Revista Mexicana de Análisis de la Conducta
ISSN: 0185-4534
ISSN: 2007-0802
editor@rmac-mx.org
Sociedad Mexicana de Análisis de la Conducta
México

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Revista Mexicana de Análisis de la Conducta, vol. 46, no. 1, 2020, -, pp. 305-352
Sociedad Mexicana de Análisis de la Conducta
México

DOI: https://doi.org/10.5514/rmac.v46.i1.76976

Revista Mexicana de Análisis de la Conducta • Mexican Journal of Behavior Analysis
2020 | Núm. 1 • junio | No. 1 • June | Vol. 46, 305 - 352
http://dx.doi.org/10.5514/rmac.v46.i1.76976

THE COURSE FOR WHICH K&S WAS WRITTEN

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Abstract

At Columbia College in the late 1940s, Fred Keller and Nat Schoenfeld established an undergraduate psychology curriculum based on B. F. Skinner's innovative research, later to be called behavior analysis. The textbook they wrote to accompany their introductory course for that curriculum, "Principles of Psychology," was published in 1950. The course included a rat laboratory in the Fall semester and a human laboratory in the Spring semester. Based on the PSYC 1-2 manual from the 1954-1955 academic year, this paper describes the course as it was offered at the time and considers some of the features that keep Keller and Schoenfeld's teachings viable to the present day.

At Columbia College in the late 1940s, Fred Keller and Nat Schoenfeld established an undergraduate psychology curriculum based on B. F. Skinner's innovative research, later to be called behavior analysis (Keller & Schoenfeld, 1949; Skinner, 1938). The textbook they wrote to accompany their introductory course for that curriculum, "Principles of Psychology," was published in 1950. I had the good fortune to register for the Fall 1954 semester of that introductory course, PSYC 1, and for its continuation, PSYC 2. in the Spring 1955 semester. It was

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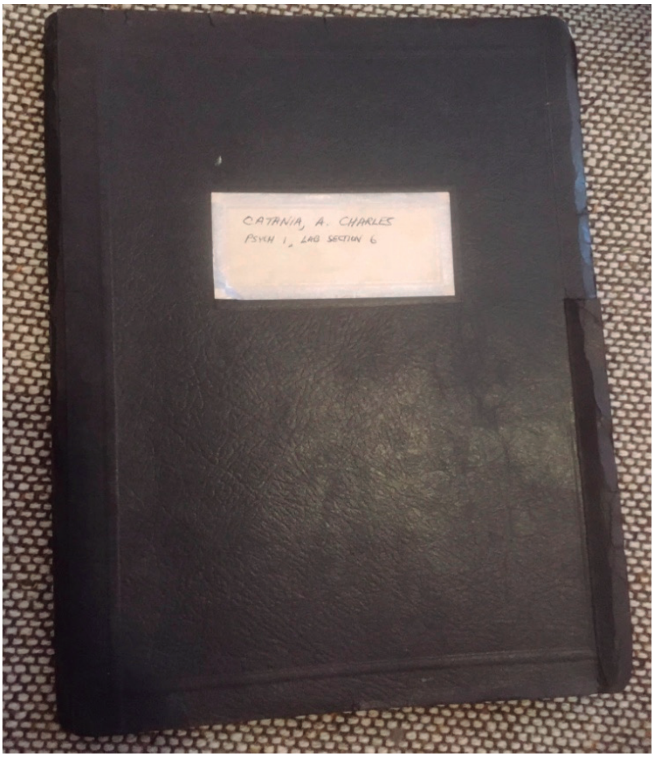
a laboratory course; in the Fall semester we experimented mostly with rats; in the Spring semester we experimented mostly with humans. I didn't know it at the time, of course, but because I was quickly caught up by the undergraduate curriculum that Fred Keller and Nat Schoenfeld had created, that was the beginning of my career in experimental psychology and in what came to be known as behavior analysis (Catania, 1996, 2017b).

As a freshman I had planned to major in mathematics, but by the start of my sophomore year I was no longer sure. I began to consider other options, and especially the pre-med sequence. That changed very soon after I enrolled in Fred Keller's course. With sixty or so in the morning lecture class, which met twice a week, we were divided into lab sections of about a dozen each, meeting on a weekday afternoon or on Saturday morning. Bill Stebbins was the teaching assistant for my section; other graduate students were often available for discussion and for help with apparatus, and Fred Keller dropped in from time to time, sometimes along with Nat Schoenfeld.

It is difficult to characterize Fred Keller's lectures. As I run through descriptors, such as witty, gentle, engaging, thoughtfully organized, vivid, their one common feature is that thinking about them makes me smile. Only many years later, after having accumulated a couple of decades of teaching, I calculated that Fred Keller was 55 years old in 1954 when he lectured in the introductory course I took. He was white-haired even then, but just a few years later he began a new career by introducing behavior analysis and self-paced instruction to Brazil. In those days, when I was tired, when the day seemed long and difficult, when there seemed too much to do and too little time to do it, I found it helpful to remind myself that I was not yet quite as old as he was when I took his course. He remained active well into his eighties, though he had clearly slowed down. When I once met him and his wife Frances as they walked together at a behavior analysis conference, he smiled and said, "Charlie, don't get old!" Only later I realized I should have asked, "But Fred, what are the alternatives?"

As Fred Keller well knew, we are effective as teachers only if what we teach survives in the behavior of our students. Along with his colleague, Nat Schoenfeld, he was an exceedingly effective teacher. The PSYC 1-2 laboratory that they had developed together was an essential adjunct to Fred Keller's lectures. Fortunately, I kept the laboratory manual I used when I took the course and some of its pages will serve here as a guide to what the course was like. The pages were mimeographed, typed on a master inked for producing multiple copies, so the unevenness of the reproduction created hurdles for optical character recognition. For the convenience of the reader, most materials are transcribed, but to show the appearance of the materials, some sections are shown as scans in Appendix 1 and Appendix 2. Also, references were included with some materials, but full citations have been transferred to the common reference section of this paper.



We were paired off with lab partners and were given a substantial laboratory outline, reproduced in Appendix I. It provided essential information about the structure of the course, basic concepts, apparatus, experimental procedures, and our rats. Throughout the course the outline was supplemented before each experimental unit with handouts and with pages to be filled in with information about our experimental results. These began with brief questions but were gradually expanded to require more detail about procedures and results, so that by the end of the semester we were writing full reports that included the traditional structure of a research paper: Introduction, Method, Results and Discussion. Appendix 2 provides the two-page handout on the writing of lab reports. The teaching and learning in PSYC 1-2 was not self-paced, but it incorporated lots of shaping and copious feedback.

The earliest course materials for PSYC 1-2 were written by Keller and Schoenfeld, as was a supplement devoted to the history of psychology. As lab procedures were modified over the years some new material was perhaps written by teaching assistants and others. For example, in his autobiography Keller refers to supplementary readings written by Donald Bullock (Keller, 2009, p. 212). Other indirect evidence is that K&S usually adhered to the usage that responses rather than organisms were reinforced (Catania, 1987), whereas a supplement on reinforcement schedules does not do so. Inconsistencies in the reinforcement language can also be found in the lab handouts detailed below. Also, we might assume Keller would not have created a cumulative record with occasional negative slopes (Appendix 1, p. 6); on the other hand those could be attributed to a shaky hand drawing directly on an uncorrectable mimeograph master.

As in the book, later lab topics built upon what had come before. The emphasis was on observing behavior and watching how it changed with changes in environmental events rather than on testing theories or confirming hypotheses. We were learning new ways of seeing behavior and new ways of talking about it.

On each lab day we picked up our rats from the animal quarters and transported them in individual cages to the lab. Our predecessors had to wear jackets and ties to class, but by our time the college dress code had relaxed, so we didn't have to worry about ties hanging so close to the cages that our rats could get at them. Mostly we worked with the same rat throughout the Fall semester. In those days, you could take your rat home as a pet after the course was done. I wanted to so, but I was a commuting student and my mother wouldn't let me keep it.

As will be detailed in lab handouts presented below, in the lab we took operant levels, shaped lever presses, labeled cumulative records, established light-dark discriminations, and discovered that the behavior of our rats was orderly. Years later, when I participated in a Fred Keller roast at an Association for Behavior Analysis meeting, I brought my PSYC 1-2 workbook with me. He asked to borrow it and eventually returned it with a note saying he thought I had a future in the field.

I discovered another record of the course fortuitously. After Fred Keller's death in 1996, I had the opportunity to help edit his autobiography for publication (Keller, 2009). The photos that had been planned for it were missing, and my search for them led me to the Fred Simmons Keller Archive at the University of New Hampshire and to the archivist Roland Goodbody, who generously made available several photos taken during the years Fred Keller taught PSYC 1-2 at Columbia College. One of those was taken in the PSYC 2 lab in Spring 1955. I had not recalled any pictures being taken at the time, but to my great surprise I was included in one of them. From left to right, those in lab coats are a teaching assistant I cannot identify, Nat Schoenfeld, and Fred Keller. The seated student in the middle booth is my lab partner, Dick Berger, and the student in the left booth talking to Fred Keller is me.

