

THE QUANTIFICATION OF DRIVE II,
TWO METHODS OF FOOD PRIVATION

Thesis for the Degree of Ph. D.
MICHIGAN STATE COLLEGE
Orville Auverne Smith, Jr.

1953

This is to certify that the
thesis entitled
The Quantification of Drive II.
Two Methods of Food Privation
presented by

Orville A. Smith, Jr.

has been accepted towards fulfillment
of the requirements for

Ph.D. degree in Psychology

M. Ray Denny
Major Professor

Date September 18, 1953

N.S.

9¹⁹⁷
195

THE QUANTIFICATION OF DRIVE II.
TWO METHODS OF FOOD PRIVATION

By

Orville Auverne Smith, Jr.

A THESIS

Submitted to the School of Graduate Studies of Michigan
State College of Agriculture and Applied Science
in partial fulfillment of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

Department of Psychology

Year 1953

THESE

1-6-56
8

ACKNOWLEDGEMENT

Grateful acknowledgement is made to
Doctor M. Ray Denny for his advice and
assistance which made possible the
successful completion of this research.

TABLE OF CONTENTS

	Page
INTRODUCTION	1
STATEMENT OF THE PROBLEM	12
SUBJECTS	13
APPARATUS.	14
PROCEDURE.	18
PREDICTIONS.	24
RESULTS.	27
DISCUSSION	66
SUMMARY AND CONCLUSIONS.	85
REFERENCES	88

LIST OF TABLES

Table	Page
1 Analysis of variance of latency scores as a function of hours deprivation.	31
2 "F" ratios of latency variances for all % Fed subgroups.	32
3 Analysis of variance of amplitude scores as a function of hours deprivation	36
4 Analysis of variance of amplitude scores as a function of % Fed (LW subgroup)	39
5 Analysis of variance of amplitude scores as a function of % Fed (SW subgroup)	40
6 Analysis of variance of amplitude scores as a function of % Fed (LD subgroup)	41
7 Analysis of variance of activity scores as a function of hours deprivation.	43
8 Analysis of variance of activity scores as a function of % Fed (Combined SW, LD and SD subgroups)	45
9 Analysis of variance of activity scores as a function of % Fed (LW subgroup).	46
10 Chi-square test of linearity for amplitude data of hours deprivation group.	50
11 Chi-square test of linearity for amplitude data of LW subgroup.	51
12 Chi-square test of linearity for activity data of the SD, LD, and SW subgroups combined.	52
13 Correlation coefficient between latencies of hours deprivation group and SD subgroup equated as to activity with a fluctuation of 2 points.	54
14 Correlation coefficient between latencies of hours deprivation group and SD subgroup equated as to activity with a fluctuation of 20 points	55

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

LIST OF TABLES Continued

Table		Page
15	Correlation coefficient between latencies of hours deprivation group and SD subgroup equated as to activity with a fluctuation of 5 points.	57
16	Correlation coefficient between amplitude scores of hours deprivation group and LD subgroup equated as to activity with a fluctuation of 5 points.	58
17	"F" test on variances of the number of trials to extinction for high and low drive subjects of % Fed Group.	60
18	't' test of the number of trials to extinction of the LW subgroup vs. the SD subgroup.	61
19	Correlation coefficients between the deprivation levels of both hours deprivation group and % Fed group with amplitude scores	62
20	Standard deviations from comparable points of amplitude scores of the hours deprivation and % Fed groups	64
21	Correlation coefficients utilizing deprivation level to predict amplitude compared to activity to predict amplitude. . . .	65

LIST OF FIGURES

Figure		Page
1	Apparatus	15
2	Mean activity scores for two groups of animals on 13 consecutive days.	28
3	Latency as a function of number of hours food deprivation.	29
4	Latency as a function of deprivation level with four different reward situations	33
5	Standard deviation as a function of deprivation level with four reward situations. . .	34
6	Amplitude of response in degrees turn of a wheel as a function of hours food deprivation	35
7	Amplitude of a response in degrees turn of a wheel as a function of deprivation level and three types of reward	38
8	Activity level as a function of the number of hours food deprivation	42
9	Activity as a function of deprivation level and four types of reward.	44
10	Mean activity scores of three combined groups (SW, LW, SD) as a function of deprivation level	48
11	Activity, latency and amplitude as a function of the number of hours food deprivation	49

1. $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$

2. $\frac{1}{2} \times \frac{1}{3} = \frac{1}{6}$

3. $\frac{1}{2} \times \frac{1}{4} = \frac{1}{8}$

4. $\frac{1}{2} \times \frac{1}{5} = \frac{1}{10}$

5. $\frac{1}{2} \times \frac{1}{6} = \frac{1}{12}$

6. $\frac{1}{2} \times \frac{1}{7} = \frac{1}{14}$

7. $\frac{1}{2} \times \frac{1}{8} = \frac{1}{16}$

8. $\frac{1}{2} \times \frac{1}{9} = \frac{1}{18}$

9. $\frac{1}{2} \times \frac{1}{10} = \frac{1}{20}$

10. $\frac{1}{2} \times \frac{1}{11} = \frac{1}{22}$

11. $\frac{1}{2} \times \frac{1}{12} = \frac{1}{24}$

12. $\frac{1}{2} \times \frac{1}{13} = \frac{1}{26}$

13. $\frac{1}{2} \times \frac{1}{14} = \frac{1}{28}$

14. $\frac{1}{2} \times \frac{1}{15} = \frac{1}{30}$

15. $\frac{1}{2} \times \frac{1}{16} = \frac{1}{32}$

16. $\frac{1}{2} \times \frac{1}{17} = \frac{1}{34}$

17. $\frac{1}{2} \times \frac{1}{18} = \frac{1}{36}$

18. $\frac{1}{2} \times \frac{1}{19} = \frac{1}{38}$

19. $\frac{1}{2} \times \frac{1}{20} = \frac{1}{40}$

INTRODUCTION

"Among the more elusive variables in the behavior of the intact organism, drive stands preeminent." This quotation from Skinner (17) is probably an understatement, principally because there remains the question of whether drive is actually a primary behavioral variable or whether the behavioral concomitants attributed to it may be derivable in terms of other principles.

Behaviorists, in reaction to the instinct theories, brought forth the term 'primary drive' with the connotation of "greatly diminished reliance upon hypothetical innate sensori-motor connections . . ." (8). However, the behaviorists have had little success in agreeing as to just what drive is and what may be attributed to it.

Referring to drive or motivation, Holt (9) has said, "In short, all of the appetite drives are persistent afferent impulses coming from organs situated within the body, and producing . . . at the outset, that is, previously to trial and error learning, merely random movements of general restlessness." This is the only way he uses the term 'drive' - which in essence is as an internal stimulus and nothing more. Holt's usage does not in the least admit of any 'directive properties' of motivation current in present day psychology.

1. The first step in the process of the scientific method is to ask a question. This question should be based on observation and should be specific and measurable. For example, "Does the amount of sunlight affect the growth of a plant?"

2. The second step is to do background research. This involves looking up information about the topic to see what is already known and to find out what methods have been used in previous studies.

3. The third step is to form a hypothesis. A hypothesis is a statement that can be tested. It should be based on the background research and should be a prediction of what will happen. For example, "If a plant receives more sunlight, then it will grow taller." This hypothesis can be tested by growing two plants under different conditions of sunlight and measuring their growth.

4. The fourth step is to test the hypothesis. This is done by conducting an experiment. The experiment should be designed so that only one variable is changed at a time. In this case, the amount of sunlight would be the variable that is changed. The results of the experiment should be recorded and compared to the hypothesis.

5. The fifth step is to analyze the data. This involves looking at the results of the experiment and seeing if they support the hypothesis. If the results do support the hypothesis, then the hypothesis is accepted. If the results do not support the hypothesis, then the hypothesis is rejected and a new hypothesis is formed.

6. The sixth step is to draw a conclusion. This is a statement that summarizes the results of the experiment and the conclusion that was reached. For example, "The results of the experiment support the hypothesis that more sunlight leads to greater plant growth."

7. The seventh step is to communicate the results. This involves sharing the results of the experiment with others, either through a presentation or by writing a paper. This allows others to see the results and to use the information in their own work.

Guthrie (7) holds a similar viewpoint. Drive or motivation for him is the action of 'maintaining stimuli'. The maintaining stimuli may come from within, e.g., hunger, thirst, or may come from without, e.g., electric shock, intense auditory stimuli. These stimuli 'drive' the organism.

Tolman (19) removes the concept from the equation with raw stimulus and gives it status as a physiological 'state', saying, "The ultimate motivators of all behavior . . . are, we assume, certain innately provided appetites and aversions. These consist in ultimate demands to get to physiological quiescences or from final physiological disturbance." The demands in this case are 'internal initiating physiological states' which emerge as one of his four independent causes of behavior. This conceptualization obviously retains instinctual and teleological connotations.

Skinner's system (17) contains a flat rejection of drive as a stimulus or as having any teleological implications. He says, "In measuring the strength of a drive we are in reality only measuring strength of behavior. A complete account of the latter is to be obtained from an examination of the operations that are found to affect it. The 'drive' is a hypothetical state interpolated between operation and behavior and is not actually required in a descriptive system." And elsewhere he states, "The conception of drive as a state rather than as a stimulus is

valuable in avoiding arguments about purpose." In these writings are found one of the first formal considerations of 'drive' as an unobservable theoretical construct.

Keller and Schoenfeld (13) more recently have again supported the Skinnerian outlook by saying that drive is not stimulus, not a response, and not a physiological concept. For them drive is the name for the fact that certain operations can be performed on an organism that have an effect upon behavior which is different from other operations.

In the above, drive has been reduced to a set of operations which have an effect on behavior. This treatment gives drive the essential requisites of a theoretical construct. However, even these conceptualizations have not resulted in the strict theoretical formulation employed by Hull, whose theory is founded on the concepts of drive and drive reduction. Hull's formulation is the most explicit available at the present time and, consequently, the most testable.

The Hullian Concept of Drive

Hull (10, 11) has attempted to formalize drive by making explicit the experimentally manipulated antecedent conditions and the associated observable behavioral consequences. In order for a concept to obtain status as a construct, it must meet several requirements.

The requirements for a construct as put forth by Maatsch and Behan (14) are:

1. Operational definition which contains "a description of manipulations which are performed in the laboratory, and a description of the effects of these manipulations upon the behavior of the experimental subjects."
2. The concept "must bear explicitly stated relationships to other constructs in the theory of which it is a part."
3. It must "vary unidimensionally and continuously, and must affect at least one abstracted aspect of behavior such that the behavior will vary unidimensionally and continuously."

Hull (10) operationally defines drive (D) by indicating the manipulations in the experimental situation (antecedent conditions) which is the number of hours elapsed since the last satiation period for the particular primary drive in question. For the hunger drive, the conditions would be the number of hours since the last food intake. The consequent event or behavioral concomitant is "the amount of energy which will be expended by the organism." If energy is expended by an organism and we ignore the magnitude of energy expenditure as a result of neural activity alone without concomitant muscular activity; or that involved in maintaining muscle tonus, then the energy transformation

from potential into kinetic will result chiefly from gross movements of the organism's musculature. In other words, the organism will be more active, i.e., the random movements of the organism will increase.

We assume from this that with an increase in the number of hours of deprivation there would occur an increase in the activity of the organism. Hull (10) uses the now classical work of Richter (16), Wada (20), and others to illustrate just this point.

As to the second requirement, Hull (11) relates D to the other constructs in his system by the formula

$$sEr = sHr \times V \times J \times K \times D$$

where sEr is reaction potential, sHr is habit strength, V is stimulus intensity dynamism, J is the delay in reinforcement and K is the amount of reward. sEr or performance is measured in terms of latency of response, amplitude of response, number of trials to extinction and the probability of reaction evocation.

Regarding the 3rd requirement, Hull's theory must say that with all other factors held constant, any variation in D will result in variation of performance (sEr) as measured by above methods, and the variation in performance will occur for every variation in drive.

According to Hull (10), ". . . when a condition arises for which action on the part of the organism is a prerequisite to optimum probability of survival of either the individual

or the species, a state of need is said to exist." A need, then, produces a primary drive and every individual drive summates physiologically with every other drive to produce a generalized drive state in the organism. It is this generalized drive which is formulated as the construct (D).

The Scientific Usefulness of Drive (D)

The problems involved in using this concept in a strict mathematical theory of behavior are not overlooked by Hull. He recognizes that there must be two equations: one expressing the degree of drive as a function of the amount of deprivation, another expressing the vigor of organismic action as a function of the degree of drive. One of the major problems is that of finding a measurement parameter with a specified extensive unit with which to express the degree of drive on the behavioral side. If (D) in conjunction with the other factors V, K, J, and sHr, bears a constant relationship to reaction potential regardless of the dominant type of privation and if this fundamental relationship can be quantitatively determined, then Drive may be used as a genuine theoretical construct. If, on the other hand, a set of equations must be derived for each primary drive constituting the major component of generalized Drive, there will be no reason to consider generalized Drive as a useful scientific construct. Inasmuch as Drive (D) is one of the most fundamental concepts in Hull's theory validating the concept is essential..

The Problem of Quantification

A curve representing drive as a function of hours of deprivation may be derived easily by using latency, amplitude, or trials to extinction as Yamaguchi (21) has done. However, as Hull (10) points out, this ignores the whole problem of getting at the intervening variable of Drive itself. Hull specifically mentions the necessity of defining a unit independent of the performance measurements with which to represent Drive. Inasmuch as the activity level of the organism is assumed to be directly associated with the drive level of the animal and yet is not considered to be a function of habit, it may be that the answer to the problem can be found in the measurement of activity. It seems reasonable that if Drive determines the energy output of the organism that possibly the activity level of the organism may be taken as the measurement parameter and provide the unit of measurement for Drive. In other words, Drive may be quantifiable in terms of activity level. If activity level is to serve as the unit of measurement, then a situation must be devised in which amount of deprivation may be functionally related to activity level, and activity level may be functionally related to latency, amplitude and number of trials to extinction.

With this situation the experimenter could manipulate drive conditions in terms of type of deprivation as well as

amount. If activity level can be used as a measure of (D) then regardless of type of deprivation, activity levels could be equated and the comparisons for the two conditions of drive should result in very similar measurements of latency, amplitude and trials to extinction, e.g., a correlation coefficient between latencies obtained from different animals under different types of deprivation but equated as to activity level should prove to be very highly significant. The use of a correlation coefficient is a much weaker requirement than demanding equal latencies for equal activity levels, but it may be that different types of deprivation may result in different absolute magnitudes of response and the use of the correlation technique would allow for this difference. Again, then, if different types of privation, or different methods of inducing drive with but one type of privation, result in different absolute values of sEr , still the shapes of the curves should be the same and a factor should be ascertainable which would enable one to convert the scores of the first condition into the scores of the other condition.

Program of Validation

A complete investigation into the possibility of quantifying drive in terms of activity level would involve two major investigations:

1. One investigation would have to be made involving

a cross comparison of different types of deprivation. For example, a group of animals trained under thirst deprivation would be compared to a group under hunger conditions. Activity levels for the two groups would be equated and latency and amplitude would be compared. This would serve to indicate whether or not activity level could be used as a measurement parameter for various types of deprivation.

2. The second investigation would involve using a different method of setting up drive conditions but with the same type of deprivation. In other words a different set of operations which should result in the same physiological effect for the animal should be performed. The consequences based upon equating of activity levels could then be compared to the results derived from the usual 'hours deprivation' method.

Problems Involved in Carrying Out Program

Before this program could be carried out there would necessarily be a great deal of preliminary investigation not only in the line of practical difficulties but also regarding the rationale for size of reward in the water and food cross comparison (1 above).

Specifically, what size food pellet equals what size water reward as an equal reinforcing value? This work has been carried out by Davis (4). The actual work on problem 1 remains to be completed. The experiment to be reported here

is concerned with the second investigation mentioned.

The alternative method of setting up drive with the same type deprivation (in this case, food) was chosen with the object not only of finding a method which would yield a change in physiological state similar changes brought about in the hours deprivation method, but also to determine whether or not a different method might yield more homogeneous results, or, better said, yield more precise results.

