JOURNAL OF THE EXPERIMENTAL ANALYSIS OF BEHAVIOR 1974, 22, 525-533 NUMBER 3 (NOVEMBER)

# CONTEXT, OBSERVING BEHAVIOR, AND CONDITIONED REINFORCEMENT[1]

ROBERT J. AUGE

DENISON UNIVERSITY

Pigeons made observing responses for stimuli signalling either a fixed-interval 30-sec schedule or a fixed-ratio x schedule, where x was either 20, 30, 100, 140, or 200 and the schedules alternated at random after reinforcement. If observing responses did not occur, food-producing responses occurred to a stimulus common to both reinforcement schedules. When the fixed-interval schedule was paired with a low-value fixed ratio, *i.e.*, 20 or 30, the presentation of the stimulus reliably signalling the fixed-ratio schedule reinforced observing behavior, but the presentation of the stimulus reliably signalling the fixed-interval schedule did not. The converse was the case when the fixed-interval schedule was paired with a large-valued fixed ratio, *i.e.*, 100, 140, or 200. The results demonstrated that the occasional presentation of the stimulus signalling the shorter interreinforcement interval was necessary for the maintenance of observing behavior. The reinforcement relationship was a function of the schedule context and was reversed by changing the context. Taken together, the results show that the establishment and measurement of conditioned reinforcement is dependent upon the context or environment in which stimuli reliably correlated with differential events occur.

A conditioned reinforcer is a stimulus that has become effective as a reinforcer because it has signalled the availability of a primary reinforcer, *i.e.*, a biologically important stimulus, or another conditioned reinforcer. A stimulus acquires conditioned reinforcing strength because of a specified experimental history of conditioning; in other words, through association with a primary reinforcer by a pairing or chaining operation. (Kelleher, 1966; Kelleher and Gollub, 1962; Keller and Schoenfeld, 1950; Skinner, 1938).

A number of recent experiments using observing-response paradigms (Auge, 1973*b;* Branch, 1970; Dinsmoor, Brown, and Lawrence, 1972; Dinsmoor, Browne, Lawrence, and Wasserman, 1971; Dinsmoor, Flint, Smith, and Viemeister, 1969; Hendry, 1969; Jenkins and Boakes, 1973; Kendall, 1972, 1973*a,* 1973*b;* Kendall and Gibson, 1965; Mulvaney, Dinsmoor, Jwaideh, and Hughes, 1974; Wilton and Clements, 1971*a, b*) are important in the analysis of conditioned reinforcement because they suggest behavioral operations necessary, at least in observing-response paradigms, for the occurrence of conditioned reinforcement. First, in order for observing behavior to develop and be maintained, the stimuli dependent upon observing responses must be differentially correlated (*cf.* Kendall, 1973*b;* Wilton and Clements, 1971*a;* Wyckoff, 1969) with separate contingencies, reinforcement magnitudes, *etc.;* when the stimuli signal identical consequences, observing responses decrease or extinguish (Auge, 1973*b;* Hendry, 1969; Kendall, 1973*a;* Wilton and Clements, 1971*a;* Wyckoff, 1969). Second, evidence from several different observing-response paradigms indicates that the occasional presentation of certain stimuli is necessary for the maintenance of observing behavior. That is to say, the presentation of only one of the stimuli in an observing-response paradigm is primarily responsible for the maintenance of observing behavior, and this stimulus is typically only occasionally presented. Viewed in this way, the stimulus primarily responsible for reinforcing observing behavior is available only a percentage of the session time, *i.e.*, it is only occasionally available. The experimental evidence shows that the stimuli that reinforce observing behavior are: (1) the

---

[1] I would like to thank colleagues, especially Drs. Peter Killeen and Joel Myerson, for helpful discussions during the course of this research. This study was conducted at Arizona State University. Preparation of the manuscript, at Denison University, was supported, in part, by a Faculty Development Stipend. Reprints may be obtained from the author, Department of Psychology, Denison University, Granville, Ohio 43023.

stimulus signalling food in a situation where another possible consequence of an observing-key response is a stimulus signalling extinction (Dinsmoor *et al.*, 1972; Dinsmoor *et al.*, 1971; Jenkins and Boakes, 1973; Kendall, 1972, 1973*a*); (2) the stimulus signalling a shock-free food schedule in a situation where another possible consequence of an observing-key response is a stimulus signalling the same food schedule *plus* conjoint shock (Dinsmoor, *et al.*, 1969); (3) the stimulus signalling the last third of a fixed-interval schedule, where stimuli correlated with successive thirds of a fixed-interval may be produced by observing-key responses (Kendall, 1972); (4) the stimulus signalling the shorter of two possible interreinforcement intervals (Kendall and Gibson, 1965), or the larger of two possible reinforcement magnitudes (Auge, 1973*b*). In each of the above cases, the occasional presentation of the stimulus signalling the other possible consequence(s), *e.g.*, the smaller reinforcement magnitude, would not maintain observing-key behavior.