We can now turn to the laboratory content of the course. In most cases, the lab handouts provide enough detail that I can keep my comments brief. The first experimental unit included just two experiments and was designed to get us accustomed to the lab and to demonstrate two behavioral basics: reinforcement, and extinction. Some minor typos and spelling variants in the originals have been corrected. Also, the spacing between discussion items was large enough to allow students to offer substantial answers. The original pages included both student entries and grading by teaching assistants, but they were of inconsistent quality with regard to such features as legibility, marker colors, and margin and page overflow and have therefore been omitted here.

The first formal unit followed a session of acclimation to the lab for both students and their rat subjects. Operant-level baselines, response rates before the introduction of reinforcement, were recorded during that session.

EXPERIMENTAL UNIT 1.

Conditioning and extinction

The first experimental unit, consisting of two experiments, is concerned with the acquisition and extinction of operant response strength. Specifically, in the first experiment, we will be interested in the manner in which we can produce an increase in the rate of bar pressing using the number of operant level responses obtained last week as a base line. In the second experiment we will attempt to reduce the rate of bar pressing.

The operation required for strengthening a response simply involves reinforcing the response in question on each occurrence. Similarly, the process of extinction is characterized by the operation of withholding reinforcement. During conditioning several precautions are to be observed. Since a reinforcing stimulus reinforces any response that immediately precedes it, care must be taken to present the pellet as quickly as possible after the bar press. Otherwise, if a period of delay is introduced, responses other than bar-pressing will be strengthened. Skinner and Ferster have reported on an experiment designed to demonstrate the effect of delaying the reinforcement for the pecking response of the pigeon. They found that by introducing special stimulus conditions during the delay period the strength of the pecking response could be maintained, but that incidental behavior, such as walking about the cage in circles, stretching the neck at constant rate and the like were also strengthened. Thus it can be seen that, since we are interested in bar-pressing response in preference to other instances of behavior, the immediate delivery of the pellet is required for successful conditioning.

Experiment 1.

Conditioning

Procedure:

1. After the briefing period, prepare your kymograph in the prescribed manner. Obtain 100 pellets from the front desk and make up a tabulation sheet on which you can keep track of the number of reinforcements that you have administer.
2. Remove the kymograph pencil from the origin on the paper by swinging the pencil holder back. When the lights are turned out, one partner should get the rat, place it on the table gently and put the glass top on the cage. Slide the door stops under cage so that the H-slot is raised about 1”.
3. Turn on the switch on the control box. Do not insert the bar. Administer 5 pellets in the same manner as the end of last week’s experiment, pressing the bar yourself as you drop in the pellet. After the fifth pellet has been administered, insert the bar. Make sure that it can swing freely, and then clamp it in place. At the same time, place the kymograph pencil on the paper. While putting the bar into the cage, one partner should hold a pellet over the food chute, so that if the rat should press the bar at once, the response can be reinforced immediately.
4. Reinforce every response until 95 reinforcements have been given. Be sure to have a pellet ready over the food chute as quickly as possible after every reinforcement.
5. If your rat is still responding at a constant rate after you have given 90 reinforcements, obtain more pellets from the desk and continue the experiment. The assistant will tell you when to stop.
6. After you have been told to stop, remove the bar, shut off the power and replace the glass with the regular cage top. Return your rat to the vivarium, and put his food cup in place

Discussion:

1. Mark the axis of your kymograph curve, staple the curve to the back of this page and write the legend for the curve. In writing the legend, be precise and complete.
2. Describe the shape and trend of your kymograph curve. In what ways does it differ from the curve that you obtained last week?
3. What features of your animals behavior during the experiment were particularly outstanding? Did his behavior change during the course of the experiment?
4. Is there any evidence that the bar-pressing response of your rat was conditioned? What is the evidence?
5. Did the rate of bar-pressing fall off towards the end of the experiment? If so, why?
6. What are some other variables that may affect the rate of bar pressing?

Experiment 2.

Extinction

Procedure:

1. Set up your kymograph as usual and obtain 25 pellets from the desk. When the lights go out, get your rat, being sure to observe all the rules about the rat convoy.
2. Place the glass top on the cage. You will not need the doorstops for the remainder of the term. Inset the bar, turn on the power switch and give 25 regular reinforcements as during last week's experiment.
3. After you have given the 25th reinforcement, leave the bar in place and begin extinction. Be sure to keep all of the stimulus conditions prevailing during conditioning present during this phase of the experiment, except of course, the administration of the pellets. Put a tick mark on the kymograph curve at the point at which extinction begun.

4. Continue extinction for 90 minutes. At the end of this period, turn off the power and remove the bar. Return the rat to the vivarium and put his food-cup in place.
5. Precautions: This experiment is quite long and somewhat tedious, and you will be tempted to leave the room frequently. Please remember that one partner must be in the cubicle all times, in order to prevent the pencil from leaving the drum at the other end. Finally, try to keep the stimulus conditions the same as last week, including holding your hand over the food chute (without pellet).

Discussion:
1. Mark and label your kymograph curve and attach it to the back of this page.
2. If forgetting is defined as the weakening of a response with the passage of time, is there any evidence that forgetting has taken place since last week?
3. Compare the rate during last twenty regular reinforcements with the rate during the first five minutes of extinction; with the rate during the second five minutes of extinction. Does the increase in rate during extinction permit us to draw the conclusion that bar pressing is stronger during the early part of extinction than during regular reinforcement.
4. Describe the overall shape of the extinction curve. Write a generalized statemen of the way in which response rate changes strength during extinction.
5. Write a paradigm that describes the operation of the first and second part of today's experiments.
6. Include a report of your rat's observable behavior during 15 minute intervals of the extinction period.

The second experimental unit, on maintaining behavior, introduced schedules of reinforcement and illustrated the manipulation of parameters as a basic procedure for the analysis of behavior. We began the systematic collection of quantitative data.

EXPERIMENTAL UNIT 2.

Maintaining behavior

In the first unit we determined some of the ways in which a certain type of behavior, in this case bar-pressing, could be strengthened and weakened. Our attention in this unit will be directed toward the problem of maintaining some aspect of behavior at a fairly high strength, given the fact that this bit of behavior has been conditioned previously.

The problem of maintaining behavior arises from the fact that, as a little consideration of the matter will show, responses are not reinforced at every occurrence in our daily life. In fact, if the maintenance of behavior were to require regular reinforcement, little if any of our behavior would be likely to persist for any length of time. Hence we are led to the investigation of the investigation of the effects of reinforcing a response intermittently, that is, not every time it occurs but according to some schedule of reinforcement.

Almost all types of reinforcement schedules can be considered as being a member of one of two basic types. The experimenter either can let periods of time elapse between reinforcements, or he can require that a number of responses be emitted between reinforcements. The former type is usually referred to as an interval schedule and the latter as a ratio schedule. The lengths of the intervals between reinforcements and the number of responses can be fixed or variable for any particular schedule.

While certain direct comparisons between schedules of reinforcement and pay-schedules in industry can be made, a word of caution is necessary in this connection. Thus, if the worker is paid every Friday, he can be said to be working on a fixed interval schedule and if he is on piece rate, he is working on a fixed ratio schedule. However, as will be discussed later in the course, the wages paid in a factory are not the only reinforcers and variables controlling the output of the worker, and these must be taken into account when a direct comparison is made.

Experiment 3.

Reinforcement at fixed intervals

Procedure:

1. Prepare your kymograph as usual. Obtain 30 pellets from the front desk. When the lights go out, get your rat and put the glass top in place.
2. Turn on the power switch and insert the bar. Reinforce the first response. Let three minutes elapse, and reinforce the first response after this period of times is over. Again, allow three minutes to pass and reinforce the first response after the end of this interval. Continue this procedure until you have given the 30th reinforcement. (During the briefing you will be shown how to time the three minute interval with the timer on the control box). Mark each reinforced response on the kymograph curve.
3. Turn off the power and remove the bar. Return the rat to the vivarium and put his food-cup into place.
4. General precautions: As in the first experiment, be sure to have a pellet ready over the food-chute when you insert the bar so that you can reinforce the first response without delay. Thereafter, either keep your hand with a pellet over the food-chute at all times or keep your hand a few inches from the cage. Do not put your hand over chute as the end of the three minute period approaches, otherwise the movement of your hand will become a cue for the rat.

If the rat appears to be extinguishing in the early part of the experiment, call the assistant, who will advise you about any changes in the procedure.

Discussion:

1. Mark your kymograph curve, affix it to the back of this page and write the proper legend.
2. Describe the overall trend of your kymograph curve.
3. What changes in rate occurred between reinforcements in the early part of the experiment? In the latter part of the experiment?
4. Give examples from everyday life of the following:
   a. Conditioning;
   b. Regular reinforcement;
   c. Extinction;
   d. Fixed interval

Experiment 4.

