SUPPRESSION OF THE GALVANIC SKIN RESPONSE BY COGNITIVELY MEDIATED BEHAVIOR

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ABSTRACT

The effects of external feedback and awareness of reward contingency upon the ability to voluntarily suppress a conditioned GSR were studied in 21 high neurotic introverted and 21 low neurotic extraverted Ss selected on the basis of the Maudsley Personality Inventory. A conditioned GSR was established by 5 classical pairings of a CS (signal lamp) and a UCS (aversive electric shock). On subsequent presentations of the CS Ss were required to maintain their GSR below 500 Ω change on 5 consecutive trials in order to receive reward (cessation of shock). Ss were instructed to suppress their GSR by employing cognitive manipulations such as "thinking relaxing thoughts."

Results showed that Ss who were aware of the reward contingency and who received appropriate positive or negative feedback after each trial were able to reduce their GSR over 20 test trials significantly more than the control group and a group which was aware of the reward contingency but received no feedback. A second finding was that high neurotic introverts were significantly more successful on this task than low neurotic extraverts. This result was interpreted as support for Eysenck's theory that introversion is characterized by cortical excitation while extraversion is characterized by cortical inhibition.

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INTRODUCTION

Operant conditioning as applied to the autonomic nervous system (ANS) continues to be a controversial area of research in the behavioral sciences. It has generally been assumed that the ANS is not susceptible to operant conditioning procedures because it is not in direct contact with the external environment, it is solely a motor system with no afferent function, and therefore is incapable of learning by reinforcement principles (Smith, 1954). Nevertheless, several investigators have recently reported successful instrumental conditioning of the ANS, prompted, as Miller (1969) has pointed out, by the obvious significance of ANS functioning in psychosomatic symptoms and the role that instrumental conditioning plays in the various controversies among contemporary learning theories.

Katkin and Murray (1968), in a critical review of the literature, have pointed out three methodological or theoretical issues involved in ANS conditioning experiments:

1. The possible influence of somatic and cognitive mediators.
2. The experimental paradigm by which reinforcement is delivered.
3. The need to distinguish between conditioning and controlling ANS responses.

Influence of Somatic and Cognitive Mediators

The first of these issues is a criticism that ANS responses can be mediated by processes other than conditioning. Specifically, both somatic and cognitive mediators can influence ANS responses in a conditioning experiment. Gross body movements, muscle tensing, and changes in respiration will cause changes in autonomic processes. Similarly, cognitive states can also mediate autonomic changes and Ss may inadvertently be rewarded for these responses which in turn result in ANS changes. While cognition is difficult to eliminate in human Ss, somatic movement is more amenable to control.

Reinforcement Paradigm

The second methodological issue deals with the experimental paradigm by which reinforcement is delivered. Typical techniques have been:

1. Rewarding the spontaneous ANS response
2. Punishing the spontaneous ANS response
3. Avoidance conditioning of the elicited response (Katkin and Murray, 1968).

Rewarding the spontaneous ANS response. Early attempts to reinforce the spontaneous GSR (Kimmel and Hill, 1960; Fowler and Kimmel, 1962; Kimmel and Kimmel, 1963) produced equivocal results as did experiments in which heart rate change was rewarded (Shearn, 1962; Engle and Hansen, 1966; Engle and Chism, 1967). These experiments were designed to reward spontaneous GSRs or heart rate changes with signal lights as

the reinforcer, but each failed to control for somatic mediation.

Replications of the GSR studies with proper controls for somatic movement again failed to yield clear-cut results. Mandler, Preven, and Kuhlman (1962) and Rice (1966) reported negative results when a signal light was used as reward. Shapiro, Crider, and Tursky (1964) and Crider, Shapiro, and Tursky (1966) likewise reported negative results when money ($.05/response) was the reward. Birk, Crider, Shapiro, and Tursky (1966) worked with one S who was partially curarized in order to control bodily movements. This study produced a clear acquisition curve when reward was contingent upon GSR. Van Twyver and Kimmel (1966) reported positive results when light was the reinforcer and EMG was monitored to control somatic movement.

Perhaps the clearest evidence of ANS instrumental conditioning where the spontaneous response is rewarded has come from a series of experments conducted by Miller (Miller and DiCara, 1967); Miller and Banuazizi, 1968; DiCara and Miller, 1968). Rats curarized to the point where artificial respiration was necessary to sustain life were used as Ss. Intracranial stimulation of the lateral hypothalamus was the reinforcement. The results of these experiments indicated that instrumental conditioning of autonomic responses occurred rapidly with intracranial stimulation, but the effect was not limited to this form of reinforcement alone. Shock applied to the tail of the rats achieved positive conditioning also but required approximately double the number of trials. Another finding showed that the conditioning was specific to

the ANS mode being reinforced. Heart rate and gastro-intestinal activity were monitored simultaneously and when heart rate was varied by instrumental methods gastro-intestinal activity did not change appreciably, and when gastro-intestinal functions were varied heart rate did not change. Though these experiments seem to demonstrate instrumental conditioning of the ANS it should be kept in mind that they were conducted on a group of abnormal Ss, rats which without artificial respiration would be non-living.

Punishing the spontaneous ANS response. While reinforcing the spontaneous ANS response has resulted in positive findings only with animal Ss, two studies have appeared which reported drastic GSR suppression when the spontaneous GSR was punished. Senter and Hummel (1965) administered electric shock to S's index finger when a spontaneous GSR occurred. Johnson and Schwartz (1967) delivered aversive noise contingent upon spontaneous GSRs. Both experiments found that GSRs dropped significantly in the experimental groups while control Ss who received punishment on a random schedule continued to emit spontaneous GSRs.

Avoidance conditioning of the elicited GSR. Avoidance conditioning of the elicited GSR has been demonstrated by Kimmel and Baxter (1964). These researchers required Ss to emit GSRs in the presence of a CS in order to escape shock. This procedure resulted in a significant difference between the experimental and control group. Subsequent studies

employing the identical avoidance procedure but with added controls for somatic mediation have yielded negative results (Kimmel, Sternthal, and Strub, 1966; Kimmel and Sternthal, 1967; Grings and Carlin, 1966). Schearn (1962) attempted to modify heart rate using the avoidance paradigm. He reported positive results but commented that significant differences in respiratory patterns were observed between the experimental and control groups.

Conditioning and Controlling ANS Responses

The third methodological issue distinguishes between conditioning and the voluntary control of ANS responses. If Ss are able to exert voluntary control over autonomic functions by employing cognitive mediators then controlling rather than conditioning would be the correct terminology (Katkin and Murray, 1968). Stern (1967) has cautioned that cognitive mediation can never be truly eliminated in conscious human Ss. He attempted to operantly condition spontaneous GSRs but was unable to obtain responses in the form of acquisition. Furthermore, a postexperimental questionnaire revealed that Ss in the experimental group thought they were being rewarded for "thinking exciting thoughts," while Ss in the control group thought they were being rewarded for "relaxing" or "thinking peaceful thoughts." Stern suggested that Ss may indeed learn to voluntarily control autonomic responses through the use of cognitive mediators.

Grings (1965) has reviewed the role of cognitive factors in

autonomic conditioning experiments. He concluded that autonomic modification can occur with or without S's awareness of the CS-UCS contingency, but that significant modification is likely to occur only when S can correctly verbalize the contingency. Grings presented data from his own laboratory to support his conclusion (Grings, Carlin, and Appley, 1962; Grings and Lockhart, 1963).

Chatterjee and Erikson (1960, 1962) have reported findings that support Gring's position. They conducted autonomic conditioning experiments where the presentation of certain words in a list was followed by administration of aversive electric shock. GSR and heart rate were recorded and the results showed that only those Ss who could accurately describe the contingency between the target words and shock had any significant autonomic changes.

Shean (1968a, 1968b) has shown that only Ss who could correctly verbalize the CS-UCS contingency displayed conditioning of GSR and vasomotor activity. In a more recent study Shean (1969) actively manipulated S's awareness of the CS-UCS contingency. In an avoidance discrimination procedure Ss could escape shock by responding with a GSR to the "respond" stimulus and inhibiting GSR to the "inhibit" stimulus. The "aware" group was instructed to avoid the shock by "thinking exciting thoughts" when the respond light occurred and "thinking calming thoughts" to the inhibit light. The "unaware" group was informed only that the shock would follow certain lights. The results showed that the "aware" Ss were able to modify their responses

and avoid the shock while the "unaware" Ss could not.

Awareness of the reward contingency has been shown to be especially effective in aiding voluntary control when combined with a source of external feedback. Hnatiow and Lang (1965) asked Ss to try to maintain their heart rate at a constant level while heart rate variation was presented to Ss by means of an electronic meter. Ss whose actual heart rate variation was displayed on the meter were able to reduce variation while Ss who received false heart rate feedback were unable to control variation.

Brener and Hothersall (1966, 1967) reinforced variability of heart rate using low tones to indicate slow heart rate and high tones to indicate fast heart rate. Ss were instructed to produce low tones (slow heart rate) in the presence of a red signal light and to produce high tones (speed heart rate) to a green signal light. The results showed that Ss were able to gain control over their heart rates under this condition of exteroceptive feedback.

In summary, the research to date supports the following conclusions:

1. Somatic responses are not necessary for autonomic modification.

2. The most effective paradigm for observing autonomic modification is punishing the spontaneous response.

3. Voluntary control of autonomic functions is possible when Ss are aware of the reward contingency.

4. External feedback enhances the level of voluntary control.

Individual Differences in Autonomic Responsivity

Previous research has largely been concerned with the average autonomic responses for a group of Ss. This approach has the undesirable effect of emphasizing autonomic functions as a class of behavioral response equal in degree for all Ss. Lacey (1950) has pointed out that individual response patterns exist such that most Ss tend to respond more in some ANS modes than in others. Ss showing typical patterns include cardiovascular responders, GSR (general body sweating) responders, gastro-intestinal responders. Wenger (1941) has added another dimension of ANS activity which he labels as "autonomic balance." This concept states that each individual is characterized by a sympathetic-parasympathetic ratio and that those individuals whose sympathetic system dominates the parasympathetic are prone to overrespond to stressful stimuli. To complicate the picture further, there is evidence that ANS response patterns are specific to different forms of eliciting stimuli (Sternbach, 1966). Electric shock has been shown to elicit responses in all ANS modes while cold pressor activates only the cardiovascular system (Engel, 1959). Sternbach (1966) has warned that individual response patterns are critical variables in any ANS experiment.

A series of experiments designed to study individual differences in anxiety level (autonomic balance) has been carried out by Spence and his associates (Spence and Taylor, 1951, 1952; Spence and Farber, 1953).

Spence proposes that anxiety effects drive level in a positive linear fashion; in Hullian terms: drive x habit strength = excitatory potential. High levels of anxiety increase drive thereby increasing the probability of a response. The typical experimental approach has been to select Ss on the basis of scores on the Taylor Manifest Anxiety scale and to compare high and low scorers on an eyelid conditioning task. Spence predicted that high anxiety Ss would condition faster than low anxiety Ss due to the increased drive level. Positive results have been found only if large numbers of Ss are used and if the groups are separated by extreme scores on the MAS (Spence, 1964).

Eysenck (1968) has attempted to integrate individual differences in autonomic functioning into a theory of personality. He postulates that personality can be described along a two-dimensional continuum consisting of introversion-extraversion on one axis and neuroticism on the second axis. Eysenck defines introversion-extraversion by employing Pavlov's concept of cortical excitation-inhibition. Cortical excitation exists in individuals whose cortical functions exert strong control over lower brain centers and is characteristic of the introverted personality. Cortical inhibition on the other hand exists in individuals whose cortical functions exert weak control over lower brain centers and is characteristic of the extraverted personality. This differential in cortical functioning has given rise to predictions that introverts will acquire conditioned responses faster, develop reactive inhibition at a slower rate and require more trials to extinguish a conditioned response

than extraverts.

Eysenck defines neuroticism as the ratio of autonomic balance possessed by each individual. The more sympathetic dominated an individual's ANS, the higher the level of neuroticism. Eysenck has developed a 48 item questionnaire, the Maudsley Personality Inventory, which contains separate scales for introversion-extraversion and neuroticism (Eysenck, 1958) and measures these two concepts within Eysenck's definitional limits.

