INTROVERSION-EXTROVERSION IN RELATION TO PERFORMANCE ON REPETITIVE SEARCH TASKS

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Introversion-Extroversion in Relation to Performance on Repetitive Search Tasks

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A Thesis

Presented to

the Faculty of the Department of Psychology

Appalachian State University

In Partial Fulfillment

of the Requirements for the Degree

Master of Arts in Clinical Psychology

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by

Stanley Kowalczyk

August 1979

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Acknowledgements

I wish to thank the members of my thesis committee, especially Dr. Terrant, for their assistance and advice, the faculty members and graduate students in this study, and the students themselves for their generous cooperation and conductive attitude.

Abstract

It was hypothesized that introverted subjects would have fewer errors than extroverted subjects on visual search tasks as a result of greater susceptibility to reactive inhibition on the part of the extroverts, that greater similarity between target and field would cause a greater increase in the number of errors for extroverts than introverts and that the imposition of pressure in the form of time comparison of scores to a fictitious norm would adversely affect introverts and improve the score of extroverts. A total of seventy-two female college students were used as subjects. Subjects were selected from a larger group on the basis of the Eysenck Personality Inventory which divided them into introverts, ambiverts and extroverts. Each subject performed both the similar and dissimilar task the order of which was alternated for the purpose of counter balancing.

The results were generally in the opposite direction from what had been predicted. The only significant difference was that of the number of errors produced on the similar task and the dissimilar task.

Introversion-Extroversion in Realtion to Performance on Repetitive Search Tasks

Introduction

Literature Review and Overview

The personality theory of Hans Eysenck is based on a series of beliefs about the effect of certain physiological processes on autonomic and voluntary behavior as well as cognition, sensation, and performance. Much of his theory, which in relation to personality bears great similarity to those of Galon, Hypocrates, Kant and Pavlov, lacks empirical support. According to his theory, individuals vary innately in the degree to which these processes, which he refers to as arousal and activation, operate. Eysenck uses the term "arousal" to refer to what has been historically referred to as "excitation". Counter to arousal is inhibition. Eysenck (1967) regards excitation as a "cortical process which facilitates learning, conditioning, memory, perception, discrimination, thinking and mental processes generally, whereas inhibition has the opposite effect of reducing the efficiency of the cortex". Excitation and inhibition are basic activities of the central nervous system and inhibition, like excitation, is believed to be an active process rather than the mere absence of activity. The other activity, activation, is often not distinguished from arousal in the literature because the two are inferred largely from the same physiological measures such as cardiovascular measures,

EEGs, skin resistance, muscle tension and others. Activation may be said to be most in effect during rage behavior. Malmo believes consciousness to be a reflection of activation (Eysenck, 1967). Eysenck's theory identifies the sources of activation as the limbic system (hippocamus, amygdola, cingulum, septum and hypothalamus) and that of arousal as the ascending reticular activating system. The two phenomena, while fundamentally independent, are necessarily related because the reticular formation is connected to the hypothalamus by ascending and descending pathways. Electrical stimulation of either area produces stimulation in the other. Arousal must be present for activation to occur but activation is not necessary for arousal. For example, rage behavior which is a manifestation of activation cannot occur without arousal, but merely to be aroused (as in normal wakeful activity), does not lead to rage or activation. The two may become paired, for example, during intense warfare when wakeful behavior may be continually accompanied over time with extremely activating stimulation.

In addition, Gray (1970) found evidence that the hippicampus which in Eysenck's theory, as part of the visceral brain, is the source of activation, is also a source of arousal along with the reticular activating system.

Although according to Eysenck's theory, inhibition functions in a general manner, there also have been numerous demonstrations of a decrement in performance believed to reflect a decrease in neural excitation following repetitive

tasks. Hull introduced the concept of "reactive inhibition (I_r)" to account for this.

> Whenever any reaction is evoked in an organism there is left a condition or state which acts as a primary negative motivation in which it has an innate capacity to produce a cessation of the activity which produced the state (Hull, 1943).