Fixed interval schedules

Part II Rate as a function of amount of reinforcement on a 3 minute fixed interval schedule

Procedure:

1. Prepare for the experiment and obtain your rat as usual. All students will need 75 pellets.
2. Insert the bar and reinforce the first response. Continua at a 3 minute PR schedule using the same procedure as in Experiment 3, except in the following detail.
   a. Group A consisting of the odd numbered cubicles will reinforce with 2 pellets for the first 45 minutes and with 3 pellets for the last 45 minutes.
   b. Group B consisting of the even numbered cubicles will reinforce with 3 pellets for the first 45 minutes and with 2 pellets for the last 45 minutes.
3. During the last ten intervals between reinforcements in each phase of the experiment, count and record the number of unreinforced responses made by your animal.

Discussion:

1. Mark and label your kymograph curve. Calculate the mean rate and the mean extinction ratio for the last ten intervals between reinforcement for each phase of the experiment. Enter these figures in the appropriate spaces in the tables on the blackboard.
2.

	Responses/minute *2 Reinforcements (Last 30 minutes)*	Responses/minute *2 Reinforcements (Last 30 minutes)*
Rat # ____		
Group____		
	Extinction Ratio	Extinction Ratio
Rat # ____		
Group____		

3. Describe the overall trend of the kymograph curve for the entire experiment.
4. Compare the extinction ratios for the two phases of the experiment.
5. Can you draw any brief conclusions form the data?

Discrimination was introduced in the third experimental unit. At this point, experiments began to be carried over from one weekly lab meeting to the next. Also, the analysis was extended to multiple functions of stimuli. The sequence of experiments culminated in a treatment of concept formation, defined in terms of discrimination between classes and generalization within classes. The concept-formation experiment was conducted with human subjects.

EXPERIMENTAL UNIT 3.

Discrimination

Response discrimination refers to the fact that certain types of behavior are more likely to occur in one situation than another. We do not sing the latest hit song in church, we cheer loudly at football games, and we adopt an all-knowing mien when we explain our work at college to our parents. Each of these samples are bits of behavior that have been reinforced in one situation and extinguished in another. The fact that extinction plays an important role in the establishment of a discrimination is not obvious in some of the examples given. Consider, however, the student who tells his roommate about Psych. 1 in the same manner as he used when telling his parents. If the roommate does not resort to punishment, the chances are that he would lose interest in the student's story quickly, stop paying attention and the like.

In this unit we will be concerned with the way in which a discrimination is established. Of the various methods possible by which a discrimination can be established, most of which are outlined in the text, we will use one that provides us with a continuous measure of response rate during S^D and S^Δ. This permits us to obtain a good measure of the degree to which the discrimination has formed by dividing the S^Δ by the S^D rate. The closer this ratio is to zero, the better the discrimination. This measure also has the advantage that it is not dependent on the absolute values of the rate of responding.

The first two experiments will be concerned with the effect of the type of schedule on the speed of formation of the discrimination. For this purpose the class will be split into two groups as during the last experiment. One group will reinforce at a two minute PR schedule while the other group will use a fixed ratio schedule of 20:1. While there is some evidence from the work done at Harvard that the animals on the ratio schedule will form the discrimination faster, this experiment has never been done in this laboratory, and we are very interested in the results you obtain. Hence we ask you to particularly careful in following the procedure, keeping the room quiet and the like.

Experiment 5.

Establishing a discrimination

Procedure:

1. Prepare for the experiment as usual. You will need a fairly large number of pellets, and you may have to replenish your supply during the experiment.
2. In order to keep the stimulus conditions as uniform as possible for all of the animals during the experiment, you will insert the bar at the signal from the instructor. Hence you must be ready to start working when the lights go out and you have gotten the rat.
3. After you have obtained your rat and placed the glass top into position, put the light can on the glass top. At the signal from the instructor insert the bar and throw the hand-switch to the right and reinforce the first response. Do not throw the hand-switch in such way as to produce a loud click. We want the light and not the click to become S^D.
4. The students in the odd-numbered cubicles will continue by reinforcing at a two minute fixed interval schedule, while those in the even-numbered cubicles should use a fixed ratio schedule of 20:1. After two and one half minutes have elapsed, return the hand-switch to the center position, turning off the S^D light. Do not reinforce any response during S^Δ (when light is off). S^Δ, like S^D, lasts for 2½ minutes, when the light is turned on again. Continue this procedure of alternating S^D and S^Δ for 2½ minute periods until you have run for 1½ hours (a total of 15 S^D– S^Δ cycles).
5. Do not measure the interval for the reinforcement or count the number of responses for the ratio from the beginning of each S^D period. Consider the schedule as being interrupted for 2½ minutes by the S^Δ period. Thus if the rat (in the PR group) was reinforced 1 minute before the end of an S^D period, reinforce after 1 minute during the next S^D period. A similar procedure should be employed with the animals on the ratio schedule.

6. Mark the beginning and end of each S^D period on the kymograph curve. Also mark the reinforced response, but be sure that you know which mark is a reinforcement and which indicates a change in the stimulus situation.
7. On the table provided, count the number of responses made during each S^D and S^Δ period.

Discussion:

1. Label your kymograph curve and write the legend for it.
2. From your data sheet, calculate the mean S^Δ rate/ S^D rate ratio by groups of three cycles. Plot these mean figures on the graph paper available at the front desk.
3. Is there any evidence that a discrimination was beginning to form? What is this evidence?
4.
    a. (Odd-numbered cubicles) Did your kymograph curve indicate that your rat was forming a temporal discrimination?
    b. (even-numbered cubicles) Describe the change in response rate and the general shape of the kymograph curve as the ratio schedule took effect. Compare today's curve with last week's.

Experiment 6.

Establishing a discrimination (continued)

Procedure:

1. The procedure for today's experiment is the same as for Experiment 5. Again be sure to be ready to start the experiment at the signal from the instructor. Also be sure to keep the room quiet and all of the stimulus conditions not directly concerned with the experiment as uniform as possible.

2. Indicate the beginning and end of each S^D period on your kymograph curve. Also mark the reinforced response. Count the S^D and S^Δ responses as during last week's experiment and enter these figures on the data sheet.

Discussion:

1. Mark and label your kymograph curve. Using the figures on your data sheet, compute the S^Δ-rate/S^D-rate ratio by groups of three cycles.
2. Plot the values of the S^Δ/S^D ratio obtained in (1) on the graph paper available at the front desk. On the same graph paper, plot the values you obtained during Experiment 5. Thus you should have 12 experimental points plotted consecutively on this week's graph.
3. Did the discrimination improve over that which you obtained in Experiment 5? By how much?
4. Describe the over-all trend of the formation on the discrimination.
5. Please give us a brief description of the experimental procedure employed with your animal during Experiments 3 and 4. We would like this information for our evaluation of Experiments 5 and 6.

Experimental Unit 3a.

Some Functions of a Stimulus

In the first two experiments of this unit we observed the manner in which a previously neutral (in some cases aversive) stimulus acquires discriminative control over a particular response. The present experiment is designed to show the fact that when we set out to establish a certain function for a stimulus, that same stimulus also acquires other functions.

Although the detailed discussion of the manner in which these other functions are acquired will not be discussed in the lectures until later in the term, it is more convenient for us to perform the experiment now.

However, aside from inconvenience, this experiment illustrates the fact that even though the text may consist of a set of chapters, each concerned with a different behavioral topic, and that we perform a series of experiments which again are supposedly limited to unique behavioral phenomena, we are always dealing with continuous flow of behavior. Thus, while we may profitably analyze an intermittent reinforcement schedule, the isolated phenomena, we must remember that whenever we perform an experiment designed to produce one effect, we are likely to produce other effects. Most of the time the side effects which are produced are not of great concern in the original experiment, but their existence does not lose importance because of this fact.

Experiment 7.

Some functions of a discriminative stimulus

Procedure:

1. For today's experiment you will not need the bar or the kymograph. We will however use the light can, placed on top of the cage as usual.
2. Place the cage on the table in the usual place but turn it slightly so that you can observe the rectangular opening for the food cup easily from a short distance away. Put the glass top and light-can in place. Do not turn on the light.
3. Count the number of times the rat pokes his nose out of the food-opening by one-minute intervals for ten minutes. Use the data sheet for keeping this record. You will have to decide on a criterion what is a nose-poke an what is not a nose-poke. Once you have chosen your criterion, adhere to it for the remainder of the experiment.
4. Continue as in (3) but turn on the light for one second immediately after each nose-poke. You may time

one second by saying "One chimpanzee" to yourself. The experiment will last for a total of one hour.

Discussion:

1. From your data sheet, construct a cumulative response curve on the graph paper available at the front desk. Mark and label this curve and write the legend for it.
2. Describe the effect that the introduction of the light had on the behavior of your rat.
3. In view of your answer above, and the results of the last two experiments, what functions had the light acquired during the establishment of the discrimination.

Experiment 8.

Shaping responses

No written material was provided for this unit, but a paper describing the shaping was required. Shaping was unsuccessful in our session, probably because the rat had inadvertently been fed the night before and therefore was not sufficiently food deprived. But the session provided the beginnings of a discussion of what we would later call operant classes. In most of the remaining experiments, without rats, lab partners became experimenters and subjects. I have been unable to determine the point at which PSYC 1 ended and PSYC 2 began.

Experiment 9.