The implication of Eysenck's theory for psychosomatic disorders has been discussed by Wolpe (1958) and Franks (1961). A high level of neuroticism is considered to predispose an individual to neurotic behaviors. Introversion-extraversion interacts with neuroticism such that high neurotic introverts tend to develop dysthymic disorders while high neurotic extraverts tend to develop behavioral disorders. The dysthymic disorders include: obsessive-compulsive behavior; anxiety syndromes; and depressive reactions. The behavioral disorders include: hysteric reactions and psychopathic deviancy. Franks (1957b, 1956b) has offered experimental evidence to support the introversion-extraversion dichotomy in neurotic disorders.

The present experiment was an attempt to study the effects of awareness of reward contingency and external feedback upon voluntary suppression of GSR within the framework of Eysenck's personality theory. High neurotic introverts and low neurotic extraverts were exposed to an avoidance paradigm which required Ss to suppress GSR to

a CS in order to avoid electric shock (UCS). Simultaneously Ss were presented with three treatment conditions: F-A (awareness of CS-UCS contingency and external feedback about success of suppression after each trial); A-O (awareness of CS-UCS contingency but no feedback); C-O (no awareness, no feedback). The treatment conditions led to the following predictions:

Hypothesis I. F-A (awareness and feedback) would be more successful in the attempt to suppress GSR than A-O (awareness) and A-O would be more successful than C-O (control). Previous research has shown that Ss can gain voluntary control over heart rate when a source of external feedback is supplied. Awareness of the reward contingency has been shown to aid in voluntary control of GSR. The present procedure was designed to measure the combined effects of external feedback and awareness of reward contingency and to compare this effect to the performance of awareness alone and a control group.

Based upon Eysenck's theory it was predicted that:

Hypothesis II High neurotic introverts would react initially with quantitatively greater GSR to the CS than the low neurotic extraverts. This prediction logically follows from the definition of neuroticism: higher levels of sympathetic dominance lead to greater autonomic response magnitude under stress.

Hypothesis III. The high neurotic introverts would be more successful at voluntarily suppressing GSR than the low neurotic extraverts. Since introverts are characterized by high levels of cortical control of lower brain centers it would follow that they could inhibit autonomic centers more than extraverts who are characterized by weak cortical control of lower brain centers.

METHOD

Subjects

The Ss were 42 introductory psychology student volunteers at the College of William and Mary. There were 22 men and 20 women. The average age was 19 years.

Apparatus

The experimental room was approximately 10 ft. x 20 ft., without windows, and maintained at a constant temperature of 70 degrees F. The room was divided by a white partition that blocked the recording equipment from Ss' view. A 3 watt white lamp was mounted at the top center of the partition facing S. This lamp served as the CS and was always lighted 6 sec. preceding the UCS. Two ft. below and to either side of the white lamp were two additional 3 watt lamps, one green and one red. These served as feedback signals during the trials in which S was attempting to inhibit his GSR. The experimental room was dimly lit at all times to facilitate S's visual perception of the signal lamps. The S sat in a dental chair that was placed in the center of a 7 ft. x 7 ft. x 7 ft. aluminum screen cubicle. The cubicle electrically isolated S from the surrounding room.

The UCS was a pulsated d.c. shock delivered by a Phipps-Bird inductorium that was supplied with a 6 v. primary source. The CS UCS interval and UCS duration were controlled by two Hunter 111-B timers.

GSR, respiration, finger pulse volume and heart rate were continuously recorded on an E & M Instrument Co. Physiograph Model Six. The GSR electrodes (Pb, 1" x 3/4") were attached to the S's index and ring fingers of the left hand, the photoelectric plethysmograph was placed on the middle finger of the right hand. Heart rate was recorded by a cardiotach that was triggered by the QRS wave complex present in the plethysmograph signal. Respiration was measured by a bellows pneumograph secured around the chest.

Procedure

The Maudsley Personality Inventory was administered to 128 introductory psychology students. The mean E-I score for this sample was 24 and the mean N score was 27. These means compare favorably with American college student norms (Bendig) which are 28 for E-I and 21 for N. In the present study, Ss scoring below 24 on the E-I scale and above 30 on the N scale were classified as high neurotic introverts while Ss scoring above 24 on the E-I scale and below 24 on the N scale were classified as low neurotic extraverts. Each S was assigned to one of three groups by an assistant who was not familiar with the purpose of the experiment. Each group was composed of seven high neurotic introverts and seven low neurotic extraverts (see Figure 1).

Pre-experimental interview. As each S arrived for the experiment he was met by E in a small conference room. S was informed that the experiment involved the recording of physiological responses to electric shock.

Fig. 1. 3 x 2 x 4 independent measures design composed of Groups (a), Personality (b) and Trial Blocks (c).

Groups (a)	Personality (b)	Ss	Trial Blocks (c) 1	2	3	4
F-A (Feedback and Awareness)	High Neurotic Introverts	1				
		2				
		3				
		4				
		5				
		6				
		7				
	Low Neurotic Extraverts	8				
		9				
		10				
		11				
		12				
		13				
		14				
A-O (Awareness)	High Neurotic Introverts	15				
		16				
		17				
		18				
		19				
		20				
		21				
	Low Neurotic Extraverts	22				
		23				
		24				
		25				
		26				
		27				
		28				
C-O (Control)	High Neurotic Introverts	29				
		30				
		31				
		32				
		33				
		34				
		35				
	Low Neurotic Extraverts	36				
		37				
		38				
		39				
		40				
		41				
		42				

The shock was described as not harmful or painful and S was given an opportunity to decline if he felt the shock to be an unreasonable request. No S declined. S was not informed about the true nature of the experiment (e.g., voluntary control of GSR) during this interview. Before proceeding to the experimental room S recorded his subjective feelings about shock on a 10-point scale, the end-points of which were represented by "not afraid at all" to "terrified" (see Appendix A).

Experimental session. Upon entering the experimental room S was seated in the dental chair and the electrodes and sensors were attached as previously described. The level of shock was adjusted for each S so that he perceived the shock as aversive but not necessarily painful. This level was achieved as E raised the shock amplitude in small increments until S requested that it not be raised further. In every case the final shock level was intense enough to induce slight contractions of the calf muscle. The shock level was recorded on a 1 to 10 ordinal scale such that the highest possible amplitude of shock was 10 and the lowest was 1.

After the shock level had been established S was cautioned to maintain his respiratory rate as steady as possible, to avoid muscular movement and muscle tensing, and to remain as relaxed as possible throughout the experiment. Respiration was monitored as a control for somatic artifact. If muscular movement was observed in the respiratory record on any trial, that trial was repeated. There were 5 repeated trials, one S received 2 repeated trials, three Ss received 1 repeated trial each.

Five preliminary trials were administered in order to establish the base rate of response for each S. A trial began when E energized the CS that remained on for 6 sec., followed immediately by the UCS that had a duration of 0.5 sec. The intertrial interval was approximately 30 sec.

Upon completion of the 5 preliminary trials the following instructions were administered to F-A:

> "I am interested in how well you can voluntarily control your internal responses when the warning light comes on. I want you to keep your responses at as low a level as you possibly can. One method of controlling responses is to think about something other than the warning light. Some people have reported that thinking of pleasant past experiences helps to control responses. This is only a suggestion, you try any thinking process that you wish. I will be monitoring your responses each time the warning light comes on. If you are successful in keeping your response to the warning light below a level I have pre-set then I will flash this green light between the time the warning light comes on and you receive the shock. If you respond over the pre-set level then this red light will be flashed. If you are able to receive 5 green lights in a row, that is if you control your responses to the warning light 5 times in a row, the experiment will terminate at that point."

A-O received the identical instructions with the feedback portion omitted. C-O received no instructions but were told that the first series of trials had been completed and that several more would follow.

Following administration of the instructions all Ss participated in 20 experimental trials. Lamp color designations were balanced for F-A such that 7 Ss received the green lamp as positive feedback and 7 Ss received the red lamp. For A-O these lamps were flashed in a random order during the CS-UCS interval, for C-O the lamps were never flashed.

The criterion for successful voluntary control was a maximum response of 500Ω change in GSR as determined from the physiograph pen movement. Ss received shock whether or not they were successful in their control efforts on any one particular trial. In the event that a F-A or A-O S was successful for 5 consecutive trials the experiment was temporarily interrupted at that point and E requested S to finish the total 20 trials. This procedure was carried out to balance the statistical design.

Postexperimental interview. Immediately following the experimental session each S again rated his feelings about shock on the 1-10 scale. In addition, F-A and A-O completed a questionnaire designed to measure:

1. The cognitive strategies employed by Ss in the effort to control their responses.

2. S's estimate of how successful they had been at controlling their responses (see Appendix B and C).

Finally the Ss were informed about the purpose of the experiment and were asked not to divulge this information to any of their fellow students.

RESULTS

This presentation of results will consider only the GSR data since this was the response mode upon which reinforcement was contingent. Heart rate and finger pulse volume will be analyzed in a subsequent report. The GSR for each trial was defined as the change in skin conductance during the 6 sec. interval between onset of the CS and administration of the UCS (see Figure 2). A logarithmic transformation was performed in order to equate individual S difference in basal skin conductance. All GSR data were analyzed as Δ log conductance.

Throughout the results section the following notations are applied: feedback and awareness treatment groups (F-A, A-O, C-O) are referred to as Groups, the high neurotic introverted and low neurotic extraverted groups are referred to as Personality.

Correlations were performed between GSR magnitude and Ss' subjective fear of shock, as well as shock amplitude. This procedure was carried out in order to determine if GSR magnitude was the result of shock amplitude or fear of shock (see Table 1). The largest correlation was between GSR on the Preliminary Trials and fear of shock as measured by the postexperimental questionnaire. None of these correlations reached significance and no further statistical tests were performed on Ss' fear of shock rating or shock amplitude since these did not effect GSR amplitude.

Fig. 2. Sample Physiograph record showing CS-UCS interval.

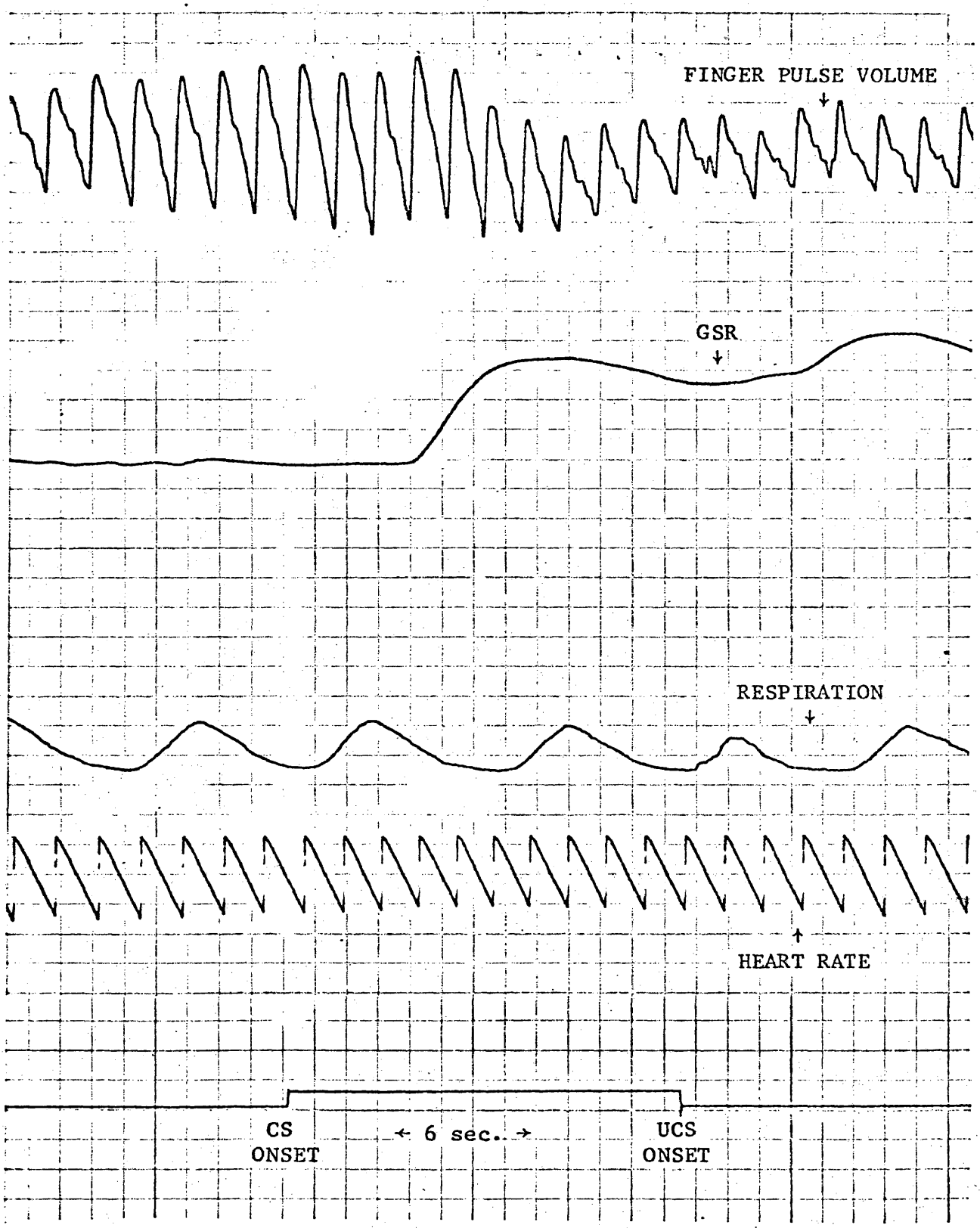

FINGER PULSE VOLUME
GSR
RESPIRATION
HEART RATE
CS ONSET
← 6 sec. →
UCS ONSET

TABLE 1

Spearman Rank Correlations : Shock Level and Fear of Shock x Response Level on the Preliminary Trials and Experimental Trial Block 4.

