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journal or publication title	Tohoku psychologica folia
volume	24
number	1-2
page range	38-45
year	1966-01-10
URL	http://hdl.handle.net/10097/00122633

THE EXPERIMENTAL STUDY OF THE HUNGER THERAPY*

1. EFFECT OF STARVATION UPON EXTINCTION AND ACQUISITION OF AVOIDANCE RESPONSE

By

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According to the Pavlovian theory, the cause of the psychosomatic disease (P.S.D.) is assumed to be an abnormal kind of conditioned responses. Following this assumption, we tried to explore the therapeutic mechanism of the hunger therapy to P.S.D. by investigating the effects of starvation upon both extinction and acquisition of avoidance response. The extinction of avoidance response was facilitated by the procedure of starvation. The acquisition of the response was also slightly facilitated. From these results it is suggested that the mechanism of the hunger therapy is due to the facilitated extinction of conditioned emotional response.

An active interest has recently been aroused in the psychosomatic medicine (P.S.M.) and clinical importance has been attached to the knowledge of P.S.M. by many clinicians. In our clinic we have been working on the study of P.S.M. for years, especially on the medical treatment.

There are various treatment for the psychosomatic disease (P.S.D.): drug therapy, electro-shock therapy, psychotherapy and so on. This disease, however, resists many treatments and there are often some cases where most of them have little or no effect. But in our clinic, employing a hunger therapy as a new method of treatments for this disease we have obtained satisfactory results.

The procedure of the hunger therapy is briefly explained as follows: we put a patient upon starvation diet for 12 days, that is, we allow him only tea. On 13th day he is allowed a prescribed diet and gradually to return finally to the pre-starvation diet on 17th day. If the other therapies employ this treatment together, their effects become more effective. The mechanism of the hunger therapy still remains unexplained.

The present study had been designed to explore the mechanism experimentally and the following two experiments were carried out: 1) effect of starvation upon extinction of avoidance response: 2) effect of starvation upon acquisition of avoidance response.

* This study was supported in part by a grant-in-aid for scientific research in 1964 from the Ministry of Education. The authors are grateful to Katsuji Kushima, M.D., Professor of School of Medicine, Tohoku University, for his advice and criticism.

METHOD

Subjects and apparatus

Forty male albino rats of the Wister-strain were used as the experimental animal, which had been maintained on an ad libitum feeding schedule. At the beginning of the experiment they had an average body weight of 200 gm, ranging from 160 to 230 gm.

The apparatus used was an ordinary shuttle box, which consisted of two compartments, separated by a sliding-door, which could be dropped to floor level. The door opening mechanism was controlled manually. The inside dimensions of each compartment were: length 40cm, width 16cm, height 20cm. The plywood walls were not painted. The compartments had wire mesh covers to observe the behavior of subjects and had hinged doors which could be locked by slide bolts.

There was a 40-w light just above the apparatus. The floor of the apparatus consisted of 14 cm steel bars 1 cm apart. The grid bars of one compartment were wired to an a-c transformer and performed the shock circuit. The shock circuit was powered by a 700 V a-c and the current in the circuit was $350\mu\text{A}$. On the other hand the grid floor of the other compartment was never charged. CS was a noise generated by a small house buzzer, which was mounted just above the apparatus. An a-c shock through the grid floor of one compartment served as the US.

General procedure

Starvation

The procedure of starvation consisted of four days complete starvation period followed by four days recovery period. Even on the starvation period a supply of water was not interrupted. On the recovery period animals were maintained on an ad libitum feeding schedule.

On the other hand the control group were allowed to eat at will during 8 days corresponding to the starvation period.

Acquisition

The sliding-door between the two compartments was closed and the animal was placed into the compartment having the grid floor served as shock circuit. The CS was the sounding for 5 sec. of the buzzer. At the onset of the CS the sliding-door was opened. Following the presentation of the 5 sec. CS, the grid floor of the compartment, where the rat was placed, was charged (US).

The shock was kept on until the animal ran into the opposite compartment. The intertrial interval was one min.. When the animal ran into the opposite compartment before the onset of the US, shock was omitted for that trial. When the rat ran into the opposite compartment, the sounding of the buzzer was interrupted and the door between the compartments was closed.