Considered together, these studies suggest that the establishment and measurement of conditioned reinforcement is relative to or dependent upon the context in which stimuli reliably correlated with differential events occur. The present study was designed to examine this possibility. Specifically, a compound schedule (Ferster and Skinner, 1957) was formed wherein a fixed-interval 30-sec (FI 30-sec) schedule was paired with a fixed-ratio (FR) x schedule, where x varied from 20 to 200. Subsequently, the opportunity to respond for stimuli signalling the various components was made available. Formally, such a response qualified as an observing response (Wyckoff, 1952; 1969) because it was instrumental in producing a stimulus signalling the particular component arranged at that particular time. Two complementary conditions were then introduced to measure the effectiveness of the two stimuli signalling the two food schedules in the maintenance of observing-key behavior. Although both schedules continued to alternate randomly, in one condition the only occasional consequence of an observing-key response was the stimulus signalling the FI schedule; conversely in a second condition the only occasional consequence of an observing-key response was the stimulus signalling the FR schedule (Kendall and Gibson, 1965). These operations were performed in order to test the notion that the strength of a stimulus as a conditioned reinforcer, as measured by the probability of an observing-key response, can be manipulated by varying the context or environment in which the stimulus occurs.

## METHOD

### *Subjects*

Five adult pigeons were maintained between 75 and 80% of their free-feeding weight throughout the experiment; four were White Carneaux and the other was a Silver King (SK64). The birds had served in experiments using mixed and multiple schedules and autoshaping procedures (Brown and Jenkins, 1968).

### *Apparatus*

The experimental chamber (Lehigh Valley Electronics, Model 1519a) contained two response-keys, which required forces of at least 15 g (0.147N) to be operated, a solenoid-operated hopper for occasionally presenting grain to the pigeon, and a speaker that sounded a continuous white masking noise. A GE 1829 white bulb mounted on the top center of the wall above and between the two response keys illuminated the chamber, which was housed in a sound-attenuating chamber. Relay switching and timing circuitry were used for scheduling. Data were collected on digital counters and a Gerbrands cumulative recorder.

### *Procedure*

*Multiple schedule training.* Because the birds had been trained to respond on mixed and multiple schedules in previous experiments it was not necessary to give them special pretraining. Hence, the birds responded on the left, or food key, on a multiple fixed-ratio 30 fixed-interval 30-sec schedule (*mult* FR 30 FI 30-sec) where reinforcement consisted of 4-sec access to mixed grain. The schedule components alternated at random, after reinforcement, with the restriction that the same component could not occur more than three times in succession. A red-lighted key signalled the FR schedule and a green-lighted key the FI schedule. Next, the schedule was gradually changed (over the course of

Table 1

Sequence of conditions with the total number of sessions devoted to each condition shown in parentheses.

| *P28* | *SK64* | *Z68* | *Y72* | *P109* | *SK64** |
|---|---|---|---|---|---|
| M(10) | M(10) | M(10) | M(13) | B(25) | M(15) |
| B(17) | B(10) | B(10) | B(29) | R(22) | B(14) |
| R(11) | I(11) | R(7) | I(28) | B(12) | I(17) |
| B(18) | B(20) | M(6) | M(8) | I(15) | M(9) |
| I(9) | R(8) | B(9) | B(16) | | B(15) |
| | | I(7) | R(30) | | R(30) |

M = *mult* FR × FI 30-sec, the pretraining schedule before the observing-behavior parts of the experiment.

B = baseline condition (*mix* FR × FI 30-sec + $R_n$ contingency) where distinctive visual stimuli were reliably correlated with the FR and FI components and were contingent upon observing responses.

R = the stimulus reliably signalling the FR schedule was the only occasional consequence of an observing-key response; when the FI schedule was arranged, observing-key pecks had no scheduled consequences.

I = the stimulus reliably signalling the FI schedule was the only occasional consequence of an observing-key response; when the FR schedule was arranged, observing-key pecks had no scheduled consequences.

$R_o$ is observing response.

