AN EXPERIMENTAL SPACE COMBINING INDIVIDUAL AND SOCIAL PERFORMANCES¹

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This report describes several primate environments in which two or more animals shared a common social area. Automatic programming was used to permit concurrent individual sessions. Some of the behavioral phenomena observed in these environments, including reinforcing properties of social interactions, are discussed.

There has been a continuous trend in the study of behavior toward longer experimental sessions and fewer restraints on the animal. Initially there was Pavlov's dog, tightly restrained in a harness for brief periods. This represented one extreme much like the typical laboratory preparation in physiology. The maze decreased restraint on the animal, although behavior was measured for only brief periods. Skinner's (1938) experiment with a free operant involved experimental sessions typically 1 to 2 hr long. Since then, however, the duration of experiments has increased and the degree of restraint on the animal has decreased. Ferster and Skinner (1957), for example, extended experimental sessions typically to 8 and 14 hr, and Findley (1962) arranged experiments in which animals lived and interacted continuously with the experimental conditions in the experimental chamber.

The experimental space described here evolved from long-term experiments with chimpanzees designed to synthesize cumulatively some of the components of an arithmetic repertoire. It was necessary to make provisions for handling the animals as they grew to adult size and to prevent possible damage from protracted isolation in a small experimental space. To this end a living-working space was built so that the animals could be together in a social area and could go back and forth into their work cubicles.

DESIGN AND USE OF THE ORIGINAL CHIMPANZEE ENVIRONMENT

The first experimental chamber was 80 ft square and was divided into a large social area and three smaller cubicles. All food was

delivered during experimental procedures carried out in the small cubicles. The two chimpanzees could interact freely when in the social area. Automatic door locks, push buttons, and a combination lock (Ferster, 1964) automatically controlled and recorded each animal's performance in the work chamber and movement from one space to the next.

The sequence of performances that took the animal through the series of chambers began with a light and a button outside the entrance door to the first work cubicle. When the door light was on, pushing the button below it unlocked the door briefly so that the chimp could open it and enter the compartment. There was a combination lock on one wall of this compartment and a work panel on another. Closing the door operated a switch in the door frame, which in turn lighted and activated the combination lock. When the animal operated the combination lock, the lights on the work panel came on. The work panel contained the various keys and lights which were the substance of the experiment. The operation of the combination lock also locked the entrance door, preventing the second animal from entering. The main purpose of the combination lock, however, was to produce a unique circuit for arranging each animal's program and for recording the performances separately. After a certain number

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of food pellets or a certain period of time, whichever came first, the light on the exit door came on. This light indicated that the exit door button could unlock the door into the second work cubicle where a second experiment was programmed. Thus, the overall sequence of performances was a chain in which one performance was reinforced by the lights which controlled the next performance. During most of the experiments the work cubicles were open throughout the day, so food intake was not limited except by the animal's inclination to engage in the procedures of the experiment.

The combined multi-animal living and experimental space solved all of the problems it was designed to solve. The daily pattern of movements from one space to the next occurred reliably and routinely once the animals were trained. The animals grew to adult size during the experiment and the maintenance, repair, construction, and cleaning of the chamber was carried out without handling them. Only occasionally was it necessary to remove the animals from the experimental space by a transfer cage. There were no problems from gastro-intestinal disturbances, such as diarrhea, probably because the large floor area was covered with wood shavings which minimized odors and bacterial growth by absorbing urine and drying feces quickly.

The schedules of reinforcement in the work chambers maintained substantial amounts of behavior despite the unlimited access to food procedures. A day's food ration typically produced from 5 to 8000 trials on matching-to-sample or other related performances in addition to the behaviors involved in operating the traffic pattern. Even though the feeding schedules maintained free-feeding body weights, the chimps' performances occurred at near maximum rates when they were in the work chamber engaging in the experimental program. The free-feeding food schedules probably contributed to the good health of the animals.