	Response Level on Preliminary Trials	Response Level on Experimental Trial Block 4
Shock Level	0.104	0.244
Pre-experimental Fear of Shock	0.145	-0.166
Postexperimental Fear of Shock	0.264	0.211

GSRs on the 5 Preliminary Trials were elicited in the absence of voluntary control efforts as Ss did not receive instructions to suppress GSR until after these trials were administered. The Preliminary Trials served as a baseline for equipment adjustment and also as a measure of possible preexperimental differences in GSR between groups. Data for the Preliminary Trials were analyzed by a two-way analysis of variance (Bruning and Kintz, 1968) No significant effects were found either for Groups ($F = 0.28$; $df = 2/36$, $p > .05$), Personality ($F = 0.64$, $df = 1/36$, $p > .05$) or A x B interaction ($F = 0.30$, $df = 2/36$, $p > .05$). These results are shown in Table 2. Figure 3 shows that all Groups responded with the same pattern over the 5 trials, with the exception of trial 2 where C-O responded higher than the other two groups. Responses for Personality are shown in Figure 4. The high neurotic introverts consistently responded at a higher level than the low neurotic extraverts but this difference was not significant.

The 20 Experimental Trials for each S were grouped into blocks of 5 trials each to form 4 Trial Blocks. A Trial Block data point for any one S consisted of the sum of the 5 trials contained in that Trial Block.

The experimental data were subjected to a test of homogeneity of variance (Winer, 1962) and found to be acceptable for analysis of variance procedures (F max = 5.87, $p > .05$). A three-way analysis of variance based on the design shown in Figure 1 (Bruning and Kintz, 1968) yielded nonsignificant results for Groups ($F = 0.15$, $df = 2/36$, $p > .05$), for personality ($F = 0.60$, $df = 1/36$, $p > .05$), and for Groups x

TABLE 2

Analysis of Variance : Preliminary Trials

Source	df	MS	F
Groups (A)	2	10.99	n.s.
Personality (B)	1	24.79	n.s.
A x B	2	11.69	n.s.
Error	36	38.63	

Fig. 3. Group responses as a function of trials: Preliminary Trials.

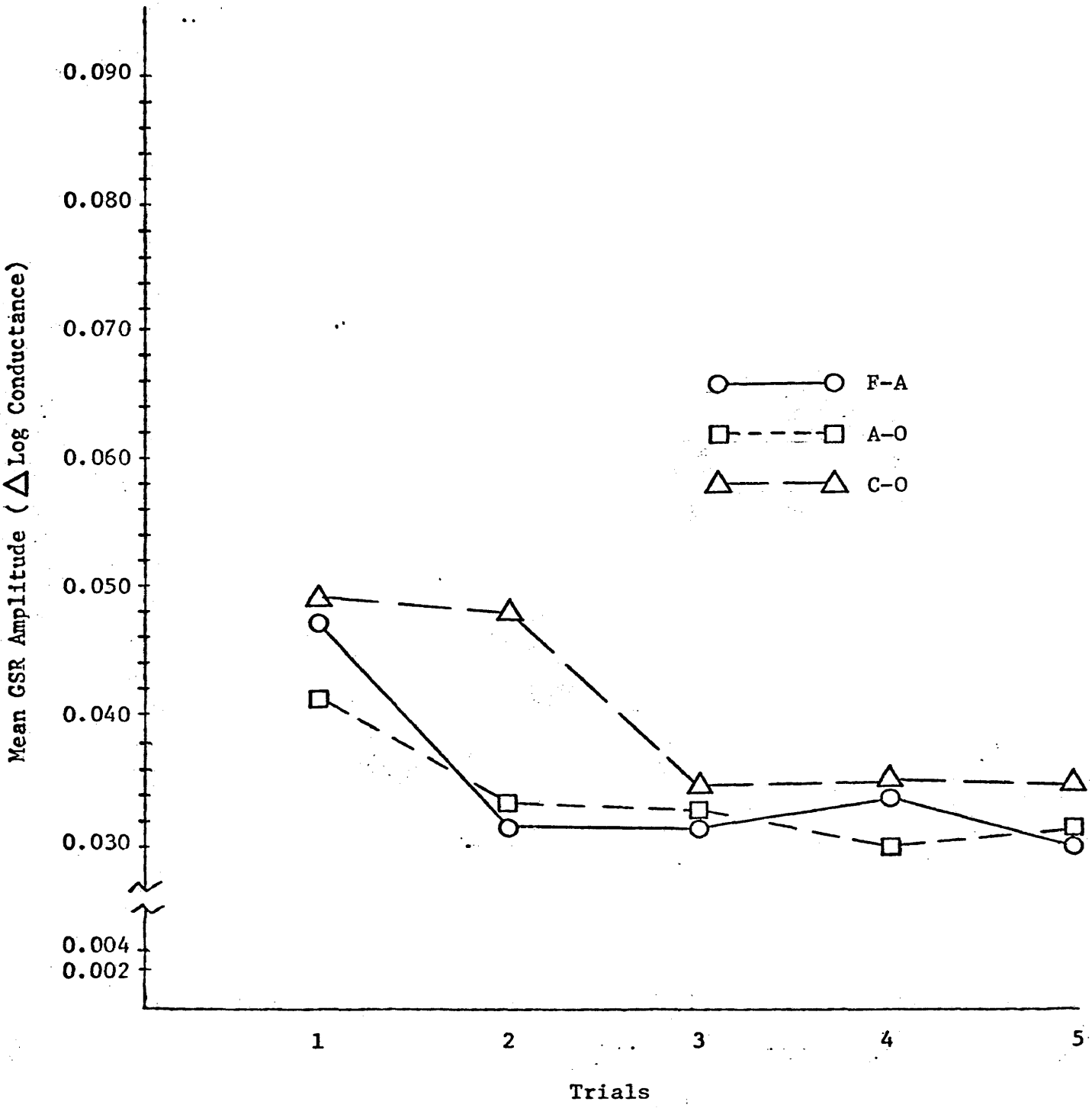
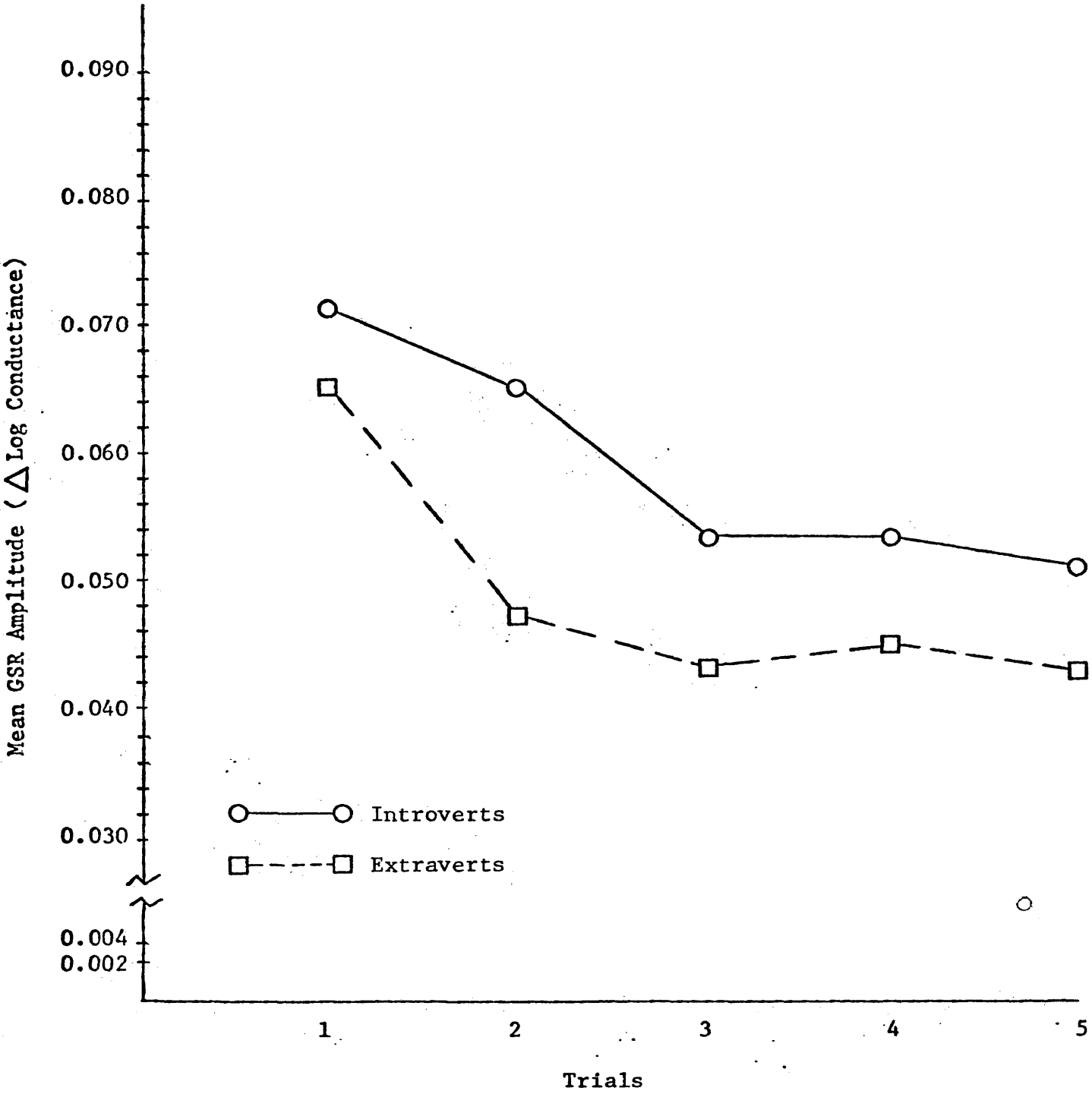

0.090
0.080
0.070
0.060
0.050
0.040
0.030
0.004
0.002
Mean GSR Amplitude (Δ Log Conductance)
F-A
A-O
C-O
1
2
3
4
5
Trials

Fig. 4. High neurotic introvert - low neurotic extravert responses as a function of trials: Preliminary Trials.


Mean GSR Amplitude (Δ Log Conductance)
0.090
0.080
0.070
0.060
0.050
0.040
0.030
0.004
0.002
Introverts
Extraverts
1
2
3
4
5
Trials

Personality interaction (F = 0.41, df = 2/36, $p > .05$). However, significant results were found for Trial Blocks (F = 253.6, df = 3/108, $p < .001$), Trial Blocks x Groups (F = 28.1, df = 6/108, $p < .001$), Trial Blocks x Personality (F = 5.4, df = 3/108, $p < .001$), Trial Blocks x Groups x Personality (F = 10.9, df = 6/108, $p < .001$). These results are shown in Table 3.

The Trial Blocks x Groups interaction resulted from F-A reducing their GSR over trials significantly more than A-O or C-O. This effect, shown in Figure 5, partially supports Hypothesis I. A Newman-Keuls Studentized Range (based on the design shown in Figure 1; a = Groups, b = Personality, c = Trial Blocks) shown in Table 4, confirms the interpretation that F-A suppressed GSR significantly more as F-A Trial Blocks 3 and 4 (a_1c_3, a_1c_4) were lower than any other Trial Block in the analysis.