*Replication for SK64 where x equalled 30; see procedure for values of x in other cases.

several sessions) to a multiple FR x FI 30-sec, where the values of x for Z68, P28, SK64, and Y72 were 100, 140, 200, and 20, respectively. Because P109 had been exposed to similar contingencies in a previous experiment it was not judged necessary to give this bird preliminary multiple schedule training; consequently, P109 was placed directly on a *mix* FR 30 FI 30-sec schedule with the opportunity available to observe (see below). During multiple schedule training the right, or observing key, was lighted blue and responses on this key were recorded but had no scheduled consequences. Sessions terminated after 50 reinforcements and were conducted six or seven days per week.

See Table 1 for the sequence of experimental conditions for individual birds and the total number of sessions devoted to each condition.

*Baseline (B) observing behavior.* After multiple schedule training, both keys in the chamber were transilluminated with a white light. Technically, the food-key schedule was *mix* FR x FI 30-sec, *i.e.,* the component schedules alternated at random after reinforcement, each in the presence of the same stimulus, a white keylight. When both keys were transilluminated with a white light pigeons would normally begin pecking the observing key within one session. A baseline of observing-key behavior was then established wherein a single peck on the observing key changed the color of the food key to either red (FR) or green (FI) depending on the component schedule in effect. The stimulus that followed an observing-key response ($S_o$) remained on for 10 sec for Z68, P28, and SK64, and then the color of the food key reverted to white. For P109 and Y72, the $S_o$ remained on for the duration of the component, after which the color of the food key changed to white. After several sessions, the color of the observing key was changed from white to blue for the remainder of the experiment for all birds except Y72, for which it remained white. Throughout, a changeover delay (COD) prevented the reinforcement of a food-key response following within 10 sec of an observing-key response for Z68, P28, and SK64; the value of the COD for P109 and Y72 was 5 sec. The only consequence of an observing-key response, then, was to produce a stimulus signalling the component schedule in effect on the food key, which was either FR or FI. In all cases, if the bird did not peck the observing key, food could still be obtained by pecking the white food key.

*FR stimulus (R) only or FI stimulus (I) only.* In the R condition, a peck on the observing key changed the color of the food key to red if the schedule was FR, but if the schedule was FI, pecking the observing key had no scheduled consequence, *i.e.,* the food key remained white (the mixed schedule stimulus) where formerly the key changed to green. The converse was the case in the I condition: an observing-key peck produced the green stimulus during FI, but had no scheduled consequence during FR.

Fig. 1. A sample cumulative record for SK64 when observing behavior was maintained with both stimuli available during the first B condition when FR 200 was paired with FI 30-sec. Slash marks represent pecks on the observing key. The cumulative recorder reset after reinforcement. See text for details.

Between the above two conditions, the birds were returned to the baseline (B) condition. SK64 injured its beak during the transition from the I condition to the B condition and was withdrawn from the experiment for approximately one week (Auge, 1972).

*Reversal.* For SK64, the experiment was replicated using a compound FR 30 FI 30-sec schedule of reinforcement and a 5-sec COD (see Table 1). Here, the $S_0$ remained on for the duration of the component.

## RESULTS

Figure 1 shows a sample cumulative record for SK64 during a condition when observing behavior was maintained with both stimuli available. In general, this record is representative of the behavior for all subjects in the experiment.

The record shows that observing-key responses were most probable shortly after reinforcement and before responding on the food key had begun. The cumulative record also shows that the bird often paused after making an observing-key response before responding on the food key. However, once responding on the food key had begun, further pecks on the observing key were highly unlikely.

Table 2 gives the median interreinforcement intervals in seconds for the last five sessions during the various FR schedules for each bird in the various conditions of the experiment. The interreinforcement interval (IRI) during FI was approximately 30 sec throughout the experiment.

The probability of an observing-key response is defined as the total number of components in which an observing-key response occurred divided by the total number of components per session. For example, if a subject made at least one observing key response in 45 of the 50 total components per session, the

Table 2

Median interreinforcement intervals in seconds for the last five sessions during the fixed-ratio components for the various conditions of the experiment.

| *Bird* | *FR x* | *B* | *R* | *B* | *I* |
|---|---|---|---|---|---|
| SK64 | 200 | 82.3 | 62.9 | 96.1 | 89.0 |
| P28 | 140 | 62.1 | 52.5 | 61.9 | 62.8 |
| Z68 | 100 | 164.0 | 78.4 | 136.9 | 97.0 |
| Y72 | 20 | 9.6 | 11.0 | 9.5 | 13.3 |
| P109 | 30 | 10.5 | 10.5 | 11.1 | 19.4 |
| SK64* | 30 | 8.6 | 11.8 | 9.2 | 18.0 |

*Replication where FR 30 was paired with FI 30-sec.

probability would be 0.90. Figure 2 shows the probability of an observing-key response for each bird during the various conditions of the experiment.