Reactive inhibition, according to Hull, is a fatigue-like state that acts to inhibit the repetition of a behavior. It is manifested behaviorally in the form of cessation when the inhibitory potential summates to a greater degree than the opposing positive tendency (or excitation). Following the instant of inhibition, the positive potential is at a greater degree of strength and the behavior again occurs. Ceasing the behavior before the inhibition overcomes the positive potential allows the inhibition to dissipate. The occurrence of reminiscence is believed to reflect dissipation of reactive inhibition. Eysenck holds that individuals who are subject to greater degrees of general inhibition are also subject to more instances of reactive inhibition, both reflecting the differential thresholds of the reticular activating system (excitation-arousal) and that this, along with the differential thresholds of the reticular system (activation), accounts for the major behavioral differences among individuals. He believes extroversion-introversion

reflect differences in excitation and neurosis-stability reflect differences in activation. It is theorized by Eysenck (1967) that greater amounts of cortical excitation cause introverted behavior or inhibited behavior because cortical activity exerts a restraint on the lower centers of the brain and that less cortical excitation allows lower centers greater influence over behavior. Introverts are expected to differ from extroverts also in such areas as vigilance, sensory and pain thresholds, and tolerance of stress.

The concept of "cortical efficiency" may be useful in understanding the relationship between personality and different levels of excitation and inhibition. For example, uninhibited behavior is noted as alcohol hinders the efficency of the cortex. Behavior seems to reflect the activity of only lower centers of the brain. As dosage is increased, these lower centers become inhibited to a point where unconsciousness results. Finally, a large enough dosage inhibits the most basic centers, resulting in death. It has been osbserved that the administration of alcohol can inhibit conditioning and that removal of the cortex eliminates all but the simplest conditioning. Alcohol can be viewed as an extroverting drug.

Similar effects have been noted with the use of sodium amytol. Laverty (1959) found that neurotic introverts were greatly extroverted by sodium amythol and that they also had the lowest sedation threshold. The administration of

epinephrine, a stimulant, has been shown by Schacrter and Latane (1962) to increase the rate of acquisition of an avoidance response in animals.

Neurotic behavior, on the other hand, as a manifestation of activation, may be seen as a heightened reactivity and is believed to result from stimulation of the limbic system which has long been established as a center of emotional activity. Neurotic individuals are believed to have lower thresholds of limbic stimulation.

The Eysenck Personality Inventory (EPI) (1963) developed after the Maudsley's Personality Inventory (MPI) (1959) is a measure of introversion-extroversion, neurosis-stability. There have been numerous studies using the EPI. Subjects divided into introverts and extroverts according to the Maudsley Personality Inventory have been shown to differ significantly on measures of economic aspiration (Sevransky, 1965), rigidity of vocational aspiration (Sinha, 1964), speed and accuracy of problem solving (Brierly, 1961; Jenson, 1966), perceptual defense (Brown, 1961), verbal conditioning (Jawanda, 1966), drug effects (Bartholomew & Marley, 1959), estimation of time (Eysenck, 1959), and estimation of duration of sensors deprivation (Reed and Kenna, 1964). The results of these studies were generally in the direction predicted by Eysenck's theory; that is, such results would be expected if introverts do in fact operate with greater amounts of cortical activity and are subject to less reactive

inhibition. Also, Franks (1957) found that introverts formed a conditoned response more quickly than extroverts in a study utilizing eyeblink conditioning.

A study by Spielman (1967) was particularly impressive. When subjects performed an electrical stylus tapping task that measured minute pauses between the subjects' taps with the stylus (involuntary rest pauses), IRPs that are believed to reflect reactive inhibition, introverts were found to have fewer IRPs than extroverts ($P < .01$).