The training trials, each ending either in escape or avoidance, were continued in 20 trials per day. The criterion for acquisition of the avoidance response was defined as

the occurrence of 19 avoidance responses out of 20 successive trials.

Extinction

After the acquisition criterion was performed the extinction trials were begun. At the beginning of extinction trial all animals were received the US following 2 sec. presentation of CS. In the extinction trials, CS was presented only and the US was never applied. Fifteen extinction trials were carried out every day for 6 consecutive days.

Procedure of Experiment I

Twenty rats were randomly divided into two groups, containing ten rats each. One group was used as the experimental group and the other as the control group. The experimental group were treated by the procedure involving a schedule of starvation period.

After the subjects reached to the acquisition criterion of the avoidance response, the experimental group were given the procedure of starvation described above. In this group the extinction trials were begun on the following day of the recovery period.

On the other hand, the control group were allowed to eat the food at will during this period and then they were given the extinction procedure after the interval of 8 days corresponding to the starvation period.

Procedure of Experiment II

Twenty rats, which had had no experience with the avoidance conditioning or the electro-shock, were divided into two groups. One group was assigned for the control group and the other group for the experimental group. In the experimental group the avoidance response was conditioned after the procedure of starvation described above. The control group were given the procedure of the avoidance conditioning without the procedure of starvation.

RESULTS

Experiment I. Effect of starvation upon extinction of avoidance response

The avoidance responses in two groups were trained by the procedure described above. The number of trials required for rats to reach the acquisition criterion is shown in Table I. A significant difference was not found between the experimental group and the control group.

Figure 1 shows the variation of the average body weight during the period of

Table I Number of trials to the acquisition-criterion

	Exp. G.	Cont. G.	P
M	34.1	36.7	$t=0.419$
SD	12.8	13.2	$df=18$ $p>.05$

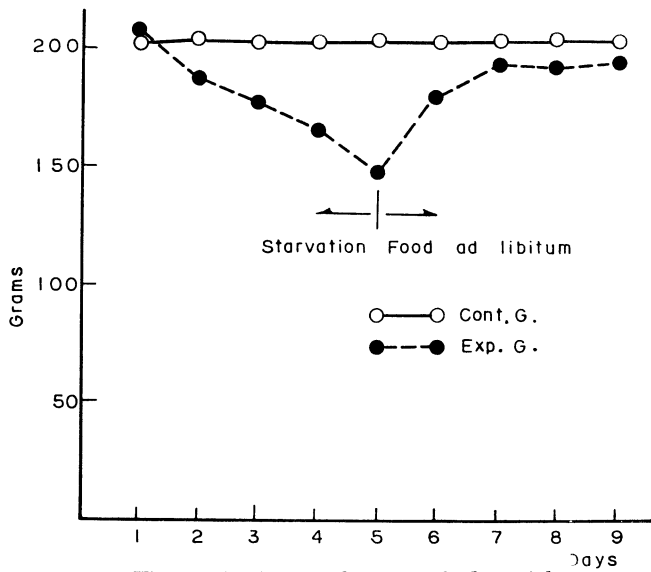


Fig. 1. Variation of average body weight.

starvation and its corresponding control period. In the experimental group the maximum decrement in the average body weight was 25% of the weight of the pre-starvation, but at the period of the extinction the average body weight recovered the same level with that of the pre-starvation.

Before the next extinction procedure both groups were given the 2 sec. CS followed by the US. The response time of escape from the US, which was delivered to subjects as mentioned early immediately before the first extinction trial, was measured by a stop watch as a measure of their health.

Table 2 shows these response time to the US. There was no significant difference between two groups.

Table 2 Response time to US

	Exp. G.	Cont. G.	P
M	0.8 ^{sec.}	0.7 ^{sec.}	$t=0.417$
SD	0.40	0.24	$df=18$ $p>.05$

Figure 2 shows the percentage of avoidance response during the extinction for 6 consecutive days. The percentage was determined by dividing the total number of avoidance responses by the total number of trials per day. The percentage of responses in the experimental group were evidently lower than that of the control group. The difference between two groups grew greater every day. Even on the first day of the extinction, the percentage of avoidance response in the experimental group decreased to 82.0%, while the control group maintained its avoidance level at 99.3%.