The 'percentage fed' method was chosen for this purpose. With this method the amount of food normally consumed by the animal which results in satiation is measured over a period of time. When the day to day amount consumed becomes asymptotic the average amount on the asymptote-days is taken as the basal amount to satiation. In varying the drive level for the various organisms, a specified percentage of the basal amount is fed to the animal a determined time before testing.

This method should result in a differential physiological state for the organism just as the hours deprivation method does. We assume that this method will consequently alter the drive of the organism in a uniform fashion.

This specific technique has, to the writer's knowledge, never been used, but it is similar to methods used by Skinner (17) and Bruce (2). Skinner fed his animals 0, 2, 4, or 6 grams of food before measuring the rate of response in the bar-pushing apparatus. The resulting curves, however,

were not clear cut; there was considerable overlap, but the general result was more rapid responding with the lesser amounts of food consumed. The results of Bruce (2) seemed to show an effect on performance brought about by prefeeding or prewatering immediately before testing. This may possibly be avoided by increasing the time between feeding and testing.

A complete study of the major drive variables could be made in this situation by altering reward size and reward type as well as deprivation level.

STATEMENT OF THE PROBLEM

The problem here undertaken is to determine whether or not activity level may be used as a means of quantifying the Hullian construct of Drive (D) when Drive is induced by two different methods of food deprivation. The study will also include variations in size and type of reward in order to gain information as to possible interaction effects between Drive (D) and the variable incentive reinforcement (K).

SUBJECTS

The subjects used in the present experiment were 48 experimentally naive male albino rats from the colony maintained by the Department of Psychology of Michigan State College. The ages ranged from 90 to 120 days.

Apparatus

In order to investigate the present problem an apparatus was constructed in which it was possible to measure activity level, response latency, response amplitude or force, and the number of responses to extinction. It consisted of a rectangular box constructed of $\frac{1}{2}$ " plywood with overall dimensions of 20" x 16" x 11".

Figure 1 presents a cross section of the apparatus. At the bottom of the activity chamber there was a false floor which was supported by 3 springs and a rubber ball at its exact center. At the four corners of this false floor, small attached, rubber balls served as stops, preventing the floor from tipping any more than $\frac{1}{4}$ " in any direction.

A guillotine door at one end of the activity chamber, when raised, gave access to a hinged, 4" x 2" panel. This panel was constructed of a thin rectangular piece of wood, 1/16" diameter; at the upper end of the panel was a small piece of $\frac{1}{2}$ " plywood 2 $\frac{1}{2}$ " long, which formed a base for the hinge and brass strips (See Figures 1, 2, and 4).

The flat gray interior was illuminated by a 7-watt bulb covered by a piece of opal-flashed glass situated at the end of the box opposite the guillotine door.

Entrance to the box from the top was gained through a hinged door, in the center of which was placed a large clear-glass observation window.

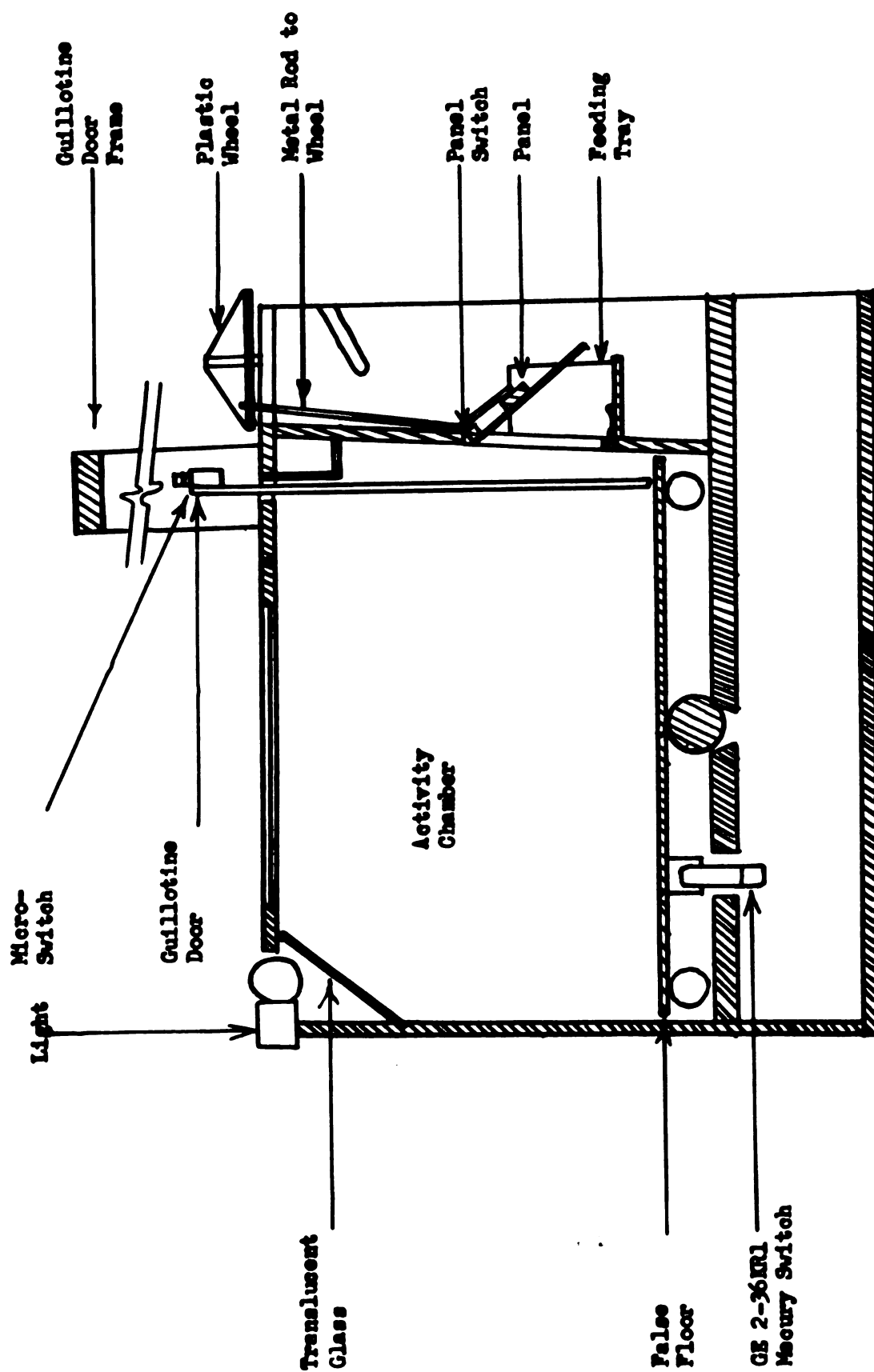


Figure 1. Apparatus described in text

Activity level was measured by a device consisting of a GE 2-36KRL mercury switch, suspended vertically beneath the false floor and connected in series to a Gorrell and Gorrell 115 volt electric counter. The mercury switch was situated beneath the floor in such a manner that movement by the animal tilted the floor, causing the liquid in the tube to move, momentarily making and breaking the circuit in accordance with the strength and number of movements (See Figure 1).

A thin metal rod, hinged at the top of the panel was twisted so as to extend to the back of the panel in one direction and to the top of the box in the other. The rod was so designed that the lower half of it "rode" back on the panel as it was pushed open, and the upper half came forward toward the activity chamber. By means of this rod, the force applied to the door was transmitted to a slender stick of wood which was attached to a light, plastic wheel, mounted on a plastic axle. The force of the response, which was applied to the door, was thus transmitted into the movement of the wheel. The distance which this wheel moved was measured in degrees. Because the wheel offered very little resistance to the metal rod, the initial movement of the push-panel invariable caused it to turn out of range of further movements of the metal rod. That is, the degrees which the wheel was displaced depended upon the force with which the door was first struck, and not merely upon the distance through which the door was moved.

Response latency was measured by a Standard Electric Timer, connected in series through two switches. The first switch consisted of two brass strips, one being placed along the top of the push-panel, and the other being attached to the upper push-panel jamb, directly above the strip on the push-panel. A second switch was attached to the top of the guillotine door. When the guillotine door was raised, this switch was closed. Thus, when the push-panel was closed and the guillotine door opened, the circuit was closed, starting the Timer. When the panel was opened by approximately $1/32$ " , the switch was opened, stopping the Timer. Thus the timer started when the guillotine door was raised and stopped as the panel was being pushed open by an animal.

Single reward pellets were placed on a tray which was located approximately $\frac{1}{4}$ " below the lower panel jamb. Metal walls were built up on either side of this tray to discourage exploratory behavior. The corners of these walls were bent towards the door, forming stops to prevent the animals from forcing the door and breaking it. This also reduced exploratory behavior. On the tray itself a small wall of solder was constructed to hold the food pellets in place.

PROCEDURE

The portion of the procedure which was common to all groups will be presented first, and the differences among the groups will be specified subsequently.

Habituation

All animals were handled for a period of 20 minutes on each of three days previous to being placed in the apparatus. The handling consisted of stroking the animals, picking them up, setting them down and allowing them to run freely on a table top on which several boxes were placed. On the fourth day the S's were placed in the apparatus for a period of six minutes during which time activity level was recorded. These six minute habituation trials in the apparatus continued for five days or up to the 9th day of the experimental series.

Training

On the 9th day the animals were given the regular six minute habituation trial and at the end of this trial the guillotine door was raised, allowing the animal access to the hinged panel. The panel door was open to its fullest extent (approximately two inches) making the reward pellet on the food receptable easily accessible. After the animal

had taken the reward the panel door was slowly closed and the guillotine door was carefully lowered. As soon as the animals had finished eating, indicated by cessation of chewing movements, the guillotine door was raised again, presenting the S with the opened panel and the reward pellet on the receptacle. This procedure continued for 8 trials. On the 9th trial the panel was opened only about $\frac{1}{2}$ inch or about $\frac{1}{4}$ of the full open position. This forced the animal to nose the panel slightly in order to obtain the pellet. Another trial was given in the same manner, making a total of ten reinforced responses for the day. On the next day the animals received two trials with the door in the full open position and eight trials with the door in the $\frac{1}{4}$ open position. The following day the panel was presented in the $\frac{1}{4}$ open position for two trials and was fully closed for the remaining eight trials. The animals, then, received 10 trials per day with the door fully closed for a period of five more days. At the end of training each animal had received 80 rewarded trials in the apparatus.

The six minute activity period before the first trial of each day was recorded.

Latency and amplitude measures for each trial were recorded on the last three days of training.

Testing

On the 17th day of the series the test trials began.

The animals were randomly assigned to the particular deprivation level under which they would be tested on that day. The appropriate deprivation manipulations were carried out (details to be specified below) and the animals were introduced into the apparatus. The six minute activity levels were recorded and the S's were given four rewarded trials in exactly the same manner as during the last five training days. Latency and amplitude were recorded for each of the four test trials. If an S refused to respond for a period of six minutes it was removed from the apparatus and a 'No Response' was recorded. Each animal was tested at each deprivation level under consideration, however the order of levels was systematically randomized for each S. There were six deprivation levels studied; hence, there were six testing days, bringing the experimental series to a total of 22 days.

Extinction

On the 23rd day of the series the animals were randomly assigned to a deprivation level. They were again given the six minute activity level period in the apparatus and the panel pushing response was then extinguished to a three minute no response criterion. The number of responses to criterion, latency and amplitude were recorded.

A summary of the procedure common to all groups is as follows:

- Days 1 - 3 Handling - 20 minutes per day.
- Days 4 - 8 Habituation in apparatus - 6 minutes - activity recorded.
- Days 9 - 16 Training - 10 trials per day - activity recorded on all days, latency and amplitude recorded on days 14, 15, and 16 only.
- Days 16 - 22 Testing - 4 trials per day under appropriate drive condition - activity recorded - latency, amplitude measured on each trial.
- Day 23 Extinction - to a three minute no response criterion - activity recorded - latency and amplitude recorded on all trials.

All animals were weighed at the beginning and end of the 23 day series and at least one other time during the series.

The aspects of the procedure which differentiated the groups were as follows:

Hours Deprivation Group - These animals were fed ad lib until day 8 of the series when they were put on a 24 hour deprivation schedule. They continued on this schedule during the training days 9-16. 22½ hours after their last feeding the animals were placed in the apparatus for the activity level period and the 10 training trials. The reward pellet was approximately 0.08 grams of dry Calf Manna. After the conclusion of the trials the animals were placed in a feeding cage for a period of at least six minutes, after which time they received the same type pellets used as reward pellets for a period of 15 minutes. They then received a wet mash composed of a 40% Purina dog chow and 60% water combination for a period of 25 minutes. After this time they were

removed to the home cages until the following day.

The procedure during the testing days involved feeding the animals with the above mentioned satiation procedure a specified number of hours before they were to be run. The periods were 1, 2, 6, 12, 24 and 48 hours measured from the time the animals were removed from the feeding cage and replaced in the home cage. Water was available in both home and feeding cages.

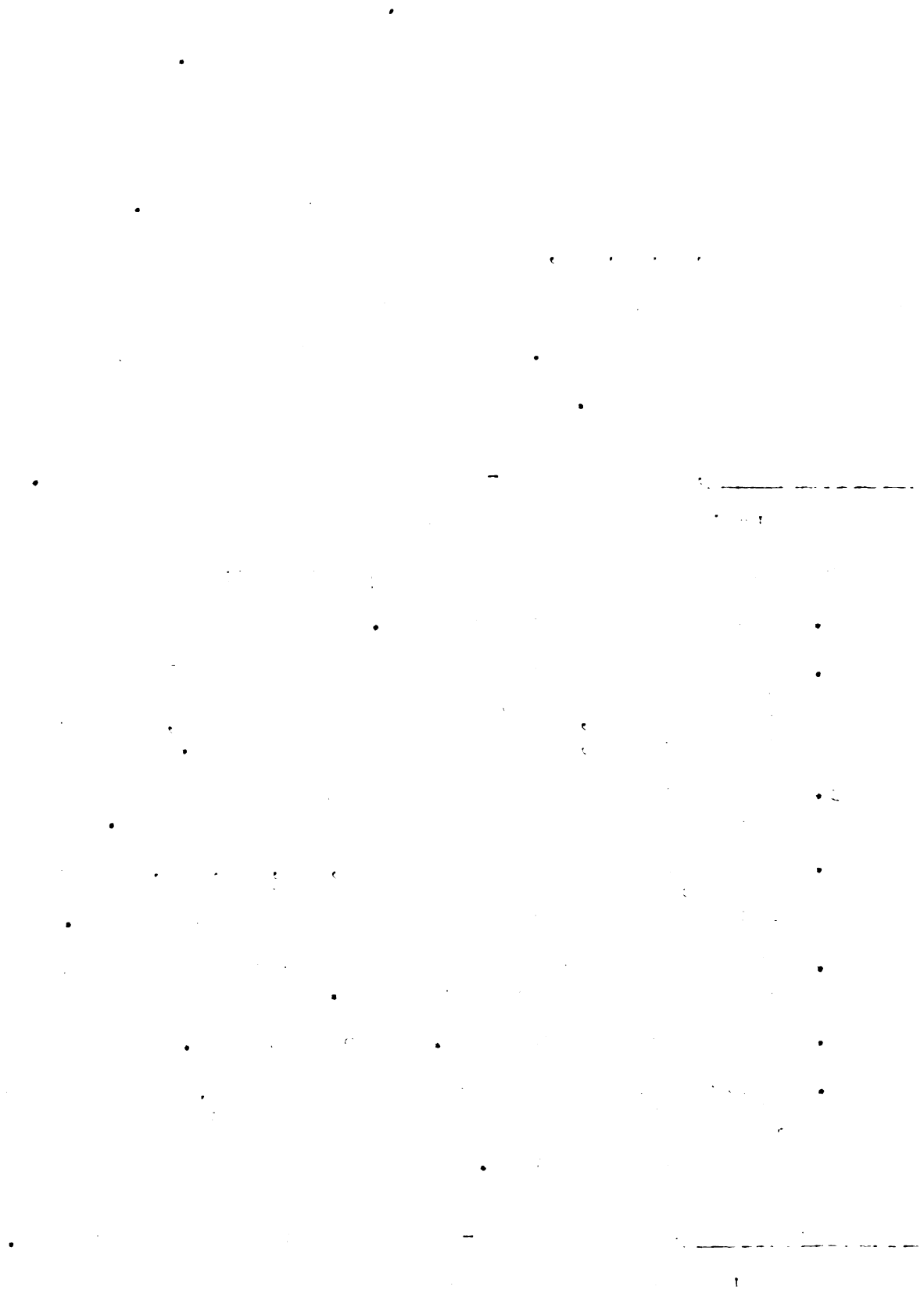
Large Wet Mash, % Fed Group - hereafter to be designated LW.