The large size of the experimental chamber made it convenient to program several experiments at once. For example, at one stage two different matching-to-sample procedures and two different adjusting procedures were carried out at the same time with the same animal. One kind of matching-to-sample was programmed on the first panel in the first

work cubicle. When the chimp finished that program, a second set of lights came on to indicate a different, but related, matching-to-sample performance. When the chimp completed both tasks, it entered the second work cubicle where there were two more experiments in which the subject actually adjusted the stimuli rather than simply indicating them as it did in the matching-to-sample procedure. It was useful to have the four ongoing experiments because they all involved control by the same binary stimuli and therefore contributed to a common repertoire.

Use of the Multi-Chamber Space to Investigate Delayed Reinforcement

The experimental space was originally designed as a practical device for managing large, difficult to handle chimpanzees. However, its physical design soon prompted suggestions for new experiments which took advantage of the social area and the novel space arrangements. In particular, the new space suggested a solution for a problem in delayed reinforcement experiments with baboons whose reinforcement had been delayed as long as 24 hr.

The results of earlier experiments suggested that the behavioral options available to the animal during the delay interval determined whether or not the food performance would be sustained despite the delay (Ferster, 1953; Ferster, 1965; Azzi, Fix, Keller, and Rocha e Silva, 1964). The social area was used to test the possibility that the delay would not weaken the food behavior if the animal could engage in a separate repertoire during the delay.

Simple behaviors, such as key-presses reinforced with water, could be used as an option during the delay, but with the disadvantage that they were similar to the performances reinforced with food. It would be difficult to determine whether a performance increased in frequency because of simple induction or because it was part of an independent repertoire. On the other hand, behaviors maintained by very different reinforcers, such as exercising or playing with another animal in the social area, would not be likely to increase the frequency of food behaviors in the work cubicle by simple induction.

The first experiment began with an animal that had already developed a stable performance with a 30-min delayed reinforcement. In

the presence of a red light, 75 key-presses produced a flashing green light. This stimulus signaled the delay interval and was present for 30 min. At the end of the 30-min delay period the flashing green light went off and a light appeared on an adjoining panel. In the presence of this light each press on the food key produced a pellet until the animal had 50 pellets. After a 2-hr timeout (for eating) the red light on the work key came on again, and the cycle repeated. Before the experiment could begin, the exit performance had to be established. This was done by allowing the baboon to leave the work cubicle during the 2-hr timeout period when it pressed an exit key five times. The baboons acquired this repertoire readily and left the cubicle an average of 2.9 times during each timeout period.

When the exit behavior was well established, the actual experiment began. Now the baboon was allowed to leave the cubicle during the period when it could operate the food key and during the delay period. Under this procedure the baboon went in and out of the work cubicle repeatedly, remained in the work chamber only briefly, and pressed the food key infrequently. During the first day, it went in and out 21 times and pressed the food key only five times. It appeared that the exit behavior was completely prepotent over the food-reinforced behavior, because the social reinforcement exerted a great deal of control and the delay in the food reinforcement reduced the frequency of the food behavior. It appeared that history of food reinforcement continued to support the behavior of entering the work cubicle, but once inside the tendency to leave was prepotent over that of pressing the food key.

This interpretation was tested by increasing to 25 the number of key-presses necessary to open the exit door in an effort to decrease the frequency of the exit behavior in relation to the food behavior.

Exit performance frequency declined when 25 presses of the exit key were required. During the first day, the baboon received 350 pellets on the food key and exited from the work cubicle 14 times. To sustain the baboon's food behavior thereafter, however, special training was required in which the food performances were sustained on optimal schedules of reinforcement, while exit behavior was weakened

by fixed-ratio schedules. By carefully adjusting the food schedules in relation to the exit behavior, it proved possible eventually to sustain the food behavior even in the face of strong disposition to enter the social area.