Response induction

Procedure:

1. One of the partners of each pair will serve as experimenter and the other as subject. The equipment required is one special board, 50 star-diagrams, a soft

pencil (kymograph pencils will not do), a doorstop, the control box or a watch with a second-hand, and the mirror mounted in the cubicle.

2. The subject should be seated at the table in such a manner as to permit him to see his hands, pushed through under the special board, in the mirror. The angle of the mirror can be adjusted with the doorstop for the position of greatest comfort for the subject. The subject should not be able to see his hand directly.
3. The subject's task is to trace the star pattern with the pencil, keeping the trace in the space between the inner and outer star. The trace should start at the vertical line crossing the pattern and should continue around in a clock-wise direction. The subject can hold the sheet of paper with the pattern with one hand while drawing with the other.
4. Each trial at tracing the pattern will last one minute and is timed by the experimenter. During the trial the subject should try to get as far as possible along the path of the star. If he should complete the trip before the minutes is over, he should start around again, continuing until told to stop by the experimenter. If the line leaves the path, it should be re-entered at the point of departure. There should be a thirty second rest period between trials.
5. During the first twenty-five trials the subject should use his preferred hand, and for the last 25 trials his non-preferred hand.

Discussion:

1. The performance on each trial is scored in two ways: (1) the total distance travelled along the path, and (2), the number of times the trace left the path. Each leg of the path completed is 1½ inches long. The trace in any leg partially completed should be measured with a ruler to the nearest ¼ inch. An error is scored whenever the trace crosses the inside or outside boundary completely. Be sure to count only

those crossings when the trace leaves the path and not re-entries

2. Complete the data sheet recording to the instructions given in (1). The performance index is calculated by subtracting the number of errors from the distance travelled. Plot this performance index on a piece of graph paper, superimposing the curves for each hand.
3. Describe the two curves you have plotted on the graph paper. Is there a difference between these curves? If there is a difference, what does this difference demonstrate?

Concept Formation

The use of the word concept or abstraction arises from the fact that much of our verbal behavior is not under the direct control of immediately apparent discriminative stimuli. Thus, while we can say with some assurance that the response "1776" is under the control of "What is the year of the American independence", it is much more difficult to specify what the controls for such responses "chairs", "table", "red", and "orange" are. However, we can specify what the psychological principles are that must be operating when we say, on the one hand, "chair" rather than "table", but still call a wide variety of other, similar objects "tables". We can also demonstrate how such concepts are acquired.

Abstractions do not involve any more than discriminations between classes of stimuli and generalizations within classes of stimuli. We generalize among all chairs but discriminate between chairs and tables. As with all discriminations and generalizations of this type, concepts are maintained by the reinforcing community in which we happen to live. This is illustrated by the fact that the Eskimo, for instance, have eleven different names for snow and that certain other cultures have a different number of primary colors than we have.

Experiment 10.

Concept formation

Procedure. In today's experiment, we are going to observe the formation of a concept based upon some property of Morse code signals. For the success of the experiment, it is important that the subject is naïve with respect to the code. PLEASE DO NOT DISCUSS THIS EXPERIMENT OUSIDE OF CLASS UNTIL ALL SECTIONS HAVE PERFORMED IT.

The role of the experimenter:

1. While the subjects are out of the room, circle the number of the signals which will be positive (S^D's) for your group.
2. If the subject responds to a signal, place a check mark in the appropriate box. If he does not respond, leave the box blank.
3. If the subject responds, and if the signal is an S^D, shake your head up and down (meaning "yes, a correct response). If he responds and the signal is an S^Δ, shake your head from side to side (meaning "No, an incorrect response").
4. If the subject does not respond, furnish no information about the signal. That is, don't move your head.
5. Be extremely careful not to supply additional cues. Do not let him see the data sheet. See that he is seated so that he cannot see the other experimenters.
6. Immediately after the experiment, obtain the information for Discussion question 3.

The role of the subject:

1. The assistant will call out a number. This is your cue that a code signal will follow. After the signal is sounded, you will have two seconds in which to decide whether or not to respond. Your response will be one bar press.
2. You will be told whether or not the signal had S^D properties as outlined in step 3 and 4 above. If you do

not respond, you will receive no information about the signal.

3. Your task is to respond to all S^D signals and to none of the S^Δ ones.
4. Base your decision to respond on the properties of the signal. It is to your advantage to respond to doubtful signals. The class has been divided into two groups, each with its own concept. If you use cues other than signal properties, you may be responding to a cue for the other group.
5. In order to establish the concept, you must respond to all of the early signals; therefore, during the first series you will necessarily have a high rate.

Discussion: Label your kymograph curve and compute the data requested.

1. The subjects have developed the concept involving properties of Morse code signals. Affirm or deny this statement with the evidence from your data sheet.
2. Compare your kymograph curve with the one you obtained during Experiment 10. Can you account for similarities or differences in their shape and regularity.
3. What is your subject's report as his basis for responding to a given signal?

Forming a light-dark discrimination and decreasing latency in a white rat

No preliminary written material was provided for this experiment, and a full laboratory report was required. From this point, lab handouts no longer included experiment numbers. One guess is that some experiments were used in different sequences in prior years, so this practice allowed the same handouts to be used in successive course offerings, thereby avoiding the laborious process of producing new mimeograph masters. Some aspects of timing and sequencing of the experiments can be inferred from the estimated ages of the rats successively used.

Testing for a Secondary Reinforcer

Analysis of behavior clearly indicates that the reinforcement contingencies that modify and maintain (i.e., control) behavior are not always of the class we call "primary" reinforcers. This is true of the simplified demonstrations conducted in the laboratory. Gross, but nonetheless accurate, examples of this fact are apparent in more complex behavior patterns including, to be sure, human behavior.

The concept of secondary reinforcement is not unitary. There are many facts to be considered, each of which has been suggested by various procedures. Thus, several procedures can be used to test for the effectiveness of a secondary reinforcer. Each technique may be important for a particular part of the theoretical formulation.

Continuing research has indicated the basic procedure necessary to establish a 'neutral' stimulus as reinforcer. In the previous experiment, where a 'chain' of behavior was formed, our analysis led directly to the concept of secondary reinforcement. In this case it was called a positive reinforcer (S^R). Each stimulus component in the chain, we said, served the dual purpose of S^D for the next response and S^R to increase the strength of the preceding response. Keller and Schoenfeld (1950) state that this is requisite procedure for establishing and S^R.

Today's problem is to select a procedure with which we can test the hypothesis that in setting up the light as an S^D for the bar pressing response this stimulus has also acquired the properties of a secondary reinforcer. This test will then be made.

Apparatus. For this experiment the following apparatus will be needed: a bar, a chain, a kymograph, a four-channel recorder, a cage. A full description of this equipment is given in the literature (Frick et al., 1948).

The subject for this experiment is a male albino rat of the Wistar strain, approximately 115 days old. The animal has been previously conditioned to press the bar in the presence of light for food, while no bar presses during the dark periods were reinforced (discrimination training). The subject has also been trained to perform a series of specific responses to secure reinforcement (chaining). The animal is 24 hours food deprived for this experiment.

The remaining rat experiments included two sessions on aversive control and a large-scale design concerned with establishing operations. We had run through the gamut of the basics of the experimental analysis of behavior.

Escape-Avoidance training

Our experimental interest up to this time has been centered upon behavioral control that is achieved through the use of positive reinforcers —- both primary and secondary. All behavior, however, is not controlled in this way. When we touch a hot stove or receive a strong electric shock, we "escape" the noxious stimulus by physical withdrawal from its source. Through experiences like these we learn to "avoid" the situations where the probability of receiving aversive stimulation is high.

We can see, then, that those responses which keep us from aversive parts of the environment are strengthened. More precisely, those responses which terminate the aversive stimuli will be reinforced (Keller & Schoenfeld, 1950). The term used for this class of stimuli is "negative reinforcers". The effectiveness of negative reinforcers in controlling behavior makes them a necessary topic for study if we are to complete the picture of behavioral control.

The principle that we are presently studying has received widespread acceptance in understanding human behavior. Psychiatric journals and reports from the psychoanalytic couch —- not to mention modern fiction —- regularly report deviant behavior pattern resulting from escape-avoidance training. Escape-avoidance conditioning is however only one segment of behavior control. We have been seen some important facts demonstrated, and have yet to discuss some that are of equal importance.

The present study is designed to demonstrate conditioning by using an aversive stimulus.

Apparatus. The apparatus for this experiment consists of manipulanda and recording instruments designed for use in Columbia College (Frick et al, 1948). Specifically these are: a bar, a four-channel recorder, a 100-watt light suspended 6 inches above the top of the cage, a power supply unit, a timer and an experimental cage.

The subject is a male albino rat of the Wistar strain approximately 122 days old, deprived of food for 24 hours prior to the experimental period.

The subject has been used previously in the following experiments:

1. Light dark discrimination training. A constant 7½ watt light was used as S^D. Following initial training of the bar pressing response (regular reinforcement) the animal was regularly reinforced in S^D (where there was the possibility of making only one response) and S^Δ was present until a period of 30 sec. of no responding has occurred. S^D was again presented, and the procedure repeated.
2. A behavior "chain" consisting of nose-poke, chain pull, and bar press was established.
3. Extinction of this "chain" of responses (without light present) was carried out for one hour. The light was then introduced and a test for the effects of light as an S^r was made.

