SOME DETERMINERS OF ATTENTION[1]

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Three experiments, using a total of 13 pigeons, examined the stimulus control acquired by the separate components of a compound visual stimulus transilluminating the pecking key. Experiment I measured the control acquired by components of compound discriminative stimuli used in discrimination training. Experiment II sought to demonstrate the effect of pretraining a single stimulus discrimination on control acquired by each component in a compound stimulus discrimination. It also investigated the effect of training the compound stimulus discrimination before the single stimulus discrimination. Experiment III sought a continuous stimulus control function when pretraining stimulus intensities were varied. The results suggest that the extent to which a bird "pays attention" to a stimulus, defined in terms of the degree of stimulus control acquired by that stimulus, is determined by how well it previously learned to discriminate that stimulus from other stimuli.

Frequent usage is a clear indication of the importance of the concept of attention. What is understood by the concept may best be considered in Skinner's (1953) identification of attention with the controlling relation of a discriminative stimulus. Any observation of stimulus control is, thus, an observation of attention. Yet, the concept is usually employed in a more restricted reference. In particular, the concept of attention frequently accompanies failures to establish stimulus control and the reference is to a lack of attention, (Terrace, 1966). On the other hand, those experiments which are often cited as demonstrations of attention show that responding is controlled by only one or a few of the several stimulus properties correlated with reinforcement. For example, Lashley (1938) found that rats trained to jump to stimulus cards containing a form were selectively controlled by either a portion of or the size of the figure. Reynolds (1961) trained two pigeons to discriminate a white triangle on a red background from a white circle on a green background. When the red background, the white triangle, the green background, and the white circle were presented separately in an extinction test period, one bird responded only to the red background and the second bird responded only to the white triangle.

If use of the attention concept is to be anything but gratuitous, it is important to determine the conditions under which stimulus control is obtained by one or a few specified dimensions but not by other specified dimensions of the stimulus correlated with reinforcement. The Reynolds and Lashley studies show that simple discrimination training to compound stimuli does not guarantee that stimulus control will be exercised by all aspects of the stimulus compound.

Lashley (1942) has suggested "set" as a variable producing selective stimulus control. Summarizing his compound stimulus discrimination research, Lashley said: "If animals are given a set to react to one aspect of a stimulus situation, large amounts of training do not establish association with other aspects, so long as the original set remains effective for reaching the food [p. 258]." To establish such a "set", a discrimination is "pretrained" along a single stimulus dimension before one or more dimensions are added to the discriminative stimuli. Mackintosh (1965) found that pretraining rats on a single dimension discrimination before reversing the discrimination and adding a stimulus aspect, determined

control by the first dimension; but no control was acquired by the added stimulus dimension. In a study by Kamin (1965), a group of rats received conditioned emotional response training for several days with a noise conditioned stimulus. However, after additional training sessions, during which a light was added to the conditioned stimulus, Kamin observed no suppression of responding to the light alone on test trials. Kamin labeled this effect "blocking". Similarly, Miles and Jenkins (1965) report that pretraining pigeons on a brightness discrimination "blocks" the acquisition of stimulus control by a tone added later to the positive discriminative stimulus.

The present experiments were designed to investigate further the observation that discrimination training to single stimuli, separate from occasions on which these stimuli appear in a compound stimulus discrimination, determine selective stimulus control by these specific features. Experiment I measured the control acquired by components of compound discriminative stimuli used in discrimination training. Experiment II sought to demonstrate the effect of pretraining a single stimulus discrimination on control acquired by each component in a compound stimulus discrimination, and to investigate the effect of training the compound stimulus discrimination before the single stimulus discrimination. Experiment III sought a continuous stimulus control function when pretraining stimulus intensities were varied.

METHOD

Subjects

Thirteen White Carneaux cocks, 5 to 6 yr old and experimentally naive at the outset, were maintained at 75% of their free-feeding body weight.

Apparatus

A standard pigeon experimental chamber (Ferster and Skinner, 1957) was housed in a ventilated and sound resistant, Fiberglas insulated box. A circular pecking key, 1 in. in diameter and requiring a minimum force of 20 g to operate, was located on one wall of the chamber. Below the key was located a 2-in. square access hole to a grain hopper where grain (50% Kaffir, 40% vetch, 10% hempseed) was occasionally available for 4-sec periods.

