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Schnur,

April W.

1973

AN INVESTIGATION OF THE INFLUENCE OF STRESS ON THE PROTESTANT ETHIC EFFECT

A Thesis

Presented to

the Faculty of the Department of Psychology

Western Kentucky University

Bowling Green, Kentucky

In Partial Fulfillment

of the Requirements for the Degree

Master of Arts

by

April W. Schnur

August, 1973

AN INVESTIGATION OF

THE INFLUENCE OF STRESS ON THE

PROTESTANT ETHIC EFFECT

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Table of Contents

Acknowledgements

to
jim
and
richard
with
affection

Introduction and Literature Review

Reinforcement typically is thought of as that thing which, when added to a situation, increases the likelihood of a response (Barnett, 1967). A certain response to a stimulus is linked by means of an underlying reinforcement process (i.e., a response-reinforcement process). The present study was an attempt to describe events in a particular situation involving operant conditioning. The behavior of interest was that emitted by an organism which has been given the choice between freeloading and performing some operant for reinforcement. Early research in the area of reinforcement typically indicated that Ss choose alternatives with greater habit strength, as measured by the number of reinforcements and that, if habit strengths are equal, Ss choose the alternative which is less laborious (Hull, 1943). Hull describes the latter as the "law of less work."

Jensen (1963) was the first to definitively study the Protestant Ethic Effect (PEE). He proposed that there is an intrinsic appeal for bar pressing which can be defined "as a pleasant emotional state experienced while performing anything which is performed when another "less-effortful" or "better-established" operant would result in the same

or a greater amount of reinforcement per unit time. To examine this thesis, Jensen studied 200 rats that had bar pressed for 40, 80, 160, 320, 640, or 1,280 pellets during training. The Ss were then given free food (FF) in the training box. The Ss were allowed to choose between bar pressing for pellets of food and eating pellets freely from the FF dish. The mean percentage of earned food consumed correlated positively with the number of rewarded presses made prior to the choice situation with only one rat eating 100% of its food from the FF dish. Jensen concluded that some rats prefer the more effortful means of obtaining reinforcement even though freeloading would provide reinforcement at a higher rate. Hullian theory suggests that the preference for bar pressing was merely habit strength. However, the normal experiences of eating prior to the experimental situation had a higher frequency of response. Guthrian theory suggests that bar pressing was a result of the recency of the training. However, the last thing the Ss did before being treated was eat from the FF dish.

Another of the early studies to deal with the PEE was that of Stoltz and Lott (1963). Thirty-seven rats that were being maintained on a 23 hour (h) deprivation schedule were trained to run down an alley to receive one pellet of food in a goal box. After training was completed, a large pile of pellets was placed in the middle of the alley in such a way that the Ss had to run over the pile to reach the goal box. The Ss continued to run to the goal box for the single

pellet even though they had to run over the pile of food. After eating the pellet in the goal box, the Ss retraced and ate from the pile of food. Though Hullian theory might account for such behavior, Stoltz and Lott point out that the behavior persisted over 22 trials (two days).

Findings such as those of Jensen (1963) and Stoltz and Lott (1963) are examples of what is termed the Protestant Ethic Effect. The term symbolizes the behavior of Ss that prefer to earn food rather than freeload in a choice situation. Though there has not been a great deal of research conducted in the area of the PEE, there has been enough to demonstrate that the phenomenon of "preferences" exists. Results of the two studies reported above indicate that some rats in certain situations prefer to work for food rather than choose a less effortful, more plentiful means. Contrary to the Hullian "law of less work" (Hull, 1943), it has been demonstrated that organisms may prefer to work for food rather than choose an operant which requires less effort.

Reinforcement Theory

Recently, researchers have attempted to discuss the ways in which reinforcement theory has failed to account for the variables involved in specific types of behavior. Bolles (1972) described learning in situations where the underlying reinforcement process is not clear. Bolles suggested that the variables underlying reinforced behavior might be more usefully discussed in terms of incentive moti-

vation and a cognitive approach. Examples of behavior in this category include superstitious behavior, polydipsia, species-specific influences, and auto shaping. Williams and Williams (1969) demonstrated by means of a series of studies that key pecking by pigeons can be maintained by circumstances not directly associated with a response-reinforcer process. Their results indicated that certain stimulus-reinforcer relationships maintain behavior regardless of response-reinforcer processes. In fact, pigeons continued to peck at the key when pecking prevented reinforcement. In a similar vein, Neuringer (1970) was able to maintain key pecking behavior in pigeons whose pecking was irrelevant to the receipt of reinforcement. Neuringer concluded that stimulus-reinforcer processes can account for this type of superstitious behavior and that response-reinforcer processes cannot account for all types of behavior.

Weisman (1972) investigated a type of behavior which is best explained by means of a stimulus-reinforcer process. Water-reinforced behavior and drinking were elicited by a discrimination stimulus in water satiated rats. The presence of the conditioned stimulus elicited the conditioned response even though the S was reinforcer-satiated. Similar results have been found by Davidson (1971) using food instead of water. The same situation in a human setting might go as follows. Mr. Jones went to a late lunch with a client and lingered over dessert until 3:30. However, upon arriving home and entering the dinner time atmosphere with his

family, he sat down at 6:00 and ate his regular, hearty meal complete with dessert. Estes (1972), however, warns against generalizing to humans due to the large number of contingencies influencing human actions. He proposed that human behavior is the result of a complex cognitive process based on a knowledge of the consequences of certain actions.

In a study demonstrating the PEE, Neuringer (1969) argued that instrumental behavior occurs naturally and the organism need not be deprived or threatened to exhibit it. Neuringer's Ss were kept in the training chamber 24h a day with food and water available at all times (ad lib), and he interpreted their preferences for the more effortful means of obtaining food as an indication that such a mode of responding serves as a motivation or reward for the Ss.

Thus, it would appear that a straight interpretation of the PEE via Hullian theory is not currently plausible. It would seem many variables underlie the behavior observed in the various PEE studies and these variables have not been conclusively delineated. A discussion of the possible variables of interest follows.

Variables Underlying the PEE

The variables underlying the PEE have been investigated only to a limited extent, and the delineation among these variables is still unclear. It is obvious that studies performed in the past decade (e.g., Jensen, 1963) have demonstrated that the phenomenon of preference exists in a variety of situations. The variables of interest that will

be discussed are: biological state of the Ss, secondary reinforcers, schedule of reinforcement, S deprivation of the reinforcer, training schedule, type of S, type of reinforcer, operant performed to receive reinforcer, and stress during choice. In order to facilitate an understanding of the studies reviewed, a listing has been provided in Table 1 beginning on page 7. Table 1 consists of information concerning author(s), number of Ss, type of results support the PEE, and a summary of results.

Biological state. The first variable of interest in the PEE studies is the biological state of the S. Kavanau (1967) discussed rat behavior as a function of captivity. He warns against generalizing the behavior of inbred rats because of the severe distoritons of behavior caused by deprivation of the wild habitat and the homogenization that occurs due to inbreeding. Of specific interest to this study is Kavanau's statement that rats require "split-second timing, coordination and quick reflex actions in the wild [p. 1629]". As Kavanau has demonstrated, rats will prefer to run a square activity wheel (more effortful) rather than a round activity wheel. Also, rats tend to vary behavior simply because a certain degree of variability is adaptive in the wild. Barnett (1967) also discussed the implications of interpreting the results found in "artificial" laboratory settings. He further notes the tendency of rats to be active when hungry. Variables such as those just described could be useful in

TABLE 1

The Protestant Ethic Effect: Studies of Interest

Author(s)	Jensen, 1963	Stoltz & Lott, 1964
No. Subjects	200	37
Subjects	male rats	male rats
Operant(s)	bar press	run maze
Reinforcement	45-mg. pellet	.15-mg. pellet
Dependent Variables	FF consumed, rewarded presses	trials S ran over FF
Support PEE	yes	yes
Results	PEE is positively correlated with rewarded bar presses prior to the choice situation	PEE is positively correlated with amount of training prior to the choice situation

Author(s)	Leung, Jensen, & Tapley, 1968	Neuringer, 1969
No. Subjects	120	2
Subjects	male rats	male pigeons
Operant(s)	run maze	peck disk
Reinforcement	45-mg. pellet	grain
Dependent Variables	FF consumed, time before S left FF, alley time	FF consumed, grain consumed after rewarded peck
Support PEE	yes	yes
Results	PEE is positively correlated with training prior to the choice situation, PEE did not vary with reinforcement schedule	PEE not a function of whether the S was deprived or threatened

TABLE 1 (cont.)

Author(s)	Neuringer, 1969 (cont.)	Carder & Berkowitz, 1970
No. Subjects	2	6
Subjects	male rats	male rats
Operant(s)	bar press	lever press
Reinforcement	45-mg. pellet	45-mg. pellet
Dependent Variables	FF consumed, rewarded bar presses	FF consumed, pellets earned
Support PEE	yes	no
Results	PEE not a function of whether S was deprived or threatened	PEE does not persist if work demands are too high

Author(s)	Jensen, Leung, & Hess 1970	Jensen, Leung, & Hess, 1970 (cont.)
No. Subjects	60	80
Subjects	male rats	male rats
Operant(s)	run maze	bar press
Reinforcement	45-mg. pellet	45-mg. pellet
Dependent Variables	length of time till S stopped eating FF to run maze	length of time till S stopped eating FF to press bar
Support PEE	yes	yes
Results	PEE is positively correlated with runs made prior to the choice situation	PEE is positively correlated with bar presses made prior to the choice situation

TABLE 1 (cont.)

Author(s)	Neuringer, 1970	Singh, 1970
No. Subjects	3	30
Subjects	male pigeons	female rats
Operant(s)	peck disk	bar press
Reinforcement	grain	45-mg. pellet
Dependent Variables	disk pecks	bar presses, FF eaten, switches back and forth
Support PEE	yes	yes
Results	PEE was demonstrated when work demands were high	PEE does not vary with work schedule

Author(s)	Singh, 1970 (cont.)	Singh, 1970 (cont.)
No. Subjects	32	-
Subjects	female rats	-
Operant(s)	bar press	bar press
Reinforcement	45-mg. pellet	45-mg. pellet
Dependent Variables	FF pellets consumed, earned pellets consumed	FF consumed, rewarded presses
Support PEE	yes	yes
Results	PEE is not schedule specific, training and testing procedures are not an artifact of PEE	PEE varies according to incentive properties associated with FF

TABLE 1 (cont.)

Author(s)	Singh, 1970 (cont.)	Davidson, 1971
No. Subjects	32	4
Subjects	boys (66-81 mos.) girls (65-77 mos.)	male rats
Operant(s)	lever press	key press
Reinforcement	marbles	45-mg. pellet
Dependent Variables	free marbles received earned marbles	key presses per minute
Support PEE	yes	yes
Results	PEE can be demonstrated using children as Ss	PEE is positively correlated with amount of prior conditioning, non-reinforcement depressed operant, satiated Ss continued to key press

Author(s)	Koffer & Coulson, 1971	Singh & Query, 1971
No. Subjects	6	80
Subjects	male cats	white boys, Indian boys, white girls, Indian girls
Operant(s)	place paw on aluminum plate	bar press
Reinforcement	water mixed with cat food	marbles
Dependent Variables	FF consumed, number of operants consumed	free marbles received, earned marbles
Support PEE	no	yes
Results	PEE is species linked	PEE is exhibited in children regardless of sex, IQ, need-achievement

TABLE 1 (cont.)