An observing-key response was a high-probability event for all birds during the baseline conditions; however, the probability declined substantially for P28, SK64, and Z68 when the FI stimulus, which signalled the shorter IRI or the high relative rate of reinforcement (see Table 2), was not an occasional consequence of pecking the observing key. Contrastingly, whenever the FI stimulus was available, observing-key behavior occurred in a considerable proportion of the total number of components per session. On the other hand, when the FI stimulus signalled the longer IRI or the low relative rate of reinforcement, in the case of Y72, P109, and the replication for SK64, its occasional presentation did not main-

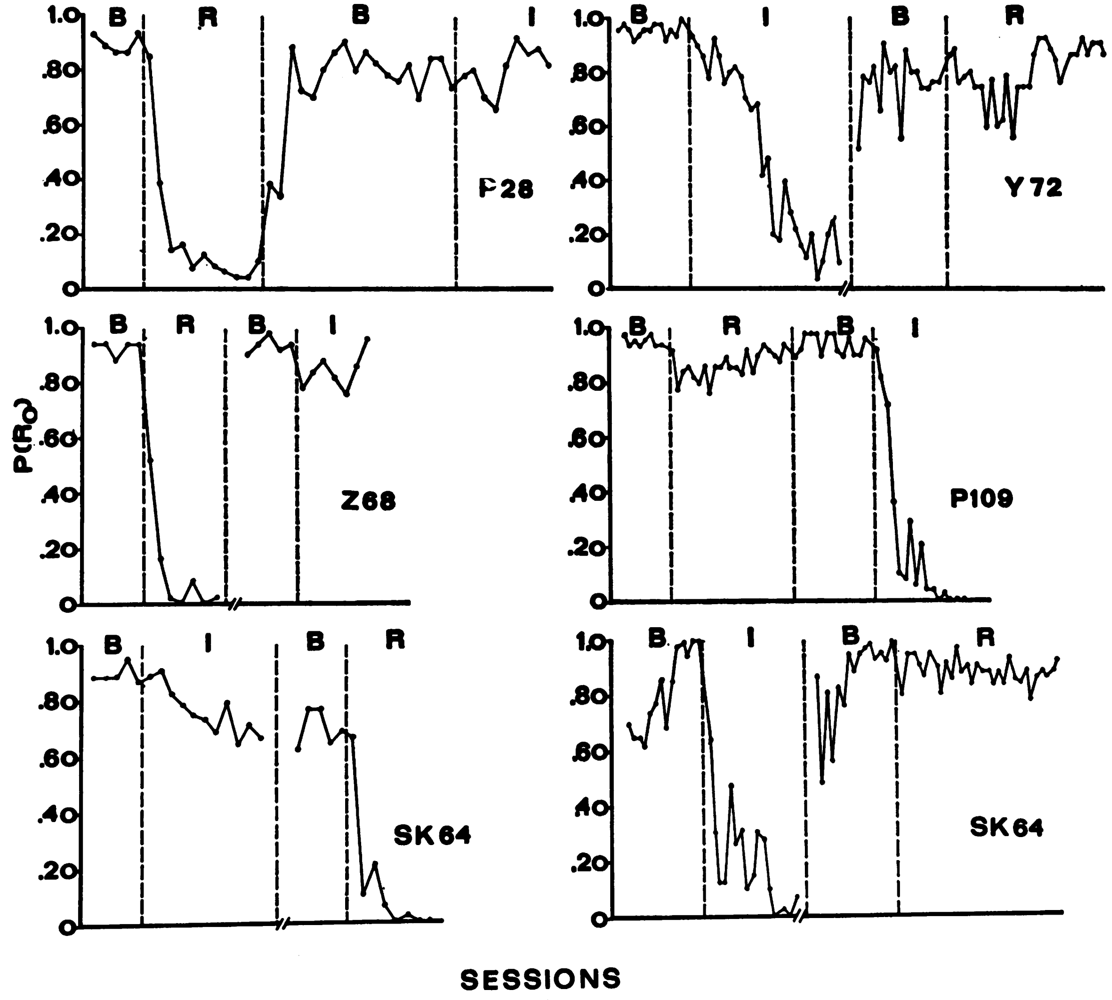

Fig. 2. Each point shows the probability of an observing-key response, $P(R_o)$, for each session during the various parts of the experiment. During baseline conditions (B), the stimulus signalling the FR schedule or the stimulus signalling the FR schedule followed a peck on the observing key when the respective component was scheduled. In the other two conditions, only the stimulus signalling either FI (I) or the stimulus signalling FR (R) was a consequence of a peck on the observing key when the respective component was scheduled; at other times, pecking the observing key had no scheduled consequence. The left half of the figure shows observing-key response probabilities for birds exposed to schedules where a large value FR was paired with FI 30-sec, whereas the right half of the figure shows observing-key response probabilities for birds exposed to schedules where a small value FR was paired with FI 30-sec. Note that SK64 experienced both conditions, *i.e.*, in one case, the FR value was 200 (left) and in the other it was 30 (right). Breaks in the abscissas represent periods of interpolated multiple schedule training except in the case of SK64 (left) where the break represents the beak injury period (Auge, 1972). See text for a more extensive description.

tain observing-key behavior; here, the occasional presentation of the stimulus signalling the FR schedule was maintaining observing behavior.

Normally, only one observing response occurred per component in the conditions where the $S_o$ remained on for 10 sec. This response occurred shortly after reinforcement and before responding on the food key had begun. After obtaining the stimulus signalling the large FR schedule, the birds would usually wait until the stimulus terminated, *i.e.,* 10 sec, before responding on the food key. Occasionally, the birds would continue pecking the observing key and thus prolong the FR stimulus duration. Still, pecking the food key usually would not occur until the stimulus signalling the FR schedule terminated. When the FI stimulus signalling the high relative rate of reinforcement was obtained, the birds would normally either respond immediately on the food key or pause briefly before responding. Here, the offset of the stimulus signalling the FI schedule normally preceded reinforcement availability by 10 sec or more.