The S's in this category were handled in the same manner as those above with the exceptions that:

1. They were fed wet mash only.
2. The amount of mash consumed by each animal was recorded on the basis of four hours eating time the first day, 1 3/4 hours the second day, 1 hour the third day, 1/2 hour the remaining days.
3. They were on a 24 hour deprivation schedule from the beginning of the habituation days (Day 4).
4. During testing they were fed 0, 10, 25, 50, 75 or 90 percent of the average amount of mash they had eaten on the four days previous to the test days.
5. All animals were run 3 hours after they had consumed the above mentioned percentage.
6. The reward pellet was 0.2 gm of wet mash.
7. After testing they were fed enough mash, after a six minute delay in the feeding cage, to equal 100% of the previously determined amount consumed to produce satiation.

Small Dry Pellet, % Fed Group - hereafter to be designated SD.

These S's were handled as the LW group with the following



exceptions:

1. They were fed 10 minutes on dry pellets (Calf Manna) and 30 minutes on wet mash: the total volume of wet food consumed was computed each day.
2. Reward pellet was 0.08 gm of dry pellet.
3. Fed only mash before running - fed pellets and mash after testing to equal 100% of satiation amount.

Large Dry Pellet, % Fed Group - hereafter to be designated LD.

The only difference between this group and the SD group was the reward pellet size, which was 0.2 gm for this group.

Small Wet Mash, % Fed Group - hereafter to be designated SW.

This group differed from the LW group regarding size of reward which was 0.08 gm of wet mash and time fed during training trials, which was 40 minutes.

A summary of the critical differences among groups is as follows:

Hours Deprivation N = 11	S's satiated a specified number of hours before running. Reward was 0.08 gm dry Calf Manna.
LW - % Fed N = 14	S's run 3 hours after receiving specified percent of amount required to produce satiation. Reward was 0.2 gm wet mash.
SW - % Fed N = 6	S's run 3 hours after receiving specified percent of amount required to produce satiation. Reward was 0.08 gm wet mash.
LD - % Fed N = 7	S's run 3 hours after receiving specified percent of amount required to produce satiation. Reward was 0.2 gm dry Calf Manna.
SD - % Fed N = 10	S's run 3 hours after receiving specified percent of amount required to produce satiation. Reward was 0.08 gm dry Calf Manna.

PREDICTIONS

In order to facilitate the presentation of the results most of the specific predictions to be tested by the present study are given below. Predictions 1 through 12 are deductions from Hullian theory and the assumptions seemingly implicit in his system with particular regard to the assumption that activity level will measure Drive (D) directly.

1. From the fourth to the ninth day of the series (corresponding to the first 5 days on Fig. 2) the average activity of all animals will gradually decrease because of adaptation or what may be termed a decrease in 'exploratory drive'.

2. The decrease in activity level will be greater for the animals satiated during this period than for those under $22\frac{1}{2}$ hours of food deprivation.

3. When the satiated animals are put under $22\frac{1}{2}$ hours deprivation activity level will rise abruptly to the level of the regularly deprived group and remain constant at that level as long as the deprivation schedule is maintained.

4. There will be differences between deprivation levels regarding activity and amplitude which will vary positively with deprivation level and latency which will

vary negatively with deprivation level.

5. The function for amplitude will be a straight line.

6. The curve for reciprocals of latency will be negatively accelerated.

7. The curve for activity should approximate Yamaguchi's (21) curve which represents Drive (D) as a function of hours deprivation. Yamaguchi's curve is described as, ". . . from $h = 0$ to about 3 hours drive rises in an approximately linear manner until the function abruptly shifts to a near horizontal, then to a concave-upward course, gradually changing to a convex-upward curve reaching a maximum of 12.3 σ at about $h = 59$, after which it gradually falls to the reaction threshold (sLr) at around $h = 100$."

8. If animals from the Hours Deprivation Group are matched with animals from the % Fed Group on the basis of activity level, the correlation coefficient between their corresponding latencies and amplitudes of response will be highly significant and positive.

9. Groups receiving large reward will perform better than those receiving small reward, i.e., lower latencies, higher amplitudes.

10. There will be no significant differences in activity level as a function of size or type of reward.

11. There will be more trials to extinction for animals

extinguished under higher deprivation conditions than those extinguished under low deprivation conditions.

12. There will be differences between groups in extinction based upon size of reward, i.e., the larger the reward, the more trials to extinction.

13. If % Fed method delimits level of deprivation better than the number of hours since satiation, then a higher correlation will result from deprivation levels of the % Fed Group with latency and amplitude than with levels of the Hours Deprivation Group and latency and amplitude.

14. Also, if % Fed method delimits level of deprivation better than the number of hours since satiation, the standard deviation at each level for % Fed animals will be less than for approximately corresponding points for the Hours Deprivation Group.

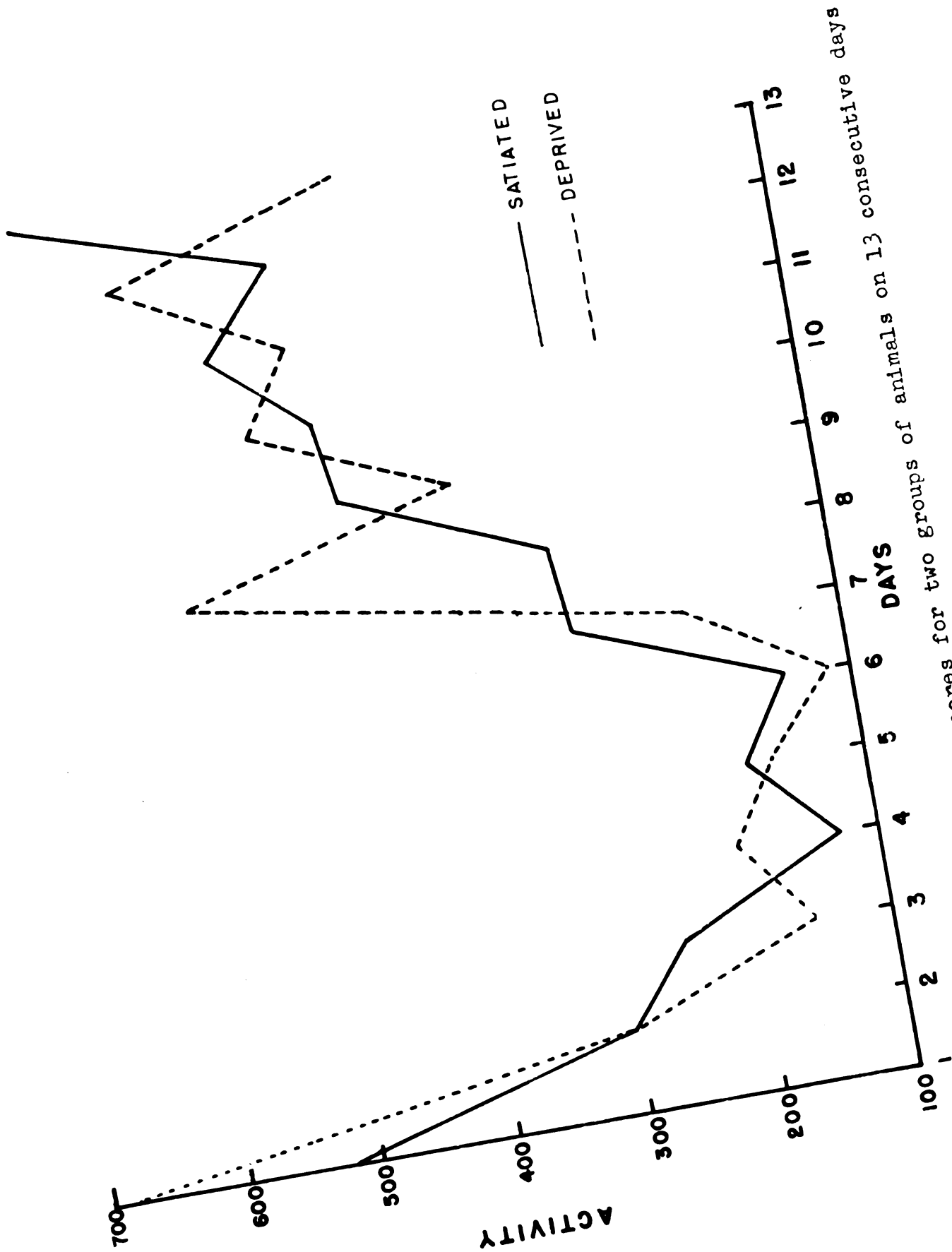
15. If activity measures Drive more reliably than hours deprivation, then there should be a higher correlation coefficient between activity and latency, and activity and amplitude than for hours deprivation correlated with latency and amplitude.

RESULTS

Figure 2 shows fluctuations in activity level of two groups of animals measured over a six minute period for thirteen consecutive days. The activity levels of the animals decreased during the first five days in the box (habituation period) as predicted. Prediction 1 was confirmed.

The animals in the Deprived Group were under $22\frac{1}{2}$ hour hunger conditions while the animals in the Satiated Group had food available at all times. Despite this difference in the groups there were no differences in activity level. Inspection reveals complete overlap of the two curves. Prediction 2 was not confirmed. Upon putting animals of the Satiated Group under $22\frac{1}{2}$ hours food deprivation on the sixth day, there was no sudden increase in activity level, and no separation of the two curves. The increase in activity level was gradual and was shown by both groups of animals from the sixth to the thirteenth days, i.e., during the training period in which time food was presented to the animals via panel pushing just subsequent to the six minute activity period. Prediction 3 was not confirmed.

Latency as a function of deprivation level in the Hours Deprivation Group is shown in Fig. 3. Inasmuch as the variances for these animals proved to be homogeneous



Activity scores for two groups of animals on 13 consecutive days

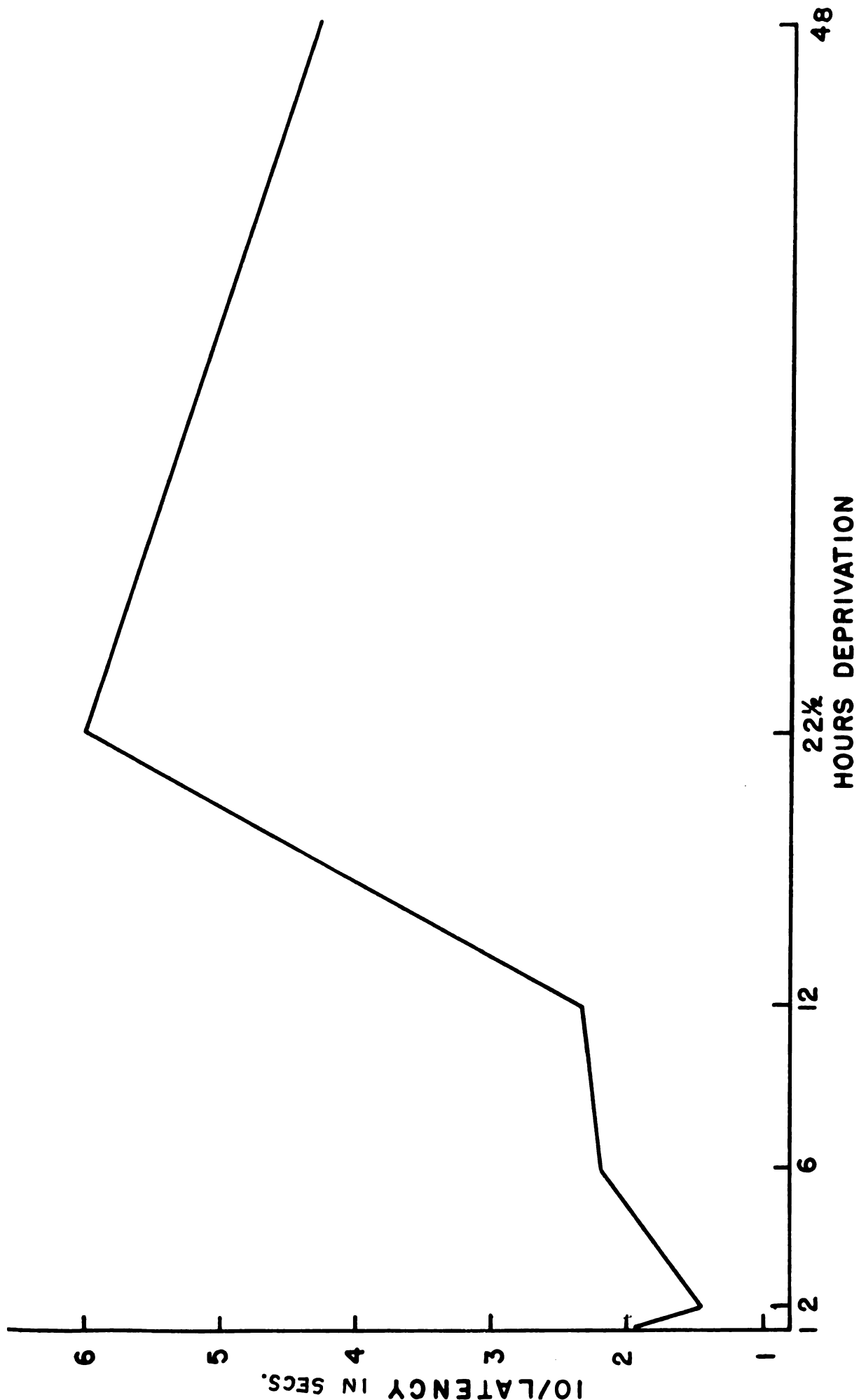


Figure 3. Latency as a function of number of hours food deprivation

an analysis of variance was performed on the data, which is given in Table 1. From the insignificant "F" it is obvious that the differences in means of the various levels could have occurred by chance. Figure 4 shows latency as a function of deprivation for the % Fed Groups, representing the four curves on a single graph to indicate the differences due to size and type of reward. Table 2 presents the results of "F" tests performed on the variances of the % Fed Group to determine whether or not the homogeneity of variance requirement was fulfilled. The "F" test indicates that the variances within the groups; that is, between drive levels, are so divergent as to preclude the possibility of performing any valid analysis of variance or "t" test. An attempt to normalize the data by eliminating all scores beyond 4σ of the mean failed to make the 'F's' non-significant.

Regarding latency data prediction number 4 is not confirmed by the results of the Hours Deprivation Group and no statement can be made concerning the results of the % Fed Group.

Figure 5 shows the changes in standard deviations of latencies with changes in deprivation level.

Figure 6 presents the changes in amplitude of response as a result of change in deprivation for the Hours Deprivation Group. Table 3 presents the analysis of variance

TABLE 1
ANALYSIS OF VARIANCE OF LATENCY SCORES AS A
FUNCTION OF HOURS DEPRIVATION

Source of variation	Sum of squares	d.f.	Mean square
Levels	137.85	5	27.57
Subjects	172.10	10	17.21
Interaction	606.45	44	13.785
No significant differences			

TABLE 2

"F" RATIOS OF LATENCY VARIANCES FOR ALL % FED SUBGROUPS

		0	10	25	50	75	90
LW	σ^2	.042	.030	.096	.067	.259	.267
	0		-	-	-	+	+
	10			+	-	+	+
	25				-	+	+
	50					+	+
	75						-
	90						
LD	σ^2	.096	.255	.109	.247	1.795	10.038
	0		-	-	-	+	+
	10			-	-	+	+
	25				-	+	+
	50					+	+
	75						+
	90						
SD	σ^2	.056	.188	.118	.373	1.932	5.76
	0		+	-	+	+	+
	10			-	-	+	+
	25				+	+	+
	50					+	+
	75						+
	90						
SW	σ^2	.0004	.0021	.0096	.011	.036	.616
	0		+	+	-	+	+
	10			-	+	+	+
	25				-	-	+
	50					-	+
	75						+
	90						

+ indicates significance at 5% level or less.