Hypothesis I also predicted that A-O would perform better than C-O. This effect was not observed, the reverse was true, C-O actually performed better than A-O. Closer examination disclosed that the low neurotic extraverts in A-O performed much worse than the low neurotic extraverts in F-A or C-O (see Figure 6). The high neurotic introverts in A-O performed almost as well as the high neurotic introverts in F-A (see Figure 7). The difference in performance among the low neurotic extraverts was the basis of the Trial Blocks x Groups x Personality interaction. A Neuman-Keuls Studentized Range performed on this interaction supported the conclusion that the low neurotic extraverts in F-A had the

TABLE 3

Analysis of Variance : Experimental Session

Source	df	MS	F
Groups (A)	2	17.47	n.s.
Personality (B)	1	68.30	n.s.
A x B	2	46.82	n.s.
Error $_{between}$	36	114.3	
Trials (C)	3	25.36	253.6**
A x C	6	2.81	28.1**
B x C	3	0.54	5.4**
A x B x C	6	1.09	10.9**
Error $_{within}$	108	0.10	

**$p < .001$

Fig. 5. Group responses as a function of Trial Blocks: Experimental session.

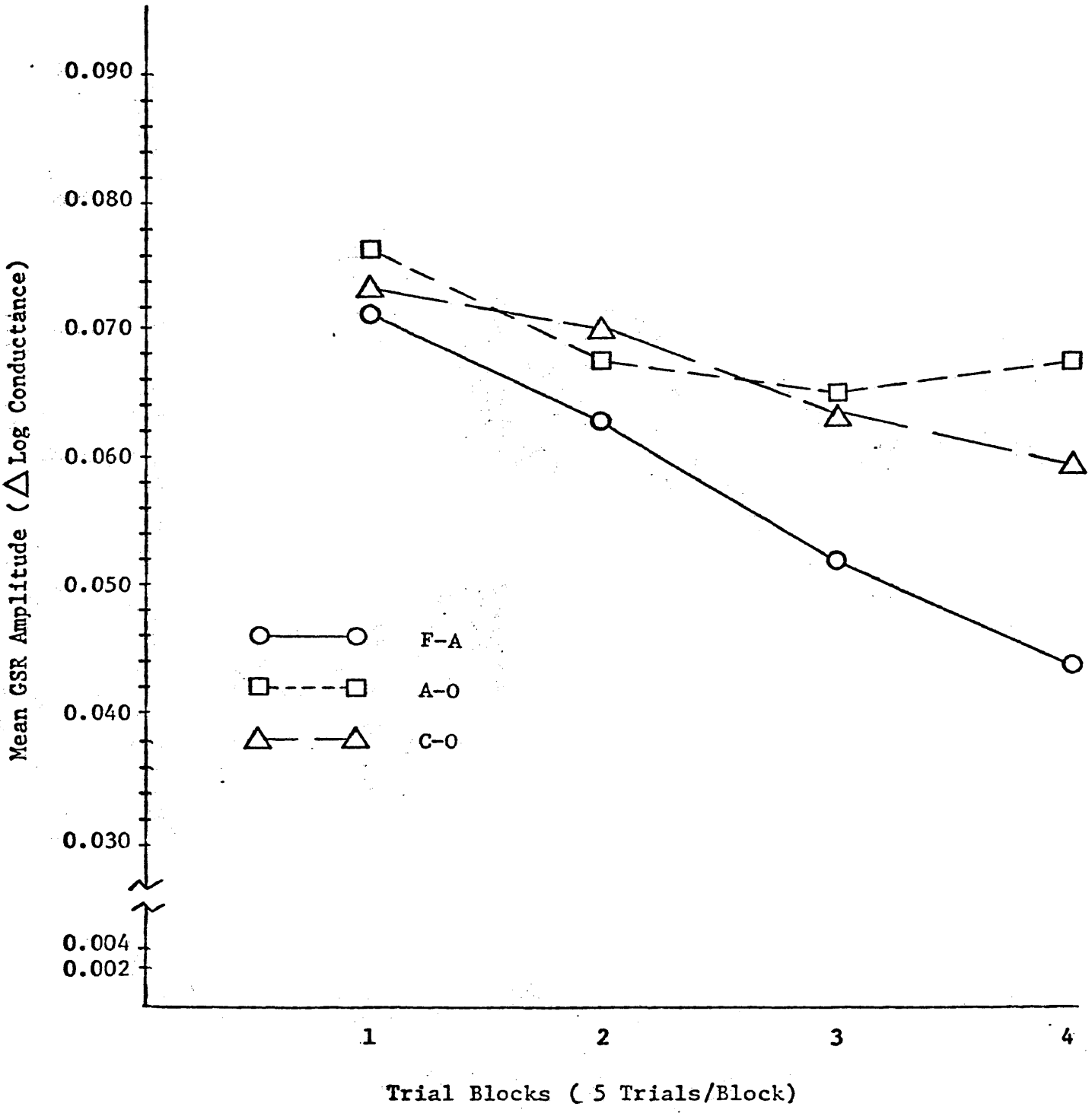

0.090
0.080
0.070
0.060
0.050
0.040
0.030
0.004
0.002
Mean GSR Amplitude (Δ Log Conductance)
F-A
A-O
C-O
1
2
3
4
Trial Blocks (5 Trials/Block)

TABLE 4

Newman-Keuls Studentized Range : Group x Trials Interaction

Cell		a_1c_4	a_1c_3	a_3c_4	a_1c_2	a_3c_3	a_2c_3	a_2c_4	a_2c_2	a_3c_2	a_1c_1	a_3c_1	a_2c_1
	Mean	.0440	.0522	.0587	.0633	.0643	.0647	.0653	.0670	.0694	.0719	.0735	.0762
a_1c_4	.0440		.82*	1.47*	1.93*	2.03*	2.07*	2.13*	2.30*	2.54*	2.79*	2.95*	3.22*
a_1c_3	.0522			.65*	1.11*	1.21*	1.25*	1.31*	1.48*	1.72*	1.97*	2.13*	2.40*
a_3c_4	.0587				.46*	.56*	.60*	.66*	.83*	1.07*	1.32*	1.48*	1.75*
a_1c_2	.0633					.10	.14	.2	.37	.61*	.86*	1.02*	1.29*
a_3c_3	.0643						.04	.10	.27	.51*	.76*	.92*	1.19*
a_2c_3	.0647							.06	.23	.47*	.72*	.88*	1.15*
a_2c_4	.0653								.17	.41	.66*	.82*	1.09*
a_2c_2	.0670									.24	.49	.65*	.92*
a_3c_2	.0694										.25	.41	.68*
a_1c_1	.0719											.16	.43
a_3c_1	.0735												.27
Critical Value			.314	.357	.383	.401	.414	.426	.436	.444	.451	.458	.464

*$p < .01$

Fig. 6. Low neurotic extravert responses as a function of Trial Blocks: Experimental session.

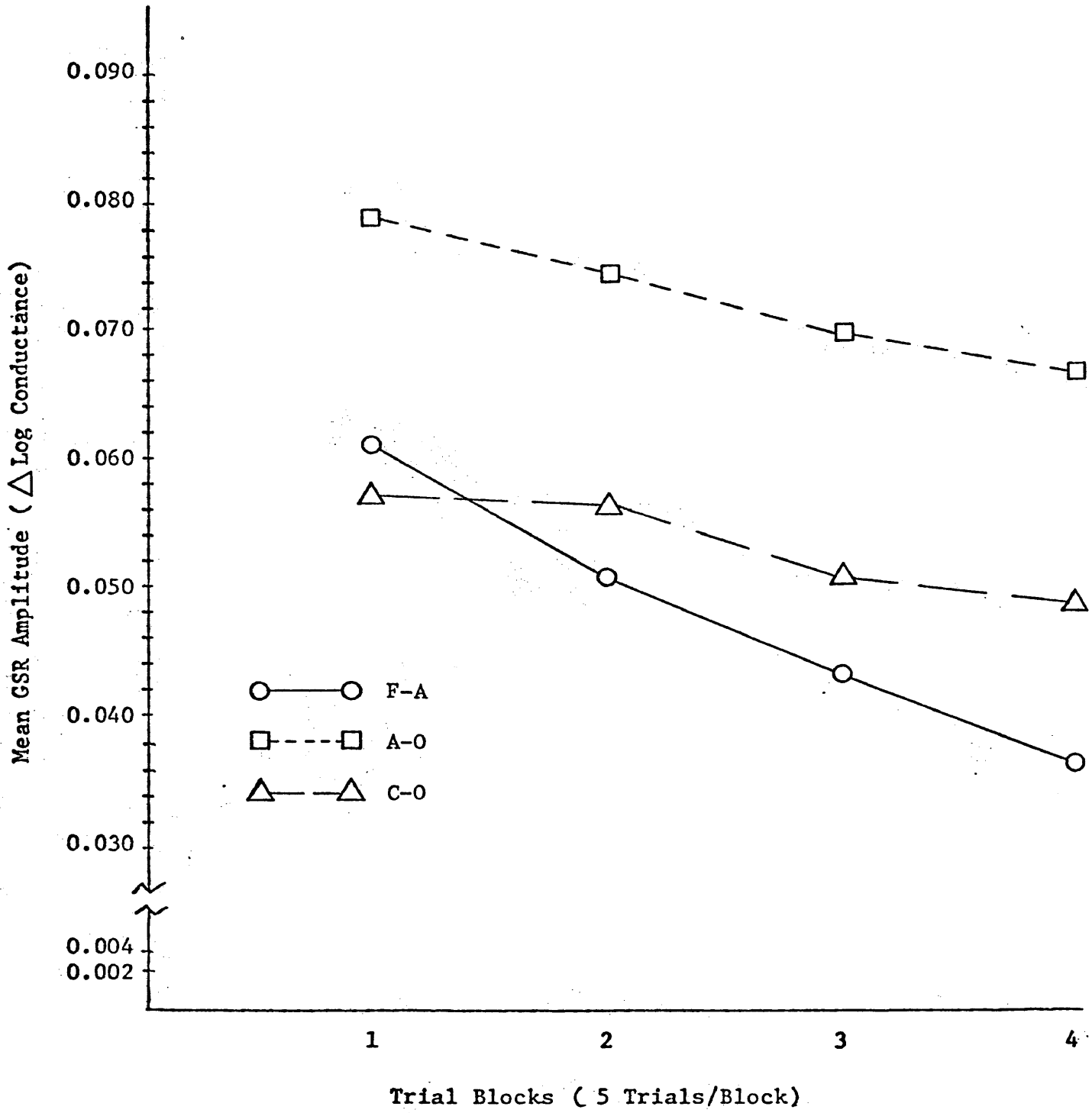

0.090
0.080
0.070
0.060
0.050
0.040
0.030
0.004
0.002
Mean GSR Amplitude (Δ Log Conductance)
F-A
A-0
C-0
1
2
3
4
Trial Blocks (5 Trials/Block)

TABLE 5

Newman-Keuls Studentized Range : Group x Personality x Trials Interaction

Cell		$a_1b_2c_4$	$a_1b_2c_3$	$a_3b_2c_4$	$a_1b_2c_2$	$a_3b_2c_3$	$a_1b_1c_4$	$a_3b_2c_2$	$a_3b_2c_1$	$a_2b_1c_3$	$a_2b_1c_2$	$a_1b_2c_1$
	Mean	.0366	.0431	.0487	.0507	.0509	.0514	.0563	.0573	.0594	.0597	.0610
$a_1b_2c_4$	.0366		.65*	1.21*	1.41*	1.43*	1.48*	1.97*	2.07*	2.28*	2.31*	2.44*
$a_1b_2c_3$	.0431			.56	.76*	.73*	.83*	1.32*	1.42*	1.63*	1.66*	1.79*
$a_3b_2c_4$	.0487				.20	.22	.27	.76*	.86*	1.07*	1.10*	1.23*
$a_1b_2c_2$	.0507					.02	.07	.56	.66*	.87*	.90*	1.03*
$a_3b_2c_3$	.0509						.05	.54	.64*	.85*	.88*	1.01*
$a_1b_1c_4$	.0514							.49	.59	.80*	.83*	.96*
$a_3b_2c_2$	.0563								.10	.31	.34	.47
$a_3b_2c_1$	.0573									.21	.24	.37
$a_2b_1c_3$	.0594										.03	.16
$a_2b_1c_2$	.0597											.13
$a_1b_2c_1$	.0610											
$a_1b_1c_3$	.0613											
$a_2b_1c_4$	.0642											
$a_2b_2c_4$	.0665											
$a_3b_1c_4$	.0686											
$a_2b_2c_3$	.0699											
$a_2b_1c_1$	.0737											
$a_2b_2c_2$	.0744											
$a_1b_1c_2$	.0760											
$a_3b_1c_3$	.0777											
$a_2b_2c_1$	.0789											
$a_3b_1c_2$	.0823											
$a_1b_1c_1$	.0827											
Critical Value			.445	.505	.541	.566	.586	.602	.617	.627	.638	.648