Author(s)	Carder, 1972	Tarte & Snyder, 1972
No. Subjects	14	28
Subjects	male rats	female rats
Operant(s)	lever press	bar press
Reinforcement	water, sucrose water, quinine adulterated sucrose water	45-mg. pellet
Dependent Variables	amount of free liquid consumed, lever presses	bar presses, total pellets consumed
Support PEE	yes, no	yes
Results	PEE demonstrated using water, opposite results with sucrose water and quinine-sucrose water	PEE is positively correlated with hours deprivation

Author(s)	Taylor, 1972	Taylor, 1972 (cont.)
No. Subjects	10 15	25
Subjects	male rats, female rats	male rats
Operant(s)	bar press	bar press
Reinforcement	45-mg. pellet	water
Dependent Variables	bar presses, total pellets consumed	earned water consumed, total water consumed
Support PEE	no	no
Results	PEE does not generalize across Ss	PEE does not generalize across reinforcers

TABLE 1 (cont.)

Author(s)	Alferink, Crossman & Cheney, 1973	Tarte & Snyder, 1973
No. Subjects	2	6
Subjects	pigeons	female rats
Operant(s)	key peck	bar press
Reinforcement	Purina Pigeon Chow	45-mg. pellet
Dependent Variables	grain consumed and key pecks when hopper light was on and off	earned pellets consumed, total pellets consumed
Support PEE	no	yes
Results	secondary reinforcers are an artifact in PEE	PEE was replicated

Author(s)	Tarte & Snyder, 1973 (cont.)	Tarte & Snyder, 1973 (cont.)
No. Subjects	12	8
Subjects	female rats	female rats
Operant(s)	bar press	bar press
Reinforcement	45-mg. pellet	45-mg. pellet
Dependent Variables	earned pellets consumed, total pellets consumed	earned pellets consumed total pellets consumed
Support PEE	yes	yes
Results	PEE not affected by allowing prechoice bar presses	PEE not affected by increasing number of bar press sessions

TABLE 1 (cont.)

Author(s)	Tarte & Snyder, 1973 (cont.)	Tarte & Snyder, 1973 (cont.)
No. Subjects	6	8
Subjects	female rats	female rats
Operant(s)	bar press	bar press
Reinforcement	45-mg. pellet	45-mg. pellet
Dependent Variables	earned pellets consumed, total pellets consumed	earned pellets consumed, total pellets consumed
Support PEE	no	no
Results	PEE was not demonstrated when training and FF sessions were alternated prior to the choice situation	PEE was not demonstrated when number of free pellets and earned pellets consumed prior to the choice situation was equal

Author(s)	Metze & Craig, unpublished manuscript
No. Subjects	4
Subjects	male rats
Operant(s)	bar press
Reinforcement	45-mg. pellet
Dependent Variables	earned pellets consumed, total pellets consumed
Support PEE	yes
Results	PEE replicated

the description of the PEE since Ss rarely fail to exhibit some of the "more-effortful" behavior when put in a choice situation.

Barnett (1967) makes another point of interest: "if rats, wild or tame, have access to two or more foods, they do not ordinarily restrict themselves to one, but at least sample all of them [p. 437]". Perhaps then, the more effortful operant (e.g., bar pressing) is merely a species specific type of behavior since organisms tend to maintain those behaviors which are likely to enhance survival. Another point with a similar answer is that activity may promote such processes as digestion or metabolism. Just as the diabetic prefers activity after eating in order to facilitate metabolic processes, bar pressing may provide a means of making the best use of food.

Secondary reinforcers. A second variable of interest in the PEE studies is those things which occur simultaneously with the reward but which do not satisfy basic biological needs (e.g., the sound of the dispenser). These secondary reinforcers can take on the function of maintaining behaviors such as bar pressing. Neuringer (1969) raised the question of whether the sound of the feeder, the sight of the grain, the motor response, or access to the reinforcer itself was the determinant of behavior. One pigeon trained to disk peck and one pigeon trained to bar press were put in a choice situation. Though the feeder operated and the grain appeared, the S could not eat the grain due to a

plexiglass shield. When the earned food became inaccessible, the number of pecks and presses decreased and the Ss ate from the FF dish. The rate of response rose again when the shield was removed and the earned grain was again accessible. Neuringer concluded that the accessibility of grain was necessary to maintain disk pecking and bar pressing and the auditory/visual/motor cues were not a sufficient explanation. Similar findings were reported by Davidson (1971). Results indicated a decrease in bar pressing by rats when food pellets were no longer delivered into the dispenser dish. He concluded that the accessibility to the food was necessary to maintain bar pressing and that "unidentified reinforcers" were not an adequate explanation. Singh and Query (1971) suggested that children exhibit a similar behavior. Incidental observation indicated that children did not continue to bar press at a high rate when the bar pressing no longer resulted in the receipt of marbles. Neuringer's (1969) pigeons were in the choice situation all the time since they lived in the experimental chamber. However, Davidson's (1971) rats were on a 23h deprivation schedule and Singh and Query's (1971) children needed to obtain marbles for a prize. It is unclear what other behavior besides freeloading would be expected of a rat whose only source of food was the FF or a child whose only means of getting a toy was obtaining marbles on the free side of the experimental choice apparatus.

Alferink, Crossman, and Cheney (1973) used a different

approach to investigate the effects of variables which could be acting as secondary reinforcers in the choice situation. Pigeons were trained to key peck on a fixed ratio (FR) schedule of 300. After 300 pecks, the key went dark, the grain hopper light went on, and the hopper was raised so that the S could eat for 3-sec. After training, the grain hopper was propped in an open position so that FF was available at all times. When the hopper light was withheld, key pecking decreased but the S continued to eat. Key pecking increased when the FR 300 schedule of hopper light presentation was again resumed. The Ss ate whether the hopper light was on or off, but the key pecking behavior was contingent on whether or not the hopper light was operable. Alferink, Crossman and Cheney concluded that the hopper light, a secondary reinforcer, was an artifact in the PEE in this situation.

Schedule of reinforcement. A third variable which has been investigated in relation to the PEE is schedule of reinforcement. Carder and Berkowitz (1970) investigated how the number of bar presses required for one pellet of food affected freeloading. Rats that preferred to bar press on a continuous reinforcement (CRF) schedule and an FR2 schedule, switched preferences on an FR10 schedule. They concluded that rats prefer to work for food only if the demands are not too high. When a CRF schedule was reintroduced, the Ss again preferred to bar press.

This return to the bar indicated that the results of earlier studies (e.g., Jensen, 1963) could not be accounted for simply by inattention to the FF or lack of experience with the FF. In an attempt to qualify these findings, Neuringer (1970) manipulated some of the independent variables. These included body weight, alternation of FF and control sessions, and prior experience. Results indicated that bar pressing was much more apt to be maintained than reported previously (Carder and Berkowitz, 1970) even when the S had to respond many times to obtain food (FR40). A direct criticism of Carder and Berkowitz' (1970) results was reported by MacDonald (1970). He argued that the rats could not obtain enough food on the F10 schedule and were thus "hungrier" since they were not fed outside the experimental situation. Carder's (1970) reply points out that in training, similar amounts of pellets were earned on the FR2 and FR10 schedules. Also, similar amounts of total pellets were consumed during the choice situations on the FR2 and FR10 schedules.

Behavior of Ss in other studies of interest tend to shed doubt on the conclusion of Carder and Berkowitz (1970) that bar pressing behavior decreases as work demands increase. Davidson's (1971) rats continued to bar press on an FR10 schedule; Alferink, Crossman, and Cheney (1973) used an FR300 schedule with pigeons; and Singh (1970) used an FR11 schedule with rats and an FR10 schedule with children.

Deprivation. A fourth variable of interest is that of hours of deprivation prior to the choice situation. Tarte and Snyder (1972) deprived rats of food for 0, 12, 24, 36, 48, 72, and 92h after bar pressing sessions of 1h. The Ss had been deprived of food on a 23h deprivation schedule during training, and the session after the last training session was the first and only choice situation the S was exposed to. Though there was a large variation within groups, results indicated that the percentage of pellets received via bar pressing had a positive correlation with the duration of deprivation. Neuringer (1970), as reported earlier, concluded that an organism need not be deprived to exhibit a bar pressing preference, but the amount of pressing may be influenced by the length of deprivation.

Another study by Davidson (1971) measured the preferences of Ss that were reinforcer-satiated. He placed four trained rats in a choice situation immediately after being allowed to eat freely for 1h. All four Ss ate significantly less FF than on three preceding days. One rat key pressed at a lower rate than on the three preceding days, two rats responded at a lower rate. He concluded that "maintenance of key pressing was independent of the short-term effects of satiation /p. 136/".

Training. A fifth variable of interest is training prior to the choice situation. Training is typically accomplished in a way similar to that reported by Jensen

(1963). That is, Ss are allowed to perform an *a priori* amount of rewarded bar presses before being placed in the choice situation. Tarte and Snyder (1973) reported a series of experiments designed to investigate some of the aspects of the training sessions which could account for behavior in the choice situation. The first three experiments were an attempt to replicate the Carder and Berkowitz (1970) findings. Training in the first experiment consisted of three FF sessions followed by six bar press sessions. Experiment 2 added a control over the number of pre-choice bar presses, and Experiment 3 spread the bar press sessions over ten days. All three experiments yielded results similar to those of Carder and Berkowitz (1970). In the fourth experiment Tarte and Snyder alternated the FF and bar pressing sessions prior to the choice situation. Results indicated that rats that have been given equal amounts of time, equally distributed to bar press and freeload do not prefer to bar press in the choice situation. In experiment five the number of pellets received by bar pressing and freeloading were equalized. Again, results indicated that rats prefer to freeload rather than bar press. Tarte and Snyder's results in the first three experiments replicated earlier findings (Jensen, 1963; Carder and Berkowitz, 1970), and they concluded that bar pressing behavior did not vary significantly as a function of the number of bar presses or the number of bar press sessions. However, opposite results were found in the last

two experiments. Tarte and Snyder found evidence contrary to the early PEE studies when the number of pellets received during freeloading sessions and bar pressing sessions was equalized and when the two types of sessions were alternated. They concluded then that training schedules affect the behavior of rats in a choice situation.