A 3-w lamp behind a milk plastic diffusing screen illuminated the chamber from above. An In-line display unit located behind the key provided transillumination of the key with either a red or green background or a horizontal or vertical white line. At times, the horizontal line appeared superimposed on the red background and the vertical line appeared superimposed on the green background; at other times, each of the four stimuli appeared alone on the key. The red and green backgrounds filled the key and the white vertical and horizontal lines were diameters about 0.18-in. wide. Programming and recording equipment was housed in a separate control room.

General Procedure

Certain procedural features were common to all experiments. Each bird was trained to key-peck in a single session when responses were given 100 reinforcements on a continuous reinforcement (CRF) schedule in the presence of a white, fully lighted key. There followed three daily, 1-hr sessions when responding was reinforced on a random-interval schedule of reinforcement having a mean interval of 1 min, (RI 1-min, T = 15 sec, P = 0.25; Farmer, 1963), in the presence of the white lighted key.

An experiment usually consisted of three phases: compound stimulus discrimination training (CSDT), single stimulus discrimination training (SSDT), and a generalization test. Discrimination training consisted of daily 1-hr sessions of a multiple schedule comprised of an RI 1-min reinforcement component followed by an extinction component (*mult* RI 1-min EXT). Schedule components appeared for 1-min periods, following each other immediately, and they alternated according to Gellerman series until each had appeared for a total of 30 min. During CSDT, responding was reinforced on an RI 1-min schedule in the presence of the vertical line on the green background (S^D) and responding was never reinforced in the presence of the horizontal line on the red background (S^Δ). During SSDT, the S^D was either the vertical line or the green background and S^Δ was either the horizontal line or the red background; the corresponding reinforcement schedule was identical to that during CSDT. Each of the four stimuli, horizontal and vertical lines and red and green

backgrounds, were presented alone for 1-min durations in a mixed order until each had appeared for 15 min during two daily 1-hr sessions of test. During the two test sessions responses were never reinforced.

EXPERIMENT I

The purpose here was to measure the degree of stimulus control acquired by each component stimulus when CSDT but no SSDT was administered.

Procedure

After preliminary training, two pigeons, P10 and P11, received five sessions of CSDT followed by two test sessions.

Results

Discriminative precision is often represented by values of S^Δ/S^D (an index obtained by expressing the total S^Δ responding relative to total S^D responding; S^Δ/S^D becomes small as the difference between S^Δ and S^D responding becomes large). One pigeon, P11, acquired the CSDT discrimination rapidly, such that $S^\Delta/S^D \leqslant 0.02$ within 3 hr of exposure. The other pigeon, P10, consistently responded during S^Δ at an average rate of 17.5 responses per min. These responses appeared late during an S^Δ interval and in bursts approximately 60 sec apart when several S^Δ components were programmed successively.

Figure 1 presents the proportion of total responding emitted in the presence of each stimulus by each bird during the two test sessions. In the first test session, indicated by solid bars, P11 emitted 1463 responses and P10 emitted 851. The greater proportion occurred in the presence of the green background and the vertical line, the features of S^D during CSDT. In both cases, responding to S^D component stimuli was unequal: more than 50% of all responding occurred to the green background light. Responding to S^Δ component stimuli was less than 5% of the total for P11, but was 14% for P10.

Responding in the second test session, indicated by striped bars, decreased with extinction, amounting to 494 and 360 responses by P11 and P10, respectively. The principal change was an increase in the specificity of control shown by the green background. For both birds, more than 90% of all responding

occurred to the green background and responding to the vertical line decreased measurably. Responding to S^Δ component stimuli also decreased and appeared only in the presence of the red background.
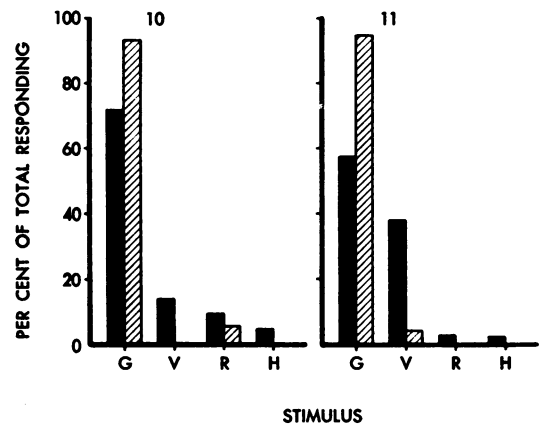