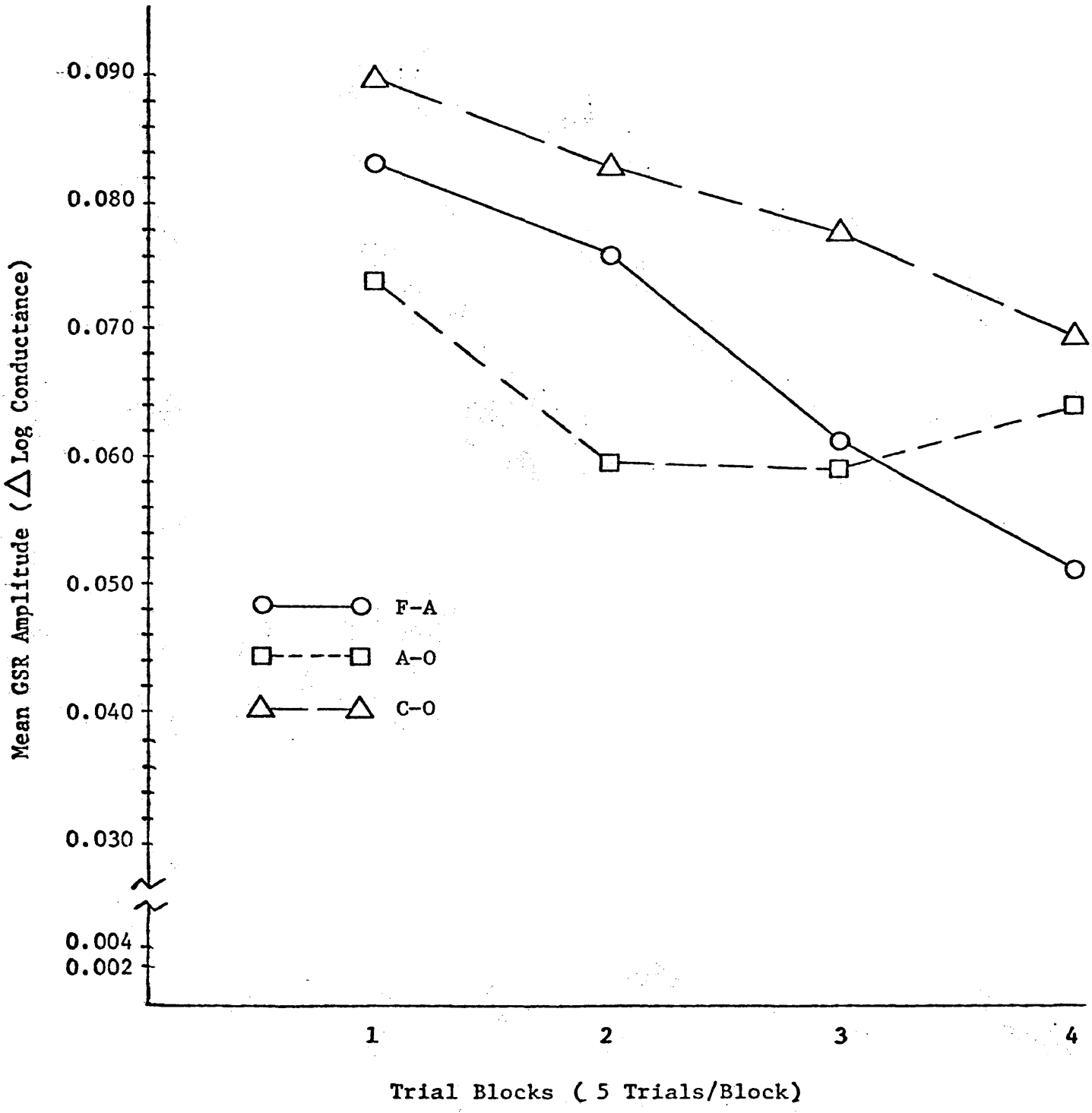
*$p < .01$

TABLE 5 (Cont.)

Newman-Keuls Studentized Range : Group x Personality x Trials Interaction

$a_1b_1c_3$	$a_2b_1c_4$	$a_2b_2c_4$	$a_3b_1c_4$	$a_2b_2c_3$	$a_2b_1c_1$	$a_2b_2c_2$	$a_1b_1c_2$	$a_3b_1c_3$	$a_2b_2c_1$	$a_3b_1c_2$	$a_1b_1c_1$	$a_3b_1c_1$
.0613	.0642	.0665	.0686	.0699	.0737	.0744	.0760	.0777	.0789	.0823	.0827	.0897
2.47*	2.76*	2.99*	3.20*	3.33*	3.71*	3.78*	3.94*	4.11*	4.23*	4.57*	4.61*	5.31*
1.82*	2.11*	2.34*	2.55*	2.68*	3.06*	3.13*	3.29*	3.46*	3.58*	3.92*	3.96*	4.66*
1.26*	1.55*	1.78*	1.99*	2.12*	2.50*	2.57*	2.73*	2.90*	3.02*	3.36*	3.40*	4.10*
1.06*	1.35*	1.58*	1.79*	1.92*	2.30*	2.37*	2.53*	2.70*	2.82*	3.16*	3.20*	3.90*
1.04*	1.33*	1.56*	1.77*	1.90*	2.28*	2.35*	2.51*	2.68*	2.80*	3.14*	3.18*	3.88*
.99*	1.28*	1.51*	1.72*	1.85*	2.23*	2.30*	2.46*	2.63*	2.75*	3.09*	3.13*	3.83*
.50	.79*	1.02*	1.23*	1.36*	1.74*	1.81*	1.97*	2.14*	2.26*	2.60*	2.64*	3.34*
.40	.69*	.92*	1.13*	1.26*	1.64*	1.71*	1.87*	2.04*	2.15*	2.50*	2.54*	3.24*
.19	.48	.71*	.92*	1.05*	1.43*	1.50*	1.66*	1.83*	1.95*	2.29*	2.33*	3.03*
.16	.45	.68*	.89*	1.02*	1.40*	1.47*	1.63*	1.80*	1.92*	2.26*	2.30*	3.00*
.03	.32	.55	.76*	.89*	1.27*	1.34*	1.50*	1.67*	1.79*	2.13*	2.17*	2.88*
	.29	.52	.73*	.86*	1.24*	1.31*	1.47*	1.64*	1.76*	2.10*	2.14*	2.84*
		.23	.44	.57	.95*	1.02*	1.18*	1.35*	1.47*	1.81*	1.85*	2.55*
			.21	.34	.72*	.79*	.95*	1.12*	1.24*	1.58*	1.62*	2.32*
				.13	.51	.58	.74*	.91*	1.02*	1.36*	1.37*	1.41*
					.38	.45	.61	.78*	.90*	1.24*	1.28*	1.98*
						.07	.23	.40	.52	.86*	.90*	1.60*
							.16	.33	.45	.79*	.83*	1.53*
								.17	.29	.62	.67	1.37*
									.12	.46	.50	1.20*
										.34	.38	1.08*
											.04	.74*
												.70
.656	.664	.669	.676	.682	.688	.694	.700	.706	.712	.718	.724	.730

Fig. 7. High neurotic introvert responses as a function of Trial Blocks: Experimental session.


0.090
0.080
0.070
0.060
0.050
0.040
0.030
0.004
0.002
Mean GSR Amplitude (Δ Log Conductance)
F-A
A-O
C-O
1
2
3
4
Trial Blocks (5 Trials/Block)

lowest GSR magnitude overall while the A-O low neurotic extraverts had the greatest GSR magnitude (see Table 5).

Hypotheses II and III were supported by the data. The high neurotic introverts responded with more GSR magnitude than the low neurotic extraverts. This was true for the Preliminary Trials, as seen in Figure 4, and for the Experimental Trials with the exception of A-O. The Trial Blocks x Personality interaction is shown in Figure 8. A Newman-Keuls Studentized Range of this interaction showed that the low neurotic extraverts responded significantly lower on all Trial Blocks than the high neurotic introverts (see Table 6). This effect was somewhat depressed by the poor performance of the low neurotic extraverts in A-O.

The main source of the Trial Blocks x Personality interaction occurred as the high neurotic introverts suppressed their GSR significantly more than the low neurotic extraverts. This effect becomes obvious if difference scores (Trial Block 1--Trial Block 4) are considered. The high neurotic introverts lowered their GSR 0.0206 units while the low neurotic extraverts changed 0.0153 units. This change is shown in Figure 8. The largest change occurred in F-A where the high neurotic introverts dropped 0.0310 units and the low neurotic extraverts dropped 0.0240 units as seen in Figure 9. The greatest amount of GSR suppression was shown by the F-A high neurotic introverts. Figure 10 presents the data for C-O which shows that the high neurotic introverts habituated to the shock slightly faster than the low neurotic extraverts.

Answers on the postexperimental questionnaire were not designed to

TABLE 6

Newman-Keuls Studentized Range : Personality x Trials Interaction

Cell		b_2c_4	b_2c_3	b_2c_2	b_1c_4	b_2c_1	b_1c_3	b_1c_2	b_1c_1
	Mean	.0504	.0547	.0605	.0614	.0657	.0661	.0727	.0820
b_2c_4	.0504		.43*	1.01*	1.10*	1.53*	1.57*	2.23*	3.16*
b_2c_3	.0547			.58*	.67*	1.10*	1.14*	1.80*	2.73*
b_2c_2	.0605				.09	.52*	.56*	1.22*	2.15*
b_1c_4	.0614					.43*	.47*	1.13*	2.06*
b_2c_1	.0657						.04	.70*	1.63*
b_1c_3	.0661							.66*	1.59*
b_1c_2	.0727								.93*
Critical Value			.257	.292	.313	.327	.338	.348	.356

*$p < .01$

Fig. 8. High neurotic introvert - low neurotic extravert responses as a function of Trial Blocks: Experimental session.