Subjects. A sixth variable of interest in studies involving the PEE is the type of Ss used. Studies demonstrating the PEE have used rats (e.g., Jensen, 1963), pigeons (e.g., Neuringer, 1970), and children (e.g., Singh, 1970). Koffer and Coulson (1971) presented evidence which they claim indicated that the PEE is species linked. In their study, six cats preferred to eat all 200 ml of the FF rather than perform an operant (putting one paw in contact with an aluminum plate) for 0.8 ml of food. However, there are certain points which question the generalizability of this study. First, two of the six Ss had a cannula implanted in the midbrain. Second, two of the Ss had previous experimental training. Third, the Ss could not maintain their normal body weight during the training sessions. Fourth, a complete account of the number of bar presses during the training and choice sessions was not reported. Fifth, when the FF dish was removed from the choice situation, the Ss did not resume performing the operant which might indicate that training was not sufficient. The point of the previous discussion is that, though there may be species linked differences, the Koffer and Coulson study does not

successfully demonstrate these differences due to the possible confounding of variables as listed above.

Reinforcer. A seventh variable of interest in the studies attempting to describe the PEE is the type of reinforcer used. The reinforcer in studies using rats as Ss was typically a 45-mg. food pellet (e.g., Jensen, 1963). Grain was typically used with pigeons (e.g., Neuringer, 1969) and marbles which could be traded in for a toy were used with children (e.g., Singh, 1970). A study dealing directly with the reinforcer as a variable was done by Carder (1972). He investigated the behavior of rats using water, sucrose solution, and sucrose solution adulterated with quinine. A preference for lever pressing over freeloading was demonstrated when the sucrose solution was used. Opposite results were found when water or quinine adulterated water was used. Carder concluded that results of this type indicate that the reinforcer should be a consideration in the study of the PEE.

Operant. An eighth variable of interest in the PEE studies is the operant by which the S earns the reinforcer. An early study using maze running as the operant was conducted by Havelka (1956) who found that rats varied in their choice of routes to food even when some routes were longer and more difficult. Moreover, the Ss were consistent in their choice of routes. Stoltz and Lott (1963) demonstrated the PEE using a second type of operant, the runway. Leung, Jensen, and Tapley (1968) also used the runway in an attempt to replicate the Jensen (1963) findings that, given a choice,

a rat's bar pressing tendencies have a positive correlation with the number of training trials. Use of the runway instead of the Skinner box resulted in an opposite effect. Jensen, Leung, and Hess (1970) replicated the findings of both the Leung, Jensen, and Tapley (1968) and Jensen (1963) studies by using both bar pressing and maze running as operants. Rats were trained using either 0, 40, or 285 rewarded bar presses or runs before being put in the choice situation. The number of operants performed in the choice situation had a positive correlation with amount of training in the Skinner box and had a negative correlation in the maze. Jensen, Leung, and Hess concluded that the operant performed by the S must not be ignored as a variable in studies attempting to describe the PEE. A fourth type of operant was employed by Singh (1970). Rats were trained to discriminate between black and white chambers of a choice apparatus based on whether the S received FF or worked for food in the chamber. Singh reported no systematic differences based on whether the Ss were bar trained in the black or white chamber.

Stress. A ninth variable of interest as it relates to the manifestation of the PEE is stress. Incidental observations in the laboratory have indicated that the PEE was possibly affected when stress was inadvertantly introduced into the choice situation. It may be hypothesized that S reactions to stress may produce variability in the observed behavior since stress may be defined "as the state of the organism following the failure of the normal homeostatic

mechanisms of adaptation (Selye, 1959 [p. 442]". Thus, stress could be operationally defined as a set of symptoms manifested by the General Adaptation Syndrome (GAS) which consists of specific changes in a biological system. Among the stressor agents which produce such changes are heat, cold, infections, injury, restraint, and shock (Ganong and Forsham, 1960).

Summary. A summary of the studies and their respective variables is found in Table 2 on page 24.

TABLE 2

Underlying Variables and Studies of Interest

Variable investigated	Author(s)
Biological state	Kavanau (1967) Barnett (1967)
Secondary reinforcers	Neuringer (1969) Davidson (1971) Singh and Query (1971) Alferink, Crossman, and Cheney (1973)
Schedule of reinforcement	Carder and Berkowitz (1973) Carder (1970) MacDonald (1970) Davidson (1971)
Deprivation	Neuringer (1970) Davidson (1971) Tarte and Snyder (1972)
Training	Tarte and Snyder (1973)
Subjects	Koffer and Coulson (1971)
Reinforcer	Carder (1972)
Operant	Leung, Jensen, and Tapley (1968) Jensen, Leung, and Hess (1970) Singh (1970)
Stress	None

Statement of Problem

In the past decade researchers have demonstrated that organisms do not always perform according to Hull's "law of less work" (Hull, 1943). In certain situations, some Ss prefer to perform an operant (e.g., bar press) rather than freeload to receive reinforcement (e.g., food). Though it can be argued that this is not behavior typical of all Ss (Taylor, 1972), lack of generality is not the point. As Metze and Craig (1973) point out, data from deviant individual Ss may prove to be the most interesting.

There are two research objectives for the present study. First, an attempt was made to replicate the findings of Jensen (1963) and others (e.g., Neuringer, 1969: and Carder and Berkowitz, 1970). They found that a number of the Ss studied preferred to work for reinforcement rather than receive it free. Therefore, it was expected that when given the choice, Ss would prefer to earn the food they consumed rather than freeload. Second, an attempt was made to investigate the effect of stress on the behavior of Ss who preferred to work. Incidental observations in the laboratory would suggest that the preference for work would be depressed and an increase in freeloading would be observed upon the introduction of stress into the situation.

Method

Subjects.

The Ss were six male and six female experimentally naive albino rats maintained in a colony at Western Kentucky University. They were 60-80 days old at the beginning of training. The Ss were fed once every 24h during the two weeks prior to the experimental sessions. They were then fed approximately 18.6 grams of rat chow once daily following each experimental session. Water was available ad lib in the home cage and during all training and choice sessions.

Apparatus.

The experimental apparatus consisted of a box (14" X 11" X 10") with front and back walls made of aluminum and with sides and top made of plexiglass. The floor was 3/16" rods spaced 5/8" apart. The 45 mg. Noyes pellets were delivered by means of a pellet dispenser. The bar and a dispenser cup were positioned side by side against the front wall. An ad lib supply of water was available at the top of the box. During all sessions, training and testing, a FF cup identical to the dispenser cup was against the back wall of the box. An *a priori* count of pellets was placed in the FF cup prior to each individual choice trial. The electrical shock was administered by means of a shock generator and scrambler attached to the grid floor.

Procedure.

Pilot study. Two pilot Ss were individually placed in the box. The shock generator was turned on at a low level. The intensity was increased until the S showed behavior typical of a stress situation. That is, the Ss attempted to escape from the shock. An intensity level of .6 ma was chosen. Duration, number of shocks, and intervals between shocks were manipulated to determine their effects. A duration of .9-sec. per trial for ten trails with 2-sec. intervals was chosen.

Design. A repeated measures design was used. The dependent variable was consumption of free versus earned food as reflected in the index ratio which equals the number of earned pellets consumed divided by the total number of pellets consumed. A mean index ratio was computed for consumption prior to and subsequent to the introduction of stress.

Training and testing. Phase I consisted of a daily 15-min. session in which bar pressing was reinforced on a continuous reinforcement (CRF) schedule. Each S was trained for ten days after reaching its individual asymptotic level of performance. Criterion for an asymptotic level was variation in number of responses not greater than ±10% of the mean number of responses over a five day period. Phase II lasted for 15 days and consisted of placing each S in the box for a 15-min. session with the bar operative and pellets in the FF cup. The ratio index was computed for each day for each S. Phase III was the same as Phase II

except that prior to each 15-min. session the shock, as described above, was administered to the S in the box.

Results

Only nine of the 12 Ss described in the method section were included in the analysis. The S_2 data were not used due to S illness while the S_7 and S_8 data were not used due to S number confusion by E and the subsequent meaningless of their data. Furthermore, S_3 did not meet the training criteria of Phase I because of a lack of stabilized bar pressing and was started in Phase II after 25 Phase I sessions. The other eight Ss varied from an absolute minimum 15 to a maximum 22 training sessions in Phase I.

The PEE found in previous research was replicated. It was found that the mean index ratios for the nine Ss ranged from .893 to .477 with only S_{12} earning less than 50% of its food. Table 3 on page 30 provides a listing of the mean index ratios for Phases II and III. An examination of the mean index ratios for Phase II shown in Table 3 indicates the large degree of variation among Ss.

The effect of the introduction of stress was to depress the preference for earned food as reflected in the observed decrease in the mean index ratio. A Pearson product-moment correlation coefficient was computed to determine the correlation between the mean index ratios for Phases II and III and between the total number of pellets consumed in Phases II and III. A scatter plot of the mean index ratios is presented in Figure 1 on page 31 ($n = 9$, $r = .841$, p .01)

Table 3

MEAN INDEX RATIOS IN PHASES II AND III

S	Phase II	Phase III
1		
3	.893	
4	.652	.676
5	.819	.372
6	.719	.609
9	.734	.518
10	.723	.586
11	.800	.698
12	.610	.891
	.477	.428
		.070