Conditioning an Avoidance Response

Responses which "put off" aversive situation are common in everyday behavior. Postponing a dental appointment, flight from capture, jumping from the path of an ongoing car –- these are ready examples of avoidance behavior. Examples of "abnormal" avoidance behavior are numerous as well –- phobias, refusal to enter a dark room, or a large group of people, are all placed in this behavior category.

In all cases, however, our interest is in discovering how such behavior is conditioned.

During last week's experiment the animal was conditioned to escape an aversive stimulus by making a specific response. We are interested now in finding out whether, to what degree and how quickly the animal will learn to avoid the aversive stimulus by "holding" some response. In the case of the nose-poking response, for example, we wish to find out how much of the time the rat can be kept in position with his nose thrust out the food cup slot. The method for doing this involves, as we know, punishing all other responses than the one we have chosen to measure.

This procedure has been used before and the discussion of the results Hefferline (1950) obtained will be of interest for this experiment.

Apparatus. For this experiment we will use a recording switch (the chain), a wax tape recorder, a 25-watt light, a power supply unit and an experimental cage. This apparatus is described fully in the literature (Frick et al., 1948).

The experimental subject is a male albino rat of the Wistar strain approximately 130 days old. He has been deprived of food for 24 hours prior to the experimental session.

The animal is not naïve. He has been used previously in the following experiments: light (S^D)–dark (S^Δ) discrimination training, "chaining" (which was subsequently extinguished) and escape training.

Behavioral Changes Correlated with a Change in Motivation

Acceptance of the fact that a "motivating" variable is operating is implicit in our experimental work to date. When working with the white rat we have stated each session that he has been "deprived of food for approximately 24 hours”. The behavioral scientist is concerned, however, with determining the precise features of all behavior modifiers. We shall turn our attention, then, to some of the important features of behavioral control affected by motivating (or “drive”) factors.

People recognize that motivational factors influence behavior. A student is said to be “highly motivated to study” if we observe him constantly reading and carrying out his study assignments. A person’s direct or indirect overt behavior is interpreted as indication that he or she is “highly sexed” or “greatly sex deprived”. In these, and all, examples where a “motivation” is assumed, there is one common factor, namely, that all estimates of motivational states of the organism are based upon the observance of certain behavior. But this is not enough.

Our analysis of motivational factors extends beyond the level of behavior observation. For an understanding of motivation, it is necessary to determine empirically those operations (e.g., depriving of food) which consistently will produce the same behavior (eating food). In this case, we may then conclude that the behavior we observe is a result of the operations we have performed. By common agreement “motivation” is defines as that state of the organism which, as a result of certain operations we have performed (food deprivation), will lead to an increase in certain types of behavior (eating).

We are interested in determining all of the behavioral consequences of our operations. What, for example, is the relationship between the extent (number of hours of deprivation) of our operations and the behavior we measure (amount of food eaten)? What is the “total” effect of our operations, i.e., does food deprivation influence other than “food getting” responses? Do drives operate singly or in conjunction, and if so, how? These are a few of the pertinent aspects of an investigation of motivation.

In today’s experiment we will use a procedure to show how the strength of certain behavior varies with the amount of motivation. The technique, generally, involves (1) a period of food deprivation, (2) a specifiable change in the drive state following this period of food deprivation, and (3) observable (measurable) changes in behavior consequent upon the operation we perform.

Apparatus. The apparatus consists of a power supply unit, a cumulative response recorder (kymograph), a bar, food pellets and an experimental cage. These have been fully described elsewhere (Frick et al., 1948).

The subject is a male albino rat of the Wistar strain, approximately 138 days old. The animal has been food deprived for approximately 24 hours prior to the experimental session. He is not experimentally naïve but has been used in the following experiments: light (S^D)–dark (S^Δ) discrimination training using the bar-pressing response, "chaining" where a sequence of response (nose poke—chain pull—bar press) was strengthened and later extinguished, escape and avoidance training where some response other than the bar-press was strengthened.

Behavioral Changes Correlated with a Change in Motivation (continued)

Apparatus and Procedure. The apparatus used in this experiment is a bar, a kymograph recorder, a power supply unit and a glass rod with which water reinforcement may be delivered to the animal. The first four of the articles are describe in detail in the literature.

The subjects are male albino rats of the Wistar strain, approximately 145 days old. The animals have been deprived of <u>both</u> food and water for twenty-four hours prior to the experimental session.

The subjects are not experimentally naïve. They have been used in the following experiments: light (S^D) – dark (S^Δ) discrimination training using a bar-pressing response, "chaining" where a sequence of responses (nose poke--chain pull--bar press) was strengthened and later extinguished, escape and avoidance training and conditioning (with a variable interval schedule of reinforcement) of the bar pressing response.

The animals were divided into three groups on the basis of the rate of responding during the "zero" prefeeding part of the last experiment. All animals were reinforced under the same schedule as was adopted during the last experiment. The experiment was in two phases and the groups were run as follows.

Phase I	Group 1	Reinforced with food, one pellet per reinforcement
	Group 2	Reinforced with water (technique explained below)
	Group 3	Randomly alternate food and water reinforcement (see below)
Phase II	Group 1	Reinforced with water
	Group 2	Reinforced with food
	Group 3	Randomly alternate food and water reinforcements

Prior to the experiment proper it is necessary to condition the animals to drink from the glass rod. This can be done by giving ten pairings of presentation of the damp glass rod with the kymograph click. Dip the rod into the water cup and insert it into the food chute. Be careful not to touch the sides of the chute, for the water will drain off the glass rod. Leave the rod in the cage as long as the animal is licking it, when he stops remove it. Be careful that the animal does not pull the rod into the cage. If this occurs, call the assistant.

A random order for alternating food and water reinforcements can be read from the table of schedules that were given our last week. By selecting "odd" numbers for "food" and "even" numbers for "water", the order can be read directly from the tables.

The following handout about a psychopharmacology experiment included no experiment number and was unaccompanied by data, so it may have been used mainly for purposes of discussion. I've included it here based on its location in the binder for my manual.

The Effect of Drug on Response Rate

The two previous experiments on motivation —- prefeeding, and multiple deprivations —- have investigated operations that were shown to change response strength. In these cases the prior deprivations (and the changes they produce) have had some "logical" relationship to the reinforcements used in the experimental situation. That is, to change the hunger drive we gave the animal food; to maintain behavior with a water deprived organism, water was used as reinforcement.

The definition of "drive" offered earlier—- "…that state of the organism which, as a result of certain operations we have performed, will lead to an increase in certain types of behavior" —- is one that might be given broad interpretation. The "state of the organism" is inferred, not defined, and with numerous ramifications. Certainly those operations that have been studied —- food and water deprivations, and light aversion —- fit well into our category, and we have called these 'motivating' factors. There are other aspects of "the state of the organism" which are not classified as motivating. The next topic of study, emotion, will deal with one of these aspects.

Certain other operations, however, that the experimenter may perform, may be of consequence with respect to the behavior of the organism. These types of operations may seem troublesome, with strict reference to our definition, when an attempt is made to categorize them. They cannot be subsumed by our class of "drives" and they are not, as later study will show, part of the class we call "emotionalizing". A case in point is the administration of drugs. Pills are taken to decrease the frequency of food ingesting responses; compounds are taken to "remain awake" or to "induce sleep"; opiates are consumed to "get a kick" or to "secure release from worry and tension"

Despite the difficulty of classifying these operations, determination of the effects of the operation is necessary first, certainly, if we are to proceed in a scientific manner. The present experiment is designed to determine the effects of benzadrine sulphate upon the rate of bar-pressing for the white rat.

Apparatus and procedure. The apparatus for the present study is described fully elsewhere (Frick et al., 1948), and consist of a bar, a cumulative response recorder, a power supply unit, and experimental cage and food pellets. Each experimental animal will be given 2 mg of Benzedrine sulphate (in solution) during the test phase.

The subjects are male albino rats of the Wistar strain, approximately 160 days old. The animals are 24 hours food deprived prior to the experiment. The subjects are not experimentally naïve. They have been used previously in several experiments, which include: light-dark discrimination training, 'chaining', escape and avoidance training, and periodic reconditioning of the bar-pressing response under different drive conditions.

The Spring semester course, PSYC 2, was primarily devoted to experiments with human subjects. Most of those involved verbal behavior. The laboratory handouts provided for these experiments were far less extensive, in large part because the task of writing up introductions and procedure sections were turned over to the students. In one experiment we examined the effects of delayed auditory feedback. Ongoing speech was maximally disrupted by delays of about 1.5 seconds, and though chaining accounts of verbal behavior would later become untenable we interpreted the results in terms of the chaining of vocal behavior. In another experiment we observed latent verbal behavior in a replication of the verbal summator procedure (Skinner, 1936).