DIRECT MEASUREMENT OF BEHAVIOR REINFORCED BY SOCIAL AREA ACTIVITIES

Although there was no clear evidence at this point that the opportunity to pass time in the social area was a stronger behavioral control than the delayed reinforcement, a large amount of the data did show that the social area controlled behavior even when compared with food-reinforced behavior. The strength of the behavior controlled by the social area was tested by varying from 5 to 1200 the number of exit key-presses needed to open the door. The exit performance schedule was maintained at FR 1200 for 11 sessions, during which exit behavior continued to occur reliably: the baboon completed the ratio requirements 35 times or approximately three times during the day.

Figures 1 and 2 summarize the main results when the number of key-presses required to exit was systematically varied between 75 and 600. As Fig. 1 shows, baboons continued to exit from the work chamber even at the largest fixed-ratio values, although at decreased frequencies. In general, the baboon left the work chamber much more frequently when food reinforcement was delayed 6 hr than when it was delayed 30 min. We cannot explain why the baboon left the chamber more frequently when 150 key-presses were required for exit than when only 75 were required.

Fig. 1. Number of times the animal entered the social area as a function of the number of key presses required to open the exit door.

The large amounts of behavior required by the fixed-ratio schedules on the exit key were sustained without disrupting the food-rein-

forced behavior. Figure 2, summarizing the same episode described in Fig. 1, shows the number of food performances emitted when the exit key-press was reinforced at various fixed ratios. With a 30-min delay in food reinforcement the frequency of food-reinforced behavior did not change despite the large variation in the amount of exit behavior required. When food reinforcement was delayed by 6 hr, the amount of food behavior was generally reduced, but was not disrupted by the large number of key-presses needed in order to enter the social area.

Fig. 2. Number of food chains the animal completed as a function of the number of key presses required to open the exit door.

Fine-Grain Descriptions of the Exit Behavior

Unfortunately, a fine-grain analysis of this exit behavior is not available because cumulative records were not taken. Cumulative records of exit performances are available, however, from a later experiment where food behavior was reinforced directly, without delay. In this experiment the baboon could enter the work chamber at any time. Once inside, food-key performances were reinforced on an FR 100 schedule. To leave, a number of exit key-presses were required.

As in the previous experiment, the key-pressing performances reinforced by access to the social area were maintained reliably at all fixed-ratio values tested. Figure 3 shows the details of a single day's performance when 100 presses on the food key produced a food pellet and 800 presses were required on the exit key to unlock the door to the social area. On this day, the baboon left the work chamber seven times. A large numeral marks each part of the cumulative record followed by entrance to the social area. Although the baboon shifted back and forth between the exit and food keys, it characteristically sustained a performance on one key and shifted to the other after reinforcement.

In the first segment of the graph (I), eight reinforcements (20 pellets each) were delivered on the FR 100 schedule before the baboon turned to the exit key and sustained the required 800 presses to open the door. The exit performance was sustained at a typically high fixed-ratio rate. Despite the very large value of the fixed-ratio schedule, there was only one instance at the end of the day, in segment VII, where a pause of any magnitude occurred. At all other times the baboon pressed the exit key at the maximum rate within 10 min after the previous reinforcement.

Because the key-presses maintained by food and those maintained by exit were recorded on the same pen, not all of the performances are exactly designated. Those segments of the graph in which more than 100 key-presses were recorded preceding a food pellet indicate a segment where the animal pressed the exit key before completing the fixed-ratio requirement on the food key. Conversely, the segments followed by exit which contain more than 800 key-presses show that the baboon pressed the food key before completing the fixed-ratio requirement on the exit key. The segment of the curve at *d*, where food reinforcements are separated by more than 100 performances, is an instance where exit key-presses were interspersed with food key-presses. The experiment was interrupted at *a*, *b*, *c*, *d*, and elsewhere because another animal was in the traffic tunnel which led from the work chamber to the social area. This caused timeouts from the experiment for the baboon in the work chamber which lasted for the length of time indicated by the downward deflection of the recording pen.

The Role of Deprivation

In many operant experiments a pigeon's weight is fixed at 75% to 80% of its free-feeding weight, and its food intake during the experiment is adjusted to maintain this value; or the animal is given extra food at the end of the day to maintain the required level. In other experiments, the level of deprivation is varied to measure its effect on the animal's performance.

