*RELATIONS BETWEEN PATTERNS OF RESPONDING
AND THE PRESENTATION OF STIMULI UNDER
SECOND-ORDER SCHEDULES¹*

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Key-pecking behavior in the pigeon was maintained under second-order schedules in which food was presented after a variable number of 2-min fixed-interval components were completed. When either the same stimulus (Exp. I) or different stimuli (Exp. II) appeared on the key during consecutive components, and a stimulus that was occasionally paired with food was presented briefly at completion of each component, (1) patterns of positively accelerated responding were maintained during the components, and, (2) mean response rates were generally as high during the initial components of a sequence as during the later components. In both experiments, when the food-paired stimulus was omitted and either no stimulus or a stimulus never paired with food was presented at completion of each component, mean rates of responding increased, but patterns of positively accelerated responding were not maintained during individual components. When a food-paired stimulus was not presented at completion of the components, mean response rates in Exp. I were low during the initial components of a sequence and gradually increased during subsequent components; in Exp. II mean response rates were variable, and pauses and abrupt changes in response rates were typical.

Under a 10-response fixed-ratio schedule of food presentation, each individual key peck is treated as a unit of behavior and food is presented after 10 successive key pecks (Ferster and Skinner, 1957). Under a second-order schedule, the responding engendered by each component schedule is treated as a unit of behavior, and food is presented in relation to the completion of components (Kelleher, 1966a). For example, under a 10-component second-order schedule, food is presented after 10 successive components are completed. If each component is a 2-min fixed-interval schedule, the first key peck after 2 min has elapsed produces the next component, *etc.*, and during the tenth component, the first key peck after 2 min produces food presentation. When the same stimulus is present during every component and there is no stimulus change at

completion of each component, the second-order schedule is a tandem schedule; when different stimuli are present during consecutive components and responding in the presence of one stimulus produces the stimulus of the next component, the schedule is a chained schedule.

DeLorge (1967), Findley and Brady (1965), Kelleher (1966a, 1966b), and Thomas and Stubbs (1966, 1967) have shown that when a stimulus that immediately precedes or accompanies food availability is presented briefly at completion of each component of a second-order schedule, rates and patterns of responding characteristic of the schedule in effect during the components can be maintained. In addition, Kelleher (1966a) described similarities between changes in responding during successive components of second-order schedules and changes in rates of responding under more conventional schedules. Kelleher studied responding in the pigeon when a stimulus was presented briefly at completion of each 20-response fixed-ratio component and food presentation followed the first presentation of the brief stimulus after 10 min. The rate of completion of successive components during each 10-min period tended to change in the same way as rate of responding under a 10-min fixed-interval schedule.

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Investigations of second-order schedules have generally been limited to studying responding when food presentation either: (1) followed the first component completed after a fixed period of time (deLonge, 1967; Kelleher, 1966a), or, (2) followed completion of a fixed number of components (Findley and Brady, 1965; Kelleher, 1966b). In these investigations, the same stimulus appeared during every schedule component, and a stimulus was presented briefly at completion of each component. Accordingly, little is known about the generality of the similarities that Kelleher described between second-order and non-second-order schedules, or about the effect of presenting different stimuli during the components when a stimulus is presented briefly at completion of each component.

The present paper describes two experiments that studied responding in the pigeon under second-order schedules in which: (1) food was presented after completion of a variable number of components, (2) different stimuli were present during consecutive components, and, (3) a stimulus was presented briefly at completion of individual components. These experiments analyzed patterns of responding when sequences consisted of a variable number of components, and also compared the effects of presenting different stimuli with the effects of presenting the same stimulus during consecutive components. In general, the experiments demonstrated that comparable patterns of responding are not necessarily maintained under second-order schedules when the same stimulus and when different stimuli are present during the components. Furthermore, an analysis of changes in mean response rates during successive components, when sequences consisted of a variable number of components, extended the generality of the similarities which Kelleher (1966a) identified between responding under second-order and non-second-order schedules.

METHOD

Subjects

Three male White Carneaux pigeons were maintained at 80% of their free-feeding body weights. Each pigeon's pecks on a transilluminated response key had been conditioned, and each had a history of responding under second-order schedules of food presentation.