Similarly, when the FI 30-sec component was paired with either FR 20 or FR 30 for Y72, P109, and SK64, one observing response was most probable shortly after reinforcement and before responding on the food key had begun. When the FR stimulus was obtained, the birds immediately commenced responding on the food key at a high rate; however, when the FI stimulus was obtained, the birds would occasionally continue pecking the observing key two or three times and then pause for a short period before responding on the food key.

## DISCUSSION

Taken together, these data suggest that the molar scheduling operations under which a stimulus is presented are important in establishing it as an effective conditioned reinforcer (*cf.* Fantino, 1969*a, b;* Stubbs, 1971; Morse and Kelleher, 1970). Traditionally, a stimulus signalling either an FI or an FR schedule would be expected to become a conditioned reinforcer (Skinner, 1938; Keller and Schoenfeld, 1950; Kelleher and Gollub, 1962). For example, Kelleher and Gollub (1962) reviewed a large body of evidence that suggested pairing a stimulus with a primary reinforcer may be sufficient to establish it as a conditioned reinforcer. Yet, the present experiment demonstrated that the stimulus signalling the longer IRI or lower relative rate of reinforcement was not a conditioned reinforcer: its occasional presentation failed to maintain observing-key behavior. It therefore seems apparent that the context within which a stimulus is based is a critical variable in the establishment of that stimulus as a durable conditioned reinforcer.

When the only occasional consequence of an observing-key response was the stimulus signalling the low relative rate of reinforcement, the data for four of the five birds show an abrupt decrease in observing-key response probability. However, when the FI stimulus was the only occasional consequence of an observing-key peck, in the case of the fifth bird, Y72, 14 sessions were required for the probability of observing-key behavior to fall below 0.50 (note that the color of the observing key was white for this bird, the same color as the mixed stimulus). The comparatively high number of sessions required for this decrement to develop would seem to allow time for the development of a new discrimination, whereby a peck on the observing key followed by no stimulus change would come to signal the FR schedule while a peck on the observing key during the FI schedule produced the usual stimulus; yet, such a discrimination did not develop, the probability of observing-key behavior eventually declined and stabilized at a relatively low level. Hence, in this case as in the others, the occasional presentation of the stimulus signalling the high relative rate of reinforcement was necessary to maintain observing-key behavior.

Moreover, the conditioned reinforcing effectiveness of the stimulus signalling the FI schedule, in the case of P28, is illustrated by the marked increase in observing-response probability when it was made occasionally available after formerly being unavailable (*cf.* Auge, 1973*a*). In general, the functional relationship depicted in Figure 2 is a reliable finding occurring under several conditions, *i.e.,* FR values (also see: Auge, 1973*b;* Dinsmoor *et al.,* 1972; Jenkins and Boakes, 1973; Kendall, 1972; Kendall and Gibson, 1965).