Oakley (1959) found introverts to have significantly better performance than extroverts in performance on the pursuit rotor. This would be expected if extroverts are subject to greater amounts of IRPs. However, no significant difference was found in reminiscence. If extroverts had built up greater amounts of reactive inhibition, a rest period would be expected to benefit extroverts more than introverts.

Another area of study important to the theory is that of vigilance, which involves the detection and response to small changes (occurring at random intervals) in the external environment. The concept is crucial to the theory of differential arousal among individuals, as it would be expected that individuals who operate under heightened degrees of inhibition would be less likely to detect minute random stimuli because some stimuli would coincide in time with IRPs. Shapiro (1965) noted the sharp per-

sistant attention of the reserved, introverted obsessive-compulsive. "These people do not concentrate; they seem always to be concentrating". Of key importance is the assumption that concentration and attendance is in effect a repetitive task although it is fundamentally non-motor.

Tune (1966) found that introverted subjects made significantly fewer errors than extroverts on a vigilance task where subjects were to report their detection of three consecutive and different odd digits in a recorded forty-minute series of digits. Claridge (1960) tested hysterics (extroverts), dysthymics (introverts), and early schizophrenics in a vigilance task. The subjects were presented with a thirty-minute tape recording of digits and told to respond to three successive odd numbers, followed by a ten-minute tape and told to respond to their hearing the number six. Dysthymics showed an initial increase in performance while the hysterics showed a decline. This was interpreted as representing the effect of the accumulation of inhibition on the part of the hysterics (extroverts). With the onset of the second task, dysthymics showed an immediate decrease in performance while hysterics showed an increase. It was believed that the introduction of the second task represented an alerting of the extroverts and a distracting of the introverts.

Similar results were found by Bakan (1959) who found that while both introverts and extroverts were improved in

performance through the inclusion of two stimuli as opposed to one on an auditory search task, extroverts improved more than introverts.

Bakan, Belton and Toth (1963) presented subjects, divided into introverts and extroverts, with a tape of repeated single digits at one-second intervals. The task was to write down all three-digit sequences that the subject heard occurring in the order odd-even-odd. The results were an initial increase in the percent of detected combinations around the total number of combinations followed by a decrease to around the initial level. Extroverts whose initial score was higher than the introverts declined in percentage score continually throughout the task.

Similar results were found by Heister and McLaughlin (1972). However, under the effects of caffeine the decrement in performance over time was eliminated. The stimulating effect of caffeine was believed to have deterred reactive inhibition.

Related to the concept of vigilance in the study of IRPs is the concept of the rotating spiral aftereffect. When a spiral pattern is rotated at a speed above the fusion threshold, the spiral will, from time to time, appear to be stationary for split instances. Holland (1965) found that extroverts would experience these "stationary flashes" more frequently than introverts. Holland assumed that IRPs in the fusion process lead to the seeing of the spiral for minor instances as stationary.

Although there is much evidence supportive of Eysenck's theory, much of the evidence is based not on the EPI or the MPI but, as with the Claridge study, on diagnosis. In the present study, subjects were divided as introverts, ambiverts, and extroverts according to the EPI. A search task similar to those used by Neisser (1963, 1964, 1964) was used. This task involved a search for a target letter in a field of letters with the similarity of the target letter to the surrounding letters to be varied, resulting in a similar (S) and a dissimilar (D) task.

It was hypothesized that introverts would have fewer errors on the search tasks than the extroverts because theoretically they would be less vulnerable to reactive inhibition. Thus, the target letter should coincide in time for them with the involuntary rest pauses less frequently than for the extroverts.

According to Neisser (1964), the process of locating a letter in a group of letters involves attending to certain characteristics or cues such as parallel horizontal lines when searching for the letter z. Theoretically, this attending to a certain cue may be subject to reactive inhibition as a result of repetition. Therefore, it is hypothesized that extroverts will experience a greater decrement in accuracy than introverts on the S tasks as opposed to the D tasks as a result of the higher frequency of key characteristics experienced in the S search.