Fig. 1. Percent of total responding in two test sessions to each of four test stimuli by two subjects in Exp. I. The four test stimuli were G, green background, V, white vertical line, both features of S^D; R, red background, H, white horizontal line, both features of S^Δ during CSDT. Subjects P10 and P11 were given five sessions of CSDT before the two test sessions. Solid bars represent first test session values and striped bars represent second test session values.

Discussion

Responding in S^Δ for P10 did not extinguish with the absence of reinforcement. Rather, S^Δ responding was maintained throughout the five CSDT sessions, implying reinforcement. Kelleher and Gollub (1962) report several experiments in which responding was maintained in a "superstitious" (Skinner, 1948) fashion by its adventitious correlation with the appearance of an S^D. Specifically, the bursts of responding in S^Δ, late during an S^Δ interval and approximately 1 min apart when several S^Δ components were programmed successively, may mean that a temporal discrimination, based on schedule component changes, had formed. Having no intervening period such as a timeout (a period when stimuli are not presented and key-pecks are unreinforced) creates the possibility for adventitious secondary reinforcement. The occurrence of superstitious S^Δ responding renders any index such as S^Δ/S^D an ambiguous measure of discriminative precision.

In this experiment, pigeons were trained on a compound stimulus discrimination, in which

both S^D and S^Δ had separable aspects. The green background exercised greater control of responding in the test, but not exclusively; both features of the compound S^D acquired some control over key-pecking. A similar experiment by Reynolds, reported above, showed that the responding of each of two pigeons was controlled by one of the two S^D components to the exclusion of the other. Reynolds' birds differed in regard to which S^D component exercised exclusive control. A reconciliation between these findings would, presumably, involve specifying the subjects' pre-experimental history with the stimulus dimensions and investigating the effects of procedural differences, such as preliminary training.

Baron (1965) has suggested that stimulus dimensions may be ordered in "attending hierarchies" by the degree to which each dimension of a stimulus complex will come to control behavior, and that positions in an "attending hierarchy" may be inborn or a result of prior experience. In particular, Baron suggested that, like monkeys and humans, colored visual stimuli acquire control more readily than form stimuli in pigeons. In that sense, the results of this experiment may coincide with Baron's suggestion, while those of Reynolds may not.

Baron's concept does not distinguish between the case where a single component of a stimulus complex controls all responding and the case in which control is distributed unequally among stimulus components. Three experiments reported by Newman and Baron (1965) apparently illustrate the former case. In all experiments pigeons were trained to respond to a white vertical line on a green background as S^D. One group received only S^D training; another group received, in addition, a red key as S^Δ; a third group received, additionally, the vertical line as S^Δ. When the white lines were presented at various angles within 45° of vertical on the green background in an extinction test, all three groups produced relatively flat functions of generalization. Only a fourth group, which received the green background also as S^Δ in training, exhibited a peaked gradient along angular orientation in the test. Thus, only when color was presented as an irrelevant dimension did line orientation show stimulus control. Pigeons in the present experiment received

training in which both line orientation and background color were relevant and the range of line angular orientation was 90°. Both dimensions acquired some stimulus control.

EXPERIMENT II

This experiment examined the effect of discrimination training to individual presentations of the single stimuli normally presented in a compound stimulus discrimination. Five birds received SSDT before CSDT and test responding was examined for selective control by components of the CSDT S^D.

