awareness. No subjects ever indicated any awareness that anything other than button-pressing was being monitored. Further, while subjects knew there was some contingency between buttonpressing and eyeblinking (via instructions) no rule specifying any of the necessary conditions for reinforcement was hypothesized.

The results indicated that "typical" discrimination performance generalization gradients could be obtained for both conscious and unconscious response systems (learning without awareness) although there were differences in the types of gradients. The finding that procedures typically employed to produce discrimination and stimulus control in non-human subjects, also control similar behavior in human subjects for both conscious and unconscious response systems, extends the purview of the Experimental Analysis of Behavior to include the stimulus control of both conscious and unconscious response systems.

Comparing groups EBD52 and EBD54, both receiving simultaneous and independent discrimination training for both response systems, to group EBS5, revealed that both groups showed area shift. For eyeblinking, area shift was obtained for groups EBD52 and EBD54; the magnitude was greater for EBD54. For buttonpressing, area shift was obtained for group EBD52 but not for group EBD54. Visual inspection of group EBD25 indicated area shift was obtained for eyeblinking but not buttonpressing (the latter showing a "central tendency effect")although the asymmetrical nature of the value of the stimuli selected prohibit adequate statistical comparison with other groups. Thus, differential reinforcement results in differential response rates during discrimination training and generalization testing for both conscious and unconscious response systems.

Groups ED52, ES52, BS52, BD52, considered collectively rule out the possibility that eyeblinking and buttonpressing are unconditionally related,i.e. that blinking and buttonpressing covaried independently in the experimental conditions Comparison of groups ED52 and ES52 for which reinforcement was contingent only for eyeblinking, revealed that good stimulus control and area shift developed only for the eyeblink response system. Similarly, for groups BD52 and BS52, for which reinforcement was contingent only for buttonpressing, good stimulus control and area shift developed only for the eyeblink response system. The failure to find good stimulus control for the buttonpress response system of group ED52 despite the attainment of a high level of discrimination during the initial discrimination phase, suggests that the large difference obtained between the S+ and S- response rates be labelled a "pseudodiscrimination".

Jenkins (1970) has proposed that during free-operant discrimination training, S+ and S- periods differ not only with regard to the selected SVs of the physical dimension under study (auditory intensity in the present investigation), but also with regard to the presence or absence of the reinforcing stimulus itself. Thus reinforcement, per se, may come to serve a discriminative function, as well as a reinforcing function for responding, in that subjects are reinforced for responding in its presence. In the present study, buttonpressing of subjects in group ED52 may have come under the control of the discriminative properties of the reinforcer; thus the reinforcer itself may have been the locus of differential S+ and S- buttonpress rates for group ED52, although further experimentation is required before such a conclusion can be fully warranted.

In developing differential response rates to S+ and S- in the absence of any programmed contingency for the discrimination (for buttonpressing, group ED52), the present study corroborates the finding of Kaufman, Baron, and Kopp (1966). One group of their subjects was correctly informed that reinforcement would be delivered according to a VI 1-minute schedule; other groups were told that they would be reinforced by fixed interval or variable ratio schedules, although in reality a VI 1-minute schedule was programmed. Other groups received accurate and inaccurate information regarding fixed-interval schedules. The "illusory" schedules came to control behavior in much the same way as actual schedules, e.g. when instructed that fixed-interval scalloping regardless of the actual schedules. Thus instructions may outweigh the actual schedules, (also see Dulany, 1962; and Weiner, 1971). Thus for human response systems, the subject's instructions (whether they be self-instructions or otherwise) are very important sources of control of experimental behavior.

Instructions might best be viewed as variables which determine the "operant level" (probability of a response in the absence of experimental contingencies) of particular sets of behaviors. Thus, when subjects are instructed that buttonpressing produces points, the operant level of buttonpressing is high. Such a manipulation is analagous to placing a rat in an operant chamber, with a lever as the only manipulandum; under these latter conditions, the experimenter has arranged the environment in such a way that the operant level of lever pressing is high. Experimental findings that instructions exert control seemingly different from the control "typically" produced by particular schedules of reinforcement do not necessarily represent a contradiction; rather they represent control exerted by variables which are diffuse and obscure to the experimenter and in need of further investigation.

Implications for Human Stimulus Control

The results obtained with the conscious response system confirm the findings of the Thomas et.al.(1973) study using a discrete-trial operant paradigm in which subjects were instructed to respond (finger movements) whenever they saw a stimulus they thoughtresembled a particular target SV. In their study, they found that when the S+ was more intense (brighter) than the S-, subjects showed more area shift and that the magnitude varied positively with the S+, S- difference. No area shift was obtained when the S- was more intense than the S+, except when the S+and S- were higher SVs than the AL for the test series. In the present study, for the buttonpress (conscious) response system, are shift was obtained with a larger S+,S- difference, but disappeared with a small S+,S- difference. No area shift was observed when the S- was a more intense stimulus than S+ and indeed (with the asymmetrical test series)there was a displacement toward the center of the test series ("central tendency effect"). The results thus confirm exactly the finding of Thomas et.al. (1973) as well as others (Thomas and Jones, 1962; Helson and Avant,1967;Doll and Thomas, 1967) with regard to area shift and the "central tendency effect".