Apparatus

Subjects were studied in a commercially available test chamber (Grason-Stadler, E3125A-3) containing an interior panel (Grason-Stadler, E5445C) on which were mounted three transparent response keys and a solenoid-actuated food tray for presenting a mixture of grain. A 10-w lamp mounted above the food tray permitted illumination of the food opening independently of food presentation; a 10-w lamp mounted near the right key served as a houselight and permitted general illumination of the chamber. Individual pecks on the center key operated electrical contacts and counted as responses. The center key could be transilluminated by any of 12 stimuli (U-N-C-L-X-S-H-K-A-Z-E-P) from a Multiple Stimulus Projector (Grason-Stadler, #4580-159) or by a single red light (G.E. #1820). To mask extraneous sounds, white noise was continuously present in the test chamber and in the room housing the chamber. In an adjacent room, relay operated switching circuits, steppers, and clocks controlled the experiments; cumulative recorders and electromagnetic counters recorded responses (Ferster and Skinner, 1957).

Procedure

In the presence of an illuminated response key, the first key peck occurring after 2 min (FI 2-min) produced a 1-sec period during which the food opening was illuminated and the houselight and keylight were turned off (1-sec paired stimulus). Food was presented upon completion of a mean of 12 components, with as few as two and as many as 27 components intervening between successive food presentations; *i.e.*, food was presented for 8 sec immediately after 8, 13, 7, 27, 3, 20, 9, 23, 15, 6, 2, and 11 presentations of the 1-sec paired stimulus. During food presentation, the food opening was illuminated and the houselight and keylight were turned off.

Changes in stimulus presentations during and at completion of the components were considered as two experiments for clarity and convenience of exposition. The order in which the stimulus conditions changed and the number of sessions each was studied are shown in Table 1. Each of the six procedures remained in effect until rates and patterns of responding showed no transitional trends during at least

Table 1

Sessions during which the six procedures comprising Exp. I and II were studied. Sessions marked with asterisks were included to avoid possible order effects between procedures, and responding during these sessions was not included in the data analysis. Session 1 followed approximately 85 sessions of responding under procedures which differed from Exp. I-A and II-A in that each component of the second-order schedule was either a 30-sec or 3-min fixed-interval schedule.

Procedure		Sessions
Exp. II-A	(different component stimuli + paired stimulus)	1-18
Exp. II-C	(different component stimuli + no stimulus)	19-38
Exp. II-A	(different component stimuli + paired stimulus)	*39-51
Exp. I-A	(same component stimulus + paired stimulus)	52-65
Exp. II-A	(different component stimuli + paired stimulus)	*66-73
Exp. II-B	(different component stimuli + non-paired stimulus)	74-95
Exp. II-A	(different component stimuli + paired stimulus)	*96-97
Exp. I-B	(same component stimulus + non-paired stimulus)	98-110
Exp. II-A	(different component stimuli + paired stimulus)	*111-148
Exp. I-C	(same component stimulus + no stimulus)	149-176

five consecutive sessions. Individual sessions were conducted seven days a week, each session terminating after the twelfth presentation of food or after a maximum of 8 hr.

EXPERIMENT I

This experiment studied patterns of responding when the same stimulus was present during every fixed-interval component and food was presented after completion of a variable number of components. At completion of each component, either: (1) a stimulus that was occasionally paired with food was presented briefly, (2) a stimulus never paired with food was presented briefly, or, (3) no stimulus change occurred.

During the first phase (Exp. I-A), the same stimulus (U) appeared on the response key during every FI 2-min component, and a 1-sec stimulus (paired stimulus) was presented at completion of each component.

The second phase (Exp. I-B) examined the effect of substituting for the 1-sec paired stimulus a 1-sec stimulus (red keylight) that was never paired with food presentation. The 1-sec paired stimulus continued to be presented at completion of the last component before food presentation, but at completion of all other components the only stimulus change was a 1-sec presentation of the red keylight (non-paired stimulus).

During the third phase (Exp. I-C), all 1-sec stimulus presentations were omitted, and the first response occurring after 2 min produced no stimulus change between consecutive com-

ponents. In other respects the procedure was as described above, and food was presented immediately upon completion of a mean of 12 components. In the absence of a stimulus change at completion of each component, the second-order schedule was a tandem schedule (Ferster and Skinner, 1957), in which the number of components comprising successive sequences varied.