In the present multi-animal environment experiments, no particular attempt was made to control the animal's weight. Under most of the schedules of reinforcement used (approximately 100 key-presses per gram of food for a

Fig. 3. Cumulative record of the exit and food performances when 800 key-presses were required for reinforcement by exit.

baboon), sustained performances occurred even though the baboon or chimp was at free-feeding body weight (Ferster and Hammer, 1966). Previous experiments (Findley, 1962; Ferster and Zimmerman, 1963) in which an animal lived continuously in a small experimental space with continuous access to food, are also cases where no explicit attempt was made to control the level of deprivation. In these experiments, the schedule of food reinforcement was the main variable that influenced food intake. For example, as the size of a fixed-ratio schedule was increased, the animal received fewer reinforcements and consequently lost weight. In the chimpanzee experiment described earlier, the frequency of the chimp's performance (and hence food reinforcement)

was reduced by large fixed-ratio schedules, even though the chimp could have maintained a free-feeding intake level by engaging in the experiment only 5 or 6 hr a day. The weight loss that eventually occurs, however, does not appear to increase the frequency of food-reinforced behavior. In the delayed-reinforcement experiments (Ferster and Hammer, 1965) where rhesus monkeys were introduced to long delays of reinforcement without the required history of successive approximations, the animals lost weight continuously without any corresponding increase in the food-reinforced behavior. These data are in contrast to many classical operant experiments (Clark, 1958; Revusky, 1963; Perin, 1942; Conrad, Sidman, and Herrnstein, 1958) which demonstrated a

general relationship between rate of performance and level of food deprivation. Conversely, there are experiments in which performances were sustained at near normal frequencies despite almost free-feeding body weights (Ferster and Skinner, 1957; Ferster and Hammer, 1966). Many laboratory workers have reported anecdotal accounts of pigeons in use in experiments for 2 or 3 yr whose body weights have been raised continuously until they were performing normally at virtually free-feeding body weights.

It seems that the effective range of the deprivational variable in the multi-animal chambers was hours rather than days as is the case of the pigeon in the standard small chamber experiment. An animal seldom went without food for more than several hours. Performances strained by schedules of reinforcement were most frequently evident as a reduced frequency of entering the work chamber rather than the reduced frequency of performances once in the work cubicle. The animals lost weight because they entered the work cubicle less frequently and remained in it for less time.

We do not know if food-reinforced performances would increase in frequency in response to loss of weight if the animal were restrained in the work cubicle rather than free to exit into the social area. Nor do we know whether the natural environment in which the animal lived continuously was the major reason why the performance was so durable despite the slight degree of food deprivation.

EVOLUTION OF THE MULTI-CHAMBER ENVIRONMENT

Experiences with the multi-chamber environment in the chimp arithmetic experiments and the baboon delayed-reinforcement experiments convinced us of the usefulness of a multi-animal environment with controlled and automatically recorded movement between social and work areas. Therefore, a new chamber was designed which incorporated experience from the earlier experiments. It allowed us to take advantage of the unique features of the large experimental space and overcame some of the limitations of the previous chamber. A description of the details of construction and general arrangements of the space of the final chamber illustrates the

general design principles that have emerged from work with the earlier versions. Descriptions of some of the earlier chambers have already been reported (Ferster, 1964; Ferster and Hammer, 1966; Randolph and Ferster, 1966; and Randolph, Ferster, and Hammer, 1967).