It is also hypothesized that there will be a differential effect of the time comparison belief with introverts adversely

affected by it. That is, introverts told that a previously established time standard exists for completion of the task and that their time will be compared with that score, will have more errors.

The Claridge study (1960) utilizing search tasks found that the introduction of a second, more difficult task resulted in a poorer performance on the part of the dysthymics (introverts). Claridge believed that the second task immediately following the first represented a distracting of the introverts and an alerting of the introverts. While these results may possibly be attributed to a dissipation of reactive inhibition, the idea of an annoyance of the introvert seems plausible because of many similarities between introversion and neurosis.

Eysenck (1967) describes introverts as the more distractable (although in the same text the hypotheses drawn by Eysenck suggest that it is the extroverts who because of their lower level of arousal are more easily distracted from an ongoing task). Eysenck does not address himself to nor recognize this apparent contradiction.

It has been shown at introverts have lower pain thresholds (Clarke & Bindra, 1956), lower sensory thresholds (Lynn and Eyserck, 1961), form conditioned responses more quickly (Franks, 1956, 1957, Jawanda, 1966) and are generally more sensitive than extroverts. Also, as mentioned earlier, arousal is necessary for activation and the reticular formation is connected to the hypothalamus of the limbic system

system by ascending and descending pathways.

Neurosis, according to Eysenck's theory, is a reflection of activation and a measure of drive tension. There is a well-established inverse-U relationship between drive-tension and performance. This is explained in the Yerkes-Dodson law which states that as drive or motivation is increased to an optimum level, optimum performance is achieved and further increase in motivation or drive results in a decrement in performance. Therefore, it is assumed that introverts are operating at a heightened level of drive and that the belief that their time performance will be compared with that of others will further increase drive.

Summary of Hypotheses

1. That introverts will have fewer errors than extroverts, at least on the tasks where subjects believe they are not competing against a previously established time standard.

2. That the difference in the number of errors between performance on the easy and difficult tasks will be greater for the extroverts.

3. That introverts performing T tasks will perform more poorly than those performing the NT tasks, while the opposite will occur for the extroverts; that is, those performing the NT tasks will have more errors than those performing the T tasks.

Method

Subjects

The subjects were seventy-two female undergraduate students enrolled in psychology courses at Appalachian State University, who were chosen for the study on the basis of their scores on the Eysenck Personality Inventory (EPI), I-E scale, Form A, from a larger group who took the EPI. The introverted group included those whose EPI score was below eleven. This group had a mean score of 8.9. No score was lower than four. The ambivert group was comprised of those with scores of fourteen and fifteen. Their mean score was 14.625. The extroverts were those whose scores were above 17. This group had a mean score of 18.58. No score was above 21. Each group had 24 subjects and the criterion for each group was based on the relative distribution of scores of those who took the EPI rather than preestablished norms. While the EPI states that the mean score for American college students, male and female combined, is 13.1, a mean of 18.8 was obtained on the original distribution and one of 14.0 resulted after the arranging of three categories. The experimental sample was, therefore, more introverted than the group they were drawn from, although no attempt was made to derive such a mean through elimination of high scores.

Most students received credit in their respective classes for taking the EPI and all subjects received credit for participating in the experiment.

Apparatus

The apparatus consisted of two type-written sheets of white paper (14" x 8.5"), each consisting of 60 characters per line and 40 single-spaced lines. After every five lines, there was a double space for the purpose of helping the subject to keep her place.

The sheet having the lesser similarity between target and field, the dissimilar (D), contains the target letter Q un a field of E, K, M, V, X, and W, while the sheet containing the greater similarity (S) contained the target letter Q in a field of C, D, G, O, R, and U. On each of the sheets the target letter appeared 96 times and the field letters an average of 384 times, a frequency four times greater than the target letter. The order of the target and field letters was random (see Appendix).

A stopwatch was used to record reponse latency.