Kamin (1965) and Miles and Jenkins (1965) found that selective control was exercised by the single stimulus component trained before the compound stimulus. They called this effect "blocking". There is the implication that whatever explains "blocking" operates only in the sequence of single stimulus training before compound stimulus training. Lashley (1942) describes pretraining with respect to one aspect of a stimulus as providing a "set" to react to that aspect, which maintains control when other aspects are later added to the stimulus situation. Lawrence (1949) says that pretraining a discrimination renders the stimuli more distinctive so that learning is facilitated in subsequent discriminations in which the pretrained stimuli are involved.

The set and the distinctive stimuli concepts do not predict the effect on stimulus selection of single stimulus training following compound stimulus training. Neither are the concepts sufficiently detailed to permit a prediction about the consequence of such a procedure. To check the effect of sequence of training procedures, two additional birds received SSDT after CSDT.

Procedure

After preliminary training, each of five pigeons was exposed to 10 sessions of SSDT, during which either the vertical line or the green background was S^D, and the horizontal line or the red background was S^Δ. The discriminative stimuli were divided among the five subjects as follows: P29, S^D—vertical line, S^Δ—horizontal line; P30 and P9, S^D—vertical line, S^Δ—red background; P31, S^D—green background, S^Δ—horizontal line; and P41, S^D—green background, S^Δ—red background. After SSDT, all five birds received five sessions of CSDT followed by two test sessions.

Two other pigeons, P64 and P42, received five sessions of CSDT after preliminary training. Then, CSDT was followed by 10 sessions of SSDT and two test sessions. During SSDT, both birds received the vertical line as S^D and the horizontal line as S^D.

Results

All five birds acquired the initial assigned SSDT discrimination. P30, P31, P41, and P9 acquired to a stabilized precision indicated by $S^\Delta/S^D \leqslant 0.02$ within 3 hr. P29 reached a stable S^Δ/S^D value about 0.05 just after 3 hr of SSDT. Established discriminations were disrupted somewhat at the beginning of CSDT. During the first hour of CSDT only, values of S^Δ/S^D for these five birds rose to values in the range 0.05 to 0.17, but performances returned to previous precision levels within the second hour of CSDT.

Compound stimulus discrimination data by the two subjects initially exposed to CSDT are comparable to the two subjects of Exp. I. Pigeon P64 acquired the compound stimulus discrimination to a precision indicated by $S^\Delta/S^D < 0.02$ within 3 hr; P42 exhibited S^Δ responding. The change to SSDT, involving the removal of the green and red background lights, disrupted P64's performance as $S^\Delta/S^D = 0.003$ on the final day of CSDT, but $S^\Delta/S^D = 0.12$ on the first day of SSDT. Performance did not return to the final level established

during CSDT until 7-hr exposure to SSDT. Responding during S^Δ by P42 continued at 22 responses per min, $S^\Delta/S^D > 0.10$, during SSDT. The pattern of S^Δ responding by P42 was similar to that in Exp. I interpreted as superstitious.

Figure 2 presents the results from the two test sessions for P29, P30, P31, and P41, showing the percent of total responding which occurred in the presence of each of the four stimuli. In the first test session, indicated by solid bars, P29 emitted 1656 responses, P30—971 responses, P31—983 responses and P41 emitted 1063 responses. Nearly all responding occurred in the presence of S^D component stimuli and responding to S^Δ components was nearly zero. With the exception of P30, more than 80% of all responding occurred to the single S^D stimulus during SSDT. For P29 and P30 this stimulus was the white vertical line and for P31 and P41, it was the green background.