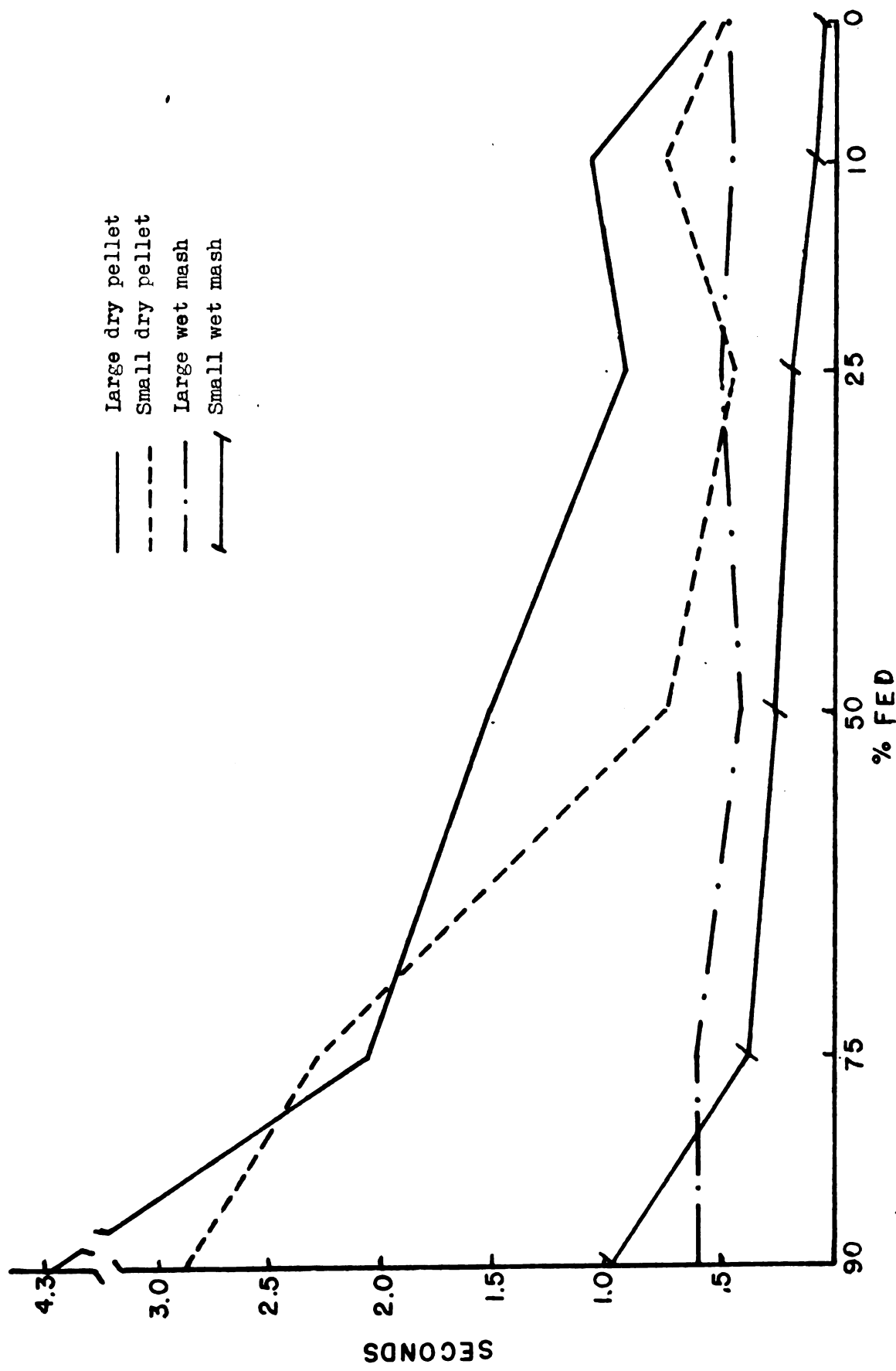


Figure 4. Latency as a function of deprivation level with four different reward situations

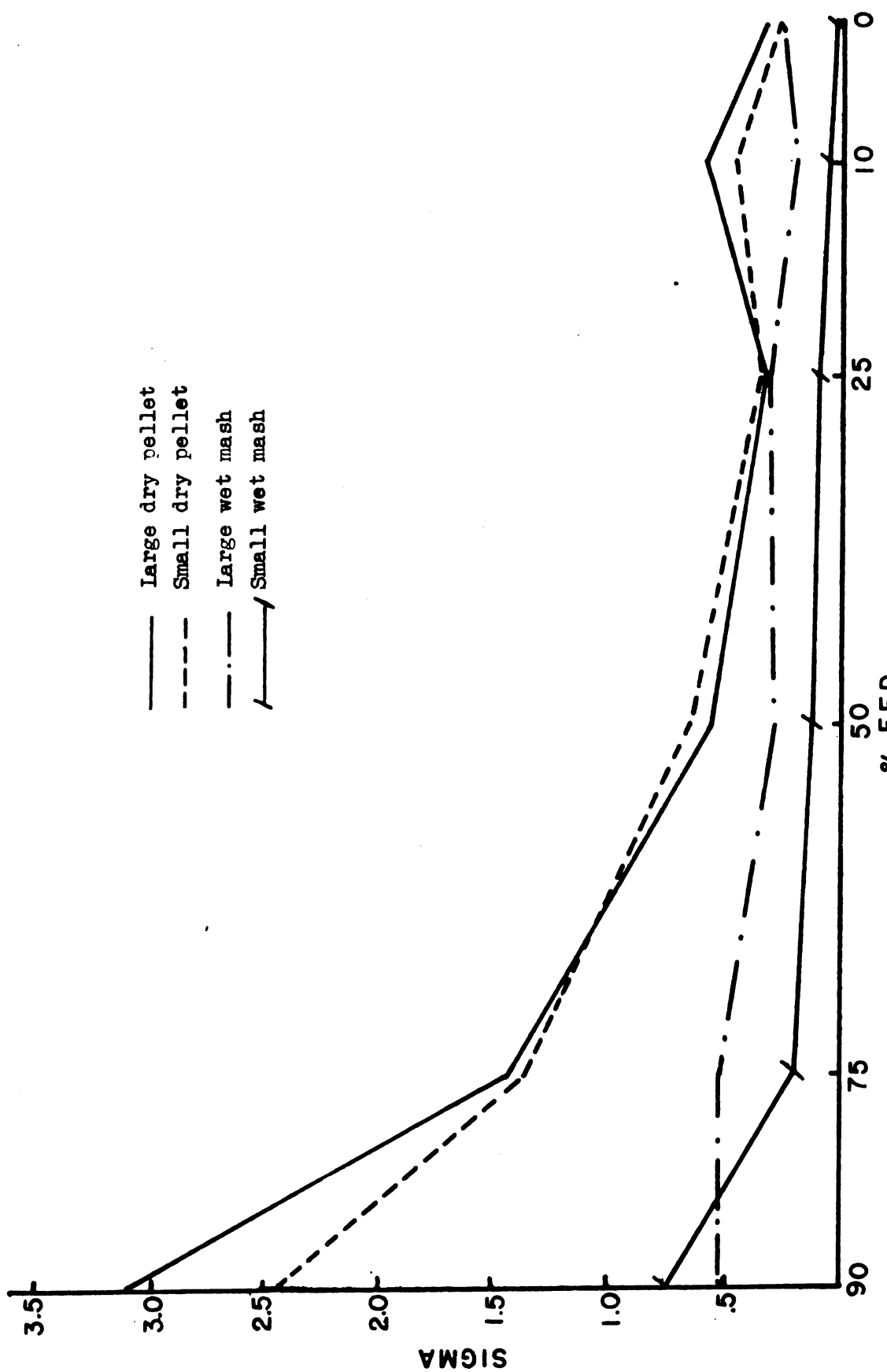


Figure 5. Standard deviation (latency) as a function of deprivation level and four types of reward

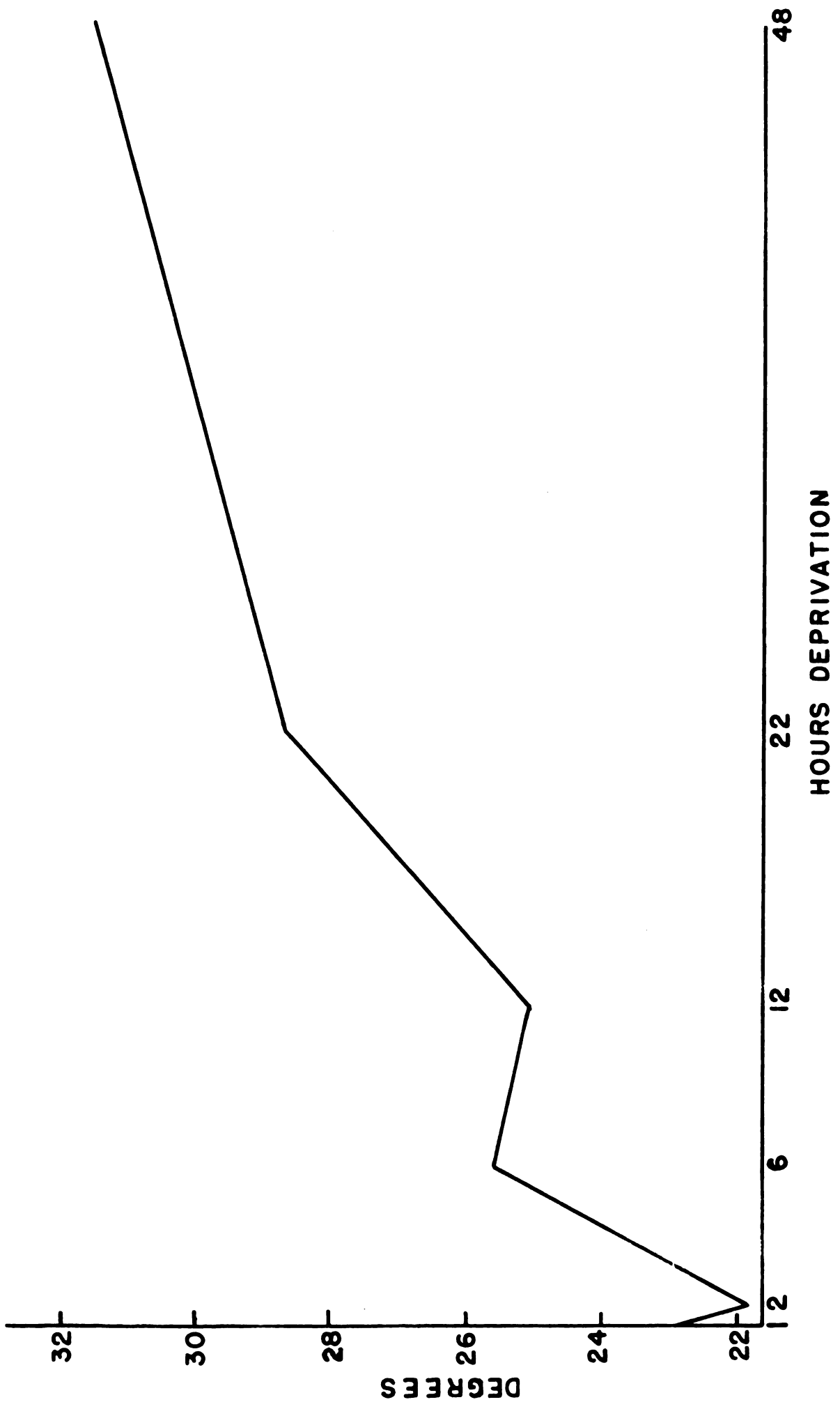


Figure 6. Amplitude of response in degrees turn of a wheel as a function of hours food deprivation

TABLE 3
ANALYSIS OF VARIANCE OF AMPLITUDE SCORES AS A
FUNCTION OF HOURS DEPRIVATION

Source of variation	Sum of squares	d.f.	Mean square
Levels	612.512	5	122.50**
Subjects	737.199	10	73.72
Interaction	606.705	43	14.109

**Significant at 1% level of confidence

1.

• •

• •

• •

• •

performed on these data. The results support the respective part of prediction 4, namely that amplitude varies directly with increase in deprivation level.

In Fig. 7 the changes in amplitude as a function of deprivation level are given for the LW, SW, and LD subgroups of the % Fed Group. Apparatus failure prevented obtaining accurate measurement for the entire SD Group, hence the data are not included. Also there was a slight difference in the setting of the amplitude measuring instrument for the LW Group, making comparisons with this group somewhat suspect. However, a mean curve for the three groups was determined and plotted. This mean curve is also represented in Fig. 7 and seems to lend support to prediction 5 concerning the linearity of the amplitude function.

Tables 4, 5, and 6 present the results of analyses of variance for the LW, SW and LD Groups respectively on the amplitude scores. Using the % Fed method prediction 4 is again supported.

The increase in activity with increase in deprivation for the Hours Deprivation Group is represented in Fig. 8 and the analysis of variance indicating significant differences is found in Table 7. The related graph for the % Fed Groups is Fig. 9 and the analyses of variance are shown in Tables 8 and 9. It was found that the LW Group differed significantly from the other three groups regarding both

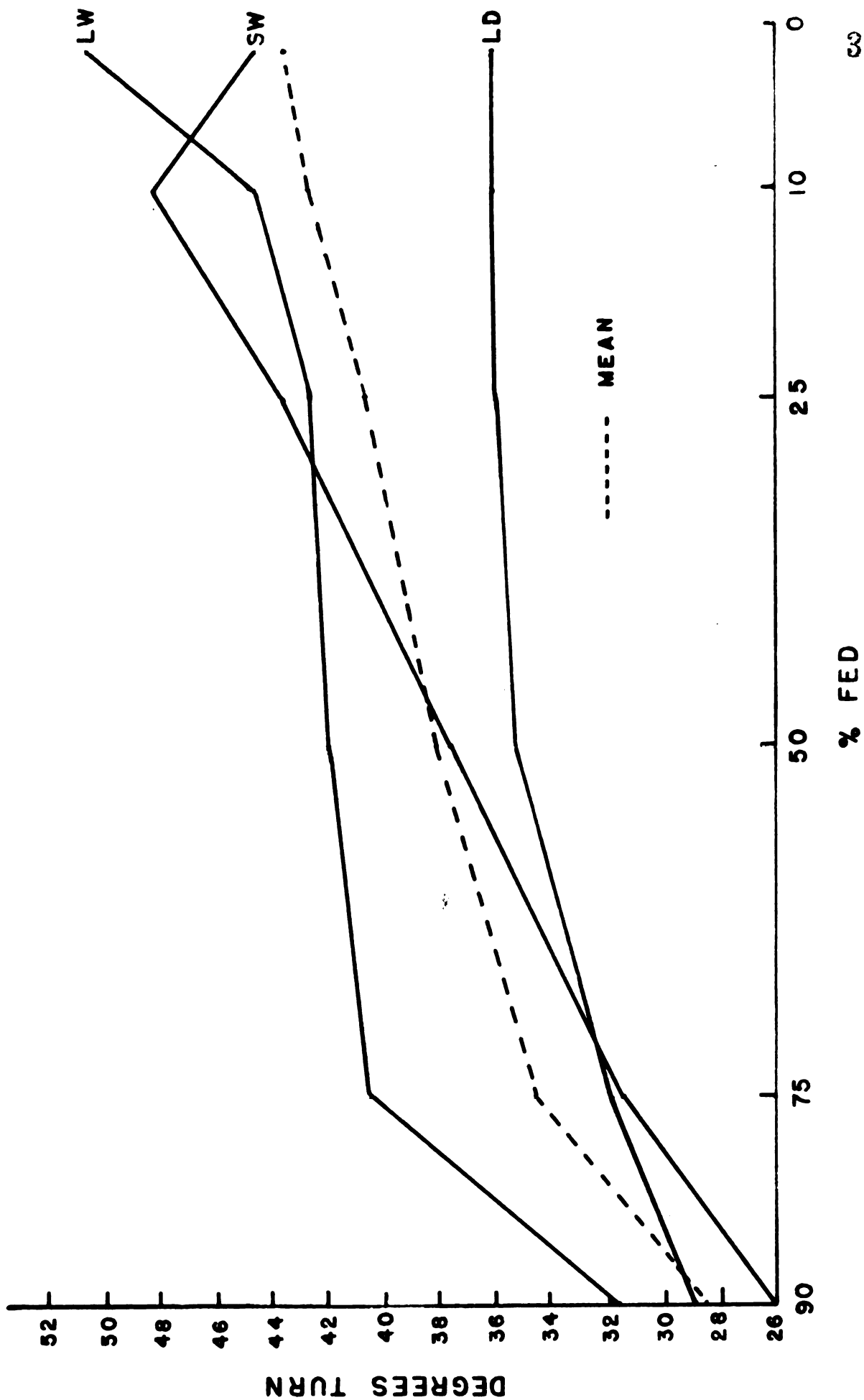


Figure 7. Amplitude of a response in degrees turn of a wheel as a function of deprivation level and three types of reward