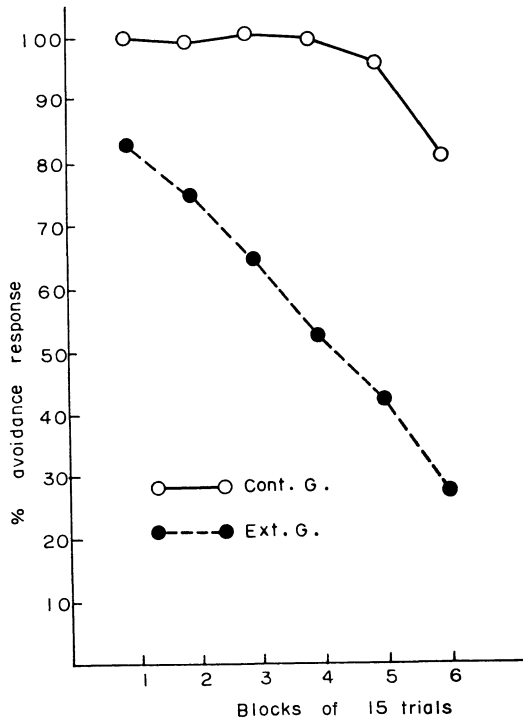


Fig. 2. Percentage of avoidance response during extinction.

The difference was significant at 1% level of confidence.

On the sixth day of the extinction, the percentage in the control group was kept at 79.3% level and that of the experimental group decreased to 27.3%. The difference was also statistically significant. On the sixth day of the extinction, four rats out of ten in the control group were subjects which had been maintaining the 100% avoidance and only two in the experimental group.

Experiment II. Effect of starvation upon acquisition of avoidance response

The procedure for this experiment was described above. The experimental group were given the procedure of starvation by the same method as in the experiment I.

The variation of the average body weight during this starvation period was similar to that in the experiment I. When the experiment of avoidance training was begun, the average body weight recovered the same level with that of pre-starvation. In both groups the response time to the US ranged from 0.5 to 3.0 sec.. There was no significant difference between two groups in the response time.

Figure 3 shows the percentage of avoidance response. On the first day the percentage of response was 64.0% in the experimental group and 42.0% in the control group. This difference between the two groups was slightly significant ($P < 0.05$). But there was no significant difference between two groups on any day in the period

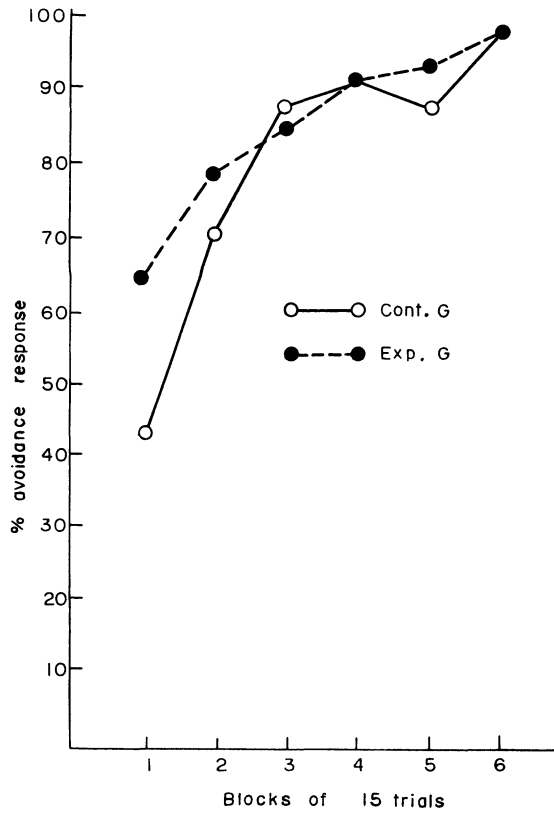


Fig. 3. Percentage of of avoidance response

from the second to the sixth day of the training.

Table 3 shows the number of trials to the appearance of the first avoidance response. The first avoidance response in the experimental group occurred slightly earlier than that in the control group. The difference was significant between the two

Table 3 Number of trials to the first avoidance response

	Exp. G.	Cont. G.	P
M	3.6	5.0	$t=2.18$
SD	1.02	1.62	$df=18$ $P<.05$

Table 4 Number of trials to the acquisition-criterion

	Exp. G.	Cont. G.	P
M	17.5	20.6	$t=0.961$
SD	4.38	6.63	$df=18$ $P>.05$

groups ($P < 0.05$).