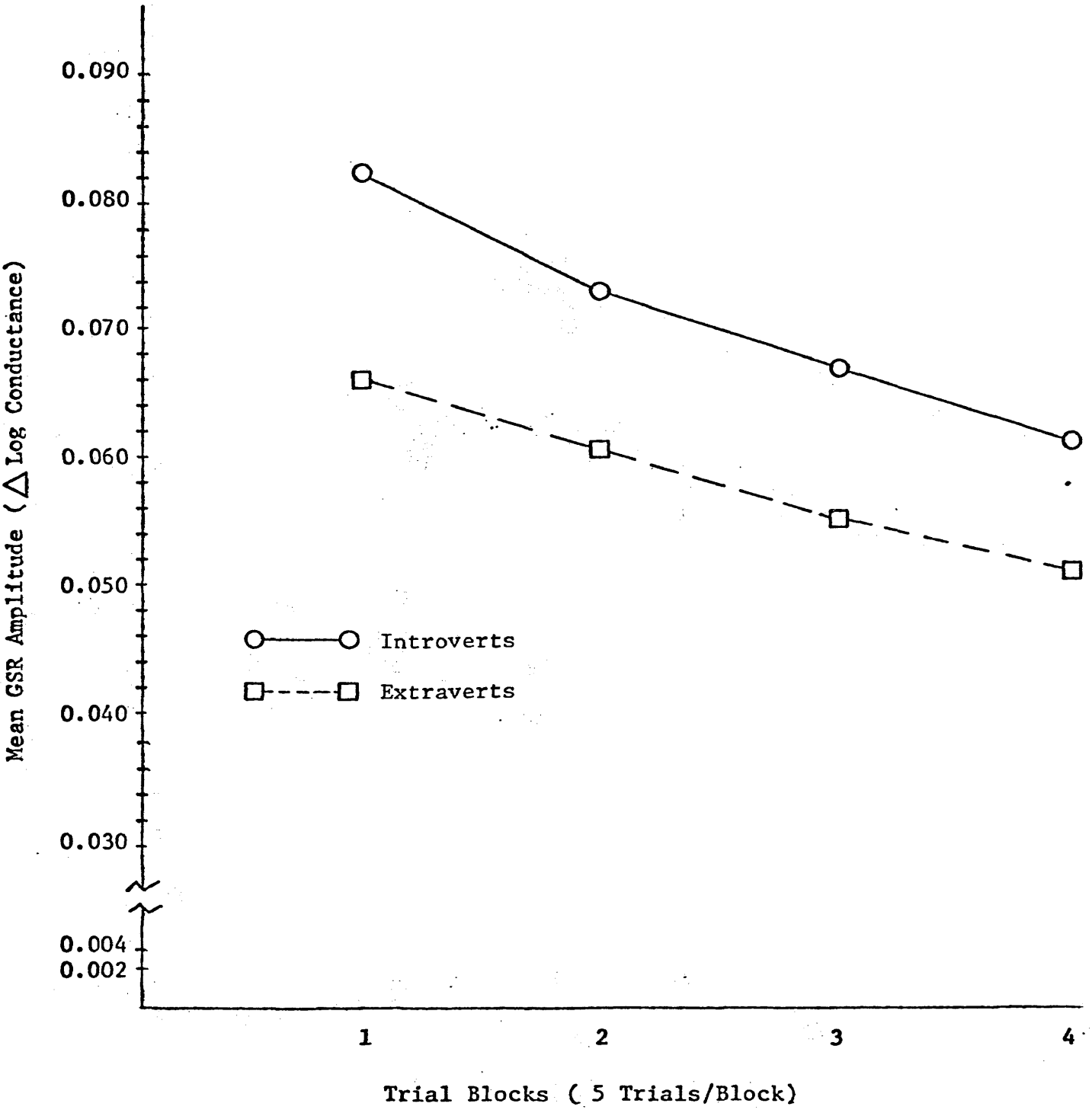

0.090
0.080
0.070
0.060
0.050
0.040
0.030
0.004
0.002
Mean GSR Amplitude (Δ Log Conductance)
Introverts
Extraverts
1
2
3
4
Trial Blocks (5 Trials/Block)

Fig. 9. High neurotic introvert - low neurotic extravert responses in F-A as a function of Trial Blocks: Experimental session.

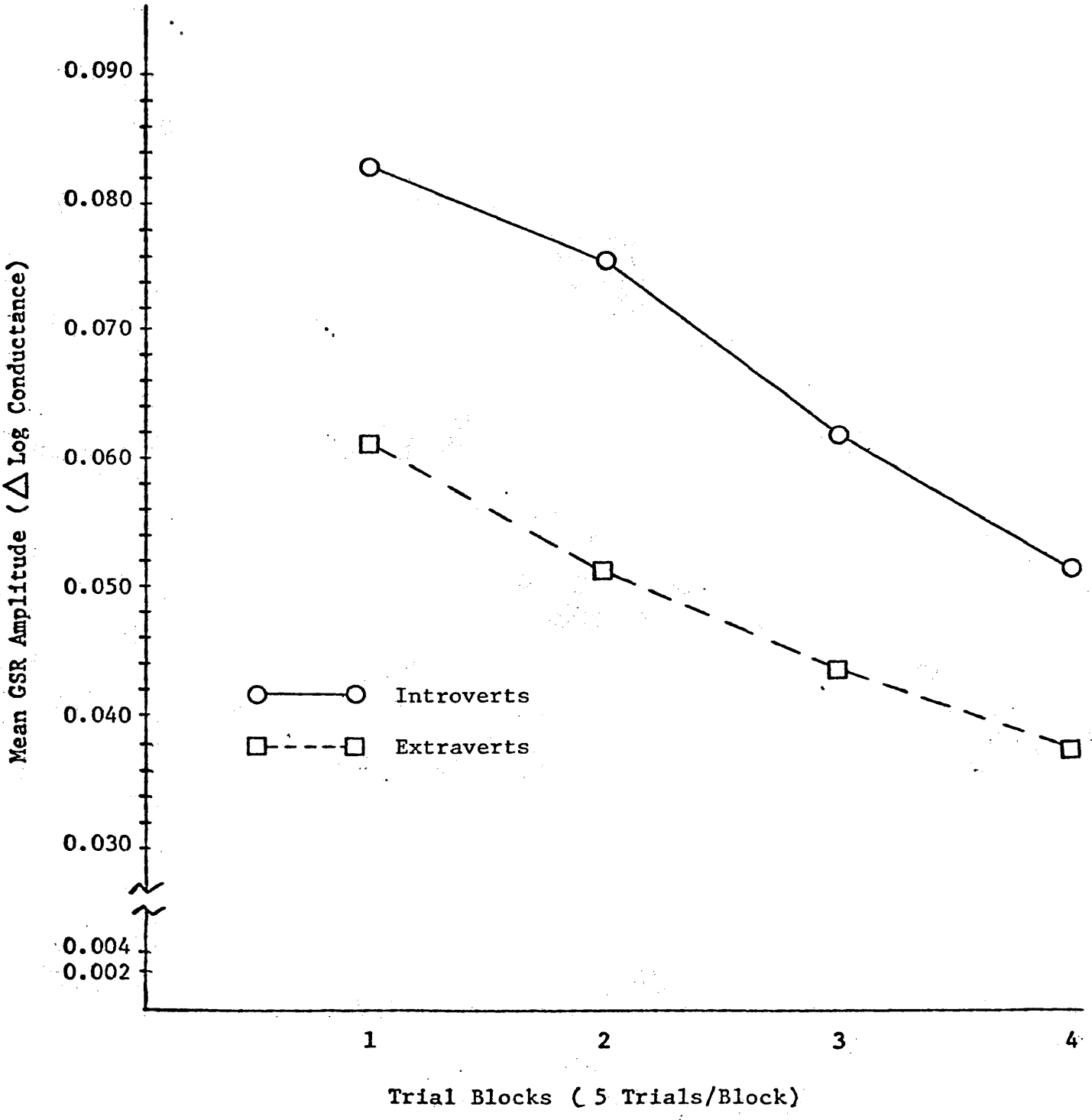
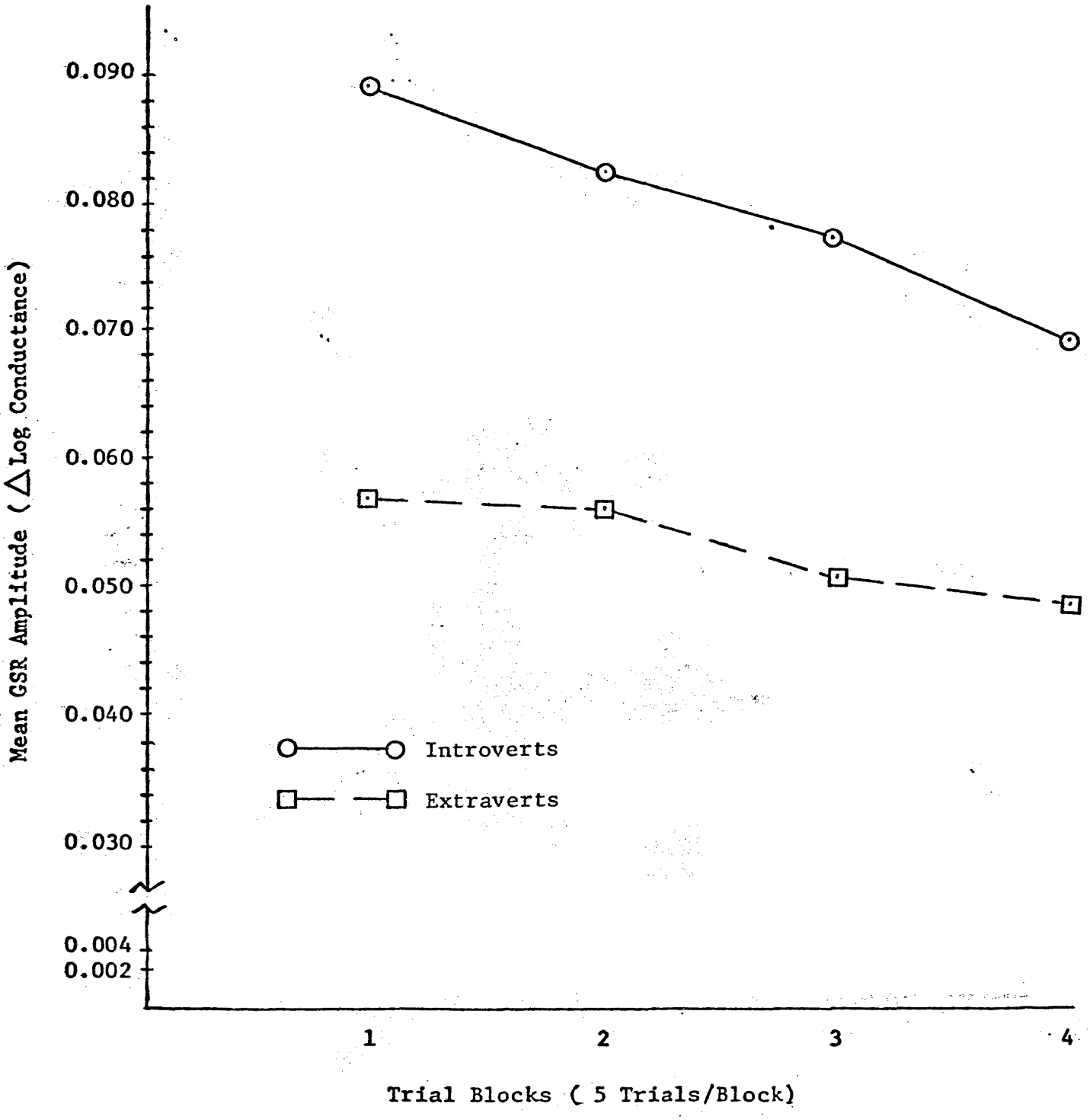

0.090
0.080
0.070
0.060
0.050
0.040
0.030
0.004
0.002
Mean GSR Amplitude (Δ Log Conductance)
Introverts
Extraverts
1
2
3
4
Trial Blocks (5 Trials/Block)

Fig. 10. High neurotic introvert - low neurotic extravert responses in C-O as a function of Trial Blocks: Experimental session.


0.090
0.080
0.070
0.060
0.050
0.040
0.030
0.004
0.002
Mean GSR Amplitude (Δ Log Conductance)
Introverts
Extraverts
1
2
3
4
Trial Blocks (5 Trials/Block)

be quantified but to give some indication of the cognitive strategies employed by Ss as well as how difficult the tasks had appeared to them. All Ss reported "Thinking about pleasant past experiences" as one cognitive strategy. Other techniques reported were: "counting numbers; singing songs; pretending the light (CS) was not there."

When asked about the difficulty of the task 8 F-A Ss thought it difficult, and 9 A-O Ss responded likewise. If considered in terms of introverts-extraverts, 9 high neurotic introverts thought the task was difficult while 8 low neurotic extraverts thought it so. The perceived difficulty or easiness of the task failed to discriminate between the groups.

Discussion

The pre- and postexperimental questionnaires were designed to measure S's subjective fear of the UCS. Fear of the shock as well as amount of shock were considered to be possible sources of confounding variables since Ss received varying amounts of shock and reported varying degrees of fear. An effort was made to equate the subjective intensity of shock for all Ss by individually adjusting the level as previously described in the method section. If GSR magnitude had been influenced by the level and/or fear of shock then subsequent voluntary control efforts would also have been influenced. The correlations between GSR magnitude and level of shock were low and nonsignificant as were the correlations between GSR magnitude and fear of shock; therefore amount and fear of shock were considered to have had little influence on the outcome of the experiment.

The present experiment selected Ss on the basis of two variables: Introversion-Extraversion and Neuroticism. GSR has typically been considered a general autonomic response, classed with heart rate, blood pressure, respiration, et cetera. This view leads to the assumption that GSR magnitude is a result of the neuroticism level such that high neurotics tend to show the largest GSR. Eysenck, on the other hand, considers GSR not as an autonomic response in the usual sense, but rather part of the orienting response and a function of cortical arousal. He

has predicted that GSR magnitude is related to Introversion-Extraversion such that introverts tend to show the largest GSR due to their higher level of cortical arousal. No attempt was made by this study to separate neuroticism from Introversion-Extraversion and no statement can be made about the relevant variable effecting GSR magnitude. Throughout the discussion the high neurotic introverts are referred to as Introverts and the low neurotic extraverts are referred to as Extraverts. The reader is cautioned that the results of this experiment are as likely to be the effect of the Neuroticism variable as the Introversion-Extraversion variable.