The results obtained for the unconscious response system confirm the findings of non-human studies in that area shift is obtained when S+ is both more intense and less intense than S- and that its magnitude varies inversely with S+, S- difference; they thus disconfirm the typical human discrimination learning data.

The failure to find stimulus control in group R need not qualify the above results. Scrutiny of the discrimination data indicates that the discrimination was much more difficult and more training was needed to improve performance. A future study should more systematically investigate this situatinn.

Implications for Human Research

There are some interesting implications of the present results for human experimentation. Clearly there are differences (and similarities) between conscious and unconscious response systems. Indeed extrapolation of the present results promulgate the following generalization at least for discrimination learning situations: unconscious behavior is typically "animal-like" and conscious behavior is typically"human-like." As a result, the potential problem arises with regard to interpreting results obtained with non-human subjects in the prediction of performance of human subjects. Clearly, the fact that subjects come under the control of stimuli is true for both conscious and unconscious response systems. However, the nature of the stimulus control varies as a function of whether the subject is aware that the response system is being manipulated. Animal results may be predictive of conscious behavior, unconscious behavior or both.

Further, data obtained for non-human laboratory situations also take on a limited generality. For example, most investigators of human discrimination have used constructs such as "central tendency effect", "AL", etc, to predict performance. Obviously the present results show that AL theory, as such, predict only conscious performance and not unconscious performance. Such results generate the interesting question of whether the typical findings associated with AL theory (see Helson, 1966, for a review) would be obtained with an unconscious response system.

In summary, the present results, while conclusively supporting the behavioristic tenet that human laboratory performance demonstrates orderly relationships between stimuli, responses, and reinforcements, in the absence of awareness, also indicate the necessity for separate consideration of conscious and unconscious response systems. Caution must be prescribed for the behaviorist, however, lest he interpret the present results as indicative of any qualitatively unique status for unconscious behavior. The present results indicate that the human being's verbal response system sufficiently modulates a wide enough portion of human behavior so that it must be given special attention. Nonetheless, the theoretical possibility exists that any other species, if an appropriate modality could be ascertained, could be trained so that he could develop a response system similar in some particular case, if not identical, in function to that of the human verbal system. If such training involved the establishment of relationships between responses which for human verbal behavior, are labelled as "syntax", "grammar", etc. then such behavior might be termed "language" and the possibility would exist for a non-human subject who could be at times "aware" and at other times, "not aware".

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APPENDIX A

Questionnaire

Instructions

Please help me by answering the following questions. On each page that follows, you will find a question at the top. Please answer each question as truthfully as possible. Be sure that you describe the thoughts you had DURING the experiment. After you have answered a question, turn the page and start the next one. Please DO NOT go back and examine or change any of the answers you have given previously. I will answer all of your questions and explain the experiment to you after you have finished the questionnaire.

1. What do you think this experiment is REALLY about? Be specific.

2. What sorts of things did you do in order to maximize your point score on the counter?

3. What sorts of rules did you follow in attempting to maximize your point score? What was your strategy? Did you use the noises in the headphones to help you in any way?

4. Did you notice that you only gained points when the loud noise was on? If so, how did you incorporate this into your strategy?

5. Did you notice that you never gained any points when the faint noise was on? If so, how did you incorporate this into your strategy?

6. Did you feel that any other of your behaviors might have helped you to gain points on the counter in some way? If so, explain as fully as possible.

7. In this experiment, I was monitoring another behavior of yours (in addition to the pressing of the buttons). Can you guess what it was?

8. Listed below are 6 behaviors of yours which I may have been monitoring (in addition to your buttonpressing). I would like you to rank these behaviors according to the certainty with which you feel that I was monitoring them. Put a "1" beside the behavior that you are most certain I was monitoring;

put a "2" beside the behavior that you feel the next most confident about, etc. A "6" should be beside the behavior you feel least certain that I was monitoring.

It may be difficult to rank these behavior but please make an effort to do so, even though you may feel that you are guessing.

_________ your movements of your thumb

_________ your touching of your head

_________ your body shifts in the chair

_________ your blinking of your eye

_________ your movements of your feet

_________ your glances at the mirror

9. Did you realize that your eyeblinking was being recorded and that it affected your point score? If yes, try to explain when you first noticed.