TABLE 4
ANALYSIS OF VARIANCE OF AMPLITUDE SCORES AS A
FUNCTION OF % FED (LW SUBGROUP)

Source of variation	Sum of squares	d.f.	Mean square
Levels	2,713	5	542.6
Subjects	8,587	13	660.5
Interaction	11,300	65	173.85

$F = 3.12$ - significant at 3% level of confidence

1. The first part of the document is a list of the names of the members of the committee who have been appointed to study the problem of the

2. The second part of the document is a list of the names of the members of the committee who have been appointed to study the problem of the

3. The third part of the document is a list of the names of the members of the committee who have been appointed to study the problem of the

4. The fourth part of the document is a list of the names of the members of the committee who have been appointed to study the problem of the

5. The fifth part of the document is a list of the names of the members of the committee who have been appointed to study the problem of the

6. The sixth part of the document is a list of the names of the members of the committee who have been appointed to study the problem of the

7. The seventh part of the document is a list of the names of the members of the committee who have been appointed to study the problem of the

8. The eighth part of the document is a list of the names of the members of the committee who have been appointed to study the problem of the

9. The ninth part of the document is a list of the names of the members of the committee who have been appointed to study the problem of the

10. The tenth part of the document is a list of the names of the members of the committee who have been appointed to study the problem of the

TABLE 5
ANALYSIS OF VARIANCE OF AMPLITUDE SCORES AS A
FUNCTION OF % FED (SW SUBGROUP)

Source of variation	Sum of squares	d.f.	Mean square
Levels	2226.2	5	445.24**
Subjects	2373.99	5	474.79
Interaction	1548.35	25	61.93

**Significant at 1% level of confidence

TABLE 6
ANALYSIS OF VARIANCE OF AMPLITUDE SCORES AS A
FUNCTION OF % FED (LD SUBGROUP)

Source of variation	Sum of squares	d.f.	Mean square
Levels	345.7	5	69.14
Subjects	2441.97	6	406.99
Interaction	984.67	30	32.82

F = 2.11 - less than 10% level of confidence

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

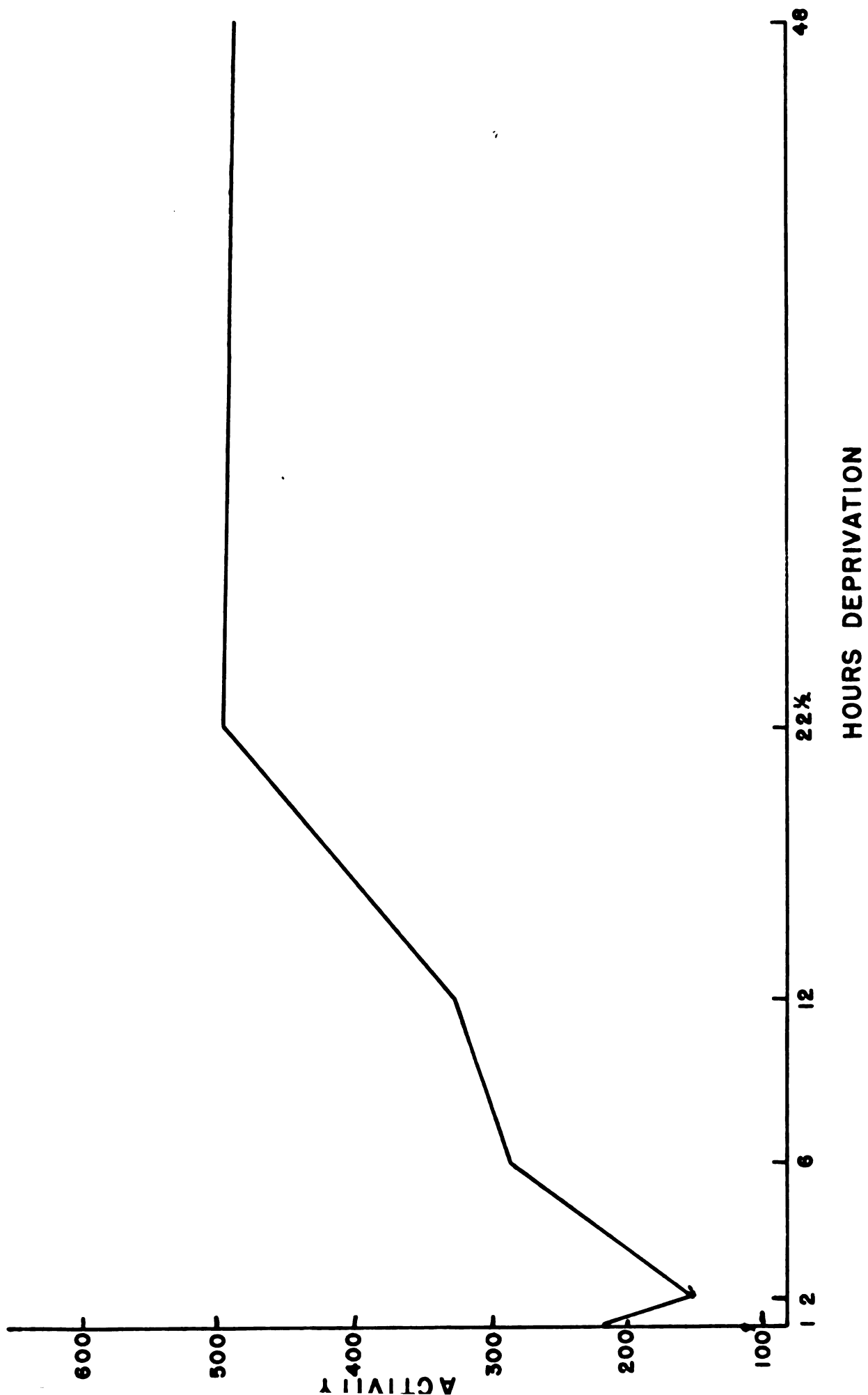


Figure 8. Activity level as a function of the number of hours food deprivation

TABLE 7
ANALYSIS OF VARIANCE OF ACTIVITY SCORES AS A
FUNCTION OF HOURS DEPRIVATION

Source of variation	Sum of squares	d.f.	Mean square
Levels	1,096,949	5	219,390**
Subjects	684,369	10	68,437
Interaction	912,536	50	18,251

**Significant at 1% level of confidence

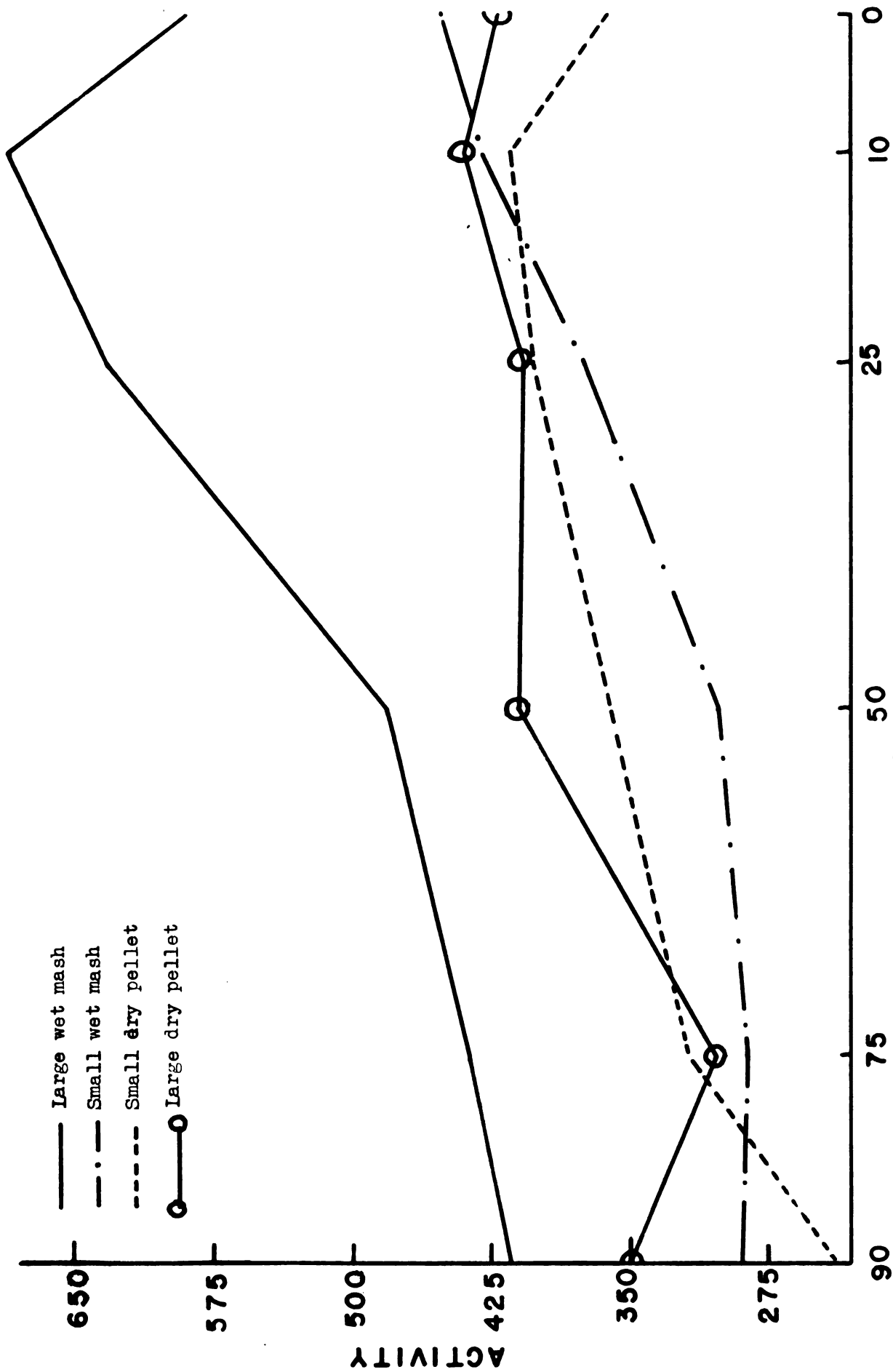


Figure 9. Activity as a function of deprivation level and four types of reward.

TABLE 8
ANALYSIS OF VARIANCE OF ACTIVITY SCORES AS A
FUNCTION OF % FED (COMBINED SW, LD AND
SD SUBGROUPS)

Source of variation	Sum of squares	d.f.	Mean square
Levels	395,666	5	79,133**
Subjects	1,302,462	22	59,203
Interaction	927,908	110	8,436

** Significant at 1% level of confidence

.....

• •

.....

f

g

h

i

j

k

l

m

n

o

p

.....

.....

q

TABLE 9
ANALYSIS OF VARIANCE OF ACTIVITY SCORES AS A
FUNCTION OF % FED (LW SUBGROUP)

Source of variation	Sum of squares	d.f.	Mean square
Levels	720,499	5	144,100**
Subjects	2,258,717	13	173,747
Interaction	1,257,629	65	19,348

** Significant at 1% level of confidence

1. *Journal of the American Medical Association*, 1997; 277: 1039-1043.

means and variances so that a comparison with the other three groups could not be made; however, the LD, SD, and SW subgroups were found to have comparable means and variances, hence were combined into a single group (Table 8). Figure 10 shows the mean curve for these three subgroups. All the results using the activity measure clearly support prediction 4.

Curves representing amplitude, latency, and activity as functions of hours of deprivation are combined on Fig. 11 to indicate the similarity of shapes, particularly regarding the drop in all curves at the two-hour level.

The Chi square test for linearity as given in Table 10 shows that the deviations from linearity for the amplitude data in the Hours Deprivation Group is not significant, indicating the rectilinearity is the best assumption for the relationship.

Using the amplitude data from the LW subgroup of the % Fed Group, which appeared when plotted to be somewhat curvilinear, it was found that there was still no evidence to indicate any significant deviations from rectilinearity. This Chi square test is found in Table 11.

Due to the extreme variability of the latency data, nothing can be said concerning the true shape of the curve.

The activity data for the SD, SW, and LD subgroups combined were analyzed for linearity in Table 12 and the

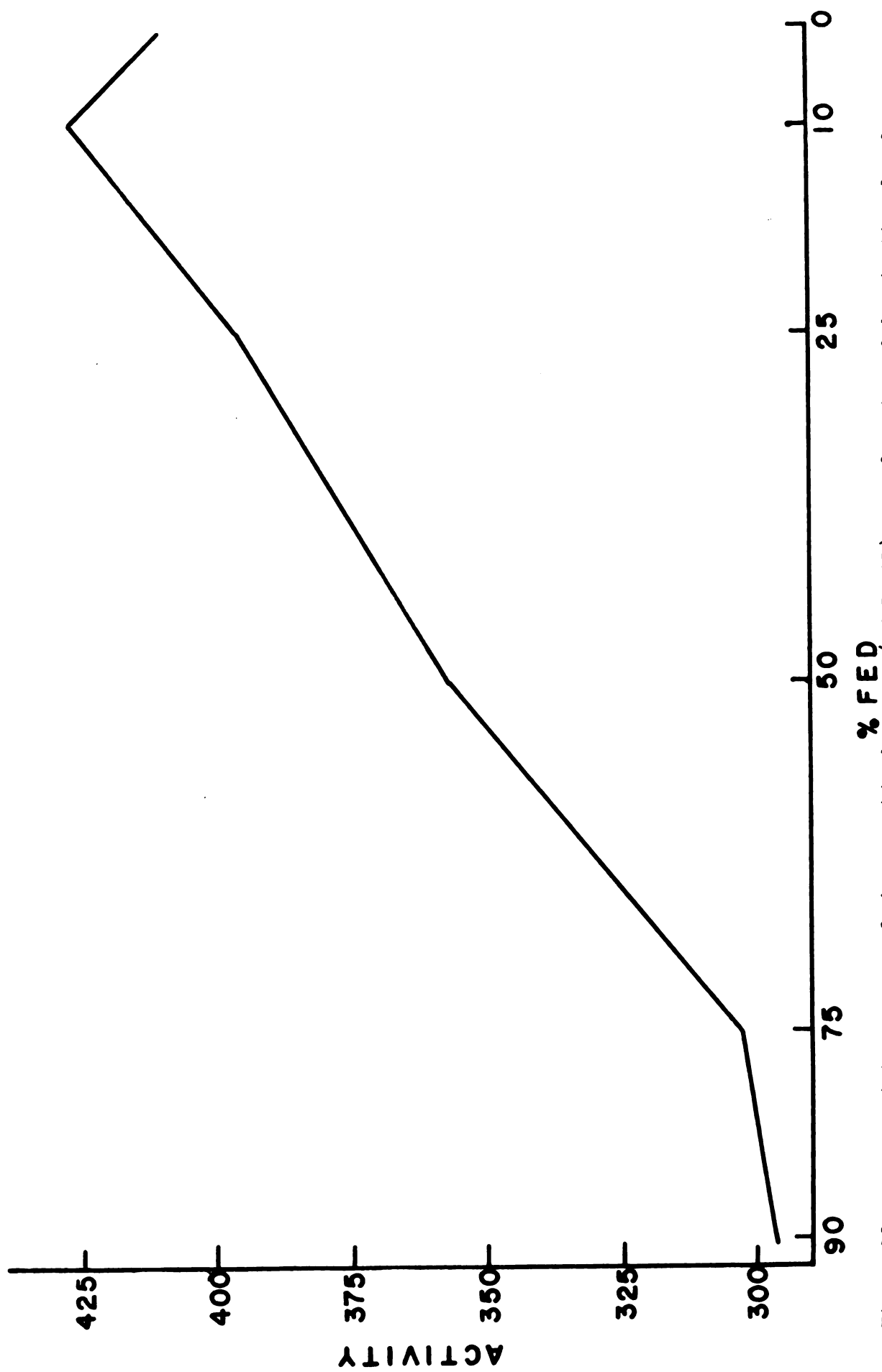


Figure 10. Mean activity scores of three combined groups (SW, LW, SD) as a function of deprivation level