Design

There were three independent variables in a 3 x 2 x 2 mixed factoral design:

1. Introversion (I)--Ambiversion (A)--Extroversion (E)
2. Similarity (S)--Dissimilarity (D) of target to background.
3. Time Comparison (T)--no Time Comparison (N)

The 72 subjects were divided into six groups:

1. ET--Extroverts-Time comparison (N = 12)
2. EN--Extroverts-No time comparison (N = 12)
3. AT--Ambiverts-Time comparison (N = 12)
4. AN--Ambiverts-No time comparison (N = 12)
5. IT--Introverts-Time comparison (N = 12)
6. IN--Introverts-No time comparison (N = 12)

The between-subject variables were Introversion—Ambiversion—Extroversion and Time comparison—No time comparison, and the within-subject variable was Similarity—Dissimilarity of target to field.

Procedure

Each subject was seated individually at a table in a room relatively free from outside distractions.

Those who believed they were performing in a comparison against a time standard (T) read instructions to that effect,

> "...Your score will be compared with that of all those taking this test and you will receive a score of + or - depending on whether it is above or below the average. The scores will be posted together with your social security numbers after the study."

For the others (N), that part of the instructions was omitted. The instructions for individuals in both groups instructed them to locate the target letter Q with a slash, scanning one line at a time from left to right while working as fast as possible. Between performance on the first and second sheets, there was a one-minute rest period.

Subjects were randomly assigned to either T or N groups, creating six groups. To assure an even number in each group in the event that some subjects were unavailable, one subject from each of the six groups was tested before another set of six was tested.

Within each of the six groups, the subjects were divided into those who received the S condition followed by the D, and those who were presented with the opposite order.

Results

The errors recorded for each subject represented the number of failures to slash an instance of the target letter (Q) which appeared 96 times on both tasks. Thus, each subject had a possible score of from zero to 96. Errors for each group are shown in Figure 1. In both time standard and no time standard groups, introverts produced more errors than extroverts. Within the no time standard group, the mean error score of the ambiverts was between that of the introverts and extroverts, while within the time standard group ambiverts produced more errors than the other groups. Divided into similar and dissimilar tasks (Table 1 and Figure 2), all groups produced more errors on the similar task. The time standard group produced more errors than the no time standard group except for the introverts and extroverts on the dissimilar task. The introverts had 8.23 times as many errors on their similar task as on their dissimilar, while the introverts had 5.98 times as many. The time group of the introverts produced a greater number of errors than the no time group, while for extroverts, the scores were almost identical.

An analysis of the error data (Table 2) reveals a significant main effect of the similarity variable ($F(1,66) = 47.44$, $p < .05$]. None of the other main effects or interactions were significant.

There was a low correlation between latency and number of errors, $r = 2.86$ for extroverts and $r = .021$ for introverts.

Table 1

Mean Number of Errors of Time Standard (T) Group and No Time Standard (N) Group of Introverts (I), Ambiverts (A) and Extroverts (E)

Conditions	Groups					
	I		A		E	
	T	NT	T	NT	T	NT
Similar	5.75	4.66	6.83	4.0	3.25	3.16
Dissimilar	.66	1.08	1.08	.416	.33	.416

Table 2

Analysis of Variance

Source of Variance	SS	df	MS	F
Between-Subject				
Personality	51.72	2	25.86	1.75
Time Standard	17.36	1	17.36	1.17
Personality x Time Standard	20.72	2	10.36	.70
Error (b)	974.40	66	14.76	
Within-Subject				
Similarity	560.10	1	560.10	47.44*
Similarity x Personality	22.88	2	11.44	.96
Similarity x Time Standard	14.69	1	14.69	1.24
Similarity x Personality x Time Standard	6.22	2	3.11	.26
Error (w)	779.07	66	11.80	