Except for P30, responding continued through the second test session. The total number of responses by the three other subjects was in the range 554 to 938, whereas P30 emitted only 21 responses. All four birds exhibited an increase, ranging from 2% to 28%, in the portion of session responding to the green background. For P31 and P41, this change was an increase in the relative control by the SSDT S^D, but it represented a reversal
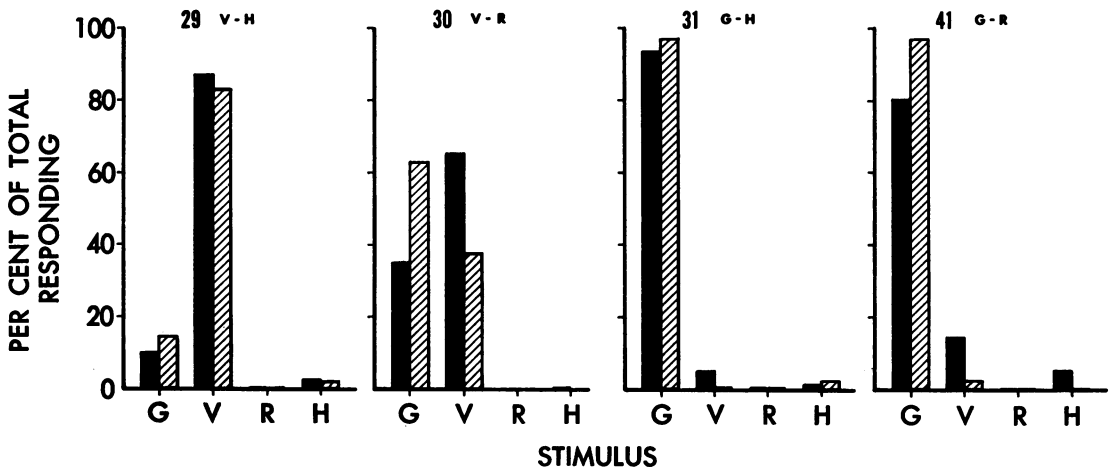

Fig. 2. Percent of total responding in two test sessions to each of four test stimuli by four subjects in Exp. II, (results from a fifth subject are given in the text). All subjects were given 10 sessions of SSDT before five sessions of CSDT and two test sessions. The subjects and their assigned SSDT stimuli were P29, vertical line S^D and horizontal line S^Δ; P30, vertical line S^D and red background S^Δ; P31, green background S^D and horizontal line S^Δ; P41, green background S^D and red background S^Δ; P9 received the same conditions as P30. Solid bars represent first test session values and striped bars represent second test session values.

in the stimulus component controlling most of the responding by P30. Since P30 was atypical with respect to extinction rate, P9 was later given experimental treatment identical to P30, and performance by P9 was more like the three other subjects'. Of 2143 responses on the first test day, 81.6% occurred to the vertical line; of 1085 responses on the second test day, 94.5% occurred to the vertical line. Responding to the green background accounted for 17.2% and 3.1% in the first and second test sessions, respectively, and responding to S^A component stimuli was never more than 1%.

Figure 3 displays the distribution of responding to stimulus components during the test sessions of P64 and P42, which received SSDT after CSDT. Responding in the first test session totaled 2364 responses by P64 and 2525 responses by P42. The greater number occurred to S^D component stimuli and, in both cases, more than 60% occurred in the presence of the vertical line which was S^D during SSDT. Responding to S^A component stimuli amounted to less than 5% of the total number by P64, but it amounted to 15% by P42, about equally portioned between the red background and the horizontal line.

Responding in the second test session, indicated by the striped bars, amounted to 763 responses by P64 and 1182 responses by P42. A greater portion of responses occurred to S^D components in the second test session, but the

principal change was an increased specificity of responding to the vertical line. Thus, with continued testing, a sharpening of stimulus control was observed about the SSDT S^D dimension.

Discussion

These results indicate that primary control by a single component of a compound stimulus may be produced by treating the single component as S^D at a time other than when it appears as part of a positive compound stimulus. Selection among aspects of a compound S^D is determined by single stimulus training before or after compound stimulus training. Thus, any account of selective attention must consider that stimulus selection is affected by single stimulus training before or after compound stimulus training.

The manner in which responding by P64 and P42, subjects receiving CSDT before SSDT, is portioned among controlling stimuli is similar to that in Exp. I, considering that the precise stimuli exercising primary control have reversed. At the same time, an average rate of 40.8 responses per min by the two subjects here may be compared with an average rate of 19.3 responses per min emitted by the two subjects in Exp. I. The difference in response rates in the presence of the vertical line accounts for this two-fold rate difference. Average rates in the presence of the green background are nearly equal, 45.6 responses per min by P64 and P42, and 48.4 responses per min in Exp. I, but average rates in the presence of the vertical line, 101.1 responses per min by P64 and P42 and 22.5 responses per min in Exp. I, show a four-fold difference.