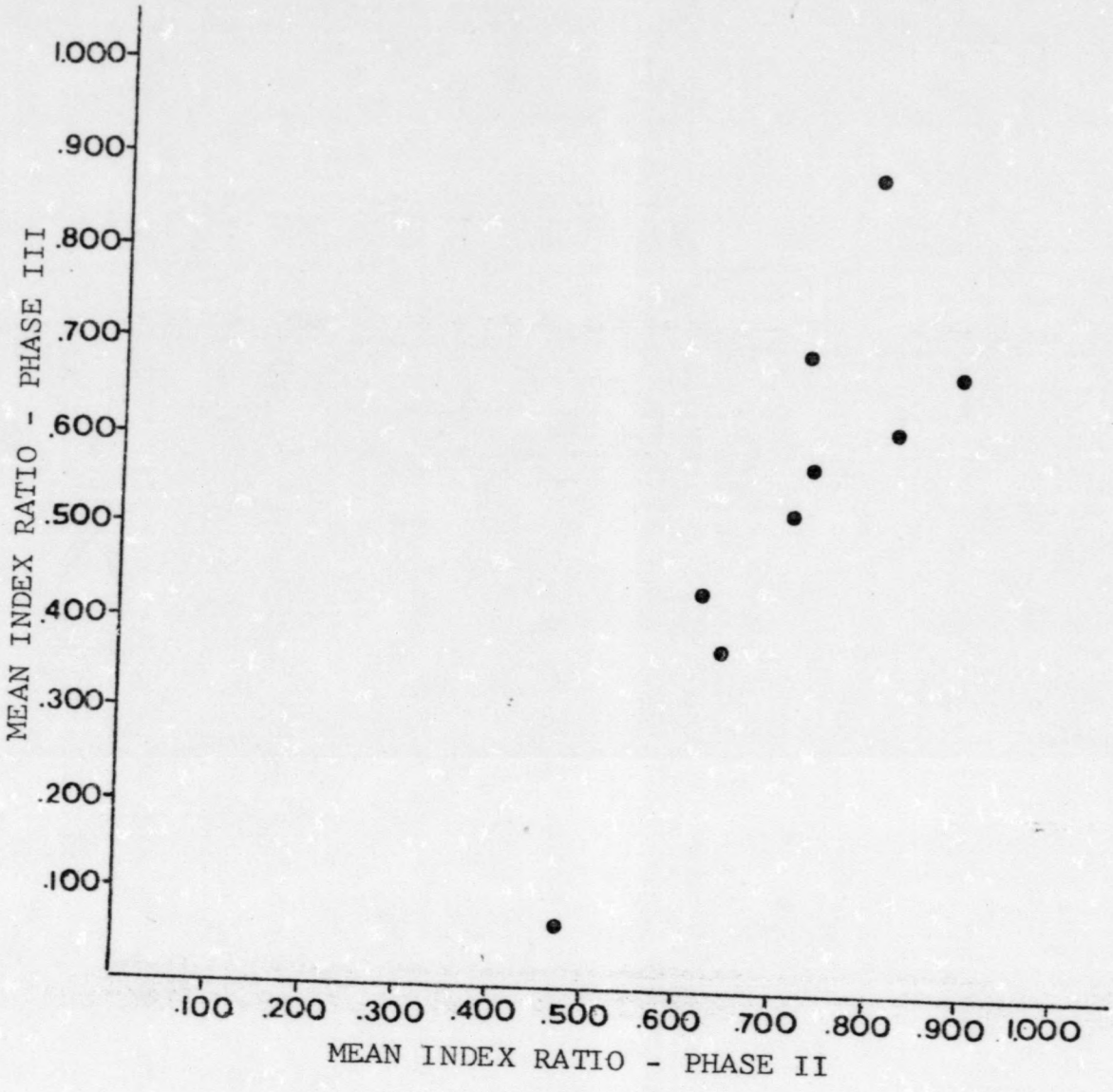

Fig. 1. Scatter Plot of Mean Index Ratios For Each S During Phases II and III

and a scatter plot of the total number of pellets consumed is presented in Figure 2 on page 33 ($n = 9$, $r = .898$, $p < .001$). There was a significant difference between the mean index ratios for the Ss between Phases II and III, $t = (18) = 3.916$, $p < .005$. Figure 3 on page 34 is a representation of the way in which the Ss ranked in Phase II and their corresponding performance in Phase III as reflected in the mean index ratios. The unbroken line represents the way the Ss ranked from high to low in Phase II and the broken line represents the Phase III mean index ratios ranked in the same order as in Phase II. A trend exists in Figure 2 which is not reflected elsewhere. That is, the higher the mean index ratio in Phase II the smaller the depression of performance tended to be in Phase III, and the lower the mean index ratio in Phase II the greater the depression of performance tended to be in Phase III.

Index ratios were computed using the number of bar presses minus earned pellets left in the dispenser cup at the end of each session as the numerator and the total number of pellets consumed as the denominator. Table 4 on page 35 lists the Ss and the total number of pellets each earned but did not consume during Phases II and III. There was a tendency to increase the total number of earned pellets not consumed from Phase II to Phase III. Table 5 on page 35 lists each S and the number of sessions that each S had earned food left in the dispenser cup in Phases II and III.

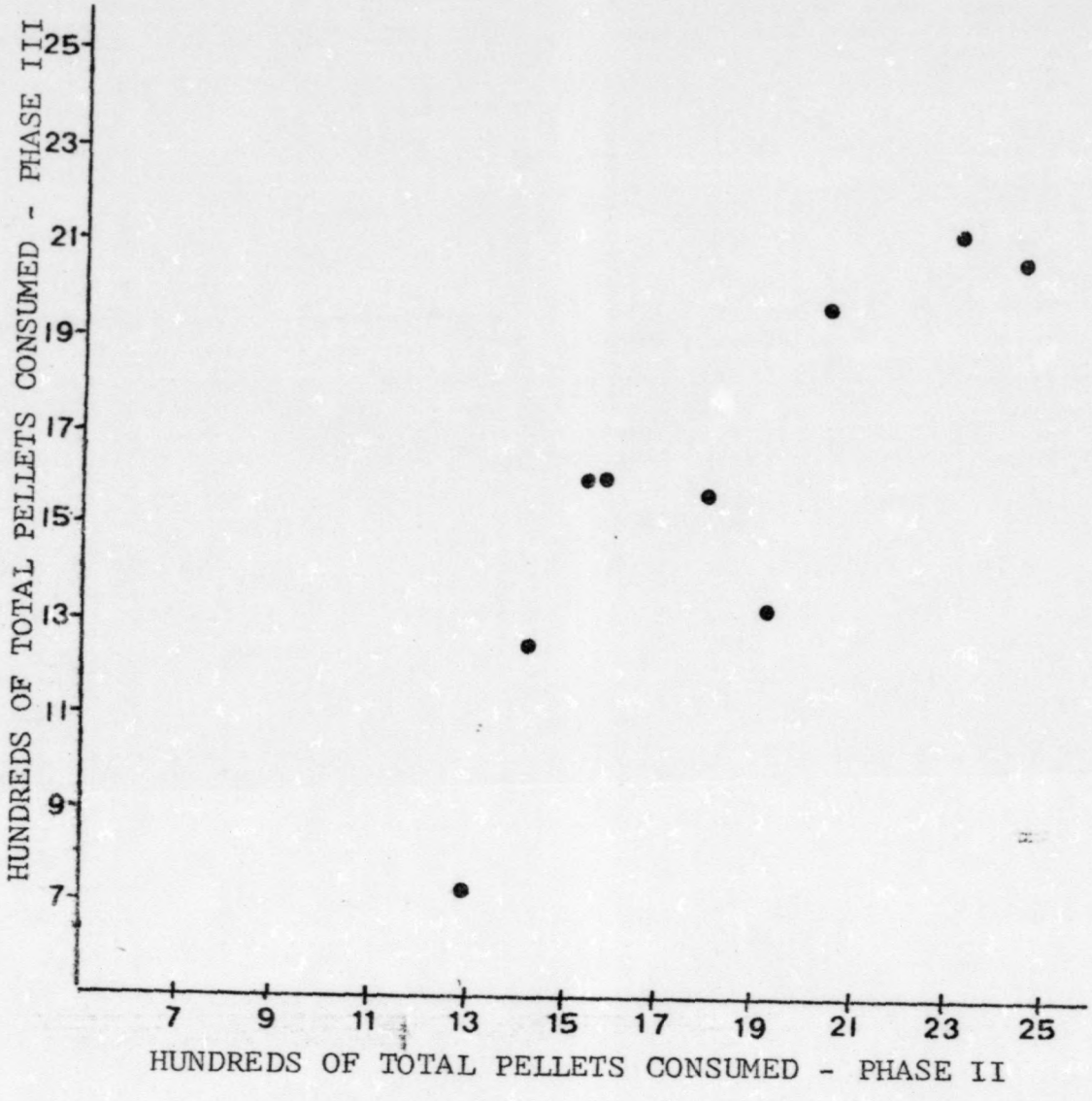

Fig. 2. Scatter Plot of Total Number of Pellets Consumed in Phases II and III

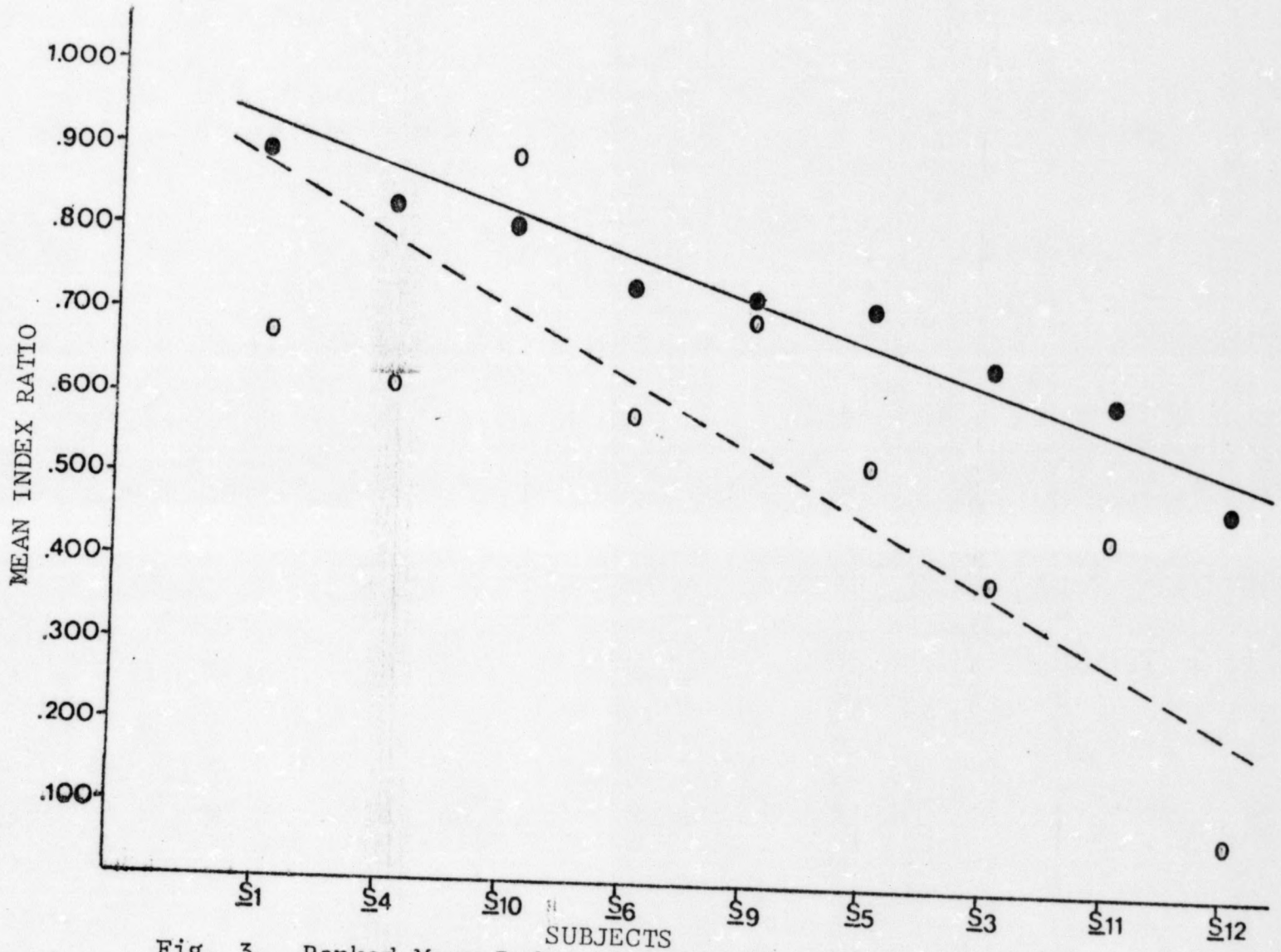

Fig. 3. Ranked Mean Index Ratios for Each S in Phase II and Corresponding Mean Index Ratio in Phase III

● Phase II ——— line of best fit

O Phase III - - - line of best fit

Table 4

TOTAL PELLETS EARNED BUT NOT CONSUMED DURING PHASES II AND III

S	Phase II	Phase III
1	14	21
3	20	34
4	61	106
5	0	1
6	59	40
9	15	46
10	12	83
11	130	189
12	2	4

Table 5

NUMBER OF SESSIONS EARNED PELLETS CONSUMED DID NOT EQUAL THE NUMBER OF BAR PRESSES

S	Phase II	Phase III
1	2	5
3	4	8
4	8	10
5	0	1
6	7	12
9	3	10
10	2	5
11	12	15
12	2	3

Individual variation among and within Ss was considerable as shown in Appendix A on page 41. The variability within Ss is most dramatically demonstrated in Figure A-S_{12} on page 49. Performance not only varied within Ss on a day to day basis, but the average measures of earned and free food increased or decreased from Phase II to Phase III in ways individual to each S as seen in Figure 4 on page 37.