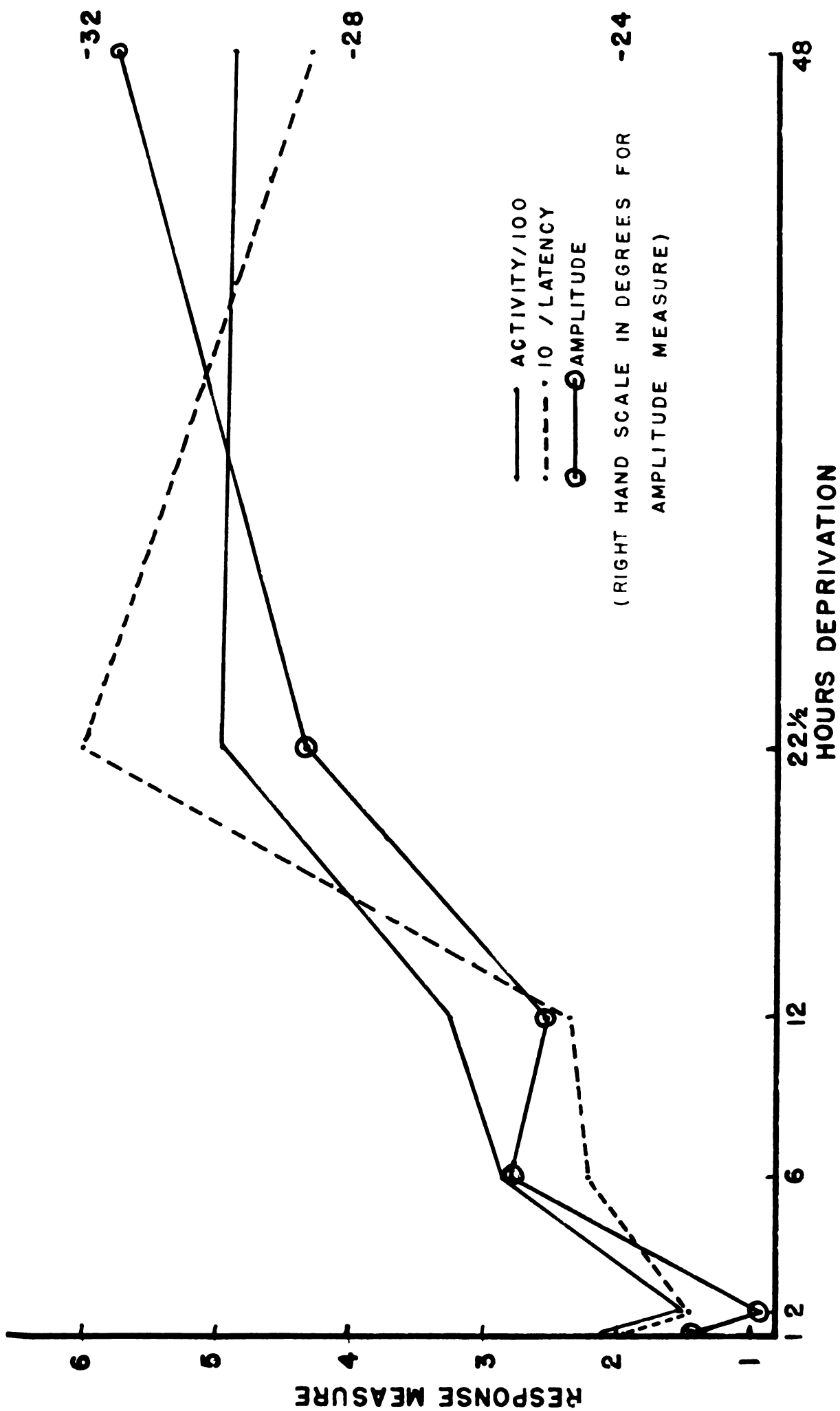


Figure 11. Activity, latency and amplitude as a function of the number of hours food deprivation

TABLE 10
CHI-SQUARE TEST OF LINEARITY FOR AMPLITUDE DATA
OF HOURS DEPRIVATION GROUP

Pearson 'r'	.557
Eta coefficient	.527
Chi-square	2.496 - not significant

1

2

3

4

5

6

7

8

9

10

11

TABLE 11
CHI-SQUARE TEST OF LINEARITY FOR AMPLITUDE DATA
OF LW SUBGROUP

Pearson 'r'	.346
Eta coefficient	.365
Chi-square	1.22 - not significant

0

-

.....

.

1.1

.

.....

.....

TABLE 12
CHI-SQUARE TEST OF LINEARITY FOR ACTIVITY DATA
OF THE SD, LD, AND SW SUBGROUPS COMBINED

Pearson 'r'	.351
Eta coefficient	.388
Chi-square	4.36 - not significant

deviations were found not to be significant; hence, activity as a function of deprivation level in the % Fed animals is most safely considered as rectilinear. However, the analysis of activity in the Hours Deprivation Group resulted in a Chi square of 9.3. A Chi square of 9.49 is needed for significance at the 5% level of confidence with 4 d.f.; however, one would still not reject the possibility that the data are curvilinear. Inspection of these data indicates that negative acceleration would probably be the best assumption if the drop from 1 hour to 2 hours is ignored. However, neither rectilinearity nor negative acceleration could be considered similar to the function found by Yamaguchi (21). Therefore no support was found for prediction 7.

With respect to prediction 8 which is concerned with the possibility of using activity as a measurement parameter of the construct Drive, three different analyses were made. Each analysis used a different amount of variation in the matching of the activity levels. The first Pearson 'r' (Table 13), using subgroup SD of the % Fed Group to equate for size and type of reward with the Hours Deprivation Group, was computed allowing a plus or minus fluctuation of 2 activity points. The N was limited to 16 with this procedure and the derived 'r' of 0.29 between latencies was not significant. Allowing a 20 point deviation (Table 14) an N of 23 was obtained from the same groups as above. In this comparison the last 3 training days were used as a

... ..

... ..

... ..

... ..

... ..

... ..

... ..

... ..

... ..

... ..

... ..

... ..

... ..

... ..

TABLE 13

CORRELATION COEFFICIENT BETWEEN LATENCIES OF
HOURS DEPRIVATION GROUP AND SD SUBGROUP
EQUATED AS TO ACTIVITY WITH A
FLUCTUATION OF 2 POINTS

$$\Sigma X = 44.92$$

$$\Sigma Y = 35.75$$

$$\Sigma X^2 = 271.7722$$

$$\Sigma Y^2 = 200.1505$$

$$\Sigma XY = 138.674$$

$$'r' = .29 + \text{not significant}$$

.....

.....

.....

.....

.....

.....

TABLE 14
CORRELATION COEFFICIENT BETWEEN LATENCIES OF
HOURS DEPRIVATION GROUP AND SD SUBGROUP
EQUATED AS TO ACTIVITY WITH A
FLUCTUATION OF 20 POINTS

$$\Sigma X = 45.17$$

$$\Sigma Y = 32.94$$

$$\Sigma X^2 = 130.3545$$

$$\Sigma Y^2 = 85.2280$$

$$\Sigma XY = 74.1898$$

$$'r' = .24 - \text{not significant}$$

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

source instead of the testing days. The resulting 'r' of 0.24 was not significant. Table 15 shows the 'r' which was based on a 5 point deviation using the testing days of the SD Group as a source. This increased the N to 34, but the obtained 'r' of 0.26 was still not significant.

Because of the previously mentioned apparatus failure there was no accurate amplitude data for the SD subgroup; however, the LD subgroup had the same range of amplitude score as the Hours Deprivation Group and was selected for the amplitude analysis. The correlation between amplitude scores of the LD subgroup and the Hours Deprivation Group, equated as to activity plus or minus 5 points was found to be -0.27 (Table 16). Prediction 8 clearly receives no support.

Prediction 9, concerning size of reward, was definitely not confirmed at least as far as latency data are concerned. This is obvious by inspection of Fig. 9. The small reward groups performed better than the large reward which is opposite to the prediction; therefore, no statistical test was employed. Regarding the amplitude data very little can be said because of the change in setting of the measuring device for the LW Group and the confounding of reward type in the other two groups. The crossing of the SW and LW curves (Fig. 6) seems to indicate, however, that at least all differences were not in favor of the large reward group. It may be concluded that in this experiment size of reward

TABLE 15
CORRELATION COEFFICIENT BETWEEN LATENCIES OF
HOURS DEPRIVATION GROUP AND SD SUBGROUP
EQUATED AS TO ACTIVITY WITH A
FLUCTUATION OF 5 POINTS

$$\Sigma X = 65.5$$

$$\Sigma Y = 126.4$$

$$\Sigma X^2 = 463.00$$

$$\Sigma Y^2 = 956.76$$

$$\Sigma XY = 347.77$$

$$'r' = .26 - \text{not significant}$$

TABLE 16

CORRELATION COEFFICIENT BETWEEN AMPLITUDE SCORES OF
HOURS DEPRIVATION GROUP AND LD SUBGROUP
EQUATED AS TO ACTIVITY WITH A
FLUCTUATION OF 5 POINTS

$$\Sigma X = 799$$

$$\Sigma Y = 656$$

$$\Sigma X^2 = 28,955$$

$$\Sigma Y^2 = 18,668$$

$$\Sigma XY = 21,487$$

$$'r' = -.27 - \text{not significant}$$

with the values employed was not positively correlated with performance.

Reference to Fig. 7 indicates that there were no differences among the SW, LD, and SD subgroups regarding activity which would tend to support prediction 10. It was found that the LW Group had lost an average of 17 grams body weight from the beginning of the experiment while on the average all other groups gained weight. Inasmuch as there were no differences between LD, SD, and SW subgroups, the indications are that the increased activity of the LW Group was due to the loss of body weight instead of to size or type of reward.

With respect to the extinction data there is support for prediction 11 as to absolute numbers. However, as indicated in Table 17, the variances are much too disparate to allow any valid 't' test to be performed. The only valid analysis which could be performed was between the LW and SD subgroups as given in Table 18. The resulting significant difference, however, gives no indication of the particular variable bringing about the difference because of the confounding of size and type of reward variables. It may possibly indicate an interaction effect between the two. Consequently no statement is made concerning prediction 12 which posited an influence of size of reward on the number of trials to extinction.

Table 19 gives the correlation coefficients between

TABLE 17

"F" TEST ON VARIANCES OF THE NUMBER OF TRIALS TO
EXTINCTION FOR HIGH AND LOW DRIVE SUBJECTS
OF % FED GROUP

	High	Low
σ	25.98	9.04
σ^2	676.	82.
Mean ²	811.2	95.66

F = 8.49 - significant at 1% level of confidence

1. The first part of the document is a list of the names of the members of the committee.

2. The second part of the document is a list of the names of the members of the committee.

3. The third part of the document is a list of the names of the members of the committee.

4. The fourth part of the document is a list of the names of the members of the committee.

5. The fifth part of the document is a list of the names of the members of the committee.

6. The sixth part of the document is a list of the names of the members of the committee.

TABLE 18

't' TEST OF THE NUMBER OF TRIALS TO EXTINCTION OF
THE LW SUBGROUP VS. THE SD SUBGROUP

	LW	SD
σ	9.3	8.48
$\bar{X}$	20.6	10.3
N	9.	10.
σ_m	3.29	2.82

$$\sigma_{\text{dif.}} = 4.33$$

$$t = \frac{10.3}{4.33} = 2.38 - \text{significant at the 5\% level of confidence}$$

1. The first part of the document is a letter from the President of the United States to the Congress, dated January 3, 1862. It is a very important document, as it contains the President's annual message to Congress. The letter is written in a formal, dignified style, and it is one of the most important documents in the history of the United States. It is a document that has been read and studied by many generations of Americans, and it is a document that has shaped the course of our nation's history.

2. The second part of the document is a letter from the Secretary of the Treasury to the Congress, dated January 3, 1862. It is a very important document, as it contains the Secretary's report on the state of the Treasury. The letter is written in a formal, dignified style, and it is one of the most important documents in the history of the United States. It is a document that has been read and studied by many generations of Americans, and it is a document that has shaped the course of our nation's history.

3. The third part of the document is a letter from the Secretary of the Interior to the Congress, dated January 3, 1862. It is a very important document, as it contains the Secretary's report on the state of the Interior. The letter is written in a formal, dignified style, and it is one of the most important documents in the history of the United States. It is a document that has been read and studied by many generations of Americans, and it is a document that has shaped the course of our nation's history.

4. The fourth part of the document is a letter from the Secretary of the War to the Congress, dated January 3, 1862. It is a very important document, as it contains the Secretary's report on the state of the War. The letter is written in a formal, dignified style, and it is one of the most important documents in the history of the United States. It is a document that has been read and studied by many generations of Americans, and it is a document that has shaped the course of our nation's history.

TABLE 19

CORRELATION COEFFICIENTS BETWEEN THE DEPRIVATION
LEVELS OF BOTH HOURS DEPRIVATION GROUP AND
% FED GROUP WITH AMPLITUDE SCORES

Group	Correlation 'r'
Hours Deprivation	.53 -- significant at 1% level
% Fed	.27 -- not significant

5

1. The first part of the document is a list of the names of the persons who have been appointed to the various positions of the Board of Directors of the Corporation.

6

1. 1

2. The second part of the document is a list of the names of the persons who have been appointed to the various positions of the Board of Directors of the Corporation.

7

1. 1

8

1. 1

3. The third part of the document is a list of the names of the persons who have been appointed to the various positions of the Board of Directors of the Corporation.

deprivation level and amplitude for both % Fed and Hours Deprivation Groups. The 'r' of 0.53 for the Hours Deprivation Group as compared to the 'r' of 0.27 for the % Fed Group (utilizing the data of the LD subgroup as it is the most comparable group to the Hours Deprivation Group) indicates a trend toward the superiority of the Hours Deprivation Group because of the significance of the 0.53 correlation and lack of significance in the 'r' of 0.27. The difference between the coefficients was not statistically significant. These results do not support prediction 13.

Prediction 14 receives no support from the data given in Table 20. The standard deviations for the % Fed Group are consistently larger than for the Hours Deprivation Group, indicating that the procedure used for the latter group served to delimit deprivation more precisely.

The slight superiority of deprivation level in predicting amplitude over activity predicting amplitude is not of sufficient magnitude to either support or reject prediction 15. The assumption of no difference is the safest. Data are given in Table 21.