In addition, on the occasions when the stimulus signalling the low relative rate of reinforcement (especially the large FRs) was produced, "emotional" behavior was observed to occur (*cf.* Terrace, 1966). The birds would often turn away from the key, flap their wings, emit several additional vigorous pecks on the observing key, engage in preening, exhibit pilomotor activity, jump and strut around the chamber, *etc.* Such behaviors were also occasionally observed to a lesser degree (*i.e.,* not as intense or often) in the presence of the mixed stimulus, following the marked decrease in observing-key behavior when only the stimulus signalling the low relative rate of reinforcement was an occasional consequence of an observing-key response. When the pigeons obtained the stimulus signalling the high relative rate of reinforcement, they would typically respond immediately or pause briefly while looking or bobbing near the key before commencing responding.

For Z68, P28, and SK64 (when FI 30-sec was paired with FR 200) the stimulus produced by an observing response lasted only 10 sec, the same length of time as the COD. Hence, during the observing-behavior parts of the experiment the birds never received primary reinforcement in the presence of the stimulus that served as a conditioned reinforcer. Nevertheless, observing behavior was maintained, *i.e.,* pairing the stimulus with grain was not necessary for the stimulus to function as a conditioned reinforcer. This result stands in contrast to those of Auge (1973*b*), which showed that "trace discriminative stimuli" (Kendall, 1969) would not maintain observing-key behavior in a case where the schedule was FI 1-min and reinforcement was either 2-sec or 10-sec access to grain.[2] In the present experiment, the IRI varied and reinforcement magnitude was constant, whereas in Auge (1973*b*) the IRI was relatively constant and reinforcement magnitude varied. If we consider the reinforcer for observing, in the present case, to be a stimulus signalling a time interval plus 4-sec access to grain, then we might argue that a brief (10-sec) stimulus reinforced observing-key behavior because it signalled, *i.e.,* preceded, the major portion of the preferred IRI.

Premack (1962) showed that the reinforcement relationship is reversible by manipulating (by deprivation) the opportunity to drink or run where one activity serves as a reinforcible response and the other activity serves as a reinforcer. This experiment showed that the reinforcing strength of a stimulus signalling food is similarly reversible by changing the context in which the stimulus occurs. When FI 30-sec was paired with FR 200, for SK64, the occasional presentation of the stimulus (green) signalling the FI schedule maintained observing-key behavior. However, in the subsequent replication, when FI 30-sec was paired with FR 30, the occasional presentation of the stimulus (red) signalling the FR schedule maintained observing-key behavior, but the occasional presentation of the stimulus signalling the FI schedule did not.

The type of schedule, *i.e.,* FI or FR, does not appear to be an important variable. This conclusion is supported by evidence indicating that the conditioned reinforcing strength of a stimulus is a function of the rate or frequency of reinforcement a stimulus signals but is independent of the response rate or response pattern occurring in its presence (Kelleher and Gollub, 1962; Killeen, 1968, 1971). However, using a concurrent-chains paradigm where reinforcement rate was held relatively constant, Fantino (1969*a*) showed pigeons consistently preferred the stimulus associated with an FI schedule and not the one associated with a differential-reinforcement-of-high rate schedule. To date there are no published reports on the effects of required rates of responding in an observing-response paradigm. When FI 30-sec was paired with FR 200 and observing-key behavior was maintained for SK64 in the present experiment, the response rate in FI was lower than that in FR; this was also the case when FI 30-sec was paired with FR 30. In both cases, the stimulus that maintained observing-key behavior signalled the shorter relative interreinforcement interval or, in other words, signalled the high relative rate of reinforcement component, which in one case was FI and in another case FR. This finding is complemented by a study using VI schedules (Branch, 1970), which suggested that observing responses during mixed schedules of reinforcement are primarily reinforced by occasional presentation of the stimulus signalling the component schedule that provides reinforcement more frequently. In the present case, a change in context profoundly changed the reinforcing strength of the stimulus signalling FI 30-sec.

---

[2] Subsequent to the present experiment, P28 and Y72 served in the experiments reported by Auge (1973*b*).

Dinsmoor *et al.* (1971) have suggested an analysis of observing behavior similar to the present one. They demonstrated that when a pigeon can control the duration of the stimuli in an observing-response paradigm it is selective in its sampling of the positive and negative stimuli, producing longer periods of exposure to the positive stimulus. The Dinsmoor *et al.* data showed pigeons selectively observed the stimulus signalling the presence of a reinforcement schedule (*cf.* Dinsmoor *et al.*, 1972) in a situation where one stimulus signalled a random-interval schedule of reinforcement and another stimulus signalled extinction. Similarly, in the present study pigeons responded to produce the stimulus signalling the shorter IRI or high relative rate of reinforcement condition. When the stimulus signalling the low relative rate of reinforcement condition was the only occasional consequence of an observing-key peck, the pigeons, by not observing, chose the mixed stimulus that then signalled, on the average, a higher relative rate of reinforcement.