*$p < .05$

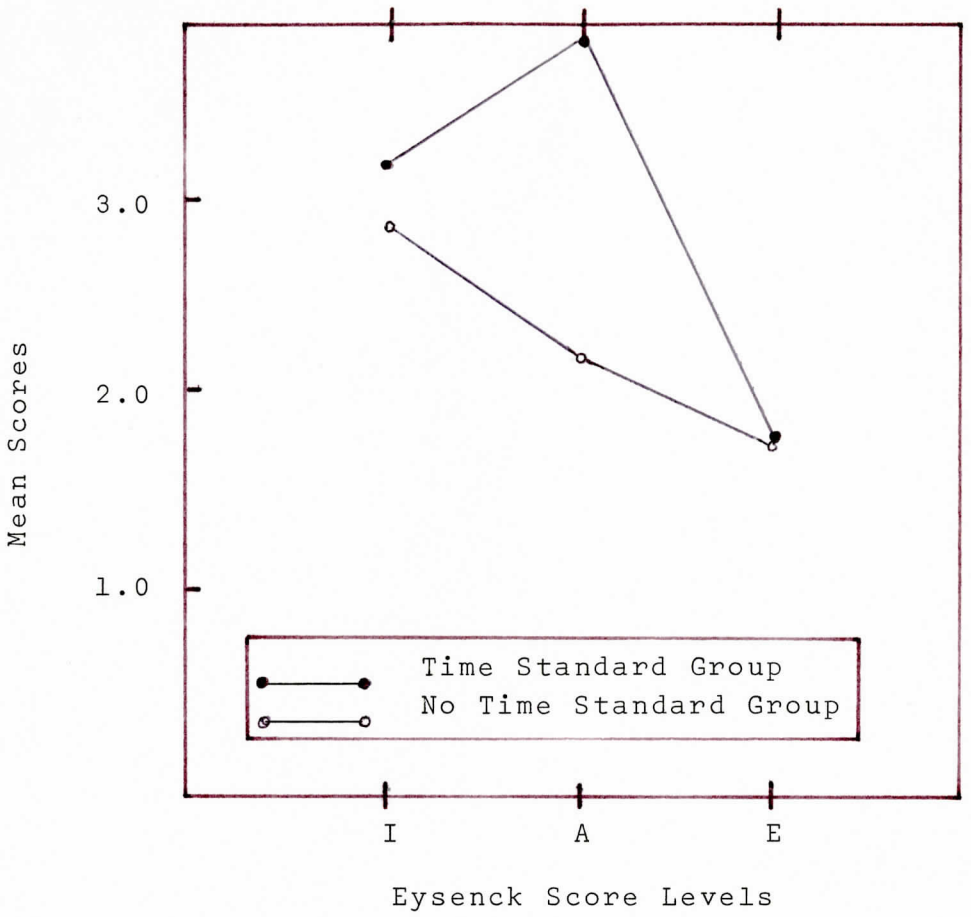

Figure 1. Mean Number of Errors of Time Standard (T) and No Time Standard (N) Groups of Introverts (I), Ambiverts (A) and Extroverts (E)