In a third experiment we applied schedules of reinforcement to verbal behavior. A student with the task of completing matches to a list of words could ask one of two other students for a word and received a word printed on a slip of paper upon doing so. Sometimes the printed word matched a word on the list and sometimes not. We regarded the receipt of a matching word as a reinforcer. Matching words were delivered by the first student of the pair according to a differential-reinforcement-of-low-rate schedule, and those by the second student according to a brief variable-ratio schedule. We were not surprised that requests to the first student occurred at a lower rate than those to the second student, though over subsequent decades we would learn that much human behavior is insensitive to schedule contingencies. Skinner's "Verbal Behavior" (1957), had not yet been published, but Keller and Schoenfeld were up to date on Skinner's work through Skinner's William James lectures and various publications. We learned to think about verbal behavior as subject to the same variables as nonverbal behavior.

One lab session was devoted to a demonstration in which Nat Schoenfeld played a crucial role (Catania, 1997). For a class simulation of lie detection in an earlier semester, two or three students were called out of the lab to serve as subjects while the rest of the class received a briefing. A teaching assistant asked one of them to make a phone call for him from a faculty office, saying that the class schedule kept him from making the call himself. The office was Schoenfeld's. Schoenfeld had been waiting nearby and entered his office on the teaching assistant's cue just as the student started the call. Berating the student for using a faculty member's phone without permission, Nat took over the phone, redialed, and was apparently in the midst of a conversation with the Dean's Office about academic suspension and other disciplinary action when the teaching assistant entered, said the student was needed for the lab, and whisked him away. That student and the others were then hooked up to a galvanic-skin-response meter and each was asked to free associate to a word list that included *office*, *telephone* and *dean* as some of the critical words nested among the neutral ones. Needless to say, the class was able to identify the "guilty" student, but the story went that, given the quality of Nat's performance, they really didn't need the physiological measure to do so.

In the offering of PSYC 2 that I took, this simulation was presented in the context of research on associative reaction times. Once again the "guilty" student was easy to identify. We wrote an experimental report for this simulation as well as for the more formal experiments.

Associate Reactions and Reaction Times

When the difficulty involved in conducting certain experiments is great, the problem —- for reasons of convention, ease, lack of proper and appropriate measures, etc. —- is often disregarded. Thus error and misconception, as well as truth, are sometimes maintained in science. The behavioral scientist is aware of this problem when "mental activity" or "thinking" are under discussion.

Events which happen too rapidly to measure are often characterizes as having "the speed of thought". Verbal chains that are subvocal are undoubtedly carried out at great speed, and this fact allows for such uncritical statement as 'I have difficulty keeping up with my thoughts'. It is the speed of with which it occurs that helps give thinking its ephemeral quality. This elusiveness, along with its location somewhere beneath our skin (currently in the brain), appears too many to give thinking the unique property of impregnability to experimental investigation.

Contrary to these time-honored notions, experimentation has proved a feasible method for investigating thinking behavior. Sensitive muscle-action recording have told us something even about dreaming. Other studies have shown that thinking, even when it is too rapid to describe verbally, occupies enough time to interfere with overt behavior. These findings have been put to practical use in guilt detection tests.

We have seen that there are several ways that the probability of occurrence of a response, or a set of responses (the strength of the response) may be changed. Reinforcement contingencies (both positive and negative; primary and secondary), change of drive states, and emotional factors can be manipulated to modify response strength. In today's experiment we will be concerned with the effects of two variables —- drive (food deprivation) and emotion (embarrassment and castigation) —- upon subjects' verbal response and reaction times to verbal stimuli.

The type of analysis that is made of this problem is not to be interpreted as "the final word", for verbal behavior is complex indeed. There is clear indication, however, that many topics -- chaining, response measurement, conditioning history of verbal repertory, drive and emotion -- that have been studied separately must also be studied where there is interaction. Yet the information that is obtained from the study of individual principles is highly essential before stepping on to larger and more complex forms of behavior.

Apparatus and subjects. Three subjects, volunteers from the class, are chosen. Two are experimental subjects and one acts as a control. Upon receiving individual instructions, the subjects leave the classroom to return at an appointed time and, individually, are a given word-association test.

The word list for the test has been compiled from the Kent-Rosanoff series, and contains 10 "critical" word appropriate to each of the experimental subject's requested actions. Qualitative (word response) and quantitative (reaction times) measures are taken of all subject's responses. The latter is recorded independently by two judges, each working with an electrically operated chronoscope.

One prominent topic in Fred Keller's lectures was the shaping of verbal behavior. Research on the reinforcement of plural nouns was current (Greenspoon, 1955). I soon had an opportunity to try verbal shaping on my own during a summer working on a locked psychiatric ward in the New York City hospital system, substituting for ward attendants who were on vacation (Catania, 2017b). My main tasks were keeping the patients out of trouble and occasionally escorting them to activities in other parts of the hospital.

The talk of one young patient on the ward consisted mainly of what psychiatrists call word salad: semi-grammatical though unpredictable and not particularly meaningful. I decided to see whether I could make verbal shaping work (Catania, 2013, pp. 331-332). Usually I'd find him standing somewhere talking to no one in particular. I sat nearby, showing interest whenever something he said included *I* or *me*; otherwise I ignored him. Over two or three weeks not only had those words become far more common in his talk, but when I was there he began speaking in full sentences, usually in first person and about himself, His talk was consistent with what the psychiatrists knew about him from his parents. I had learned that the literature on verbal shaping was controversial, but all my doubts vanished with the success of that verbal shaping.

This application was just one of the effects of K&S and the course it supported. The book became a model for me, in its breadth of coverage as well as in its clarity. I aspired to emulate its scope in my own book for courses in the psychology of learning (Catania, 1979) and, when the book became too large for undergraduate courses (Catania, 2013), in a textbook I wrote explicitly not for a course in psychology but rather as an introduction to behavior analysis in its own right (Catania, 2017a).

Keller and Schoenfeld played the role of Huxley to Skinner's Darwin. Verbal behavior was included in K&S. Though we may have had some idea at the time how novel it was for that topic to be included in a psychology course, not to mention an introductory one, we had no idea how novel their entire behavioral approach was. The labs seemed like well-honed standard offerings. We didn't recognize that they were cutting-edge. In retrospect we can see that they were experimental works in progress rather than well-established course procedures. But that may have been one of the features that made them so effective. They worked, not only in generating data that made sense to us, but also in making us active participants in the evolution of our new science from the very beginning.

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Appendix 1
PSYC 1 Handout: Laboratory Course Outline
Appendix 1.1

LABORATORY OUTLINE

I. GENERAL

A. Laboratory: The laboratory for Psychology 1-2 is located in room 252, Schermerhorn Extension. The room is divided into 15 cubicles, to each of which students will be assigned. Each cubicle contains all of the apparatus and other necessities that will be used in this course.

B. Orientation: The first meeting of each laboratory section will be used: (1) for assignment of cubicles, rats, lockers, and the arrangement of partnerships; (2) to acquaint you with the basic pieces of apparatus, the experimental animal, and general laboratory procedure; (3) to obtain an indication of the general activity level (operant level) of your animal and to make certain that he will eat pellets of food.

This information will be poured forth at a rather lively pace, so to relieve you of excessive note taking this outline has been prepared.

It is suggested that you record the following information as it becomes available:

1. Partner's name and address: ____________________

2. Cubicle No. 2

3. Rat No. 102

4. Locker Combination: Left ____ Right ____ Left ____

5. Total time of your rat's operant level run 35 min.

6. Time to first bar press 15.3 min.

7. Total number of bar presses 1

C. Consultation: During each laboratory period an instructor and an assistant will be present. It will also be possible to consult with instructors or assistants outside of laboratory hours. Appointments may be arranged during laboratory periods.

SECTION	INSTRUCTOR	ROOM	ASSISTANT	ROOM
Monday	Mr. Brandauer	267	Mr. Geis	264
Tuesday	Mr. Brandauer	267	Mr. Geis	264
Wednesday	Prof. Heiferline	361	Mr. Clark	264
Thursday	Mr. Verhave	264	Mr. Stebbins	264
Friday	Prof. Keller	265	Mr. Clark	264
Saturday	Mr. Stebbins	264	Mr. Verhave	264

The assignment of students to sections is handled by Mr. Carl Brandauer, who may be found in Room 267 Schermerhorn Extention.

Appendix 1.2

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All matters concerning grades, examinations, and make-up labs should be referred to one of the assistants in Room 264, Schermerhorn Extension.

D. Partnerships: It is our policy to allow the maximum freedom of choice in the students' selection of a co-worker. The partnership contract is for both semesters of Psychology 1-2. In cases of incompatability, divorce is not impossible but is sometimes difficult to arrange.

E. Lockers: One locker, corresponding in number to that of your cubicle, will be assigned to each pair of students. Upon leaving at the end of the period, replace the lock through the brackets, close the door, and spin the combination knob. Don't leave anything behind as the locker will be used by other students on the following day.

F. Your Rat: You and your partner will be the only persons who will experiment with this animal. The result of treating your rat inconsiderately - like shaking him up while transporting him to the lab - is often followed by an "emotional" reaction on his part which delays experimentation getting under way. If the business relationship between you two turns out to be a happy one, it will be possible at the end of the semester to obtain your rat for a pet.