RESULTS

When a 1-sec paired stimulus was presented at completion of each component, responding during individual FI 2-min components was positively accelerated, a pattern of responding typically maintained when food is presented under an FI 2-min schedule (Fig. 1A). Mean response rates during individual components were generally as high during the initial components of a sequence as during the remaining components. Although mean response rates during individual components varied slightly, significant systematic increases or decreases in the mean response rates of successive components in a sequence were absent (Fig. 2A). Both the pattern of positively accelerated responding during individual components and the relative uniformity of the mean response rates during components comprising a sequence were more pronounced for P33 than for P35 and P31. Mean rates of responding were approximately 0.17 responses per sec for P31, 0.27 responses per sec for P33, and 0.54 responses per sec for P35 (Fig. 3).

Mean rates of responding increased but patterns of positively accelerated responding

Fig. 1. Responding by pigeons P31, P33, and P35 under a second-order schedule in which the same stimulus appeared on the response key during every FI 2-min component, and food was presented after completion of a variable number of components. At completion of each component either: (A) a stimulus occasionally paired with food was presented briefly; (B) a stimulus never paired with food was presented briefly; (C) no stimulus change occurred. A diagonal mark of the response pen indicates completion of a component; a mark of the event pen indicates food presentation. The response pen reset upon cumulation of 550 responses or upon food presentation. Cumulative records show performance during one of the last three sessions under each procedure.

were not maintained during individual components when a 1-sec non-paired stimulus was substituted for a 1-sec paired stimulus (Fig. 1B). Responding by P35 approached a more steady, uniform rate during most of the components, but P33, and to a lesser extent P31, occasionally paused briefly at the beginning of a component before moving rapidly to a steady response rate. Although patterns of positively accelerated responding were not maintained during individual components, there were systematic changes in the mean response rates in successive components under this procedure, with relatively low mean response rates occurring during the initial components of a sequence and increased mean rates occurring during the remaining components (Fig. 2B).

When all 1-sec stimuli were omitted, mean response rates increased above those maintained when either a paired or a non-paired stimulus was presented at completion of the components (Fig. 3). Relatively low rates of responding tended to occur only during the initial components of a sequence. During the remaining components, responding gradually increased to a high rate which persisted until the sequence of components was terminated

by food presentation (Fig. 1C and 2C). Except for the initial components of a sequence, P33 and P35, and to a lesser extent P31, responded at a relatively steady, uniform rate during individual components.

EXPERIMENT II

Experiment I analyzed the patterns of responding engendered when the same stimulus appeared on the response key during every fixed-interval component and food was presented after a variable number of components. This experiment studied whether patterns of responding comparable to those maintained under each of the three procedures of Exp. I would be engendered when different stimuli appeared on the response key during consecutive fixed-interval components. At completion of each component, either: (1) a stimulus occasionally paired with food was presented briefly, (2) a stimulus never paired with food was presented briefly, or, (3) a brief stimulus was not presented and only the stimulus of the next component appeared.

The procedure studied during the first phase (Exp. II-A) was similar to the first procedure described in Exp. I, except that a dif-

Fig. 2. Changes in mean response rates during a single occurrence of one representative sequence consisting of 23 successive components. Food was presented at completion of the twenty-third component. Vertical bars represent mean rates of responding for pigeons P31, P33, and P35 during individual FI 2-min components of a second-order schedule in which food presentation followed completion of a variable number of components. The same stimulus appeared on the response key during every component, and at completion of each component either: (A) a stimulus occasionally paired with food was presented briefly; (B) a stimulus never paired with food was presented briefly; (C) no stimulus change occurred.

ferent stimulus appeared on the response key during consecutive fixed-interval components. In the presence of Stimulus U, responding under an FI 2-min fixed-interval schedule produced a 1-sec stimulus (paired stimulus) followed by presentation of Stimulus N; in the presence of Stimulus N, responding under FI 2-min produced the 1-sec paired stimulus followed by presentation of Stimulus C, and so forth. The 12 stimuli available on the Multiple Stimulus Projector were ordered U-N-C-L-X-S-H-K-A-Z-E-P and Stimulus N always followed Stimulus U, Stimulus C always followed Stimulus N, Stimulus P always followed Stimulus E, Stimulus U always followed Stimulus P, and so forth. If Stimulus K appeared during the last component of a sequence, Stimulus A appeared during the first component of the next sequence, and Stimulus Z appeared during the second component. Food was presented after 8, 13, 7, 27, 3, 20, 9, 23, 15, 6, 2, and 11 presentations of the 1-sec paired stimulus. These values assured that during a single

session each of the 12 stimuli appeared with equal frequency during the first and during the last component of sequences.