TABLE 20
STANDARD DEVIATIONS FROM COMPARABLE POINTS OF
AMPLITUDE SCORES OF THE HOURS DEPRIVATION
AND % FED GROUPS

Group	σ	
	At 0% or 22½ hours deprivation	At 90% or 2 hours deprivation
Hours Deprivation	5.31	3.09
% Fed -- LW	17.61	9.25
LD	11.94	5.31
SW	14.14	6.58

[illegible][illegible]

1. *Journal of Management Studies*, 1997, 34, 1, 1-14.

1000

TABLE 21

CORRELATION COEFFICIENTS UTILIZING DEPRIVATION LEVEL
TO PREDICT AMPLITUDE COMPARED TO ACTIVITY
TO PREDICT AMPLITUDE

Deprivation level correlated with amplitude

Hours Deprivation Group	'r' = .53
% Fed Group	'r' = .34

Activity correlated with amplitude

Hours Deprivation Group	'r' = .50
% Fed Group	'r' = .23

DISCUSSION

As is the case in many experiments, the peripheral data, analyzed simply because they are available, have produced illuminating implications. The first indication that activity level does not reflect Drive, per se, is found in the gradual decrease in activity of animals under $22\frac{1}{2}$ hours deprivation (Fig. 2). The decline for these animals actually exceeded in some degree the decline in activity of the satiated animals. The lack of any difference between the groups presents evidence contrary to the implications assumed by Hull (10) to be present in the work of Wada (20), Richter (16) and others; namely, that the general activity of the organism is a function of deprivation level. The present data indicate that with the gradual decline in activity an asymptote is reached and after introduction of food into the apparatus there is an increase in activity which shows the common negative acceleration of a 'normal learning curve'. This apparently represents activity as a function of learning rather than of Drive or deprivation. If this be the case, then the consequent side of Hull's operational definition of Drive has been removed and Drive has been left hanging by its antecedent conditions. As further support for the thesis that the bulk of the activity measure does not reflect Drive but Habit, is the lack of

correlation between the performance (sEr) measures of the two groups (Hours Deprivation and % Fed) when they were equated as to activity level (prediction 8). Besides showing that activity cannot be used as a basic measurement parameter for the quantification of Drive, the lack of correlation indicates that activity is peculiar to the situation and to the past experience of the organism rather than to a 'state' of the organism which would be common to all members of the species when they were put under the same deprivation conditions.

The question may then arise as to why activity varies positively with deprivation level as was indicated by the analyses of variance and the correlation coefficients. And even more disturbing is the question of why amplitude varies with deprivation level if neither Drive nor habit is invoked to explain it.

The answers to these questions must necessarily involve some reformulation of current Hullian theory. It is believed that utilizing our knowledge of physiology, in conjunction with a strict mechanistic approach to the study of the overt behavior of the organism, we may arrive at a plausible answer to the question, 'Is organismic activity a function of generalized Drive or is it a function of learning?'

In answering this question we must first recognize that a certain amount of activity is due to the structural

connections between afferent and efferent nerve fibers. Modern neurophysiology provides a comparatively thorough list of the various innate responses of the organism to external and internal stimuli and also lists the interconnections from sense organs to the various parts of the nervous system which could result in innate responses. These reflexes are not limited to minute pupillary dilations or knee jerks, but may involve complete bodily orientation. The ramifications and interconnections of the olfactory system are particularly important and peculiarly ignored by the comparative psychologists. As an indication of the numerous possibilities for reflex action originating with olfactory stimuli we find the olfactory bulb connected to the cortex in the anterior perforated space, the lamina terminalis and the gyrus subcallosus; in the hypothalamus it connects with the mamillary bodies and the ventromedial hypothalamic nucleus. The habenula of the epithalamus is particularly important in that it is an olfactory-somatic correlation center. Connections also go to the dorsal tegmental nucleus, the interpeduncular nucleus, the nuclei of 5, 7, the superior and inferior salivatory nuclei, the dorsal efferent nucleus and nucleus ambiguus. Most psychologists are aware of the autonomic connections with the olfactory bulb, but unaware of the connections with the skeletal muscle system via the habenula. This latter fact will prove more important when we consider the amplitude

data. Besides the routing of the neural pathways we also have some knowledge as to nerve fiber action in conjunction with spread of effect. We know, for instance, that the greater the afferent stimulation the greater the efferent resultant - especially concerning innate responses, for example it is obvious that an auditory stimulus of above threshold intensity may result in the reflex action of neck and head orientation in the direction of the stimulus, whereas increased intensity will result in increased bodily involvement, culminating in the well known startle response. It should also be acknowledged that not all efferent resultants are measureable or even observable as they may be visceral as well as skeletal.

It is here being suggested that the major activity component, however, is due to learning, and not a resultant, at least entirely, of innate receptor-effector connections qualified by the action of "generalized Drive".

Using an elicitation theory of reinforcement* which asserts that S-R connections are set up by contigual association of a new stimulus with an inherent S-R bond or reflex, it is readily visible that if we can assert an innate tendency for the animal to approach food, that approach would involve locomotion or activity. It also follows that with optimal bodily conditions the approach response would

*Current Michigan State College theory. Papers soon to be published on it by Dr. M. Ray Denny and Jack L. Maatsch.

be enhanced and a simple conditioning pattern appears as follows:

Bodily conditions -- Food_{smell} -- approach or locomotion

The conditioning pattern above says that bodily conditions will bring about activity, but the same principle holds in this situation as holds in any conditioning situation, that is the stimulus complex must remain constant, any change in stimulus conditions will result in decreased response strength. Also, before a locomotion response will occur in a particular situation there must be a series of reinforced trials in which the constant stimuli of environmental surroundings are associated with the innate Food --- locomotion bond. This then presents a complex stimulus situation in which bodily conditions are merely a small portion of the total complex, hence its effects are minimal and may be superseded by almost any additional extraneous stimulus, until learning has occurred in the situation. Following well substantiated conditioning theory we know that if the organism is put under given deprivation conditions so as to keep the internal stimuli constant and is placed in a given apparatus, and a response is learned under these conditions, then any deviation from these conditions results in generalization. It is asserted here that the response learned in the present situation was not only the panel pushing response but that the locomotion response (not new to the animal, but new to the animal in

the particular situation) is also learned.

From this type analyses it follows that in a new situation the organism must learn to eat or make the association between a stimulus complex and the response to food. It is seen then that the maximal activity of the animal will occur when bodily conditions are optimal and the response of eating in a particular situation is asymptotic. If either of the above conditions does not hold, activity declines. The decrease in activity of the animals in all groups away from the original $22\frac{1}{2}$ hour training deprivation level is then asserted to be a generalization effect instead of a decreased Drive effect. The obvious deduction from this approach would be that if the animal were fed in a new situation under given bodily conditions (i.e., deprivation level) that shifting the animal to a different deprivation level would result in generalization from the learned response and a consequent decrease in activity. Now, it does not seem reasonable that if an animal were trained under 10 hours deprivation that when it was put under 24 hours deprivation that a decrease in activity would occur. Yet, this result is what this analysis demands; however, it is very possible that there is an interaction effect between the innate reflexes and the learned responses such that at low levels the innate reflexes might predominate, so that if an actual decrease from 10 to 24 hours did not occur, the increase would be very slight, not at all

comparable to the increase between those approximate levels in the present study.

Actually in the present study there is some evidence for this stimulus generalization effect in that there was a decline in activity from the $22\frac{1}{2}$ hour level to the 48 hour level shown in Fig. 8. The reduction in activity is definitely not significant, but even if it is considered to be a straight line, this still does not compare with the curve derived by Yamaguchi (21) who stated that Drive is maximal at 59 hours deprivation. In fact, the function Yamaguchi derived shows the increase between $22\frac{1}{2}$ and 48 hours to be very steep. That the absence of increase is not due to the approach to the upper limit of the apparatus in recording activity is seen in the fact that at times several of the animals scored over 1000 on the activity scale and the mean for the $22\frac{1}{2}$ hours group equals only 425, which leaves ample room for increase as deprivation increased.

Theoretically, to a certain extent amplitude and activity are correlated. In the free situation in which the organism responds directly to a bit of food the locomotion of the organism will be highly correlated with the amplitude of the response; in fact, they may be identical. In the panel pushing device, the difference between the two is increased principally by forcing the animal to make a pushing response instead of a simple approach response which would be entirely determined by locomotion. The difference between

the two measures allows the possibility for operation of a new factor in the amplitude measures. The additional factor is the olfactory stimulus. If we can assume that the deviation of the LW Group (Fig. 9) from the others is due to loss of body weight, it may be readily assumed that the activity levels do not deviate as a function of type or amount of reward. In the Hours Deprivation Group (Fig. 8) the range is between 150 and 500 which compares closely to the ranges of the % Fed animals (Fig. 9). However, in making the available amplitude comparisons we can see that the animals who were rewarded with wet mash were definitely superior at the high drive levels; whereas, the groups were essentially the same at the low levels. Figure 6 shows this quite clearly regarding the LD Group; although the data for the SD Group is not plotted, the highest mean amplitude recorded for this group was 36 which coincides with the high point for the LD Group. Also, if four points are added to the amplitude scores of the Hours Deprivation Group to make the low point coincide with the low point mean of the % Fed Groups, we find that the maximum amplitude score attained is about 36. These three groups just mentioned were rewarded with the dry pellets. A glance at Fig. 6 again shows that the high points for the wet mash rewarded groups were above 48 in both cases. The differences between the groups cannot be validly tested, due to differences

in settings of the instrument and size of reward but the weight of the evidence indicates that wet mash rewarded groups respond more forcibly at the high deprivation levels than do the dry pellet rewarded groups. These data probably tie in with the food preference studies carried out by Young (23); however, if one continues to adhere to the strict S-R outlook, one would be forced into asserting the operation of an additional stimulus to account for the preference. In this case, it is believed to be the operation of an olfactory stimulus. To the human receptors, at any rate, there is a decided difference in the intensity of the olfactory sensation between the wet mash and the dry pellet. It does not seem to be overly anthropomorphic to suggest that there is definitely a discriminable difference between the two types of reward for the rat.

It may be noticed that there is a definite increase from $22\frac{1}{2}$ hours to 48 hours in the amplitude data of the Hours Deprivation Group (Fig. 6). Although the increase is not statistically significant, it still indicates a trend away from the generalization gradient from the $22\frac{1}{2}$ hour training conditions asserted to hold for activity. This may be an interaction effect between the drive stimuli and the olfactory stimuli. We know from Tinbergen's results (18) that the internal conditions of an organism must be optimal before the innate response to a stimulus will be optimal. The maximal amplitude measure may reflect the existence of

the optimal internal conditions prerequisite for elicitation of approach response to food by the external olfactory stimulus. Also, from Tinbergen (18) we know that the external stimulus which elicits a response must also be of optimal quality and intensity. It is suggested that the wet mash more closely approximates the optimal conditions than does the dry pellet. No measurements were taken beyond the training level for the % Fed Groups; hence, evidence for this is not available.

The preceding analysis asserts that the amplitude of response is a function largely of the eliciting olfactory stimulus; in other words, if no olfactory cue were available, there should be very little change in amplitude as a function of change in internal conditions (i.e., deprivation level). This, then would remove amplitude as a possible means of quantifying "Drive". In fact, if activity is a function of learning and amplitude is a function of the eliciting stimulus, there is little basis for asserting the action of the construct Drive unless a case for "Drive" may be built upon the fluctuations of latency with fluctuations in deprivation level.

With regard to latency the present data could be dismissed as apparently confounded by the action of unknown variables, changing, so to speak, the populations from which the various samples were drawn. From the statistical viewpoint, this might be the thing to do, but it is the author's

contention that the effect of variables on the variance of groups has been totally ignored by most investigators and that the variances may be the source of important information unattainable by reference to group means or correlation coefficients. Reference to Fig. 5 will show the increase of the standard deviations of the various groups as a function of decrease in deprivation level. Comparison of this figure to Fig. 4 shows the high degree of correlation between the latency measures and the variances of the groups. One fact is particularly outstanding. At the training level, under zero % Fed conditions, the latencies, and the standard deviations for that matter, are very similar. In other words, the animals were apparently responding with approximately the same latencies, and it was not until the stimulus conditions (internal stimuli) were changed that the means and variances began to become disparate.

In all of the % Fed Groups the 'F's' were significant but the variances were also very highly significant. In the Hours Deprivation Group however, the variances were homogeneous and the means were not significantly different from one another. This presumably indicates that the differences in means is only a reflection of the difference in variances which shows that in this case the effect of varying deprivation level is to increase variability of response, not to affect the speed of the response directly.

When considering the differences between subgroups, the type of reward rather than size of reward seems to be the important variable. The means and variances of the wet mash group are consistently below those of the dry pellet reward group. This represents an interaction effect between type of reward and drive level. This could be an indication of different gradients of generalization as a function of different types of reward. This again may be explained by referring to the interaction between internal conditions and external stimuli emphasized by Tinbergen. It may be that an external stimulus of lesser intensity will exert progressively less effect as bodily conditions are altered than will a stimulus of stronger intensity.

The indications are that latency does not reflect the same principle as either amplitude or activity. There are indications from the work of Cotten (3) that the major portion of latency is due to the intervention of competing responses. Cotten found that after eliminating trials during which responses incompatible with performing the learned response occurred, the difference in latencies between deprivation levels from 0 to 22 hours was only 0.4 of a second, measured in an eight foot long runway. This component is so small that the effects of deprivation level on latency of response can be considered negligible as far as representing a relevant behavioral variable.

Cotten's findings are supported in some degree by the results of the present study, when the range of latency scores within a group for all levels of deprivation are considered. The smallest range was 0.2 second occurring in the LW subgroup, the greatest was 4.7 seconds in the LD subgroup. The other ranges were 2.4 seconds for the SD subgroup and 0.9 second for the SW subgroup. The greatest range was more than 23 times that of the smallest range. The difference appears to be a function of the type of reward interacting with varying internal conditions. With near optimal reward, in this case large wet mash, bodily conditions are for all practical purposes behaviorally inconsequential with respect to latency. The type of reward seems to be a much more important variable in determining mean latency than deprivation level.

The charge that latency of response is not a reflection of sEr is particularly important in view of the fact that sEr was quantified by Hull and his associates on the basis of the latency of a bar pressing response (5, 6, 12, 22). Drive was held constant at 23 hours deprivation and the number of reinforcements were varied. The construct sEr was then quantified on the basis of the derived latencies. In the body of one article (6) it is explicitly stated that the validity of the quantification is dependent upon the equation

$$sEr = sHr \times D$$

and the appeal to the validity of the Drive construct was

in reference to Perin's data (15), in which reinforcements were held constant at 16 and the deprivation level was varied, in a situation similar to the one employed in the sEr quantification series. Perin pointed out in this study that the latency data were not amenable to any sort of analysis, so he presented most of his results in terms of the number of trials to extinction. It was the extinction data which Hull used as support for his $sEr = sHr \times D$ equation. In addition when Yamaguchi (21) quantified Drive more fully he also used the number of trials to extinction as his measure. It would seem that if latency yields data adequate for quantifying sEr it would also yield data adequate for quantifying Drive which supposedly is reflected in sEr. Why then, was the utilization of two different measures necessary? The results of the present study seem to indicate that the reason for this is that variation of internal bodily stimuli introduces extreme variability in latency scores. If latency is considered a function of the number of competing responses in action at the time, this would mean that latency would probably not be a measure of momentary effective reaction potential and therefore not a valid basis for quantifying sEr. It should also be pointed out that the standard deviations for latencies at the various reinforcement levels were not published in the quantification series, making it impossible to determine whether or not even those variances were homogeneous.

The extinction data in the present study were of small value because of the small N in each group and the extreme variability of the data. There was an increase in the mean number of trials to extinction with increase in deprivation in every group. However even this measure cannot be used as evidence for greater strength of reaction potential mainly because of the lack of any operant level data and the possibility that much of the panel pushing after the first few extinction trials may be merely a concomitant of activity. Such possibilities may be easily tested by allowing untrained animals access to the panel after an initial activity recording period and comparing the number of panel activations with the recorded activity.