II. EXPERIMENTATION

We select somewhat arbitrarily one act from the rat's repertoire of emitted behavior, and concentrate the major share of our interest on this one response. We pick an act that is easily observable, that can be recorded each time it occurs without needing complicated apparatus, and that occurs during free activity with moderate frequency, so that any change in frequency, either up or down from this operant level "base-line," may be readily detected. There is experimental evidence that one such response can adequately represent, for our purposes, the class of all emitted (operant) behavior, whether simple or complex. By focusing on one act, we avoid complications which might obscure the basic underlying processes upon which all such behavior is built.

The act of depressing a small lever fills all the above requirements; so for this introductory course we have made it our "unit of behavior." Most of the apparatus in your cubicle is designed to measure and record the frequency (rate) at which the lever (bar) is pressed.

Your role as experimenter is that of a manipulator. You manipulate in a systematic fashion aspects of the rat's environment (both external and internal) and observe the effects upon the rate of response. We attempt to discover what chang in environment are accompanied by systematic changes in behavior. Such lawful relationships are known as psychological principles.

Another advantage in using the same response in all experiments is that we can measure the relative effectiveness of different environmental manipulations.

A. Precautions: Here are some of the precautions that will be pointed out during the orientation lecture:

1. Bar or lever:
   a. Strap down securely with bar strap.
   b. Plug jacks in only the top two of the three holes.
   c. See that the lever does not bind against the cage at any point, but swings freely in the H-slot.
   d. Watch for failure of bar to return to "normal" position after release.

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2. Kymograph:
   a. Sharpen pencil point before each new record.
   b. Draw axes about three-fourths of an inch from the edge of the paper to allow for calibration.
   c. Be alert for sticking of the ratchet arm.
   d. Make certain that the pencil is marking.

3. Control Box:
   a. Don't throw power seitch until the instructor or assistant checks your wiring. (Control box is on when the red light is burning.)
   b. Take care that you plug into the right set of holes.

4. Wires:
   a. Examine plugs for loose screws of breaks in insulation.
   b. Whenever two G-R jacks are plugged in next to each other see that the screws do not touch.

5. Pellets:
   a. Take the number of pellets needed out of the jar and put them in the ash tray.
   b. At the end of the experiment replace any unused pellets in the jars.
   c. Keep the jar tightly sealed to prevent any drying out of the pellets.

III. THE SUBJECT:

If you have read this far, no doubt you have gathered that some of the experiments we are going to perfom are to be carried on with animal subjects rather than with human beings. "What's this got to do with psychology?"you ask. "What about psychoanalysis, regression, masochism, and such things?"

Well, we can enumerate in this outline only a few of the reasons we selected animal subjects in preference to man, but the subjects will be discussed in some detail during the course. About all that can be said here is that men and animals seem to display many behavioral characterisitcs that are surprisingly similar. You will learn how important adequate controls are to experimentation. Human subjects just aren't willing to sacrifice their freedom sufficiently to provide us with the degree of standardization we find necessary. Laboratory animals have no choice. So our position is that it is better to sacrifice a certain amount of scope in favor of soundness of results. But the scope hasn't been reduced as much as you might think. Maybe near the end of the course we shall be able to talk to each other in surprisingly basic terms about some of those things you were asking about.

The white rat was selected as our representative of the animal kingdom purely for practical reasons. They are small and can be cared for with a minimum of effort and expense; they are hardy and fare well under laboratory conditions; lastly, because they are easily domesticated and, contrary to popular belief are extremel clean and friendly when properly tamed.

As far as the demonstration of psychological principles is concerned, we could substitute apes, dogs, cats, pigs or pigeons and come out with the same result. Of course, there are species differences (the dog has better eyesight than the rat; the pigeon can fly and the cat can't; etc.) but these are largely difference in capacities and interest us but little. Our major concern is with processes. We ask ourselves such questions as: Under what conditions are new responses

Appendix 1.4

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learned? How is anxiety built up? How is it dissipated? The answers we get through experiments seem to reach across species boundaries, with little modification in content.

When your rat reaches you, he will be between 90 and 110 days old. He has been living a more healthful, well-protected life than you have. He is the scion of a long line of purebred white rats. The Wistar Institute bred his ancestors back some thousands of generations ago. His anatomy, growth curves, and general physiological characteristics are all known in great detail and carefully charted as were his father's and grandfather's before him. Since arriving in our laboratory, these rats have been treated in the manner to which they were accustomed: they have been fed a balanced diet; they have been kept in a quiet vivarium at a congenial temperature (70–80°); they have had continuous access to a supply of water; the living quarters have been kept dry and clean.

We do not expect any animals to get sick, but accidents will happen. Rats, too, can develop sniffly noses and running eyes in the winter time. If your animal looks ill, let us know; this will prevent epidemics among the rats, and is an obvious experimental control in your work. Replacements for unhealthy animals will be available.

The following data are of general interest concerning the white rat:

1. Span of life: Between 3 and 4 years.

2. Breeding:
   a. Period of gestation approximately 21 days.
   b. Weaned at three to five weeks.
   c. Litters average about 10, and it is estimated that 5 or 6 litters may be easily reared by a single pair in a year. (the sex ratio is somewhat in favor of the female, although with young rats it is extremely difficult to tell the Hefrom the She).
   d. Rats average about 6 grams (about one quarter of an aunce) at birth, attain full growth in approximately 150 days with an average weight for males of 200 to 300 grams; females are somewhat smaller.

A. The Rat Convoy: Transporting the rats to and from the laboratory is more of a problem than you might guess. Experimental results can be distorted by improper handling at this stage. Note carefully these instructions designed to protect you from the rat, and vice versa.

   1. When going out to pick up the rat from the Vivarium, leave by the front door of the lab, return through the back door. This prevents wrecks at the blind intersections.

   2. Line up in the hall just outside the vivarium. The first three men go to the racks. When the first man comes out with his rat cage, the fourth man goes in to fill his place and so on.

   3. Lift the rat cage from the rack by grasping the sawdust tray with both hands. Place cage gently on the nearby table. Turn cage so that the H-slot end faces your body (if you fail to do this you may pay with a shredded neck tie or ripped sweater as your rat can reach out from the food window). Again pick up the cage by the sawdust tray and return to the lab.

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4. When carrying your rat, walk slowly, keep the cage floor-level and try not to sway the cage from side to side. Don't sneeze on the rat as he's apt to catch your cold.

5. After returning your rat to the vivarium at the end of experimentation, hook on his food cup in the food window at the back of the cage.

6. If you should get a rat bite, be sure you receive treatment if the skin is broken. First Aid Supplies are in the vivarium.

IV. LABORATORY PROCEDURE:

Briefing will begin promptly at 1:15 on weekdays and at 9:00 Saturdays, it is suggested that you arrive 10 or 15 minutes before time in order to read over the experimental procedure before class discussion begins. We ask that you make every effort to be prompt as a rather tight schedule must be adhered to if you are to complete your work within the allotted 4 hours.

When you first arrive at the laboratory, stow your gear in your hall locker. All you will need in the lab is your loose-leaf notebook in which procedure sheets are filed, pencil and millimeter rule (a small 10-cent one will be adequate.)

Pick up a procedure sheet from the end of the desk as you come in the door. Please don't take more than one as we make up only a limited number each week. We know that the unprinted side of this sheet makes splendid scratch-paper, but we have separate supplies of old sheets available just for this purpose.

The first day your section meets the chairs will be pulled up around the lecture desk. On subsequent days, when you come in bring a chair up from your cubicle into this area. The acoustics aren't good and the blackboard is small in Room 253, so if our weekly pre-experiment discussion is to serve its purpose we must pack you a little. The last row of chairs should be no further back than the dividing partition between cubicle 3 and 4.

The discussion of briefing usually lasts 30 to 45 minutes, and consists of a report of the previous week's results and a detailed discussion of the new experiment, with reference to purpose, wiring of apparatus, any special technique and treatment of data. It usually lasts 0 to 45 minutes, at the end of which you will have a five-minute break before beginning experimentation.

Following the break take an inventory of the equipment in your cubicle (see poste list). Report at once any damaged or missing items. By doing this you clear yourself of responsibility for loss or breakage. (If you fail to check this at the beginning of the experiment, it will be assumed that you accepted the cubicle as complete and functioning.)

Next you set up and wire in your apparatus. Then get it checked for correctness by either the instructor or his assistant. DO NOT THROW THE CONTROL BOX SWITCH BEFORE YOU OBTAIN THIS CLEARANCE.

When all students have their apparatus ready for the experiment the person in charge of the lab will turn off the overhead lights. This is the signal for one member of the partnership to go to the vivarium (animal colony) for his rat. (Also see Rule #1). The one who remains in the lab turns on the cubicle drop light and pulls it down close to the surface of the table so that the room is in semi-darkness.

Appendix 1.6

Even when utmost care is exercised to disturb the rat as little as possible during transportation into the lab, you will find that he requires several minutes to adjust to this new environment. All you can do is to insert the bar into the H-slot as quietly as possible and wait.