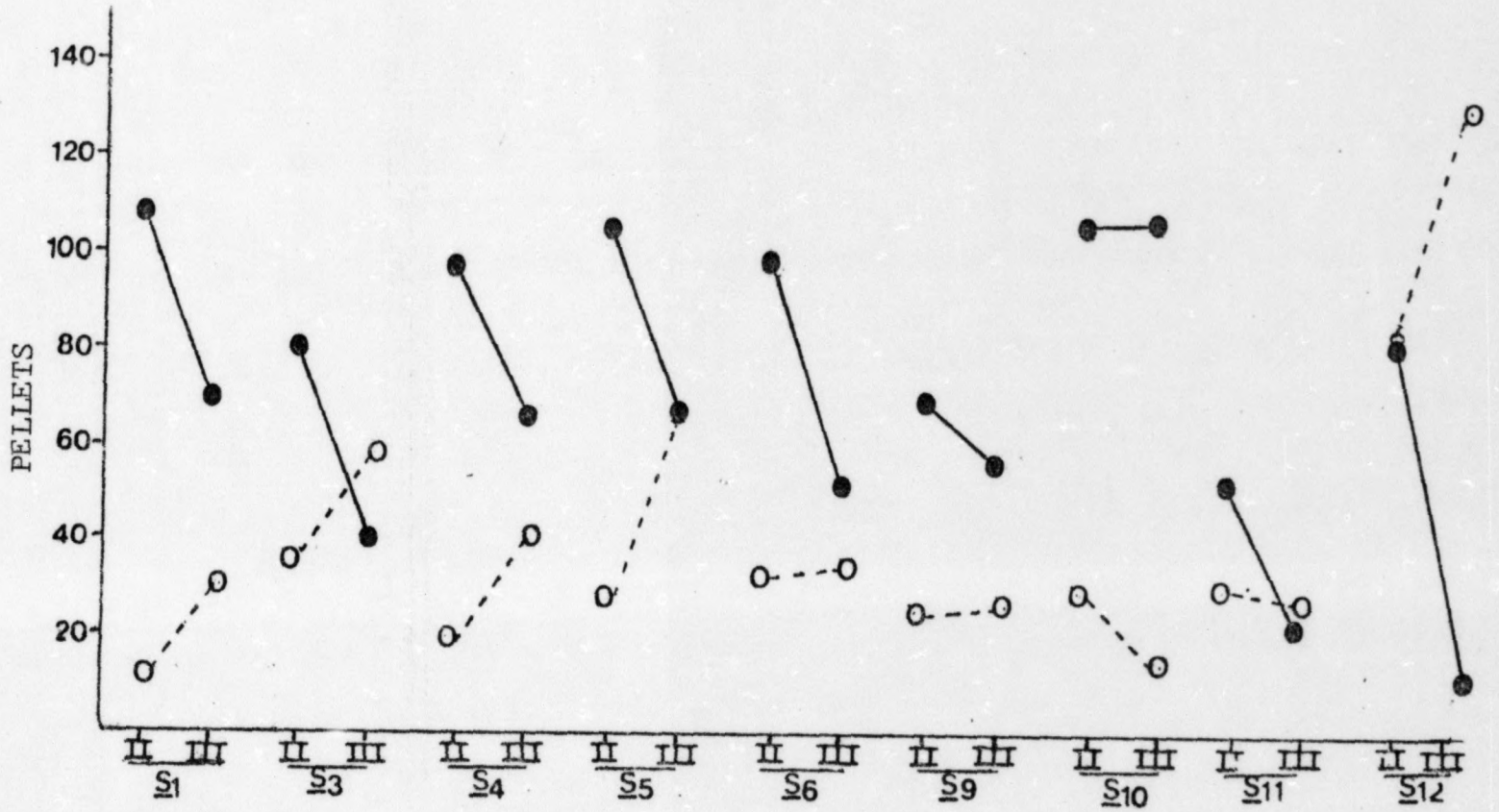

Fig. 4. Mean Earned and Mean Free Pellets Consumed in Phases II and III

Discussion

The PEE was replicated which is consistent with findings of others (e.g., Jensen, 1963). Almost all Ss preferred to earn most of the food consumed rather than freeload if given the choice. In fact, only one S preferred to work for less than 50% of the pellets consumed.

The effect of stress introduced in Phase III was to depress bar pressing as reflected by the mean index ratio. There was a tendency to increase the number of free pellets consumed as well as to decrease the number of earned pellets and the total number of pellets consumed. There was a trend which possibly indicates that a high established preference for earned food is a more durable behavior. The Ss that had a high preference for earned food in Phase II tended to maintain that preference at a high level in Phase III, and Ss that had a lower preference for earned food in Phase II tended to switch their preference to FF in Phase III. This trend was unexpected, but seems a likely area for replication and extension. However, Ss tended to rank in the same order in Phases II and III when performance was measured in terms of the mean index ratio and the total number of pellets consumed.

The number of earned pellets not consumed and the number of days that earned pellets were left in the dispenser cup had a tendency to increase from Phase II to Phase III. Though the method employed did not allow for constant observation such a procedure could have indicated if the earned pellets not consumed were a result of accidental bar presses (e.g., by the tail) which were incidentally observed. It is suspected that the high manipulation operant of rats as discussed by Kavanau (1967) and the change in biological state discussed by Selye (1959) could be possible variables of interest in explaining earned pellets not consumed. In order to examine the manipulation hypothesis, other operants, unrelated to the receipt of reinforcement, could be made available to the S in the choice situation and a measure taken of the Ss preference to perform them.

Based on the limitations of the method employed, suggestions for further research have been generated. A measure of the latency between the last shcok and the first response in each session may have accounted for the depression in the total number of pellets consumed from Phase II to Phase III since any latency period decreased the time spent performing operants during the 15-min. sessions. A more careful selection of Ss would have allowed the effects of variables such as sex and age to be factored out. A record of S weights and extra-experimental food could have been useful in explaining day to day variability based on weight losses or gains. Finally, a record of sequences and durations of performing operants could provide additional

information concerning the effects of stress in the choice situation since incidental observation indicated that, even the Ss who had low index ratios in Phase III, bar pressed at a high rate immediately following the shock.

In summary, the PEE was replicated as expected. The PEE seems to violate Hull's "law of less work" (Hull, 1943) and to lend itself to an explanation in terms of a manipulation operant which suggests that the survival value of manipulating the environment can account for the preference for controlling the environment (e.g., bar pressing), (Kavanau, 1967). The tendency for the application of stress to depress the preference for earned food cannot currently be accounted for. Further research would obviously involve the manipulation of variables used to operationally define the stress and the use of other types of stress (e.g., induced illness). Finally, since there was a considerable amount of fluctuation within some Ss and considerable differences between Ss, replication and amplification of the findings is indicated.