The general phenomenon that pigeons will respond to produce the stimulus signalling the most highly valued possible consequence (Auge, 1973*b;* Dinsmoor *et al.*, 1972; Jenkins and Boakes, 1973; Kendall, 1972; Kendall and Gibson, 1965) also holds true for certain schedules that include electric shock. Dinsmoor *et al.* (1969) trained pigeons to observe in a situation where one stimulus signalled a VI food schedule and another stimulus signalled the same VI food schedule *plus* conjoint FR punishment (electric shock). A substantial observing-key response rate was not maintained when the stimulus signalling VI plus punishment was the only occasional consequence of an observing-key response; however, a substantial observing-key response rate was maintained when the stimulus signalling the simple VI food schedule was occasionally available.

Additional supporting evidence for ordering the stimuli in observing-response paradigms on a scale of value (Auge, 1973*b;* also see Baum, 1973; Baum and Rachlin, 1969) is obtained from a study by Bower, McLean, and Meacham (1966). After showing that pigeons preferred a multiple schedule over a mixed schedule, where the two schedules generated identical rates of reinforcement, they showed that the various stimuli were preferred (or valued) in the following order: (1) green (FI 10-sec); (2) yellow (the mixed schedule stimulus, signalling an average IRI of 25 sec); and (3) red (FI 40-sec). The present experiment shows that the value of a stimulus is a function of its context and demonstrates the influence of the relative IRI signalled by a stimulus in determining its value.

Normally, one might expect a stimulus signalling an FI 30-sec schedule to be a potential conditioned reinforcer. However, the present experiment demonstrates that the measurement of conditioned reinforcement is critically dependent upon the context in which an event occurs (Bevan, 1968; Fantino, 1969*a*, *b;* Herrnstein, 1970; Squires and Fantino, 1971). The relative nature of stimuli signalling differential contingencies of reinforcement illustrates the importance of considering the molar scheduling operations in the establishment and measurement of conditioned reinforcement.

## REFERENCES

Auge, R. J. Differential control of responding following beak injury. *The Psychological Record,* 1972, **22,** 217-220.

Auge, R. J. Extinction of observing behavior. *Psychological Reports,* 1973, **33,** 603-609. (*a*)

Auge, R. J. Effects of stimulus duration on observing behavior maintained by differential reinforcement magnitude. *Journal of the Experimental Analysis of Behavior,* 1973, **20,** 429-438. (*b*)

Baum, W. M. The correlation-based law of effect. *Journal of the Experimental Analysis of Behavior,* 1973, **20,** 137-153.

Baum, W. and Rachlin, H. C. Choice as time allocation. *Journal of the Experimental Analysis of Behavior,* 1969, **12,** 861-874.

Bevan, W. The contextual basis of behavior. *American Psychologist,* 1968, **23,** 701-714.

Bower, G., McLean, J., and Meacham, J. Value of knowing when reinforcement is due. *Journal of Comparative and Physiological Psychology,* 1966, **62,** 184-192.

Branch, M. N. The distribution of observing responses during two VI schedules. *Psychonomic Science,* 1970, **20,** 5-6.

Brown, P. L. and Jenkins, H. M. Auto-shaping of the pigeon's key peck. *Journal of the Experimental Analysis of Behavior,* 1968, **11,** 1-8.

Dinsmoor, J. A., Browne, M. P., and Lawrence, C. E. A test of the negative discriminative stimulus as a reinforcer of observing. *Journal of the Experimental Analysis of Behavior,* 1972, **18,** 79-85.

Dinsmoor, J. A., Browne, M. P., Lawrence, C. E., and Wasserman, E. A. A new analysis of Wyckoff's observing response. *Proceedings, 79th Annual Conven-*

*tion, American Psychological Association,* 1971, 679-680 (Summary).

Dinsmoor, J. A., Flint, G. A., Smith, R. F., and Viemeister, N. F. Differential reinforcing effects of stimuli associated with the presence or absence of a schedule of punishment. In D. P. Hendry (Ed.), *Conditioned reinforcement.* Homewood, Illinois: Dorsey Press, 1969. Pp. 357-384.