At this point, it may be reasonable to consider that the resulting stimulus selection observed here is a function of number of reinforcements given in the presence of each component, since the separate S^D component was present longer than the other component. The test response rate comparisons between P10 and P11 in Exp. I, and P64 and P42 here, make this explanation a real possibility.
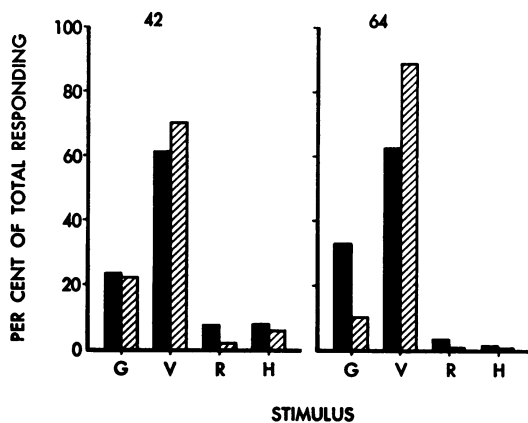

Fig. 3. Percent of total responding in two test sessions to each of four test stimuli by two subjects in Exp. II. Two subjects, P42 and P64, were given five sessions of CSDT before 10 sessions of SSDT and two test sessions, and both subjects were trained using vertical line S^D and horizontal line S^A during SSDT. Solid bars represent first test session values and striped bars represent second test session values.

EXPERIMENT III

This experiment sought a variable which was continuously related to the degree of stimulus control by components of a compound stimulus and was not confounded with num-

ber of reinforcements. In particular, it was suspected that intensity of the vertical and horizontal lines in SSDT was such a variable.

Procedure

After preliminary training, each of four pigeons received five sessions of SSDT in which S^D was the vertical line and S^Δ was the horizontal line. Following SSDT, all birds received five sessions of CSDT and two test sessions.

During SSDT, both lines were presented at the same intensity to any single bird, but a different line intensity was assigned to each bird. During CSDT and the test sessions, lines appeared at the same, 3.3 foot lamberts (ft-L) to all birds. SSDT line intensities were assigned to the four birds as follows: P60—0.19 ft-L, P61—0.36 ft-L, P62—1.8 ft-L, and P63—3.3 ft-L. Line intensity in the preceding experiments was equal to 3.3 ft-L. The experimental variable involved different line intensity changes from SSDT to CSDT levels, taking incremental values of 3.11 to 0.0 ft-L. The different line intensities were produced by different series resistances to the stimulus lamps and intensity values were measured with an SEI photometer. Subsequent calibration of the photometer revealed an approximate 0.5 log unit, negative constant error; intensity values were thus higher than those listed, but they remained in the same proportion to one another.

Results

All four subjects acquired the vertical-line–horizontal-line discrimination within 5 hr of exposure to SSDT. The subjects at the three higher line intensities, P61, P62, and P63, acquired the SSDT discrimination at approximately the same rate. The rate was, on the average, slower than overall SSDT discrimination learning rates in Exp. II; after the first hour of SSDT, S^Δ/S^D values ranged from 0.50 to 0.29 and after the fifth hour-long session, the S^Δ/S^D ranged from 0.06 to 0.01. Discrimination acquisition at the lowest line intensity by P60 was even slower; S^Δ/S^D decreased from 1.01 to 0.06 after the first and fifth hours of SSDT, respectively.

During CSDT, when colored backgrounds appeared and lines were presented at full intensity, P60, P61, and P62 at the three lower SSDT line intensities continued to improve discriminative performances; S^Δ/S^D took val-

ues about 0.02 after 5 hr of CSDT. Pigeon P63 was unusual here, developing and maintaining an average rate of 13 responses per min during S^Δ with the introduction of and throughout CSDT. The temporal distribution of responses during the S^Δ period was similar to other cases interpreted as superstitious in Exp. I and II.

The proportion of total responding occurring to each of the four test stimuli in the two test sessions is presented in Fig. 4. In the initial test session, shown by the solid bars, P60 emitted 2676 responses, P61—1819, P62—1511, and P63—3766 responses. Total responses apparently bore no consistent relation to line intensity. In all cases, more than 85% of these amounts occurred in the presence of S^D component stimuli. Except in the case of P63, responding in S^Δ component stimuli was negligible.