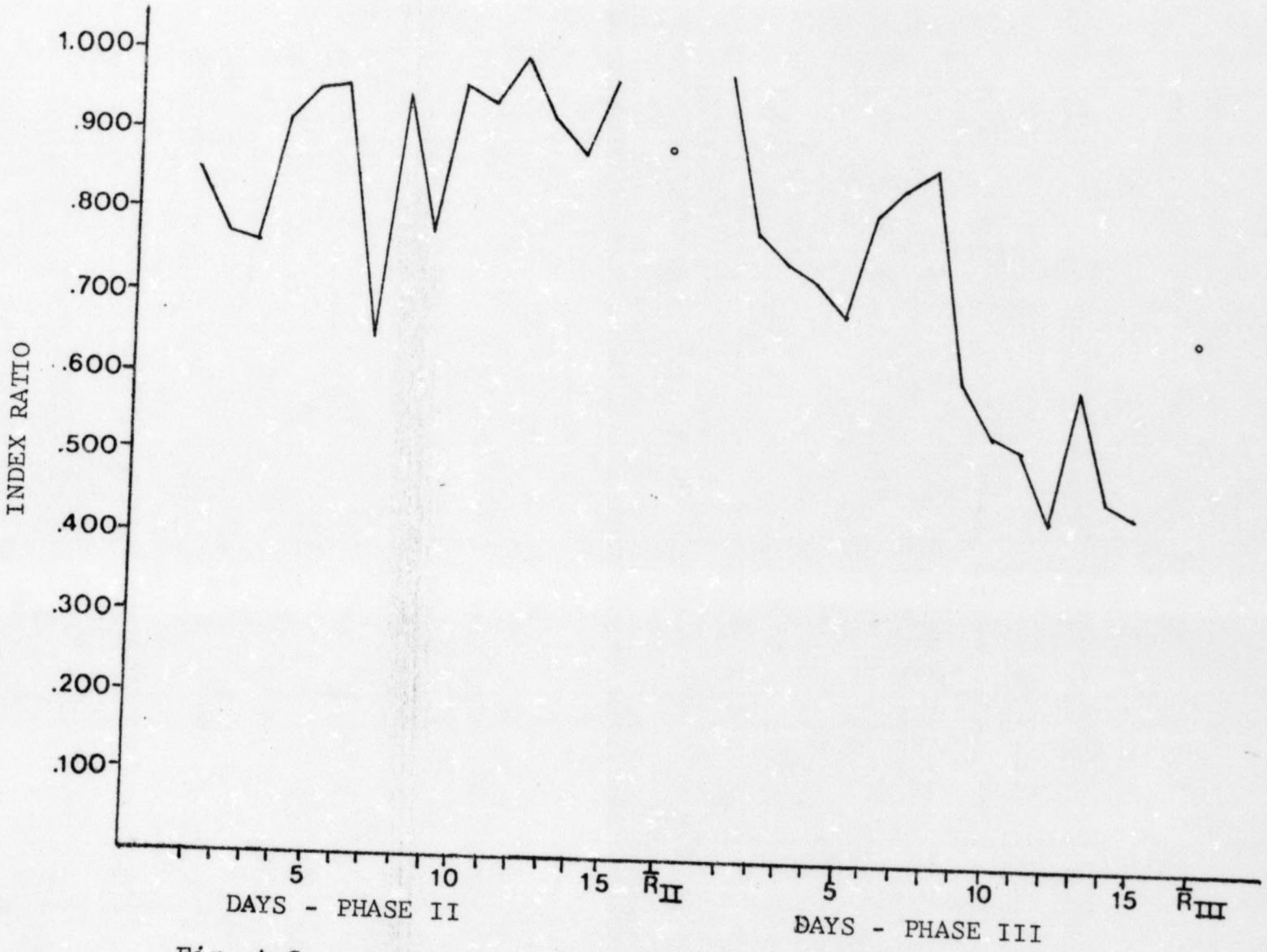

Fig. A-S_1. Index Ratios for S_1 during Phases II and III

$\bar{R}_I$ = mean index ratio - Phase II

$\bar{R}_{II}$ = mean index ratio - Phase III

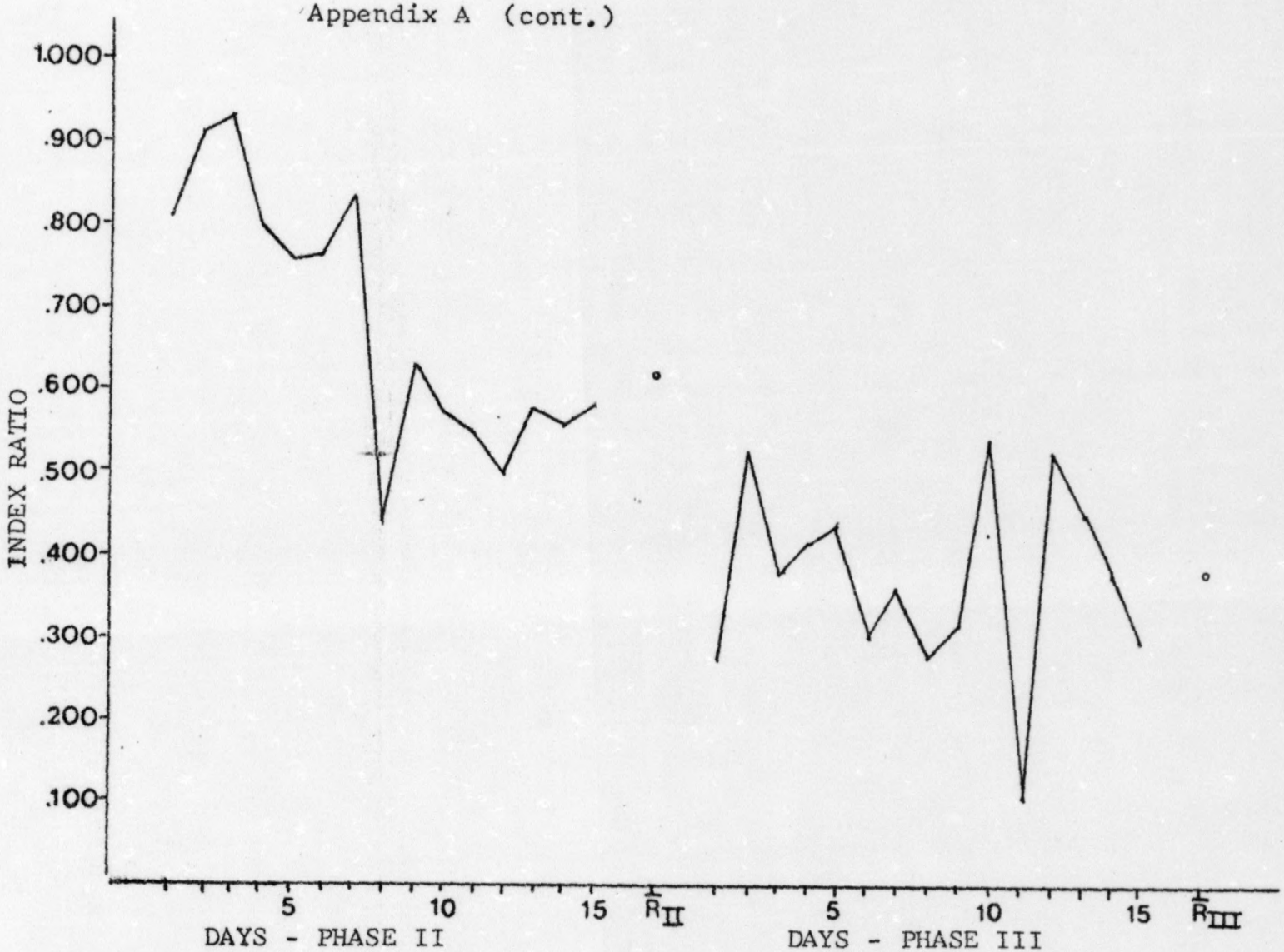

Fig. A-S_3. Index Ratios for S_3 during Phases II and III

$\bar{R}_I$ = mean index ratio - Phase II

$\bar{R}_{II}$ = mean index ratio - Phase III

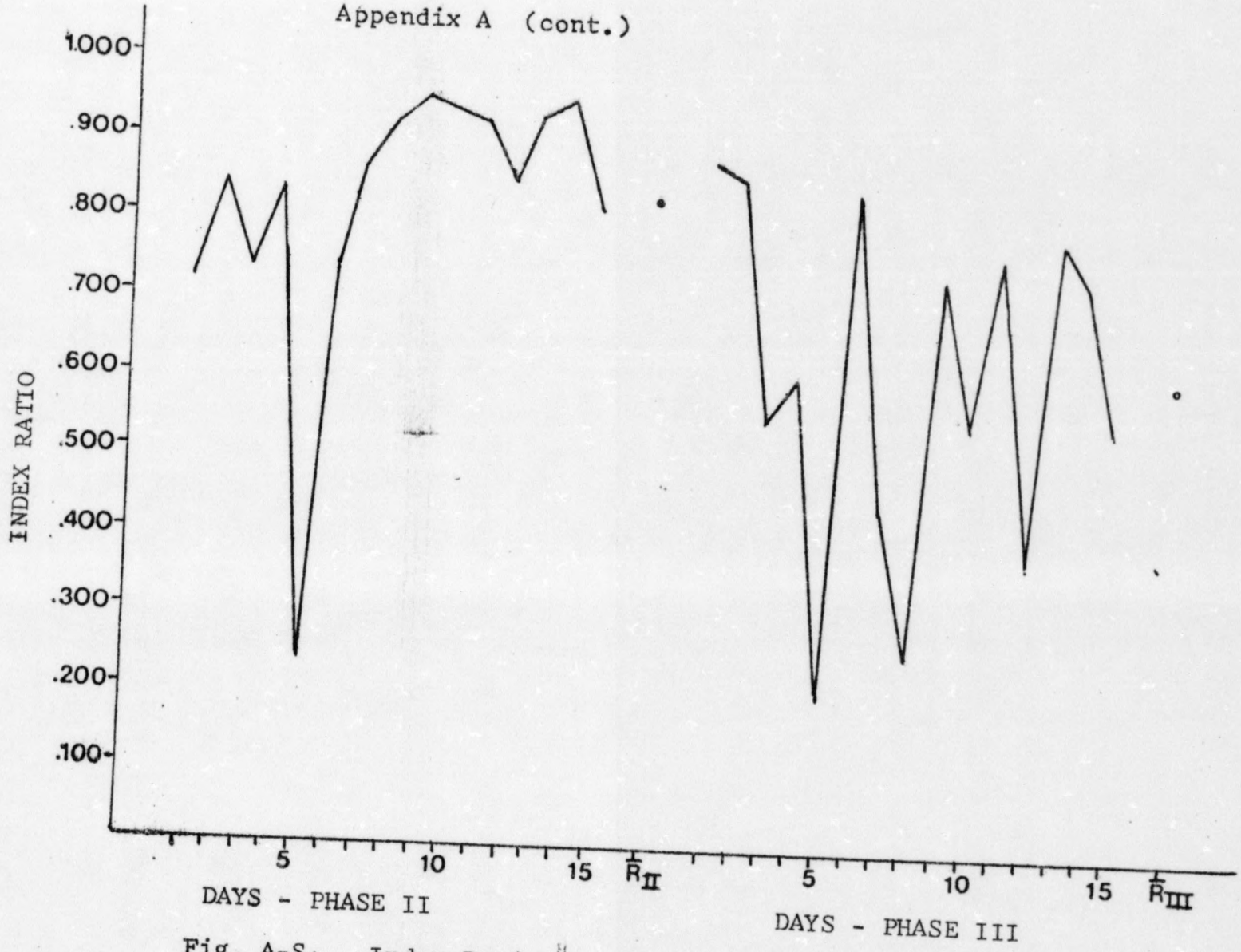

Fig. A-S_4. Index Ratios for S_4 during Phases II and III

$\bar{R}_I$ = mean index ratio - Phase II

$\bar{R}_{II}$ = mean index ratio - Phase III

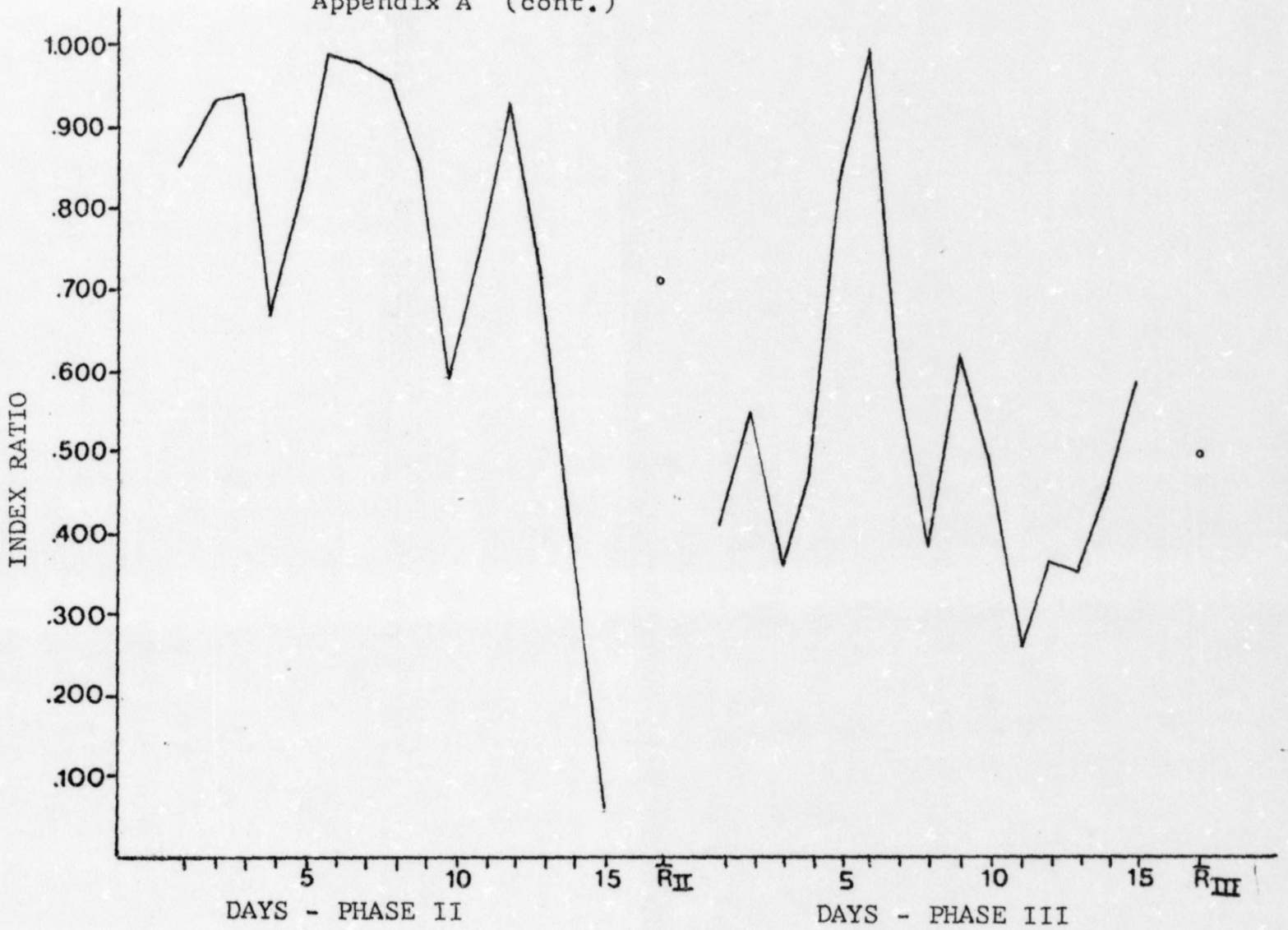

Fig. A-$\underline{S}_5$. Index Ratios for $\underline{S}_5$ during Phases II and III