A recent chamber was designed so that each animal's position was identified by an electrical signal to the control board. This overcame problems such as two animals entering a chamber together, two animals entering together into the traffic pattern through the sequence of cubicles and entering the wrong chambers, or an animal interrupting other experiments by lingering in the traffic pattern. Often an animal tried to enter another animal's chamber when the frequency of reinforcement in its own work chamber was low, and discovered, by accident, a higher frequency of reinforcement in another animal's chamber. Sometimes an animal entered another animal's compartment to escape or avoid aggressive activities with other animals in the social area. Once each animal's position was identified, it was possible to arrange circuits to guarantee an animal's position. Thus, if a circuit on the control board, which registered when each animal was in an assigned space, indicated that one animal was missing, all of the combination locks were turned off. This prevented entrance into any work cubicles until the missing animal entered some assigned space such as an entrance, a work cubicle, or the social area. Such a timeout over a period of time decreased the frequency of going to an unassigned experimental space.

The Door System

The door system, designed to lessen the chances of two animals entering a work chamber together, included a push button inside and outside each door. When an animal entered a chamber by pushing the outside entrance button, a light inside the door came on (see Fig. 4). Pushing the button inside the door turned on the lights on the combination lock and turned off the entrance door so that no other animal could enter. The circuit which accomplished the locked doors also indicated the baboon's location.

Only in the social area was there no positive identification of the animal's location; there was no performance there which could identify each animal. In one experiment such a per-

Fig. 4. Diagram illustrating the door procedures.

formance was provided by a fruit juice dispenser which a chimp routinely operated when it first entered the social area.

Overall Design of the Experimental Space

The most recent baboon experimental space consisted of eight work areas, two large and six small, all connected to a 576 cu ft social area. The size of the work area for a given experiment was generally determined by how much equipment was needed and how much spatial separation was required between the various keys, displays, and dispensers. With multiple procedures, particularly when stimuli overlapped, we assumed that induction between the stimuli was less when each procedure was in a separate location. The principle of the work cubicle was the same

regardless of its size. Figure 5 is a diagram of a small work area consisting of a 64 sq ft cube constructed from four connecting modules. Whenever the door light was on, the baboon should enter the area by pressing the button outside the door. The door locked as soon as it was closed. If the baboon entered the compartment, it could proceed through the sequence by pressing the button on the inside of Door A. Pressing this button turned on the combination lock and prevented another animal from entering the chamber by deactivating the button on the outside of the door. When the baboon held the pointer of the combination lock in the required position for 5 sec, the light on Door B came on and the subject could unlock Door B by pushing the button below the light. When the baboon

went through Door B, it locked when closed and the work panel lights came on as soon as the baboon pushed the inside button.

The sections of the cage between Door A and B functioned as an "air lock" between the social and work areas. It isolated the animal from the animals in the social area. Door B connected with the work cubicle containing the work panels and food dispensers.

Opportunity to leave the work cubicle was indicated by the light on the inside of Door B. In experiments where key-presses were reinforced by exit to the social area, the actual reinforcer which followed key-presses was the light on the inside of Door B. To get to the social area, the baboon needed only to push

the door buttons in turn, as each one produced the light for the next.

A Food Panel from the Work Panel

The spatial separations that were possible in the large experimental space led us to separate the location of the food delivery equipment from the main work panel. Performances on the work panel were reinforced by lights on the food panel, which sometimes was located nearby and sometimes in an adjoining cubicle. Such an arrangement allowed flexibility for varying amounts and kinds of reinforcement as well as for bringing amounts and kinds of reinforcement under the control of special stimuli.

Fig. 5. Schematic diagram of a work cubicle.

Training the Animals in the Multi-Chamber Environment

The training was carried out in successive approximations, using a small training cubicle as well as the whole chamber. First the animals were allowed to live in the large chamber with the doors propped open and none of the automatic circuits in operation until they were familiar with each other and with the gross details of the experimental space. The small training cubicle was used to teach the animals to push buttons, to press keys, to operate the combination lock, and to bring the performances under control of the lights. Most of the components of the final traffic pattern were successively approximated with food reinforcement before the sequence was synthesized into a chain. The final performance in the training chamber was a chain beginning with pushing a button whenever its associated light was on. Pushing the button was reinforced by the light on the combination lock. When the combination lock was lit, selecting the correct pattern was reinforced by a light above a key which operated the food dispenser. It took about a week to develop the performances in the training cubicle. The training in the large chamber consisted mainly of teaching the chimpanzees to open the door and to combine the various performances into a complete chain. The final stage of training in the large chamber also took approximately one week.

