

COLLATERAL BEHAVIOR IN HUMANS¹

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In most experiments, only the specific class of responses directly producing reinforcement is recorded. Intervening or collateral behaviors are usually ignored, although they may control the rate at which the recorded responses are emitted. Wilson and Keller (1953) have described a procedure demonstrating the important role such collateral behavior may take: A bar press is reinforced only when a specified minimum duration of time has elapsed since the preceding response. This procedure has been called differential reinforcement of low rates (DRL) (Ferster & Skinner, 1957). Wilson and Keller observed that rats developed stereotyped chains of collateral behavior (*e.g.*, nose pokes, grooming, or climbing) of sufficient length to exhaust the period of no bar presses required before reinforcement was possible. They suggested that the components of the collateral chain served as a sequence of conditioned reinforcers maintained by the food reinforcement given at the end of the chain. However, no quantifiable record of their observations could be obtained.

This study describes a procedure for use with human subjects to induce collateral behavior that can be recorded. In this instance, collateral behavior refers to responses made on three telegraph keys (the collateral keys), all of which are irrelevant to the reinforcement contingency. Reinforcement is obtained only when a specified inter-response time (IRT)³ occurs on a fourth key (the reinforced key).

METHOD

Subjects and Apparatus

The Ss were four high school boys procured through a job-placement bureau affiliated with Indiana University. Each S sat alone in a sound-deadened room at a large table which supported a keyboard and a relay rack. Four telegraph keys were mounted on the keyboard, spaced 5 inches apart; and a buzzer was concealed under each key. A key press operated a small, white, light bulb on a relay panel mounted in the rack, as well as the buzzer beneath the key. The bulb thus illuminated corresponded in position to that of the key. To discourage holding behavior, the

duration of the buzzer was limited to a maximum of 0.05 second regardless of the duration of the key press. A bell, a red light, and a counter were provided on the rack to indicate reinforcements to S. Key depressions and reinforcements were recorded on a polygraph event recorder. All programming and recording apparatus were located in a separate room and were inaudible to S.

Procedure

Each S served in two sessions on consecutive days. The first session was 2 hours, whereas the duration of the second session depended on S's performance but was always at least 1 hour. After the first hour of each session, S was given a 5-minute break. The essential and major portion of the instructions was: "The amount you earn depends on how well you perform. Sometimes when you press a key, a bell, a red light, and this counter (to which E pointed) will operate. When that happens, you will have earned 5 cents, which will be given to you following the experiment tomorrow. The total number of points on the counter will show how much you have earned . . . You may press only one key at a time, using only one hand at a time." (This precaution was intended to insure that each S could clearly identify the reinforced key. The third key from S's left was always the reinforced key.) Because these instructions were nondirective about S's task, questions were inevitable. However, care was taken to keep such information obviously vague, and most questions were parried with "That's all part of your job."

The experiment included three phases:

(a) Operant level: 30 minutes during which no responses were reinforced.

(b) Continuous reinforcement of DRL: The first three reinforcements were given for IRT's greater than 8.2 seconds. Then, only IRT's greater than 8.2 seconds but less than 10.25 seconds were reinforced until S had obtained approximately 80 reinforcements.

(c) Extinction: 2 hours during which no reinforcements could be obtained.

RESULTS AND DISCUSSION

The nature of each S's performance is shown in Fig. 1, which presents polygraph records of the final 1-minute portions in each phase of the experiment. The heavily inked blocks of responses in several parts of Fig. 1 represent response rates up to 5 per second, which were too high to permit identification of single presses on this record. A given S repeated the same sequence of responses with but slight variation from one minute to the next during CRF; therefore, after

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³An IRT is defined as the temporal interval between two successive responses. In this study, an IRT began with the release of the key and terminated with its next depression.

the reinforcement contingency had gained control, the final 1-minute segments are quite representative of the chains each of the *Ss* used. One can readily see the systematic response patterns of all *Ss* during the CRF phase and how responding on the collateral keys "fills up" the necessary temporal delay between responses on Key 3 (the reinforced key). In contrast, the operant level and extinction phases exhibit very erratic response patterns.

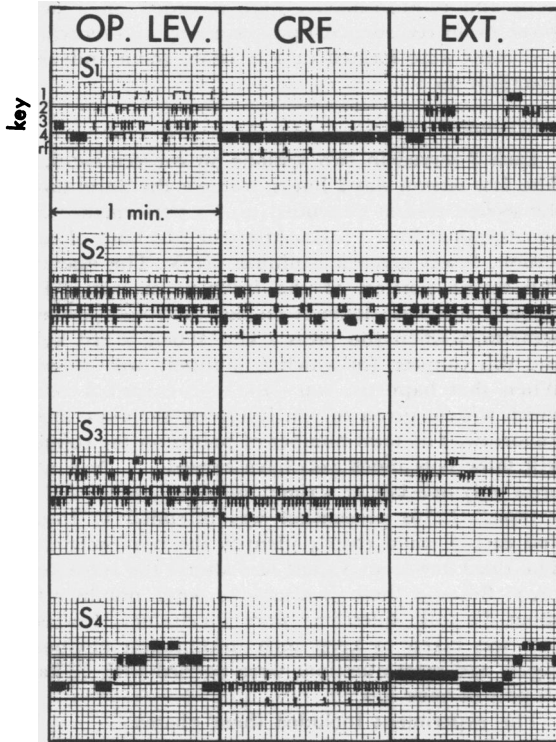


Fig. 1. Polygraph records of final 1-minute portions of operant level, CRF, and extinction for all *Ss*. The legend in the upper left indicates the four keys numbering from *Ss*' left. The small *rf* pips indicate reinforcements. Each small square represents 2 seconds.

Figure 1 shows that *Ss* 1, 3, and 4 selected very similar strategies, pressing only Key 4 during the time interval under CRF. This was probably influenced by the fact that all *Ss* were right-handed and Keys 3 and 4 were located to *Ss*' right, and also were placed rather far apart (5 inches). The record of *S* 2 shows a few

extra presses on Key 3, even though a reinforcement might just have been obtained. These additional responses on the reinforced key postponed the start of the ensuing delay interval, and thus appear somewhat maladaptive in terms of optimal strategies. However, the record clearly indicates that these presses served as the initial component of this *Ss*' reinforced chain, thereby taking on a role analogous to that of responding on the collateral keys and maintained in a similar manner.

Postexperimental interviews revealed that all *Ss* were convinced that reinforcements could be obtained only by a pattern of responses on at least one collateral key in order to "set up" the reinforced key. Subjects were unable to explain why it was that early in CRF they had received some reinforcements for patterns of collateral responses other than those later selected. No *S* expressed the opinion that reinforcement depended in any way upon the passage of time.

In this situation, the *Ss*' preconceptions about the role of the keys very likely were important determiners of their behavior. In rats, nuzzling and sniffing around the food cup probably had a parallel role (Wilson & Keller, 1953). In both instances, we see examples of how "impromptu" behaviors which have a high *a priori* probability are effectively integrated into a collateral chain as a function of exposure to the reinforcement contingency. Thus, these unsolicited, "impromptu" responses become a functional chain of conditioned reinforcers which successfully maintains DRL performance.

SUMMARY

To demonstrate the role which collateral behavior may take in maintaining effective performance under a DRL reinforcement schedule, humans were given access to four telegraph keys, only one of which was relevant to the reinforcement contingency. Responses on the three irrelevant keys took the form of definite patterns and were observed to maintain a required temporal spacing of presses on the reinforced key.

REFERENCES

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