The second phase (Exp. II-B) studied the effect of substituting for the 1-sec paired stimulus a 1-sec stimulus (a red keylight) that was never paired with food presentation. The 1-sec paired stimulus continued to be presented at completion of the last FI 2-min component before food presentation, but at completion of all other components the 1-sec red keylight was presented.

During the final phase (Exp. II-C), all 1-sec stimulus presentations were omitted, and the first response after 2 min immediately produced the stimulus of the next component. The order in which the component stimuli appeared during an individual sequence and during successive sequences was the same as during Exp. II-B and Exp. II-C; omission of the 1-sec stimulus presentations was the only change made. In the absence of 1-sec stimulus presentations at completion of the

Fig. 3. Mean rates of responding for pigeons P31, P33, and P35 under a second-order schedule in which the same stimulus appeared on the response key during every FI 2-min component and food was presented following completion of a variable number of components. Mean rates of responding were determined from performance during the last five sessions under each of the three procedures studied. At completion of each component either: a stimulus occasionally paired with food was presented briefly (paired-stimulus); a stimulus never paired with food was presented briefly (non-paired stimulus); no stimulus change occurred (no stimulus).

components, this procedure was a chained schedule (Ferster and Skinner, 1957) in which the order of component stimuli was different during each successive sequence of components and the number of components comprising successive sequences varied.

RESULTS

Patterns of positively accelerated responding were maintained during individual FI 2-min components when a different stimulus appeared on the response key during consecutive components and a 1-sec paired stimulus was presented at completion of each component (Fig. 4A). Rates and patterns of responding during individual components were similar to rates and patterns typical under an FI 2-min schedule of food presentation. Differences in the mean response rates of successive components were small, and there was no indication of a systematic increase or decrease in the mean response rates during components comprising a sequence (Fig. 5A). Responding was maintained at mean rates of 0.21 responses per sec by P31, 0.28 responses per sec by P33, and 0.46 responses per sec by P35 (Fig. 6).

Mean rates of responding and variability in responding increased, especially for P33 and

Fig. 4. Responding by pigeons P31, P33, and P35 under a second-order schedule in which different stimuli appeared on the response key during consecutive FI 2-min components, and food was presented following completion of a variable number of components. At completion of each component either: (A) a stimulus occasionally paired with food was presented briefly; (B) a stimulus never paired with food was presented briefly; (C) a brief stimulus was not presented. Cumulative records show performance during one of the last three sessions under each procedure. Recording as in Fig. 1.

Fig. 5. Changes in mean response rates during a single occurrence of one representative sequence consisting of 23 successive components. Food was presented at completion of the twenty-third component. Vertical bars represent mean rates of responding for pigeons P31, P33, and P35 during individual FI 2-min components of a second-order schedule in which food presentation followed completion of a variable number of components. A different stimulus appeared on the response key during consecutive components, and at completion of each component either: (A) a stimulus occasionally paired with food was presented briefly; (B) a stimulus never paired with food was presented briefly; (C) a brief stimulus was not presented.

P35, when a 1-sec non-paired stimulus was presented at completion of individual fixed-interval components (Fig. 5B). Pauses and low response rates were typical during initial components of the sequences. Responding during the remaining components was highly variable, and frequently, steady responding at a moderately high rate was interrupted by a pause or an abrupt change to a lower rate of responding. No single pattern characterized responding during the fixed-interval components when a 1-sec non-paired stimulus was presented. Responding sometimes occurred at a steady rate, sometimes at an increasing rate, and sometimes at a decreasing rate (Fig. 4B).