Ideal Case

For some experiments we developed a training cubicle consisting of two compartments, separated by a door. Each compartment had a food magazine and a combination lock. Animals trained in such a chamber were almost completely prepared to operate in the larger chamber in almost any kind of traffic pattern.

Details of the Construction of the Chamber

The cage was constructed with Unistrut components² which are functionally similar to an erector set. This type of cage can be assembled, dismantled, or rearranged with a few simple tools. Various gauges of Unistrut are available which are strong enough to hold either a large baboon or a full-grown chimpanzee.

A cage was fabricated by constructing an overall frame into which panels (2 by 2 or 3 by 3 ft) were inserted. Since the design was completely modular, a blank aluminum panel, a wire-mesh screen or a panel containing experimental equipment was inserted into any space. These panels connected to the Unistrut with a simple fitting supplied by the manufacturer. Additional Unistrut components were then used to construct virtually any arrangement of cubes inside.

In the baboon experiments the automatic doors were constructed from flat, opaque metal sections. In the chimp experiment the door was constructed of 0.75-in. steel bars welded to a heavy steel frame. The door was hinged on one side and held closed by a light-weight, coiled spring wound around the door axle. A system of magnets and reed switches inside the door frame gave a positive indication of when the door was opened or closed and also permitted a tight seal around the electromechanical system.

OTHER POSSIBLE USES

The following discussion is intended to suggest the general direction of other suggestions for experiments which the experimental space prompted.

Single Animal Experiments

As in the typical individual animal experiment, the multi-animal chamber may be used with a single animal living in each work cubicle. The social area in this case is used to transfer the animals without handling so that the cage may be routinely cleaned and the apparatus modified and repaired.

Multiple Reinforcers, Chains, and Generalized Reinforcement

The multi-chamber space lends itself especially to experiments with long sequences of performances with deferred reinforcement. For example, in an early version of the chimpanzee space, all food and water reinforcements were deferred to the third cubicle so that individual behaviors in each cubicle were reinforced by conditioned reinforcers several steps removed from the food. In this procedure, each correct matching-to-sample sequence was reinforced by a brief tone. Every twentieth correct matching-to-sample performance produced the sound

²Components may be ordered from Unistrut Virginia Sales & Service, Inc., of Alexandria, Virginia.

of the pellet dispenser, but did not produce food. When the pellet dispenser had sounded 20 times (400 matching-to-sample performances), the chimp could go through the door into the second chamber. Here the performances were reinforced by the same brief tone and the sound of the pellet dispenser. Finally, by opening the door to the third cubicle, the animal could eat.

By deferring all of the food reinforcement to the third cubicle it was possible to use pellets and water as well as fruit juice and biscuits as a reinforcer for each performance in the sequence. Thus, four foodstuffs combined to support each of the performances in a manner parallel at least in principle to a generalized reinforcement.

There were four hierarchies of conditioned reinforcement, each supporting a different aspect of the chimp's behavior. The relation between the performances, the conditioned reinforcers, and the food are, in concept, similar to the arrangements which Findley (1962) describes as multi-operant chains, Kelleher (1958, 1966) as second-order schedules, Ferster

(1960) as an intermittent schedule of matching-to-sample, and Ferster and Skinner (1957) as percentage reinforcement. At the first level each matching-to-sample, or adjusting, or counting procedure was reinforced by a brief tone (S^A performances by a brief timeout). The sound of the pellet dispenser (second level) specified a fixed-ratio schedule of the unit performances. The completion of 10 fixed-ratios was followed by the lights on the next work panel (third level). The opening of the door to the third cubicle where food was delivered was the fourth level. The food might be considered to occur on FR 4 schedule in which the unit performance is the completion of 10 fixed ratios on each of the work panels.