Table 4 shows the number of trials to the acquisition criterion. There was no significant difference between the two groups. The difference between these two groups in the number of the US to the acquisition criterion was not significant too.

DISCUSSION

There are various theories about the mechanism of causing such diseases as neurosis, psychosis and psychosomatic disease (P.S.D.): a psychological theory, a cultural sociological theory, a psychophysiological theory and a theory originated in Pavlovian tradition. According to the Pavlovian theory, the mechanism is explained as follows: under some conditions a cerebral cortex often falls into an abnormal state. When an external stimulus is given to a cerebral cortex under this abnormal conditions, this stimulus is temporarily connected with the abnormal state of cortex. The connection is quickly established and has a strong tendency to be fixed firmly. In other word an abnormal conditioned reflex is formed in the cortex.

Man lives in the environment where he receives various stimuli again and again. When man once falls into an abnormal state by chance, these stimuli act to make him remain in that state. As a result many abnormal conditioned reflexes are formed one after another and he can not live healthfully. This diseased state is called neurosis or P.S.D.. In a word we can regard these diseases as an abnormal kind of conditioned responses. Therefore, for the purpose of exploring a mechanism of a therapeutic effect of the hunger therapy on these diseases, we investigated an effect of starvation upon both extinction and acquisition of avoidance response as described above.

It has been generally reported that rapid or complete conditioning is associated with slow or less complete extinction. Further there is a possibility of declining physical strength due to the starvation. These possible conditions, such as rate of conditioning avoidance and declining of physical strength, may have an effect on a rate of extinction.

In order to check these possibility, we compared the two groups in the number of trials to the acquisition criterion, in the body weight during starvation period and in the response time to US given just before the first extinction trial; the first measure is to test the difference of learning ability, the second and the third measures are to test the possible difference in physical strength. As already described their differences were not significant. Therefore the more rapid extinction of the experimental group, which we observed in the experiment I, seems to be due to the procedure of starvation.

Then, a question may be raised, why did the extinction occur more rapid in the experimental group?

Following the assumption that the drive evoking an avoidance response is a conditioned fear, there may be next two answers for this question: 1) the more rapid extinction is due to the fact that the conditioned fear is weakened by a procedure of starvation,

in other word a procedure of starvation has an effect of reducing anxiety: 2) the more rapid extinction is due to the fact that a counter conditioning occurs rapidly, in other word a procedure of starvation promotes the learning of new avoidance response.

For the purpose of examining the possibility mentioned above, we investigated in the rate of conditioning avoidance response after the procedure of starvation (Exp. II). In the experiment II we obtained the following two results: the percentage of avoidance response in the experimental group was slightly larger than that of the control group; the first avoidance response of the experimental group occurred earlier than that of the control group.

With only these results, we can not conclude that the procedure of starvation has an effect of facilitating the learning of avoidance response, nor that the procedure has an effect of reducing anxiety. From the present experiments we found the fact that the procedure of starvation facilitates an extinction of avoidance response. The mechanism of these effects, however, could not be explained by the present study only. Further detailed experimental analysis will reveal the mechanism of these effects.

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(Received Aug. 15, 1965)

ZUSAMMENFASSUNG

Als eine Heilkunst für die Krankheiten (Psychose, Neurose oder Psychosomatische Krankheit) haben wir eine neue "Hungertherapie" angewandt und haben einen wirklichen Erfolg erreicht. Nach der Pawlowstheorie ist die Krankheit eine Art von abnormal bedingten Reaktionen, daher, um den therapeutischen Mechanismus von unserer "Hungertherapie" weiter klar zu machen, untersuchten wir den Einfluss von Hunger auf die Extinktion und den Lernverlauf von der bedingten Ausweichungsreaktion (conditioned avoidance response) bei den weissen Ratten.

Aus den Ergebnissen folgt: 1) Durch die Hungerprozedur wurde die Extinktion von der bedingten Ausweichungsreaktion gefördert. 2) Auch der Lernverlauf von der bedingten Ausweichungsreaktion wurde durch dieselbe Prozedur leicht gefördert.