There was a systematic relation between the portioning of responses to S^D components and the assigned SSDT line intensities. At the lowest SSDT line intensity, responding to the green background light accounted for 67% of all responding by that subject. As the assigned SSDT line intensity increased, the proportion of responses to the green background decreased to a minimum of 36% for the subject at the highest line intensity. The proportion of responding to the vertical line increased with SSDT line intensity to a maximum of 56% for the subject at the second highest intensity. The reversal in this trend for the subject at the highest intensity was not evident in computations based on total S^D component responding.

Response distribution to stimuli during the second test session, indicated by the striped bars, held the same relations exhibited during the first test session. At the same time, the total number of responses emitted by each subject differed. Subject P60 emitted 62 responses, P61—252, P62—724, and P63—1374. Amounts during this session varied directly with line intensity assignment, but no other consistent relation was observed.

Discussion

The results of this experiment show that variations in the intensity of SSDT line stimuli during the SSDT procedure only, produced corresponding variations in the amount of responding controlled by the vertical line.
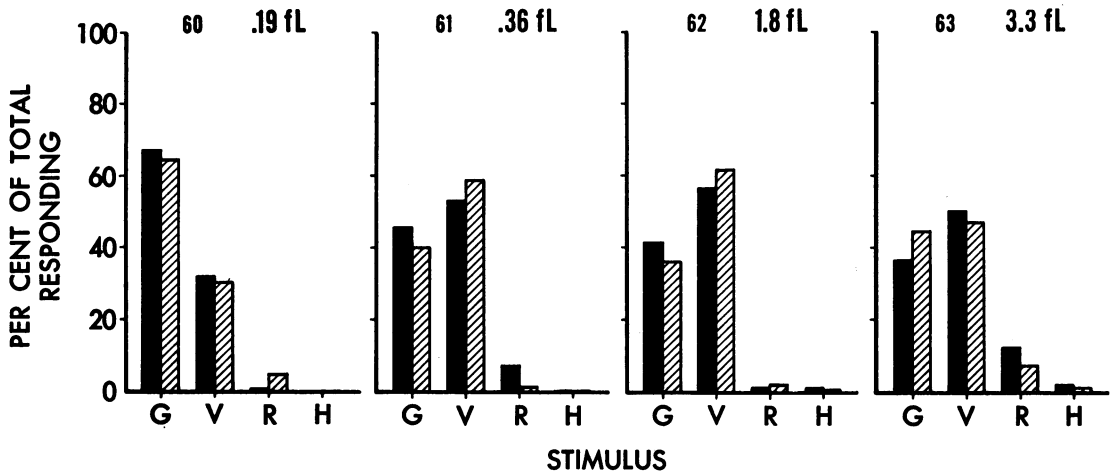
Fig. 4. Percent of total responding in two test sessions to each of four test stimuli by four subjects in Exp. III. Each subject was given five sessions of SSDT during which the vertical line was S^D and horizontal line was S^Δ, before five sessions of CSDT and two test sessions. During SSDT only the vertical and horizontal lines were equal in intensity, but each bird was assigned a different line intensity. The subjects and their listed intensity values were P60, 0.19 ft-L; P61, 0.36 ft-L; P62, 1.8 ft-L; P63, 3.3 ft-L. The vertical and horizontal lines were equal and at full brightness, 3.3 ft-L, during CSDT and test sessions. Solid bars represent first test session values and striped bars represent second test session values.

Variations in control by the compound S^D components ranged from the point at which more responding occurred to the vertical line than to the green background, at high SSDT line intensities, to a point where the reverse was true at a low SSDT line intensity. The distribution of responses to stimulus components for the subject at the lowest line intensity was similar to those of subjects which received only CSDT in Exp. I. While the vertical line controlled most responding for subjects with 5 hr of SSDT at higher line intensities, the vertical line did not dominate to the extent shown by P29, which received 10 hr of SSDT with the line stimuli in Exp. II.