Mean rates of responding increased further when all 1-sec stimulus presentations were omitted and the first response after 2 min immediately produced the stimulus of the next component (Fig. 6). None of the subjects maintained patterns of positively accelerated responding as a general characteristic of per-

formance during individual fixed-interval components, even though different stimuli appeared on the response key during consecutive components (Fig. 4C). P35 sometimes responded at a high, steady rate, and sometimes at a slightly increasing rate during individual components; for P33 and P31, a more uniform rate of responding was typical. In all subjects, pauses and decreased rates of responding tended to occur during the initial components of a sequence, and increased rates of responding tended to occur during the remaining components (Fig. 5C).

DISCUSSION

Responding under second-order schedules can be described in terms of two characteristics: systematic changes in responding during individual components, and systematic changes in mean response rates during sequences of components. In both experi-

Fig. 6. Mean rates of responding for pigeons P31, P33, and P35 under a second-order schedule in which different stimuli appeared on the response key during consecutive FI 2-min components and food was presented following completion of a variable number of components. Mean rates of responding were determined from performance during the last five sessions under each of the three procedures studied. At completion of each component either: a stimulus occasionally paired with food was presented briefly (paired stimulus); a stimulus never paired with food was presented briefly (non-paired stimulus); a brief stimulus was not presented (no stimulus).

ments, when a stimulus occasionally paired with food was presented briefly at completion of each FI 2-min component, a pattern of positively accelerated responding was maintained during individual components; secondly, mean response rates during successive components were relatively uniform, and did not systematically increase or decrease during sequences of components. The tendency for mean response rates to be as high during the initial components of a sequence as during the later components was suggestive of the pattern of responding engendered when food is presented after a variable number of key pecks (Ferster and Skinner, 1957; Kintsch, 1965). Compared to the relatively long post-reinforcement pause engendered when food is presented after a fixed number of key pecks (a fixed-ratio schedule), there tends to be a relatively short post-reinforcement pause when food is presented after a variable number of key pecks (a variable-ratio schedule). Similarly, when food is presented after a fixed number of components, mean response rates tend to be low during the initial components of each sequence (Kelleher, 1966b). In the present experiments, the presentation of food after a variable number of components engendered

relatively uniform mean response rates during sequences of components when a food-paired stimulus was presented at completion of each component.

Brief presentation of a stimulus occasionally paired with food was the event that maintained patterns of positively accelerated responding during the fixed-interval components in the present experiments. The performance changed when a stimulus never paired with food was presented briefly, and also when a 1-sec stimulus was not presented. In Exp. I and Exp. II, an acceleration in responding during each component was maintained only when a food-paired stimulus was presented at completion of each component. Although mean rates of responding increased when a food-paired stimulus was omitted, patterns of positively accelerated responding were generally not maintained. These results are consistent with other studies which have shown that patterns of responding during individual components of a second-order schedule are dependent upon events at completion of each component and the schedule during each component (deLonge, 1967; Findley and Brady, 1965; Kelleher, 1966a and 1966b; Thomas and Stubbs, 1967).

Appearance of the same stimulus (Exp. I) or of different stimuli (Exp. II) during consecutive components did not have a differential effect upon performance when a food-paired stimulus was presented briefly at completion of each component, but there was a pronounced effect when a food-paired stimulus was not presented. Except during the initial components of a sequence, responding during Exp. I-B and I-C occurred at a relatively constant, uniform rate when a food-paired stimulus was not presented. On the other hand, responding during Exp. II-B and II-C was characterized by abrupt changes in response rate and by the absence of any regularly occurring response pattern when a food-paired stimulus was not presented. These differences show that patterns of responding maintained under second-order schedules of food presentation can be influenced by the stimuli appearing during successive components, notably when a food-paired stimulus is not presented briefly at completion of individual components. The absence of contrast between responding during Exp. I-A and responding during Exp. II-A suggests that

briefly presenting a food-paired stimulus at completion of the components is a more powerful determinant of behavior than the stimuli appearing during successive components. Indeed, the extent to which a stimulus that precedes or is paired with food can engender and maintain patterns of responding characteristically maintained under schedules of food presentation has been demonstrated in numerous experiments of chained schedules and conditioned reinforcement (e.g., Findley, 1962; Kelleher, 1966a; Kelleher and Gollub, 1962; D. Zimmerman, 1969; J. Zimmerman, 1963).