Preliminary Trials served as a measurement of possible preexperimental differences in GSR magnitude between Groups and between Introverts-Extraverts. No significant effects were found, although Introverts responded at a higher level across the 5 trials than the Extraverts. Since no differences were observed, the Groups and Introverts-Extraverts were considered to be equally matched on GSR magnitude.

Results of the Experimental Session partially supported Hypothesis I. Awareness of the reward contingency combined with a source of external feedback greatly facilitated voluntary suppression of GSR in both Introverts and Extraverts. F-A lowered their GSR across the 20 test trials significantly more than A-O or C-O. This finding is consistent with past experiments which have reported both variables alone to be effective in aiding voluntary control of autonomic responses.

The second part of Hypothesis I was not substantiated as A-O failed to modify their GSR in relation to the performance of C-O. As previously mentioned in the Result section, the poor performance of A-O was due to the inability of the A-O Extraverts to modify GSR. This finding is not in agreement with past studies which have shown awareness of reward contingency to be an effective prerequisite for GSR modification (Shean, 1969; Grings, 1960). The procedure employed by these experiments was one whereby Ss could avoid the UCS (shock) by raising the GSR to a "respond" signal and lowering it to an "inhibit" signal. The important feature of this procedure is that Ss were receiving an indirect, unintentional form of feedback based on whether or not shock was administered following any given trial. If shock followed a presentation of the signal lamp then Ss were by necessity "informed" that they had not met the requirements on that trial. By the same measure, if shock did not follow then positive feedback was transmitted. It appears that feedback as well as awareness was manipulated in these studies.

Experiments in which awareness was purposely not manipulated but where feedback in the form of shock avoidance was presented seem to indicate that feedback alone is not adequate for GSR modification (Stern, 1967). In these experiments Ss were informed that they would receive shock when a signal lamp was energized if they did not emit the correct behavior. Ss were not told what the correct behavior was (GSR above spontaneous level). Stern has reported that only Ss "who in the course of the experiment discovered that thinking exciting thoughts would avoid

shock" showed modification of GSR. Only a small percentage of the Ss were able to make this discovery. None of the above experiments made an attempt to study GSR modification in Ss of different personality traits.

Results of the Preliminary and Experimental Trials supported Hypothesis II that the high neurotic introverts would respond with greater GSR than the low neurotic extraverts. The Introverts responded with higher GSR on the preliminary Trials as previously stated. During the Experimental Trials F-A and C-O Introverts likewise responded with a higher GSR but this phenomenon was reversed in A-O. In A-O the Extraverts responded at a much higher level than the Introverts. One possible explanation for this reversal lies in the clinical description of Introverts and Extraverts. Extraverts have been described as people who are highly dependent on external sources of stimulation, especially inter-personal communication. In the present experiment A-O Ss were placed in a situation of having a performance task imposed on them by E, but with no method to communicate with E. F-A Extraverts were in effect "communicating" with the feedback lamps. C-O Ss had no task to perform and, therefore had no need to communicate. It seems reasonable that A-O Extraverts would find this task frustrating and would manifest this frustration in their GSR.

The A-O Introverts responded at a much lower level than the Extraverts, in fact they performed almost as well as the F-A Introverts. This is not surprising since Introverts tend to depend on internal rather than external stimuli, awareness of autonomic activity is an internal

source of stimulation and could possibly serve as a form of feedback. A feasible argument is that the A-O Introverts were able to utilize autonomic awareness as feedback and this aided them in suppressing their GSR.

Hypothesis III was supported as the Introverts lowered their GSR over Trial Blocks more than the Extraverts. This effect was observed in both F-A and A-O. It was predicted from Eysenck's theory that Introverts would suppress GSR more than Extraverts. Two possible explanations arise from the theory: Introverts learn faster than Extraverts, therefore under a feedback condition Introverts would learn the appropriate responses more quickly and thereby perform better; or Introverts have more cortical control over lower brain centers and are able to suppress GSR as a result of this control. These two explanations arise from the same source (e.g., higher cortical arousal in Introverts) and are not mutually exclusive.

An alternative explanation is that Introverts adapted to the UCS faster and therefore showed more habituation than the Extraverts. This argument is seen to be invalid in Figure 7 where the performance of F-A Introverts is compared to that of C-O Introverts. Since C-O received no instructions, the change over Trial Blocks is assumed to be entirely due to habituation. The F-A Introverts suppressed their GSR significantly more than the C-O Introverts, therefore habituation cannot explain the total change in F-A Introverts, although as Figure 10 shows, the Introverts did habituate at a slightly faster rate.

The most logical conclusions based on the findings of the present

experiment are:

1. Low neurotic extraverted Ss require both awareness of the reward contingency and a source of external feedback in order to accomplish voluntary suppression of a conditioned GSR.

2. High neurotic introverted Ss require only awareness of the reward contingency in order to suppress GSR.

It is suggested that Introverts can effectively utilize autonomic awareness as a source of feedback while Extraverts are highly dependent on external sources of feedback.

The findings of the present experiment support Eysenck's theory. His theory predicts that high neurotic introverts should show greater ANS responses than low neurotic extraverts when presented with an aversive stimulus. This effect was observed although it is impossible, due to the experimental design, to establish causation of GSR magnitude. Eysenck clearly states that he considers GSR magnitude to be a function of Introversion-Extraversion while all other ANS response levels are governed by Neuroticism.

Eysenck defines Introversion-Extraversion on a physiological level, introverts are characterized by higher levels of cortical arousal than extraverts. From this position he predicts that introverts have more conscious control over lower brain functions, learn faster, and develop inhibition slower than extraverts. Eysenck discusses conscious control of lower brain functions in a behavioral sense, that is, extraverts tend to be more emotional, less socially inhibited than introverts. It seems

logical that the theory would also predict that introverts would be able to suppress lower brain functions on a physiological level as well. The present experiment demonstrated that introverts can indeed suppress one lower brain function (GSR) better than extraverts.

These findings have implications for Wolpe's theory of psychoneurosis which is based in part upon Eysenck's theory of personality. Wolpe, as discussed in the Introduction, has suggested that the magnitude of ANS responses elicited by a stimulus governs the probability of a neurotic behavior being formed. Therefore, those who score high on the Neuroticism scale would be more likely to develop neurotic behaviors than those who score low because, under stress, high scorers would exhibit higher ANS responses. Neurotic introverts tend to develop dysthymic disorders (anxiety, depression, et cetera) while neurotic extraverts tend to develop behavioral disorders (hysteria, psychopathic deviancy).

The results of the present experiment showed that high neurotic introverts responded with greater GSR magnitude than low neurotic extraverts when presented with electric shock. This supports both Eysenck and Wolpe and indicates that individual differences in GSR responsitivity exist. These individual differences could partially account for the observed phenomenon that under stress some individuals develop neurosis while others do not.

Another important implication is in the area of treatment of neurosis. Wolpe's central technique is the use of desensitization

where the patient is required to relax and to monitor his autonomic responses when presented with stress producing "mental" scenes. Results of the present experiment showed that in a situation where Ss had only internal cues by which to monitor autonomic responses (A-O), high neurotic introverts succeeded much more than low neurotic extraverts. Clearly, high neurotic introverts would be expected to benefit from Wolpe's procedure more than low neurotic extraverts. This would be true for implosion therapy (Stampfl and Levis, 1967) as well.

In a condition where external feedback was available to Ss (F-A) both high neurotic introverts and low neurotic extraverts were able to lower their GSR, and high neurotic introverts were again able to lower their GSR more than the low neurotic extraverts. In terms of therapy with neurotic patients, the evidence seems clear that some form of external feedback about their autonomic responses during the therapy session would be of great benefit to all patients. Again, high neurotic introverts would be expected to respond more favorably to this type of therapy than would low neurotic extraverts.

APPENDIX A

FEAR OF SHOCK SCALE

Please circle the number that represents your fear of electric shock.

Not Afraid at All									Terrified
1	2	3	4	5	6	7	8	9	10

APPENDIX B

POSTEXPERIMENTAL QUESTIONNAIRE

ADMINISTERED TO F-A.

1. What were you doing to try and control your responses when the red light came on?

2. What were you doing to try and control your responses when the green light came on?

3. Do you feel that it was difficult for you to control your responses?

APPENDIX C

POSTEXPERIMENTAL QUESTIONNAIRE

ADMINISTERED TO A-O.

1. What did you do to try to control your responses?

2. How successful do you think you were in controlling your responses?

APPENDIX D

MAUDSLEY PERSONALITY

INVENTORY

E N ?

Are you happiest when you get involved in some project that calls for rapid action?	Yes	?	No
Do you sometimes feel happy, sometimes depressed, without any apparent reason?	Yes	?	No
Does your mind often wander while you are trying to concentrate?	Yes	?	No
Do you usually take the initiative in making new friends?	Yes	?	No
Are you inclined to be quick and sure in your actions?	Yes	?	No
Are you frequently "lost in thought" even when supposed to be taking part in a conversation?	Yes	?	No
Are you sometimes bubbling over with energy and sometimes very sluggish?	Yes	?	No
Would you rate yourself as a lively individual?	Yes	?	No
Would you be very unhappy if you were prevented from making numerous social contacts?	Yes	?	No
Are you inclined to be moody?	Yes	?	No
Do you have frequent ups and downs in mood, either with or without apparent cause?	Yes	?	No
Do you prefer action to planning for action?	Yes	?	No
Are your daydreams frequently about things that can never come true?	Yes	?	No
Are you inclined to keep in the background on social occasions?	Yes	?	No
Are you inclined to ponder over your past?	Yes	?	No
Is it difficult to "lose yourself" even at a lively party?	Yes	?	No
Do you ever feel "just miserable" for no good reason at all?	Yes	?	No
Are you inclined to be overconscientious?	Yes	?	No
Do you often find that you have made up your mind too late?	Yes	?	No
Do you like to mix socially with people?	Yes	?	No
Have you often lost sleep over your worries?	Yes	?	No
Are you inclined to limit your acquaintances to a select few?	Yes	?	No
Are you often troubled about feelings of guilt?	Yes	?	No
Do you ever take your work as if it were a matter of life or death?	Yes	?	No
25. Are your feelings rather easily hurt?	Yes	?	No
26. Do you like to have many social engagements?	Yes	?	No
27. Would you rate yourself as a tense or "highly-strung" individual?	Yes	?	No
28. Do you generally prefer to take the lead in group activities?	Yes	?	No
29. Do you often experience periods of loneliness?	Yes	?	No
30. Are you inclined to be shy in the presence of the opposite sex?	Yes	?	No
31. Do you like to indulge in a reverie (daydreaming)?	Yes	?	No
32. Do you nearly always have a "ready answer" for remarks directed at you?	Yes	?	No
33. Do you spend much time in thinking over good times you have had in the past?	Yes	?	No
34. Would you rate yourself as a happy-go-lucky individual?	Yes	?	No
35. Have you often felt listless and tired for no good reason?	Yes	?	No
36. Are you inclined to keep quiet when out in a social group?	Yes	?	No
37. After a critical moment is over, do you usually think of something you should have done but failed to do?	Yes	?	No
38. Can you usually let yourself go and have a hilariously good time at a gay party?	Yes	?	No
39. Do ideas run through your head so that you cannot sleep?	Yes	?	No
40. Do you like work that requires considerable attention?	Yes	?	No
41. Have you ever been bothered by having a useless thought come into your mind repeatedly?	Yes	?	No
42. Are you inclined to take your work casually, that is as a matter of course?	Yes	?	No
43. Are you touchy on various subjects?	Yes	?	No
44. Do other people regard you as a lively individual?	Yes	?	No
45. Do you often feel disgruntled?	Yes	?	No
46. Would you rate yourself as a talkative individual?	Yes	?	No
47. Do you have periods of such great restlessness that you cannot sit long in a chair?	Yes	?	No
48. Do you like to play pranks upon others?	Yes	?	No

APPENDIX E

INDIVIDUAL S DATA; GSR, PRE- AND POSTEXPERIMENTAL FEAR OF SHOCK, AND SHOCK LEVEL.