In the Hours Deprivation Group there is one phenomenon which is particularly interesting. This is the dip in every curve at the two hour level. Every measure showed a decrease in response strength from one to two hours. None of the decreases reached the 5% level of significance. However, the coincidence of the drop in all three curves is ~~not~~ hardly attributable to chance, particularly since there were no consistent reversals of the % Fed Group curves. The dip, probably more than anything, reflects the period of time required for complete assimilation of food into the blood stream. This supports the work of individuals who claim that the neural basis for hunger is not localized

solely in the stomach, but is more essentially dependent upon central neural centers which respond to changes in blood chemistry, i.e., chemo-receptors. The present data indicate that there is probably a constant decrease in the organism's responsiveness from complete satiation to a point somewhere near two hours after satiation. Reference to minimal effective internal conditions should probably be in terms of this two hour level instead of zero hours of deprivation from time of satiation. This observation is consistent with the foregoing drive stimulus analysis and does not support the "Drive" construct formulation. The drive stimulus point of view would postulate that any decreased firing of receptors would, innately, reduce the magnitude of certain aspects of behavior. Also, decreased receptor firing would result in internal stimulus conditions further out on the gradient of generalization from the originally conditioned stimulus complex and would serve to reduce performance of the learned aspects of behavior.

The two hour dip may be one of the causes for the curvilinearity of the activity data for the Hours Deprivation Group, which is in contrast to the same data for the % Fed Group which was rather definitely a rectilinear function. Another possible difference was the fact that the Hours Deprivation Group was tested at 48 hours which is past the original training point, and the decrease rather than a continued increase would tend to make the function appear to be

curved instead of rectilinear. The % Fed Group was never extended beyond the point of original training hence only one side of the gradient was involved.

Although the results of this study very definitely show that activity cannot be used as a means of quantifying Drive and that the whole concept of a generalized Drive is extremely tenuous it does not present exactly incontrovertible evidence against Drive. The Drive theorist might say that every time a reference in this paper was made to internal conditions or internal stimuli or drive stimuli that the word 'Drive' could have been substituted. However, this would at any rate point up the confusion existing between the concepts of Drive and drive stimulus. If the Drive theorist did not make this assertion then it should be clear that the behavioral results attributed to Drive may be explained more parsimoniously with more primary physiological and behavioral concepts. The value of doing this lies chiefly in the fact that modern research methods are enabling the physiologist and ethologist to investigate more thoroughly the various aspects of stimuli and their interaction with an organism. We have shown in the present paper that Drive cannot be tied down on the consequent side of the operational definition by measuring energy expenditure in the form of activity. This means that Drive, then, must be accepted as a matter of faith and not scientifically testable. It must be acknowledged that the present analysis

consists in part of ad hoc explanations; however the point is that the explanations were made by appealing to well known or highly substantiated ethological and physiological data which lead to deductions which may be experimentally investigated.

Obviously if one denies the concept of Drive, then something must be said concerning an even more important concept - that of reinforcement, which for the Hullians is drive reduction. If one accepts the notion of reduction of drive stimulation instead of "Drive" reduction then the essence of the principle may possibly be retained. However, then again, of what use in this connection is the concept of generalized "Drive"? Although various individuals have been interpreting drive reduction as reduction of drive stimulation, even this tack becomes difficult in the light of some evidence from the present study. Three of four activity curves and one of three of the amplitude curves in the % Fed Groups showed an elevation of the 10% Fed level over the 0% which might indicate that feeding a slight amount of food would actually increase the intensity of the stimulation instead of acting to reduce it. This ties in with the results from the experiments on pre-feeding (1, 2) which show that pre-feeding seems to aid performance, increases activity, etc. If this is the case that pre-feeding increases activity (shown in three of the four groups of the present study), then a bit of food would neither

reduce drive stimuli nor generalized "Drive" and thusly the possibility of using these principles as explanations of reinforcement is effectively eliminated.

The value of the present study lies not so much in the absolute evidence which it presents for or against a given theory but in the opening up of new methodological approaches to clearing up several pertinent problems in modern learning theory. The technique utilized in this study measures practically every aspect of measurable behavior of the organism, enabling the author to make inter-behavioral comparisons which heretofore could not be made. The failure to do this in the past shows up especially in the formulation of what were supposed to be reflections of reaction potential (sEr). As this discussion has attempted to point out, these measurements may be only slightly related. The major portions of each seem to be a result of the operation of very different principles, with particular reference to habit, innate reflexes and competing responses.

SUMMARY AND CONCLUSIONS

The present investigation is concerned with the possibility of utilizing the activity level of an organism as a direct reflection of Drive when two different methods of inducing hunger conditions are employed. The results of such a study should present evidence as to whether or not activity level may be used as a measurement parameter which would make possible the quantification of the construct Drive independent of the commonly used reaction potential (sEr) measures, e.g., latency, amplitude, trials to extinction. Further, the size and type of reward are varied to give an indication of the effect of these variables on the behavior of organisms while performing under varying drive levels.

A combined activity box and panel pushing device was employed in the study. The panel pushing device was so arranged as to provide measurements of latency of response, amplitude of response and the number of trials to extinction.

Forty-eight male albino rats were used in the study, and were divided into two major groups:

1. Hours Deprivation Group N = 11
2. % Fed Group N = 37

The % Fed Group was divided into four subgroups on the basis of size and type of reward as follows:

1. The first part of the document discusses the importance of maintaining accurate records of all transactions and activities. It emphasizes the need for transparency and accountability in financial reporting.

2. The second part of the document outlines the various methods and techniques used to collect and analyze data. It includes a detailed description of the experimental procedures and the statistical analysis performed.

3. The third part of the document presents the results of the study. It includes a series of tables and graphs that illustrate the findings of the research. The data shows a clear trend of increasing activity over time.

4. The fourth part of the document discusses the implications of the findings. It suggests that the results have significant implications for the field of study and may lead to further research in this area.

5. The fifth part of the document concludes the study. It summarizes the key findings and provides a final statement on the importance of the research.

6. The sixth part of the document includes a list of references and a list of figures. The references cite the various sources used in the study, and the figures provide a visual representation of the data.

1. LW subgroup (Large wet mash - 0.2 gm) N = 14
2. SW subgroup (Small wet mash - 0.08 gm) N = 6
3. LD subgroup (Large dry pellet - 0.2 gm) N = 7
4. SD subgroup (Small dry pellet - 0.08 gm) N = 10

All animals were given habituation in the apparatus for a period of five days, and received training on the panel pushing device 10 trials per day for the next 8 consecutive days. All animals were under $22\frac{1}{2}$ hours food deprivation.

On the testing days the animals in the Hours Deprivation Group were satiated and then given four trials in the apparatus either 1, 2, 6, 12, 24, or 48 hours later. The % Fed animals were fed either 0, 10, 25, 50, 75, or 90 percent of the total amount of food required to produce satiation, computed on the basis of the amount of food each animal had eaten to satiation on the last four days of the training procedure. They were then given four trials in the apparatus three hours after they had consumed the stipulated percentage. All animals performed under each deprivation level in their respective groups, being assigned to each level in a randomized order. Activity level, latency and amplitude were recorded on each trial. At the conclusion of the testing days all animals were extinguished under various deprivation levels.

The findings were as follows:

1. Activity is not a reflection of Drive per se, but is dependent upon learning in a given situation.
2. Activity cannot be used as a measurement parameter for Drive, inasmuch as the correlations between response

1. The first part of the document discusses the importance of maintaining accurate records of all transactions and activities. It emphasizes the need for transparency and accountability in financial reporting.

2. The second part of the document outlines the various methods and techniques used to collect and analyze data. It includes a detailed description of the experimental procedures and the statistical analysis performed.

3. The third part of the document presents the results of the study. It includes a series of tables and graphs that illustrate the findings of the research. The data shows a clear trend of increasing activity over time, which is consistent with the hypothesis.

4. The fourth part of the document discusses the implications of the findings. It suggests that the results have significant implications for the field of research and may lead to further developments in the future.

5. The fifth part of the document concludes the study. It summarizes the main findings and provides a final statement on the importance of the research.

measure of different animals equated as to activity show no significance.

3. There is definite interaction effect between type of reward and deprivation level.

4. Latency as a measure of reaction potential is extremely suspect.

5. The results do not support the notion of generalized Drive as a hypothetical construct.

The possibility that the various measures of reaction potential were essentially measures of very different factors was discussed and evidence was offered for this point of view.

the first of these is the fact that the
the second is the fact that the
the third is the fact that the
the fourth is the fact that the
the fifth is the fact that the
the sixth is the fact that the
the seventh is the fact that the
the eighth is the fact that the
the ninth is the fact that the
the tenth is the fact that the
the eleventh is the fact that the
the twelfth is the fact that the
the thirteenth is the fact that the
the fourteenth is the fact that the
the fifteenth is the fact that the
the sixteenth is the fact that the
the seventeenth is the fact that the
the eighteenth is the fact that the
the nineteenth is the fact that the
the twentieth is the fact that the
the twenty-first is the fact that the
the twenty-second is the fact that the
the twenty-third is the fact that the
the twenty-fourth is the fact that the
the twenty-fifth is the fact that the
the twenty-sixth is the fact that the
the twenty-seventh is the fact that the
the twenty-eighth is the fact that the
the twenty-ninth is the fact that the
the thirtieth is the fact that the
the thirty-first is the fact that the
the thirty-second is the fact that the
the thirty-third is the fact that the
the thirty-fourth is the fact that the
the thirty-fifth is the fact that the
the thirty-sixth is the fact that the
the thirty-seventh is the fact that the
the thirty-eighth is the fact that the
the thirty-ninth is the fact that the
the fortieth is the fact that the
the forty-first is the fact that the
the forty-second is the fact that the
the forty-third is the fact that the
the forty-fourth is the fact that the
the forty-fifth is the fact that the
the forty-sixth is the fact that the
the forty-seventh is the fact that the
the forty-eighth is the fact that the
the forty-ninth is the fact that the
the fiftieth is the fact that the
the fifty-first is the fact that the
the fifty-second is the fact that the
the fifty-third is the fact that the
the fifty-fourth is the fact that the
the fifty-fifth is the fact that the
the fifty-sixth is the fact that the
the fifty-seventh is the fact that the
the fifty-eighth is the fact that the
the fifty-ninth is the fact that the
the sixtieth is the fact that the
the sixty-first is the fact that the
the sixty-second is the fact that the
the sixty-third is the fact that the
the sixty-fourth is the fact that the
the sixty-fifth is the fact that the
the sixty-sixth is the fact that the
the sixty-seventh is the fact that the
the sixty-eighth is the fact that the
the sixty-ninth is the fact that the
the seventieth is the fact that the
the seventy-first is the fact that the
the seventy-second is the fact that the
the seventy-third is the fact that the
the seventy-fourth is the fact that the
the seventy-fifth is the fact that the
the seventy-sixth is the fact that the
the seventy-seventh is the fact that the
the seventy-eighth is the fact that the
the seventy-ninth is the fact that the
the eightieth is the fact that the
the eighty-first is the fact that the
the eighty-second is the fact that the
the eighty-third is the fact that the
the eighty-fourth is the fact that the
the eighty-fifth is the fact that the
the eighty-sixth is the fact that the
the eighty-seventh is the fact that the
the eighty-eighth is the fact that the
the eighty-ninth is the fact that the
the ninetieth is the fact that the
the ninety-first is the fact that the
the ninety-second is the fact that the
the ninety-third is the fact that the
the ninety-fourth is the fact that the
the ninety-fifth is the fact that the
the ninety-sixth is the fact that the
the ninety-seventh is the fact that the
the ninety-eighth is the fact that the
the ninety-ninth is the fact that the
the hundredth is the fact that the

REFERENCES

1. Anderson, E. E., The externalization of drive IV. The effect of prefeeding on the maze performance of hungry non-rewarded rats. J. comp. Psychol., 1941, 31, 349 - 352.
2. Bruce, R. H., The effect of lessening the drive upon performance by white rats in a maze. J. comp. Psychol., 1938, 25, 225 - 248.
3. Cotton, J. W., The relationship between running time in a straight runway and length of the period of food deprivation. To be published in J. exp. Psychol.
4. Davis, R. H., The quantification of drive I. Incentive values of food and water. Ph.D. thesis on file in the Michigan State College Library, 1953.
5. Felsing, J. M., Gladstone, A. I., Yamaguchi, H. G., and Hull, C. L., Reaction latency as a function of the number of reinforcements (N). J. exp. Psychol., 1947, 37, 214 - 228.
6. Gladstone, A. I., Yamaguchi, H. G., Hull, C. L., and Felsing, J. M., Some functional relationships of reaction potential (sEr) and related phenomena. J. exp. Psychol., 1947, 37, 510 - 526.
7. Guthrie, E. R., The psychology of learning. New York: Harper and Brothers Publishers, 1935.
8. Helson, H. (Ed.), Theoretical foundations of psychology. New York: Van Nostrand, 1951.
9. Holt, E. B., Animal drive and the learning process. New York: Henry Holt and Company, 1931.
10. Hull, C. L., Principles of behavior. New York: D. Appleton-Century Co., Inc., 1943.
11. _____, Behavior postulates and corollaries - 1949. Psychol. Rev., 1950, 57, 173 - 180.
12. _____, Felsing, J. M., Gladstone, A. I., and Yamaguchi, H. G., A proposed quantification of habit strength. Psychol. Rev., 1947, 54, 237 - 254.

• • • • •

• • • • •

• • • • •

• • • • •

• • • • •

• • • • •

• • • • •

• • • • •

• • • • •

• • • • •

• • • • •

• • • • •

13. Keller, F. W. and Schoenfeld, W. N., Principles of psychology. New York: Appleton-Century-Crofts, Inc., 1950.
14. Maatsch, J. L. and Behan, R. A., A more rigorous theoretical language. Psychol. Rev., 1953, 60, 189 - 196.
15. Perin, T. C., Behavior potentiality as a joint function of the amount of training and the degree of hunger at the time of extinction. J. exp. Psychol., 1942, 30, 96.
16. Richter, C. P., Animal behavior and internal drives. Quar. Rev. Biology, 1927, 2, 307 - 343.
17. Skinner, B. F., The behavior of organisms. New York: D. Appleton-Century Company, 1938.
18. Tinbergen, N., The study of instinct. Oxford: Clarendon Press, 1951.
19. Tolman, E. C., Purposive behavior in animals and men. New York: The Century Co., 1932.
20. Wada, T., An experimental study of hunger in its relation to activity. Arch. Psychol., 1922, No. 57.
21. Yamaguchi, H. G., Drive (D) as a function of hours of hunger (h). J. exp. Psychol., 1951, 42, 108 - 117.
22. _____, Hull, C. L., Felsing, J. M., and Gladstone, A. I., Characteristics of dispersions based on the pooled momentary reaction potentials (sEr) of a group. Psychol. Rev., 1948, 55, 216- 238.
23. Young, P. T., Motivation of behavior. New York: Wiley, 1936.

1. The first part of the document discusses the importance of maintaining accurate records of all transactions. It emphasizes that proper record-keeping is essential for the transparency and accountability of the organization. This section also outlines the various methods used to collect and analyze data, ensuring that the information is reliable and up-to-date.

2. The second part of the document focuses on the implementation of the proposed changes. It details the steps involved in the rollout process, from initial planning to final execution. This section also addresses potential challenges and provides strategies to overcome them, ensuring a smooth transition to the new system.

3. The third part of the document discusses the impact of the changes on the organization's overall performance. It presents data and analysis showing the positive effects of the implementation, such as increased efficiency and reduced costs. This section also highlights the ongoing monitoring and evaluation process to ensure continued success.

4. The fourth part of the document provides a summary of the key findings and conclusions. It reiterates the importance of the changes and the successful outcome of the implementation. This section also offers recommendations for future actions and areas for further research.

5. The final part of the document is a conclusion that summarizes the entire report. It expresses the confidence in the proposed changes and the commitment to ongoing improvement. This section also includes a statement of appreciation for the support and collaboration of all stakeholders involved in the process.

ROOM USE ONLY

Sep 4 '56

JAN 5 1962

ROOM USE ONLY

MICHIGAN STATE UNIVERSITY LIBRARIES



3 1293 03175 0189