$\bar{R}_I$ = mean index ratio - Phase II

$\bar{R}_{II}$ =mean index ratio - Phase III

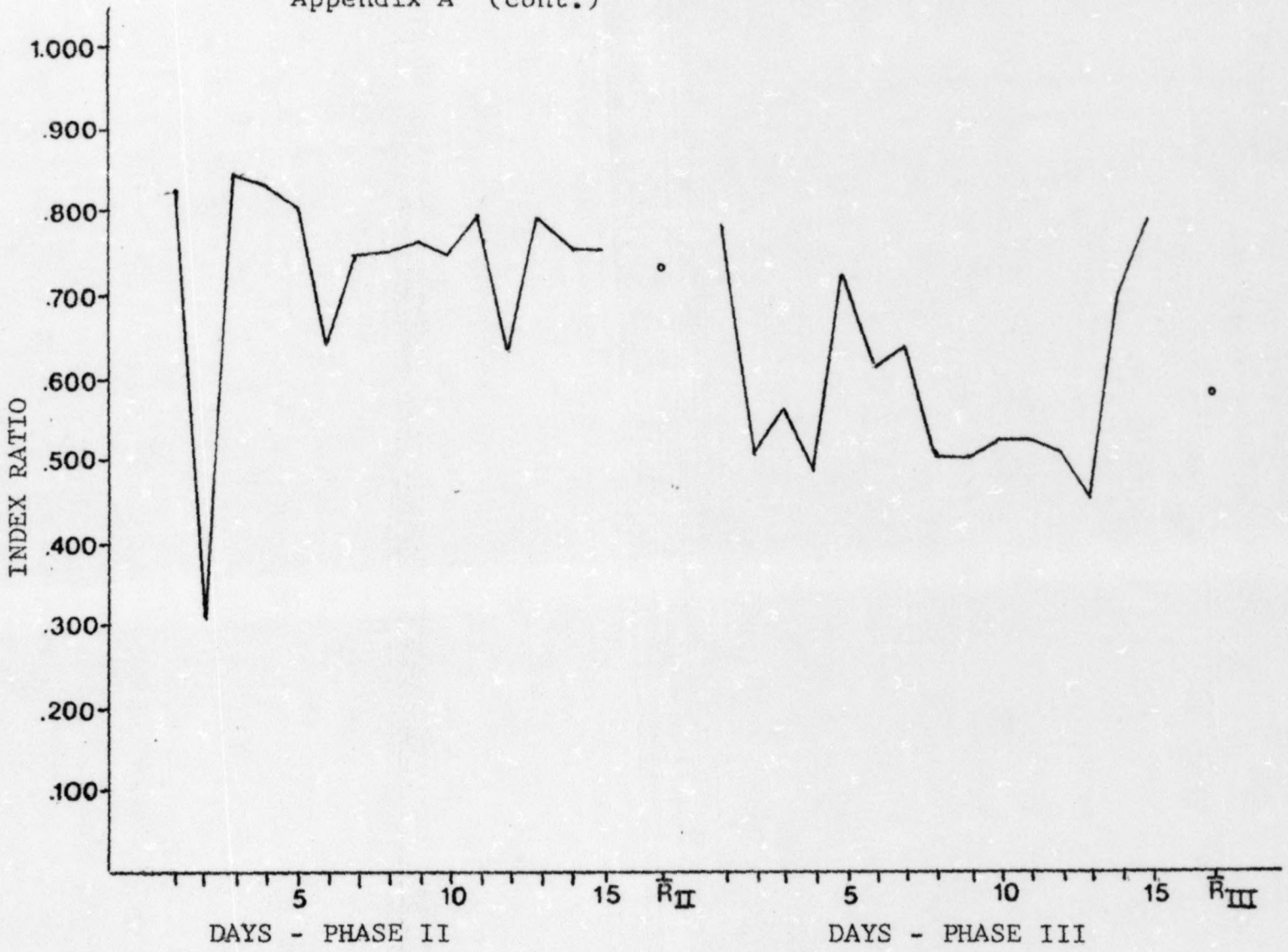

Fig. A-$\underline{S}_6$. Index Ratios for $\underline{S}_6$ during Phases II and III

$\bar{R}_I$ = mean index ratio - Phase II

$\bar{R}_{II}$ = mean index ratio - Phase III

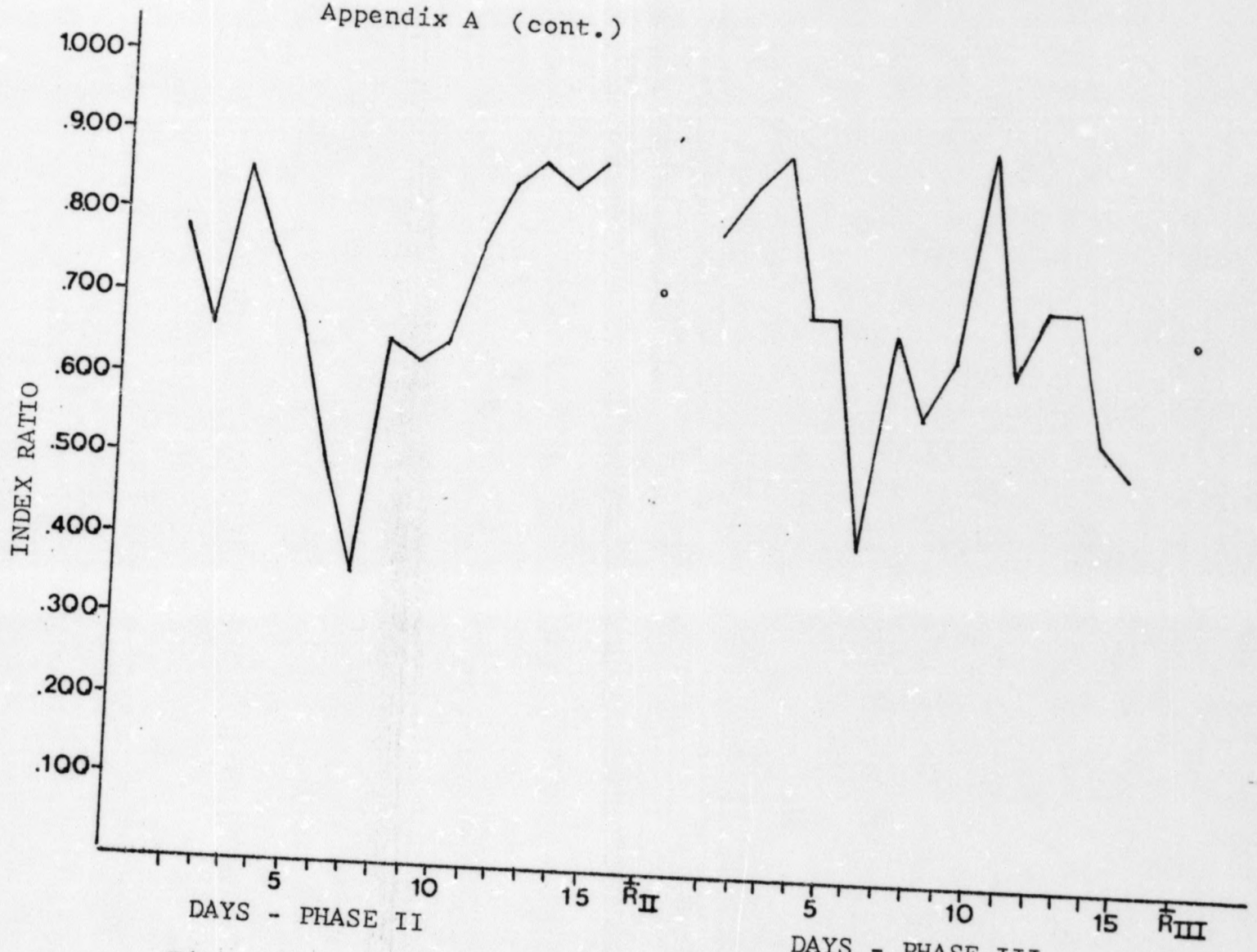

Fig. A-$\underline{S}_9$. Index Ratios for $\underline{S}_9$ during Phases II and III