Findley (1962) and Kelleher and Fry (1962) have shown that when the number of components comprising sequences is small, relatively uniform patterns of responding can be maintained during the components of chained schedules when either the number of components in successive sequences varies or the order in which the stimuli appear during the components varies. In the present experiment (Exp. II-C), uniform patterns of responding were not maintained under a chained schedule when the number of components comprising sequences was relatively large, and when both the number of components and the order of stimuli during successive sequences varied. High mean response rates were maintained when all 1-sec stimuli were omitted from presentation at completion of the components, but responding was variable and uniform response patterns were not maintained during the components. Differences between this performance and the performances studied by Kelleher and Fry (1962) and Findley (1962) may be related to the duration of each component and to the greater number of components comprising individual sequences in the present experiment. For example, Findley studied responding in the pigeon under a second-order schedule in which the component stimuli appeared in a fixed order, but the number of components comprising successive sequences varied. Uniform patterns of responding were maintained when each component was an FI 1-min schedule; but when each component was an FI 2-min schedule and the number of components comprising sequences varied between 1 and 5, periods of no responding frequently occurred during the initial components of individual sequences.

In summary, the present investigation showed that when a food-paired stimulus is presented briefly at completion of individual components, comparable rates and patterns of responding can be maintained whether the same stimulus or different stimuli appear during consecutive components; but when a food-paired stimulus is not presented at completion of the components, response patterns vary depending upon the stimuli appearing during the components. Of equal significance is the demonstration that performance under second-order schedules can be described: (1) in terms of the patterns of responding maintained during individual components, and, (2) in terms of changes in the mean response rates during successive components comprising a sequence. These data are consistent with the thesis (see Kelleher, 1966a) that the responding engendered during each component of a second-order schedule can be treated as a unit of behavior, i.e., as a unitary response. Whether the unit of behavior is the completion of a component, as under second-order schedules, or the occurrence of a key peck, as under more conventional schedules, changes in the rate of key pecking and changes in responding during successive components are found to vary as a function of the schedule under which food is presented.

REFERENCES

- deLonge, J. O. Fixed-interval behavior maintained by conditioned reinforcement. *Journal of the Experimental Analysis of Behavior*, 1967, 10, 271-276.
- Ferster, C. B. and Skinner, B. F. *Schedules of reinforcement*. New York: Appleton-Century-Crofts, 1957.
- Findley, J. D. An experimental outline for building and exploring multi-operant behavior repertoires. *Journal of the Experimental Analysis of Behavior*, 1962, 5, 113-166.
- Findley, J. D. and Brady, J. V. Facilitation of large ratio performance by use of conditioned reinforcement. *Journal of the Experimental Analysis of Behavior*, 1965, 8, 125-129.
- 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. (a)
- Kelleher, R. T. Conditioned reinforcement in second-order schedules. *Journal of the Experimental Analysis of Behavior*, 1966, 9, 475-485. (b)
- Kelleher, R. T. and Fry, W. Stimulus functions in chained fixed-interval schedules. *Journal of the Experimental Analysis of Behavior*, 1962, 5, 167-173.
- Kelleher, R. T. and Gollub, L. R. A review of positive

- conditioned reinforcement. *Journal of the Experimental Analysis of Behavior*, 1962, 5, 543-597.
- Kintsch, W. Frequency distribution of interresponse times during VI and VR reinforcement. *Journal of the Experimental Analysis of Behavior*, 1965, 8, 347-352.
- Thomas, J. R. and Stubbs, A. Enhancement of fixed-ratio performance by briefly presented conditioned reinforcing stimuli. *Psychonomic Science*, 1966, 5, 329-330.
- Thomas, J. R. and Stubbs, A. Stimulus control of temporally spaced responding in second-order schedules. *Journal of the Experimental Analysis of Behavior*, 1967, 10, 175-183.
- Zimmerman, D. W. Concurrent schedules of primary and conditioned reinforcement in rats. *Journal of the Experimental Analysis of Behavior*, 1969, 12, 261-268.
- Zimmerman, J. Techniques for sustaining behavior with conditioned reinforcement. *Science*, 1963, 142, 682-684.

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