Despite the displacement of the food reinforcement by four steps from the individual matching-to-sample and adjusting performances, it was possible to sustain both the accuracy and the amount of the behavior. Figure 6 summarizes the two animals' performances for the final seven days before deferred reinforcement, the final seven days during deferred reinforcement, and the final seven days when

Fig. 6. A comparison of the accuracy and amount of the chimp's performance under deferred and immediate reinforcement. Accuracy is the ratio of incorrect to correct performances.

reinforcement was again immediate. Although the deferred reinforcement reduced substantially the total number of performances completed each day, both animals continued to perform sufficiently to maintain normal body weights. The accuracy of the complex performances was only slightly affected.

Experiments such as this provide convenient baselines for studying many aspects of conditioned reinforcement because the performances are spread out spatially in long sequences. Each performance is under fairly narrow control of the place where it is emitted, and it is usually possible to manipulate each reinforcer in the chain independently of the others.

Such experiments lead to the area of generalized reinforcement, in the sense of long chains of performances which are under the control of reinforcers occurring somewhat later and which do not depend on a single reinforcer and a single kind of deprivation. The possibility of arranging several reinforcers at the end of a chain leads particularly to experiments on generalized reinforcement in which performance is maintained by one or more of several reinforcers each under the control of separate kinds of deprivation. The behavior in the social area is particularly useful in experiments on generalized reinforcement because these behaviors are not influenced by satiation of metabolic reinforcers and *vice versa*.

Social Areas as a Reinforcer

The social area, because it does not depend on metabolic reinforcers and because it is such an effective reinforcer, may be used in situations where food reinforcement is inadvisable. Some drugs, for example, have been studied primarily with aversive control because it was feared that the animal would be influenced through its inclination to eat rather than the details of the specific behavioral processes. In multi-animal chamber experiments, food may be used as a means of periodically isolating an animal so that some performances may be reinforced by an opportunity to enter a social space. Performances reinforced by access to the social area could serve the same purpose as the avoidance and escape from electric shock in drug experiments.

Conversely, entrance to the work chambers is a performance sometimes reinforced by escape and avoidance from events in the social

area. In other circumstances a space which is usually unavailable may provide some reinforcers because of its novelty. An override switch on Door B was useful in arranging these non-metabolic consequences of entering the chamber. Any time an animal pressed the override switch it could leave the first compartment without operating the combination lock or entering the work area.

The behavior in the social area itself may be thought of in the context of generalized reinforcement. The light on the exit door which signals when the door can be opened derives its reinforcing properties from each of several behaviors in the social area, such as a change in location, an opportunity to exercise in a large area, a chance to groom other animals, and a chance to engage in sexual behaviors. The arrangement of the experimental space suggests experiments for analyzing how these component behaviors contribute to the reinforcing properties of exit to the social area. The multi-animal environment would lend itself to the study of the reinforcing effect of each of these behaviors as well as social factors such as dominance, familiarity, or duration of social history.

The Total Repertoire

The availability of an objective count of a wide spectrum of behaviors that the animal engages in throughout the day when it lives in the multi-animal chamber provides a baseline which may have very different uses from the frequency of a single arbitrary performance such as pressing a key.

The overall amount of behavior, the adherence to the traffic pattern routines, and the distribution of activity among the various kinds of performances have some of the connotations implied by emotional state, mood, or general condition of the repertoire (Skinner, 1938, 1953; Ferster, 1966). At least some aspect of the animal's performance is always under some kind of direct measurement, similar to the continuous human environment described by Findley (1966). Such an experimental arrangement, therefore, provides a dependent variable which can be read continuously throughout the day. Aspects of the animal's performance that can be automatically recorded are (1) the time the animal spends in the work area, (2) the time spent in the social

area, (3) the amount of food eaten daily, (4) the distribution of eating during the day, (5) the amount of time to eat a given quantity of food, (6) the latency of performances on the combination locks and door controls, (7) the relative frequency of behaviors reinforced by food and social consequences, and (8) the frequencies of play, aggression, and sexual behavior.

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