$\bar{R}_I$ = mean index ratio - Phase II

$\bar{R}_{II}$ = mean index ratio - Phase III

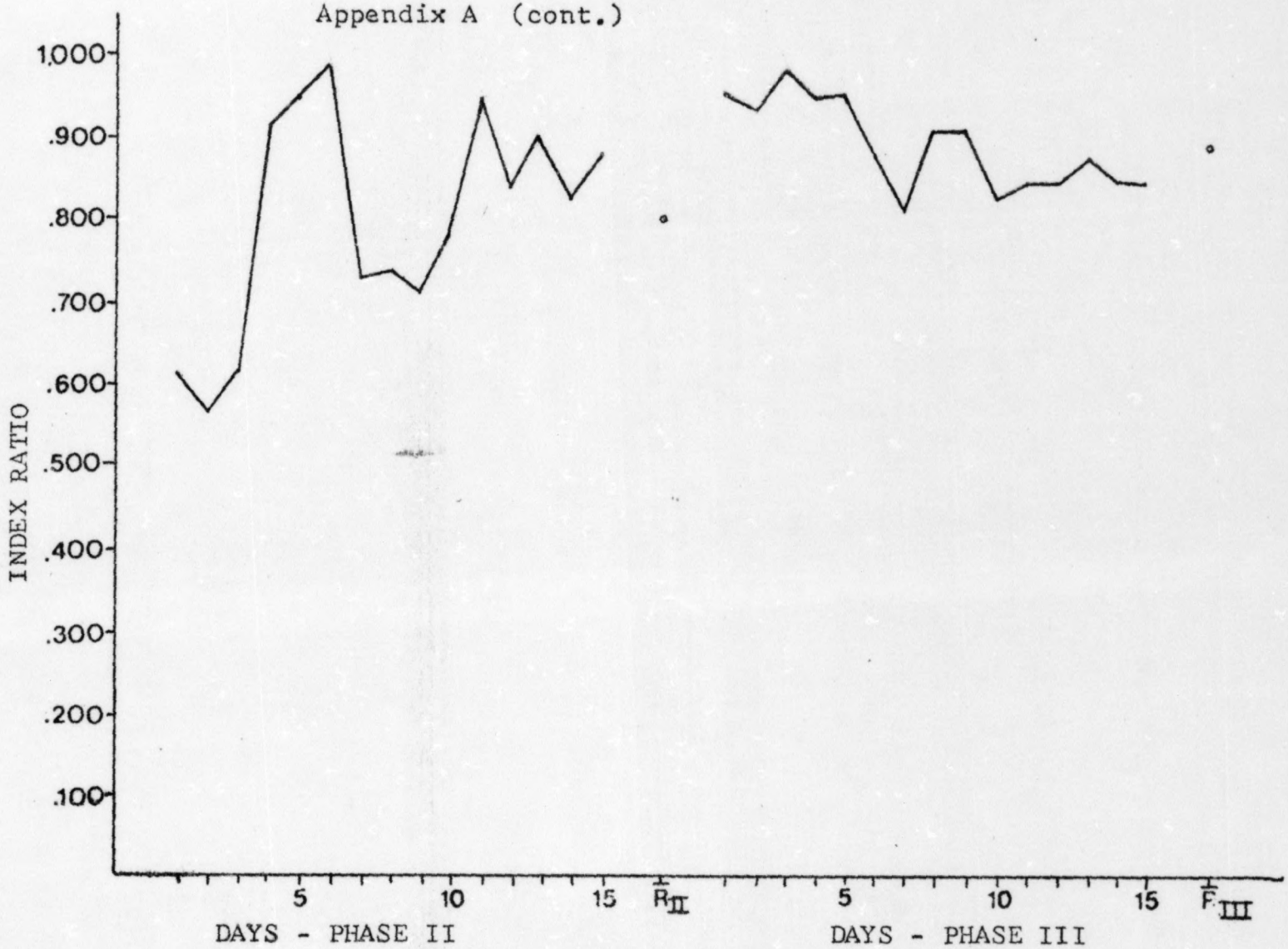

Fig. A-S_{10}. Index Ratios for S_{10} during Phases II and III

$\bar{R}_I$ = mean index ratio - Phase II

$\bar{R}_{II}$ = mean index ratio - Phase III

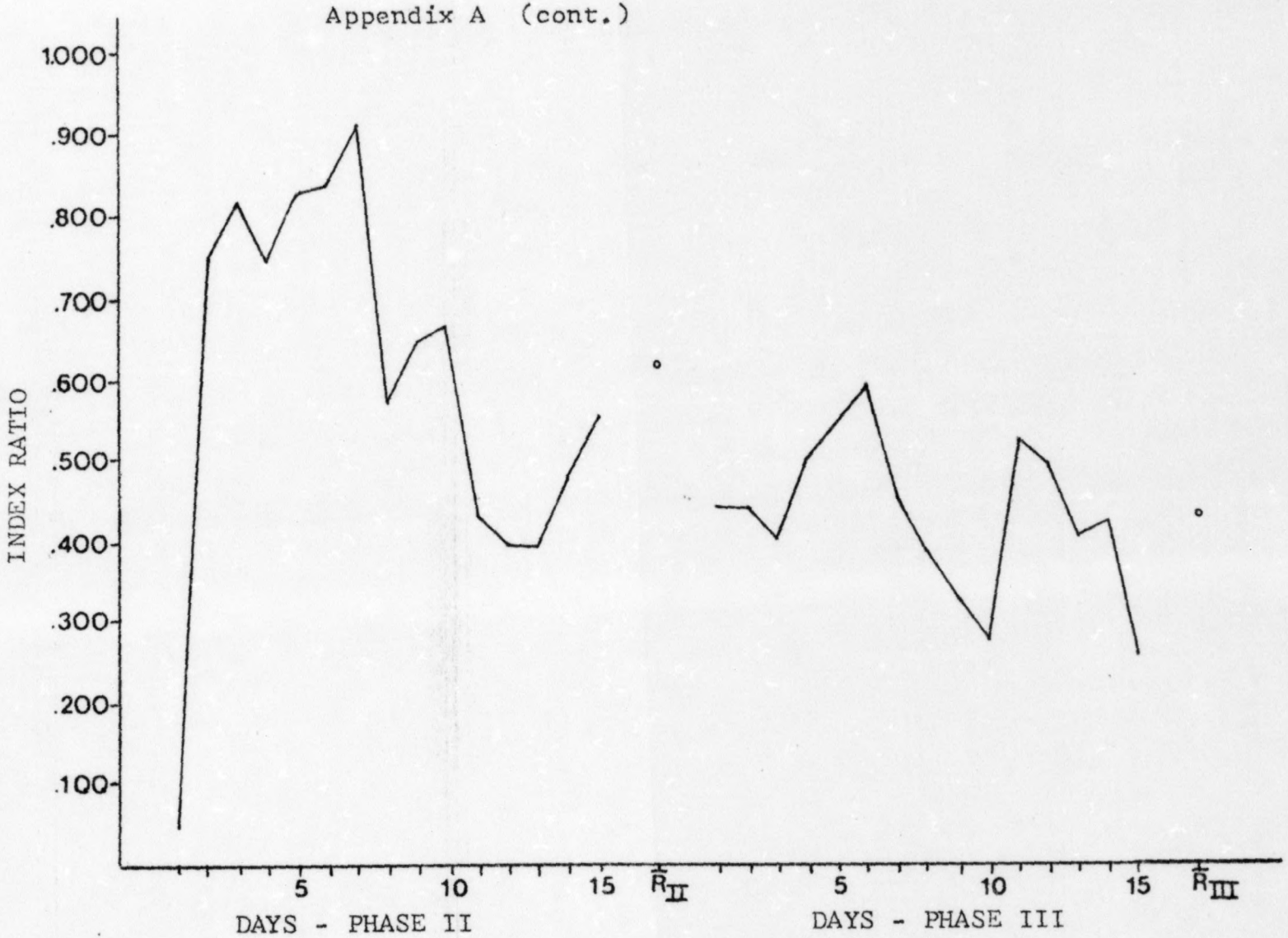

Fig. A-S_{11}. Index Ratios for S_{11} during Phases II and III

$\bar{R}_I$ = mean index ratio - Phase II

$\bar{R}_{II}$ = mean index ratio - Phase III

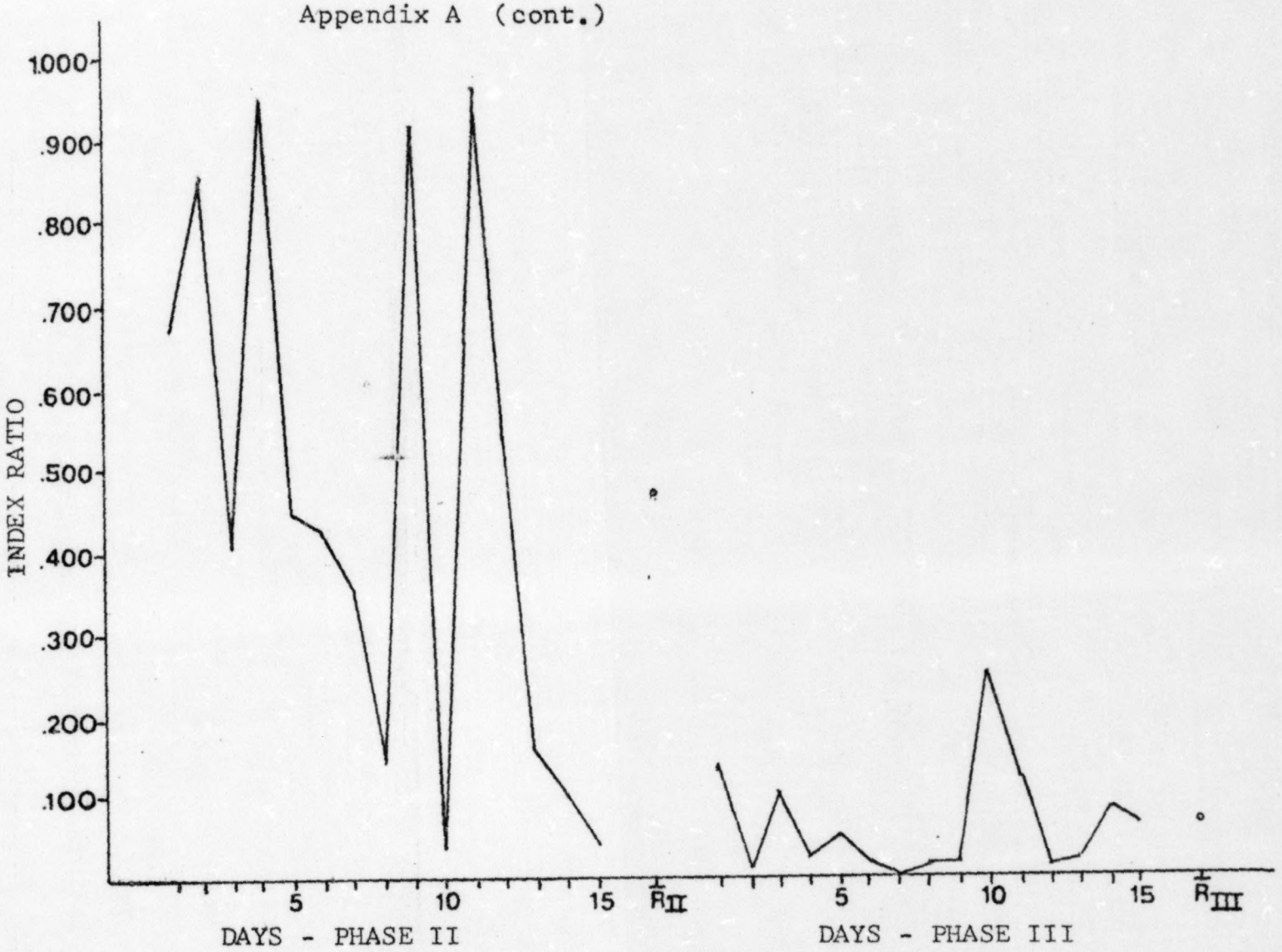

Fig. A-S_{12}. Index Ratios for S_{12} during Phases II and III

$\bar{R}_I$ = mean index ratio - Phase II

$\bar{R}_{II}$ = mean index ratio - Phase III

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