During experimentation, at least one member of the pair should keep the rat under observation. A glass plate is substitued for the regular cage top to make this task easier. While a recording is made only of the bar pressing response, we are also interested in other behavior that the rat emits. Usually you can get an indication from the procedure sheet of the type of response to look for.

Some experiments will have long stretches where very little of interest will happen. This cannot be avoided without sacrificing some of the certainty of results. We attempt to reduce the boredom at these times by allowing one partner to tend the equipment while the other reads or goes out to the water cooler for a drink, or smoke. However any going out or coming into the lab must be done very quietly and the noise level in the hall kept low.

V. THE LABORATORY REPORT

Experimentation is usually completed early enough to permit you to write up and hand in your report by 5 o'clock. The requirements for each experiment will be explained in the procedure sheet and amplified during the briefing.

Most of the difficulty experienced by beginning students attempting to write reports seems to be concentrated in two areas - labeling kymograph curves and describing behavior other than bar pressing.

The kymograph curve tells a story about the rat's lever pressing behavior. To those who understand its special language, this curve imparts information with precision and brevity. However, the conditions under which this behavior took place must be clearly explained if the figure is to be meaningful. In addition, important changes in behavior as related to the curve should be pointed out so that its implications are not overlooked. This type of complementary information is presented directly under the kymograph record and is what we refer to as "labeling". Here is an example of adequate labeling.

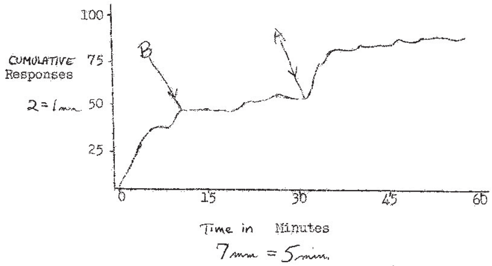

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Figure 1. Cumulative response curve for Rat #22, during extinction of conditioned bar pressing after 23 hours of food deprivation. Extinction was begun in semi-darkness, but after 30 minutes (see A) a continuous light was introduced which had been present throughout conditioning. Note the immediate increase in rate during the next 5 minutes, followed by a sharp decline to the former low rate which continued throughout the final 25 minutes of extinction. It may be inferred from this that only a temporary increase in frequency was effected by the introdudtion of the light stimulus (20 candle power) At point B a loud street noise (horn blowing) occurred following which the rat did not approach the bar during the next 5 minutes.

NOTE: Attention was not called to the rapid rate during the first 10 minutes or to the irregularities in the curve, because these are established characteristics of the extinction curve.

At first it will be difficult for you to decide what should be included in a legend and what may be omitted. Err on the side of inclusion while you are in the process of learning.

The other area of difficulty, the description of behavior, can be easily mastered if you will confine yourself to observables - those responses which you see the animal make. If other experimenters were to stand by you and watch the rat, there would probably be little or no disagreement among you about what you saw the subject do. On the other hand, if each of you tried to interpret what was being "experienced" by the rat, the reports would vary widely.

Consider this example: "The rat <u>expected</u> to get a pellet every time he pressed the bar. When I <u>disappointed</u> him by withholding reinforcement, he became <u>furious</u>. After pressing the lever very rapidly for five minutes, the <u>frustration</u> overcame him and he <u>sulked</u> at the back of the cage." Each of the underscored words is a guess about something going on inside the animal. When we deal with the topic of verbal behavior it will become clear to you how terms of this sort acquire sufficient descriptive validity to make them extremely useful in everyday communication. It should be obvious however, that in establishing an experimental science of behavior one must constantly guard against reading into the behavior of the experimental animal more than is actually observed. Putting yourself in the rat's place - describing how you would "feel" in a similar situation - is an intriguing pastime, but statements derived in this fashion reveal more about the experimenter than the rat. Examining the above example in this light, you will see that the writer is in large part describing his own probable behavior in this situation. Interpreting an animal's behavior in this fashion is called <u>anthropomorphism</u>, one of the most ignominious sins of which an experimental psychologist can be accused (a sin of which most of us are all too frequently guilty).

Another sin in scientific work (by no means restricted to psychologists) is the uncritical assignment of "causes". "Explaining" an event is commonly considered equivalent to finding its "cause". This is at best an oversimplification, since a little consideration makes it evident that the occurence of any event is dependent upon a number of conditions or "causes". At worst, it is an out-and-out fallacy when we fall into the error of assigning <u>mythical</u> causes. If we were to ask the author of our example <u>why</u> the rat "sulked", he would doubtless say: "Because he was frustrated." The attractive convenience of this sort of fictional explanation helps to account for the lure of anthropomorphism. If it is not at once clear to you why we term this "explanation" a convenient fiction, do not despair. Clarification of this point is one of the objectives of this course.

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VI. REGULATIONS

We don't like rules and would be happy to get along without any. However, we have found these five to be essential. Please try to remember them and cooperate in seeing that they are observed.

1. During experimentation it is imperative that the laboratory be kept as quiet as possible. Rats won't work if they can listen. Unfortunately we start out with one strike on us, due to the sound of the equipment. Therefore, we must be especially careful to prevent all noises which we can control. When the overhead lights are turned out, stop all talking and all unnecessary moving about.

2. During experimentation the apparatus and rat must be under constant supervision. At least one member of the partnership must be in the cubicle at all times.

3. Smoking is not permitted in the laboratory room, either during briefing or experimentation. This ruling is aimed at the welfare of your rat, not yours.

4. All clothing which is not actually worn in the lab must be placed in your hall locker before beginning the experiment. The cubicles are too small to serve as both work benches and clothes racks.

5. If you wish to leave the vicinity of the laboratory, obtain permission from the instructor or assistant.

VII. ABSENCE AND MAKE-UP

Your absence from the laboratory will inconvenience you, your partner, and us. Therefore, no absences, other than those accompanied by a written excuse from either the Medical or the Dean's Office are permitted.

VIII. GRADES AND Q UIZZES

Laboratory work will be graded on the basis of your reports and your performance during experimentation. A four point scale is used in scoring reports: 0 = unsatisfactory (requiring that the work be repeated); 1 = poor to fair; 2 = good; 3 = exceptional. In addition there may be periodic short quizzes.

Appendix 2. PSYC 2 Handout: Lab Reports

Appendix 2.1

Psychology 2

Experimental Reports

The scientist's task does not end with the successful completion of an experiment. Data that are "hidden under a bushel" are of little use, and the accepted procedure by which information is disseminated is the written work.

The publication of hundreds of articles each year has led to the development of certain ways of writing scientific reports. The outline given below, which you will follow in writing your reports, is a compromise between the established psychological practice and certain necessities of this course.

It should help you to communicate speedily, easily and more efficiently with your "colleagues."

*　　*　　*　　*　　*　　*

Your report should have a title. For example:

Increase in the Strength of the Bar Pressing Response

Under Conditions of Regular Reinforcement

John Q. Student

Columbia University

The first section of your report is an introduction to all of the material that will follow, and as such is an essential part of the report. The information given here "sets" the stage for the reader and should include:

1) An explicit, but brief, statement of the problem.

2) The relation of your experiment to other experiments.

Usually the introduction can be given adequately in a few brief sentences. Discussion pro or con is not to be included here.

Procedure

A brief statement as to subject(s) (species, sex, age, etc.) and kind of apparatus used. Where a modification of standard equipment has been used, describe this modification.

Specify the operations in your experimental design, stating exactly what you did. Without these facts the reader will be unable to evaluate the results

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Skinner, B. F. (1936). The verbal summator and a method for the study of latent speech. *Journal of Psychology, 2,* 71-107.

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Skinner, B. F. (1957). *Verbal behavior*. Appleton-Century-Crofts.

Appendix 1. PSYC 1 Handout: Laboratory Course Outline

Appendix 2.2

Page Two.

you will later report. In a situation where alternate procedures are feasible ou should state the reasons for your choice.

Results and Discussion

Having previously reported what you did, you are now to present the results of your experiment. Data are to be presented in tables and graphs. (The procedure for compiling tables, drawing figures, and labeling them should already have been differentiated out in your behavior; the format used in Psychology I will be used here.)

Certain questions were asked in your introduction and comments upon these problems, on the basis of your results, are to be made here. Generally your experiment has been performed in order to (a) test some hypothesis or (b) determine how behavior is affected by certain variables under specified conditions. Do your results conform with, or contradict, the results of related or similar experiments? If there is agreement, what are the implications of these findings? If your results are at variance with other studies, the reasons for the contradiction should be considered.

In addition to a discussion of results bearing on the primary purposes of the experiment, incidental findings may be considered as well.

Where your findings lead you to suggest additional relevant studies, or improvements, do so succinctly.

* * * * * *

Note

1. Use paragraphs and sentences when writing your report. Listing points under numerical sequence will not be acceptable. The report is a single unit and don't break the continuity.

2. Write in a straightforward, comprehensive manner. Strive for brevity. Short sentences are better than long ones.

3. Scientific terminology has been developed for a specific purpose. A single word or short descriptive phrase (eg. reinforcement, discriminative stimulus, etc.) is greatly preferred to an extensive discourse that conveys the same information. Besides, it demonstrates to the reader your familiarity with the subject matter you are writing about!