S	Shock Level	Pre-experimental Fear of Shock	Postexperimental Fear of Shock
1	5.0	5	4
2	5.0	5	4
3	6.5	3	1
4	5.0	6	7
5	4.0	8	4
6	4.5	6	7
7	4.0	4	6
8	8.0	1	1
9	5.0	6	1
10	4.5	5	4
11	4.0	4	4
12	5.5	8	5
13	4.5	3	2
14	5.5	4	4
15	8.0	8	4
16	6.0	4	3
17	5.0	5	3
18	5.0	7	7
19	4.0	6	6
20	5.0	4	4
21	7.0	5	6
22	5.5	6	5
23	6.0	4	3
24	1.5	6	1
25	4.5	4	6
26	6.0	4	6
27	5.0	3	2
28	5.5	6	5
29	7.0	5	4
30	6.5	6	6
31	4.0	6	4
32	5.5	5	3
33	6.5	6	5
34	4.5	5	4
35	3.5	3	3
36	5.5	4	2
37	4.5	4	4
38	3.5	4	4
39	3.5	4	3
40	4.5	7	2
41	5.8	2	1
42	10.0	6	6

GSR

S_1	S_2	S_3	S_4
.0140	.0192	.0098	.0157
.0175	.0160	.0071	.0218
.0154	.0172	.0078	.0045
.0175	.0190	.0021	.0121
.0144	.0192	.0049	.0111
.0132	.0201	.0037	.0162
.0159	.0184	.0035	.0193
.0159	.0217	.0000	.0206
.0121	.0217	.0034	.0176
.0155	.0217	.0026	.0101
.0128	.0184	.0000	.0192
.0115	.0151	.0000	.0156
.0127	.0159	.0061	.0149
.0118	.0197	.0026	.0149
.0096	.0157	.0026	.0195
.0096	.0140	.0051	.0123
.0107	.0119	.0060	.0152
.0077	.0127	.0026	.0061
.0075	.0129	.0034	.0000
.0118	.0127	.0000	.0052
.0076	.0192	.0026	.0009
.0077	.0135	.0043	.0000
.0134	.0156	.0000	.0018
.0045	.0154	.0017	.0079
.0056	.0186	.0026	.0017

S_5	S_6	S_7	S_8
.0159	.0809	.0099	.0136
.0176	.0421	.0108	.0092
.0168	.0367	.0149	.0087
.0201	.0382	.0152	.0102
.0141	.0348	.0230	.0068
.0088	.0383	.0086	.0090
.0118	.0389	.0111	.0025
.0078	.0469	.0109	.0033
.0078	.0422	.0110	.0032
.0109	.0322	.0186	.0040
.0084	.0388	.0095	.0056
.0023	.0482	.0107	.0072
.0054	.0435	.0096	.0040
.0046	.0319	.0129	.0065
.0046	.0411	.0220	.0049
.0023	.0212	.0189	.0057
.0038	.0389	.0143	.0089
.0077	.0376	.0132	.0073
.0054	.0357	.0136	.0081
.0039	.0327	.0126	.0107
.0039	.0257	.0079	.0093
.0039	.0331	.0147	.0101
.0055	.0315	.0113	.0097
.0000	.0277	.0124	.0135
.0000	.0220	.0166	.0119

$\underline{S}_9$	$\underline{S}_{10}$	$\underline{S}_{11}$	$\underline{S}_{12}$
.0123	.0108	.0110	.0300
.0038	.0072	.0100	.0157
.0114	.0052	.0139	.0179
.0000	.0115	.0102	.0197
.0000	.0066	.0156	.0193
.0147	.0167	.0188	.0125
.0142	.0107	.0166	.0203
.0109	.0112	.0096	.0183
.0091	.0051	.0095	.0179
.0000	.0095	.0147	.0122
.0000	.0095	.0138	.0110
.0000	.0095	.0150	.0154
.0000	.0091	.0194	.0086
.0000	.0104	.0171	.0144
.0000	.0097	.0114	.0097
.0000	.0076	.0152	.0098
.0000	.0139	.0208	.0000
.0029	.0145	.0157	.0000
.0000	.0078	.0132	.0000
.0021	.0113	.0128	.0000
.0000	.0076	.0126	.0065
.0000	.0076	.0140	.0000
.0000	.0083	.0128	.0000
.0025	.0046	.0142	.0000
	.0110	.0101	.0039

$\underline{S}_{13}$	$\underline{S}_{14}$	$\underline{S}_{15}$	$\underline{S}_{16}$
.0216	.0621	.0134	.0284
.0180	.0246	.0085	.0261
.0126	.0177	.0060	.0263
.0122	.0436	.0084	.0212
.0106	.0244	.0083	.0212
.0088	.0280	.0128	.0328
.0018	.0175	.0092	.0286
.0116	.0202	.0079	.0300
.0106	.0197	.0089	.0280
.0149	.0197	.0110	.0286
.0043	.0261	.0088	.0261
.0150	.0167	.0055	.0329
.0106	.0197	.0077	.0348
.0088	.0212	.0065	.0218
.0031	.0175	.0088	.0232
.0061	.0239	.0099	.0296
.0009	.0158	.0077	.0260
.0144	.0010	.0066	.0183
.0018	.0223	.0044	.0193
.0080	.0195	.0066	.0293
.0080	.0099	.0088	.0208
.0027	.0113	.0088	.0328
.0101	.0159	.0079	.0223
.0027	.0170	.0022	.0202
.0028	.0056	.0056	.0171

$\underline{S}_{17}$	$\underline{S}_{18}$	$\underline{S}_{19}$	$\underline{S}_{20}$
.0073	.0151	.0300	.0245
.0038	.0144	.0281	.0215
.0000	.0197	.0226	.0300
.0000	.0134	.0229	.0246
.0025	.0193	.0228	.0168
.0058	.0117	.0387	.0131
.0052	.0170	.0253	.0136
.0000	.0189	.0160	.0067
.0016	.0147	.0278	.0084
.0016	.0117	.0165	.0136
.0024	.0164	.0080	.0084
.0016	.0061	.0125	.0153
.0000	.0068	.0238	.0067
.0024	.0106	.0060	.0205
.0057	.0157	.0135	.0000
.0016	.0110	.0242	.0099
.0016	.0150	.0082	.0088
.0076	.0187	.0060	.0141
.0017	.0090	.0053	.0052
.0000	.0130	.0137	.0070
.0017	.0020	.0160	.0159
.0000	.0171	.0160	.0106
.0017	.0133	.0145	.0088
.0025	.0113	.0107	.0088
.0035	.0144	.0024	.0000

$\underline{S}_{21}$	$\underline{S}_{22}$	$\underline{S}_{23}$	$\underline{S}_{24}$
.0181	.0349	.0155	.0280
.0066	.0325	.0182	.0175
.0152	.0328	.0114	.0147
.0077	.0370	.0155	.0132
.0079	.0366	.0167	.0217
.0133	.0312	.0169	.0256
.0058	.0393	.0103	.0151
.0057	.0276	.0142	.0167
.0163	.0312	.0159	.0164
.0090	.0339	.0091	.0208
.0106	.0262	.0153	.0131
.0134	.0240	.0156	.0286
.0117	.0285	.0183	.0150
.0144	.0322	.0150	.0103
.0101	.0221	.0209	.0238
.0166	.0303	.0209	.0150
.0119	.0377	.0185	.0095
.0131	.0272	.0175	.0199
.0173	.0364	.0223	.0056
.0187	.0269	.0213	.0105
.0254	.0373	.0189	.0075
.0285	.0353	.0075	.0076
.0300	.0343	.0213	.0037
.0193	.0284	.0203	.0019
.0292	.0293	.0137	.0000

$\underline{S}_{25}$	$\underline{S}_{26}$	$\underline{S}_{27}$	$\underline{S}_{28}$
.0128	.0165	.0212	.0240
.0062	.0100	.0083	.0279
.0062	.0000	.0079	.0246
.0049	.0000	.0099	.0294
.0049	.0098	.0066	.0166
.0051	.0168	.0114	.0294
.0036	.0114	.0014	.0244
.0061	.0061	.0079	.0167
.0086	.0085	.0057	.0214
.0062	.0159	.0048	.0162
.0062	.0075	.0021	.0256
.0086	.0008	.0055	.0218
.0037	.0056	.0075	.0192
.0099	.0048	.0055	.0227
.0049	.0131	.0055	.0214
.0062	.0000	.0042	.0199
.0049	.0016	.0021	.0225
.0074	.0024	.0106	.0186
.0062	.0056	.0050	.0150
.0037	.0040	.0109	.0190
.0074	.0056	.0086	.0117
.0062	.0096	.0079	.0265
.0061	.0089	.0056	.0163
.0036	.0008	.0063	.0258
.0037	.0109	.0028	.0242

$\underline{S}_{29}$	$\underline{S}_{30}$	$\underline{S}_{31}$	$\underline{S}_{32}$
.0139	.0548	.0380	.0256
.0100	.0857	.0264	.0216
.0036	.0273	.0278	.0064
.0161	.0281	.0307	.0075
.0139	.0366	.0300	.0037
.0161	.0177	.0379	.0177
.0206	.0156	.0189	.0111
.0196	.0188	.0341	.0047
.0159	.0000	.0181	.0000
.0182	.0214	.0269	.0023
.0227	.0166	.0370	.0058
.0252	.0237	.0127	.0058
.0175	.0159	.0204	.0023
.0163	.0000	.0091	.0000
.0226	.0141	.0160	.0069
.0241	.0071	.0141	.0000
.0192	.0035	.0057	.0104
.0229	.0017	.0028	.0046
.0229	.0088	.0233	.0175
.0218	.0036	.0000	.0177
.0232	.0055	.0058	.0090
.0207	.0073	.0109	.0156
.0157	.0095	.0010	.0174
.0229	.0000	.0000	.0143
.0232	.0000	.0020	.0090

$\underline{s}_{33}$	$\underline{s}_{34}$	$\underline{s}_{35}$	$\underline{s}_{36}$
.0000	.0371	.0280	.0216
.0000	.0575	.0128	.0160
.0000	.0428	.0147	.0107
.0000	.0522	.0088	.0051
.0000	.0429	.0132	.0066
.0000	.0477	.0132	.0038
.0000	.0473	.0044	.0077
.0000	.0521	.0092	.0117
.0000	.0458	.0139	.0072
.0000	.0497	.0092	.0000
.0000	.0473	.0119	.0019
.0000	.0454	.0122	.0058
.0000	.0458	.0098	.0032
.0000	.0462	.0098	.0097
.0000	.0493	.0100	.0019
.0000	.0399	.0077	.0019
.0000	.0422	.0236	.0000
.0000	.0481	.0156	.0000
.0000	.0434	.0152	.0000
.0000	.0489	.0177	.0140
.0000	.0522	.0126	.0044
.0000	.0429	.0103	.0098
.0000	.0408	.0000	.0134
.0000	.0380	.0183	.0000
.0000	.0445	.0075	.0072

$\underline{s}_{37}$	$\underline{s}_{38}$	$\underline{s}_{39}$	$\underline{s}_{40}$
.0121	.0142	.0218	.0000
.0081	.0155	.0106	.0000
.0200	.0152	.0064	.0000
.0065	.0140	.0141	.0000
.0096	.0112	.0091	.0000
.0044	.0110	.0064	.0000
.0022	.0042	.0141	.0000
.0021	.0082	.0100	.0000
.0075	.0069	.0098	.0000
.0078	.0069	.0060	.0000
.0021	.0084	.0083	.0000
.0053	.0071	.0123	.0000
.0043	.0084	.0039	.0000
.0021	.0084	.0039	.0000
.0126	.0056	.0062	.0000
.0073	.0056	.0000	.0000
.0042	.0056	.0047	.0000
.0021	.0056	.0040	.0000
.0021	.0085	.0000	.0000
.0042	.0042	.0025	.0000
.0031	.0056	.0000	.0000
.0042	.0028	.0025	.0000
.0000	.0028	.0091	.0000
.0000	.0043	.0058	.0000
.0000	.0043	.0040	.0000

S_{41}	S_{42}
.0421	.0277
.0423	.0280
.0458	.0205
.0369	.0237
.0368	.0290
.0229	.0308
.0315	.0232
.0195	.0201
.0353	.0291
.0273	.0236
.0339	.0291
.0505	.0194
.0219	.0230
.0295	.0175
.0265	.0238
.0320	.0278
.0350	.0231
.0346	.0227
.0410	.0260
.0260	.0121
.0177	.0196
.0394	.0168
.0346	.0199
.0378	.0246
.0238	.0235

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