Fantino, E. Conditioned reinforcement, choice, and the psychological distance to reward. In D. P. Hendry (Ed.), *Conditioned reinforcement.* Homewood, Illinois: Dorsey Press, 1969. Pp. 163-191. (*a*)

Fantino, E. Choice and rate of reinforcement. *Journal of the Experimental Analysis of Behavior,* 1969, **12,** 723-730. (*b*)

Ferster, C. B. and Skinner, B. F. *Schedules of reinforcement.* New York: Appleton-Century-Crofts, 1957.

Hendry, D. P. Reinforcing value of information: fixed-ratio schedules. In D. P. Hendry (Ed.), *Conditioned reinforcement.* Homewood, Illinois: Dorsey Press, 1969. Pp. 300-341.

Herrnstein, R. J. On the law of effect. *Journal of the Experimental Analysis of Behavior,* 1970, **13,** 243-266.

Jenkins, H. M. and Boakes, R. A. Observing stimulus sources that signal food or no food. *Journal of the Experimental Analysis of Behavior,* 1973, **20,** 197-207.

Kelleher, R. T. Chaining and conditioned reinforcement. In W. K. Honig (Ed.), *Operant behavior: areas of research and application.* New York: Appleton-Century-Crofts, 1966. Pp. 160-212.

Kelleher, R. T. and Gollub, L. R. A review of positive conditioned reinforcement. *Journal of the Experimental Analysis of Behavior,* 1962, **5,** 543-597.

Keller, F. S. and Schoenfeld, W. N. *Principles of psychology.* New York: Appleton-Century-Crofts, 1950.

Kendall, S. B. Discriminative and reinforcing properties of differential trace stimuli. In D. P. Hendry (Ed.), *Conditioned reinforcement.* Homewood, Illinois: Dorsey Press, 1969. Pp. 261-280.

Kendall, S. B. Some effects of response-dependent clock stimuli in a fixed-interval schedule. *Journal of the Experimental Analysis of Behavior,* 1972, **17,** 161-168.

Kendall, S. B. Redundant information in an observing-response procedure. *Journal of the Experimental Analysis of Behavior,* 1973, **19,** 81-92. (*a*)

Kendall, S. B. Effects of two procedures for varying information transmission on observing responses. *Journal of the Experimental Analysis of Behavior,* 1973, **20,** 73-83. (*b*)

Kendall, S. B. and Gibson, D. A. Effects of discriminative stimulus removal on observing behavior. *The Psychological Record,* 1965, **15,** 545-551.

Killeen, P. Response rate as a factor in choice. *Psychonomic Science,* 1968, **12,** 34.

Killeen, P. Response patterns as a factor in choice. *Psychonomic Science,* 1971, **22,** 23-24.

Morse, W. H. and Kelleher, R. T. Schedules as fundamental determinants of behavior. In W. N. Schoenfeld (Ed.), *The theory of reinforcement schedules.* New York: Appleton-Century-Crofts, 1970. Pp. 139-185.

Mulvaney, D. E., Dinsmoor, J. A., Jwaideh, A. R., and Hughes, L. H. Punishment of observing by the negative discriminative stimulus. *Journal of the Experimental Analysis of Behavior,* 1974, **21,** 37-44.

Premack, D. Reversibility of the reinforcement relation. *Science,* 1962, **136,** 255-257.

Skinner, B. F. *The behavior of organisms.* New York: Appleton-Century-Crofts, 1938.

Squires, N. and Fantino, E. A model for choice in simple concurrent and concurrent-chains schedules. *Journal of the Experimental Analysis of Behavior,* 1971, **15,** 27-38.

Stubbs, D. A. Second-order schedules and the problem of conditioned reinforcement. *Journal of the Experimental Analysis of Behavior,* 1971, **16,** 289-313.

Terrace, H. S. Stimulus control. In W. K. Honig (Ed.), *Operant behavior: areas of research and application.* New York: Appleton-Century-Crofts, 1966. Pp. 271-344.

Wilton, R. N. and Clements, R. O. Observing responses and informative stimuli. *Journal of the Experimental Analysis of Behavior,* 1971, **15,** 199-204. (*a*)

Wilton, R. N. and Clements, R. O. The role of information in the emission of observing responses: a test of two hypotheses. *Journal of the Experimental Analysis of Behavior,* 1971, **16,** 161-166. (*b*)

Wyckoff, L. B., Jr. The role of observing responses in discrimination learning. *Psychological Review,* 1952, **59,** 431-442.

Wyckoff, L. B., Jr. The role of observing responses in discrimination learning. In D. P. Hendry (Ed.), *Conditioned reinforcement.* Homewood, Illinois: The Dorsey Press, 1969. Pp. 237-260.

*Received 10 January 1974.*
*(Final Acceptance 30 May 1974.)*