While SSDT line intensity varied across birds, all were exposed for equal durations to equal rates of reinforcement. Thus, the suggestion that control by stimulus components is a function of number of reinforcements delivered in the presence of each is not sufficient to incorporate the findings of this experiment.

GENERAL DISCUSSION

Data from discrimination training sessions clearly indicate that all subjects, with three exceptions, acquired the assigned discriminations. Three subjects, one in each experiment, exhibited a high response rate in S^Δ, temporally distributed in a way that suggested superstitious responding maintained by adventitious correlation with the onset of S^D. In addition, large amounts of responding to S^Δ components in tests were emitted only by subjects showing superstitious responding during training.

Its occurrence creates the prospect of examining test session data for selective control by parts of the compound S^Δ. In general, it appeared, from the few available cases, that superstitious responding was under exteroceptive stimulus control, that this control was stimulus selective, and that selection was determined in the same manner that selective control was exercised by components of the compound S^D. However, any conclusive interpretation requires additional experimentation to measure response strength to these stimuli before any discrimination training.

Experiment II showed that stimulus selection was altered by discrimination training with single stimuli before or after discrimination training with compound stimuli of which the single stimuli were parts. Experiment III showed that stimulus selection was altered by variations in the intensity of the lines during SSDT only, a variable not confounded with number of reinforcements.

One suggestion incorporating these observations states that the degree of control demonstrated by each aspect of a stimulus correlated

with reinforcement in a testing situation is directly related to the discriminative precision an animal has previously acquired about each stimulus aspect. That is, the greater the differentiation between response strengths to an S^D feature and some S^Δ, the greater control that feature later exhibits in test situations such as a generalization test, a discrimination reversal, or a compound stimulus discrimination in which previously experienced stimuli are aspects of the situation. It is suggested that the integral class of determiners consists of all factors which affect formation of a discrimination between stimuli, independent of other factors which vary. In general, a large number of variables are known to affect the rate at which a discrimination is acquired and might be listed. These variables would be expected to affect selection among stimuli according to the precision attained with the stimuli employed under the prevailing conditions. The extent to which an organism "pays attention" to a stimulus depends upon how well it previously learned to discriminate that stimulus from other stimuli. The sequence of various discriminations is not critical to this suggestion.

Discrimination performance is a function of number of reinforcements delivered in the presence of each stimulus (Spence, 1936). Thus, the results of Exp. II are interpretable since discriminative precision acquired about the S^D feature employed in SSDT would be greater after 10 hr of SSDT and 5 hr of CSDT than the precision acquired to the S^D feature not employed in SSDT with only 5 hr of CSDT. The results of Exp. III indicated that discrimination formation was a function of SSDT line intensity and, in particular that P60, which received line stimuli at the lowest intensity level, acquired the vertical-horizontal line discrimination at a slower rate than subjects assigned to higher intensity stimuli. Thus, the results of Exp. III may be interpreted by supposing that the discriminative precision acquired by P60 to the vertical line after 5 hr at low intensity in SSDT and 5 hr of CSDT is less than that acquired about the green background in CSDT. This is a reasonable supposition since the green background acquires greater control than the vertical line after CSDT alone in Exp. I. Data from the three other subjects in Exp. III are explained similarly to those of Exp. II, and the fact that vertical line exercised less control after 5 hr

of SSDT in Exp. III than after 10 hr of SSDT as in Exp. II is also consistent.

This concept is similar to others in the literature, e.g., Lawrence's "acquired distinctiveness of cues" concept, (1949, 1963). Indeed, the present suggestion may provide a reasonable basis for specifying the degree of "distinctiveness" or for the degree to which an organism is "set" (Lashley, 1942) about a stimulus situation, as well as the basis by which stimulus dimensions are ordered for organisms, as in a "stimulus-attending hierarchy" (Baron, 1965).

Several relevant propositions are not to be implied from this suggestion. There should be no implication that degree of stimulus control shown in some testing situation is any particular, simple function of previously acquired discriminative precision. Nor should the suggestion imply that discriminative precision about one stimulus aspect is independent of precision about other aspects. Both are empirical matters.

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