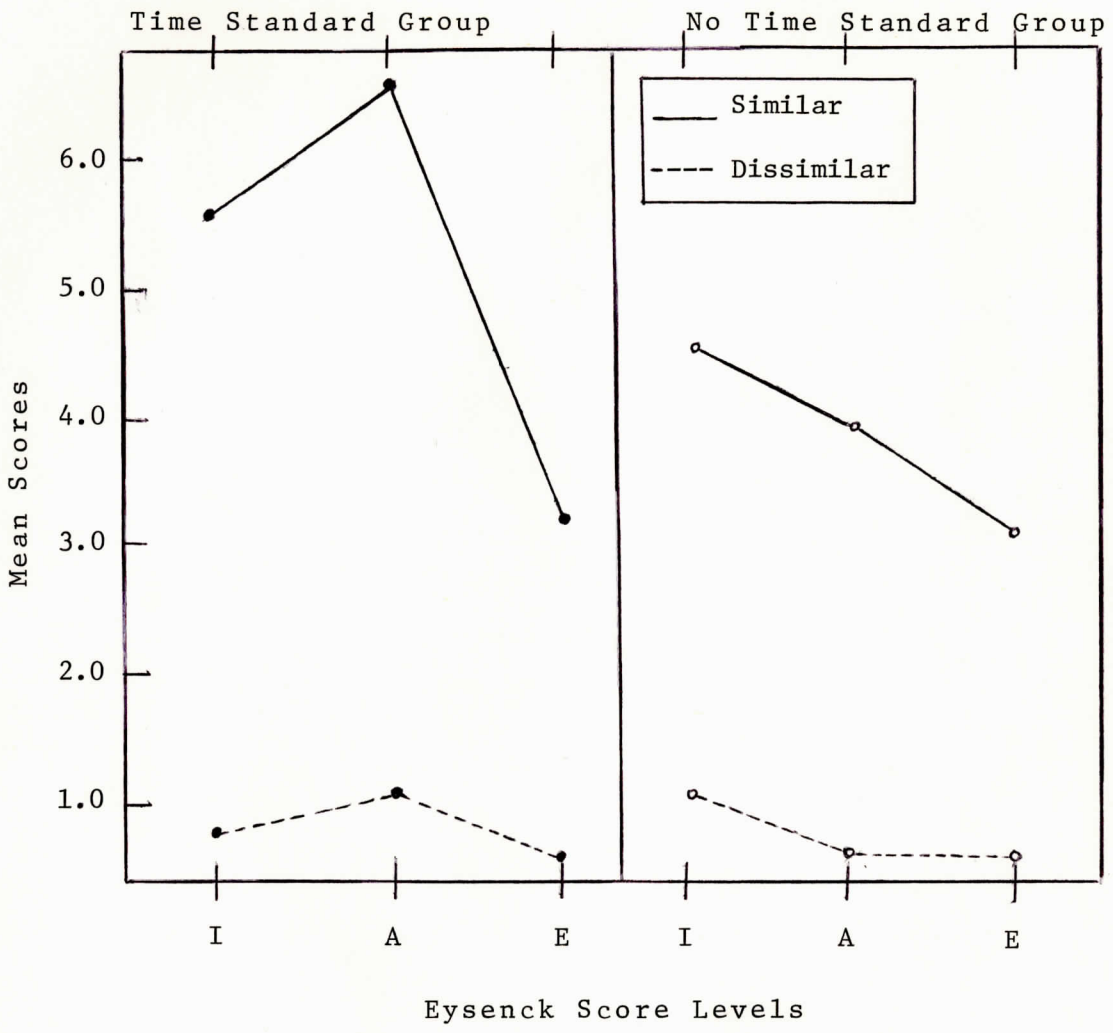

Figure 2. Mean Number of Errors of Time Standard (T) Group and No Time Standard (N) Group of Introverts (I), Ambiverts (A) and Extroverts (E) on Similar and Dissimilar Task.

Discussion

The aim of this study was to investigate the relationship of the personality variable of introversion-extraversion to tasks which were believed to reflect continual attentive ability and the ability to work under pressure. It was hypothesized that extraverts would be more adversely affected than introverts by increased attention requirements and that introverts would be adversely affected by increased pressure. Subjects were divided according to their scores on the Eysenck Personality inventory since the hypotheses drawn were derived largely from the theories and findings of Eysenck. The only significant experimental effect was that of the differential number of errors between the tasks of high and low similarity. Such a finding is frequently obtained.

Although there are studies cited by Eysenck with clear and significant findings there are perhaps as many which he ignores. The nonsupportive results are therefore not surprising. In this study extraverts failed to produce more errors on the search tasks than introverts. There was an insignificant difference in the opposite direction. It is possible that the type of search task used in this experiment does not generate reactive inhibition, and that search for certain visual characteristics is not subject to reactive inhibition the same way a motor task is. Cohen and Horn (1974) also found no significant difference between introverts or extroverts on repetitive non-motor tasks.

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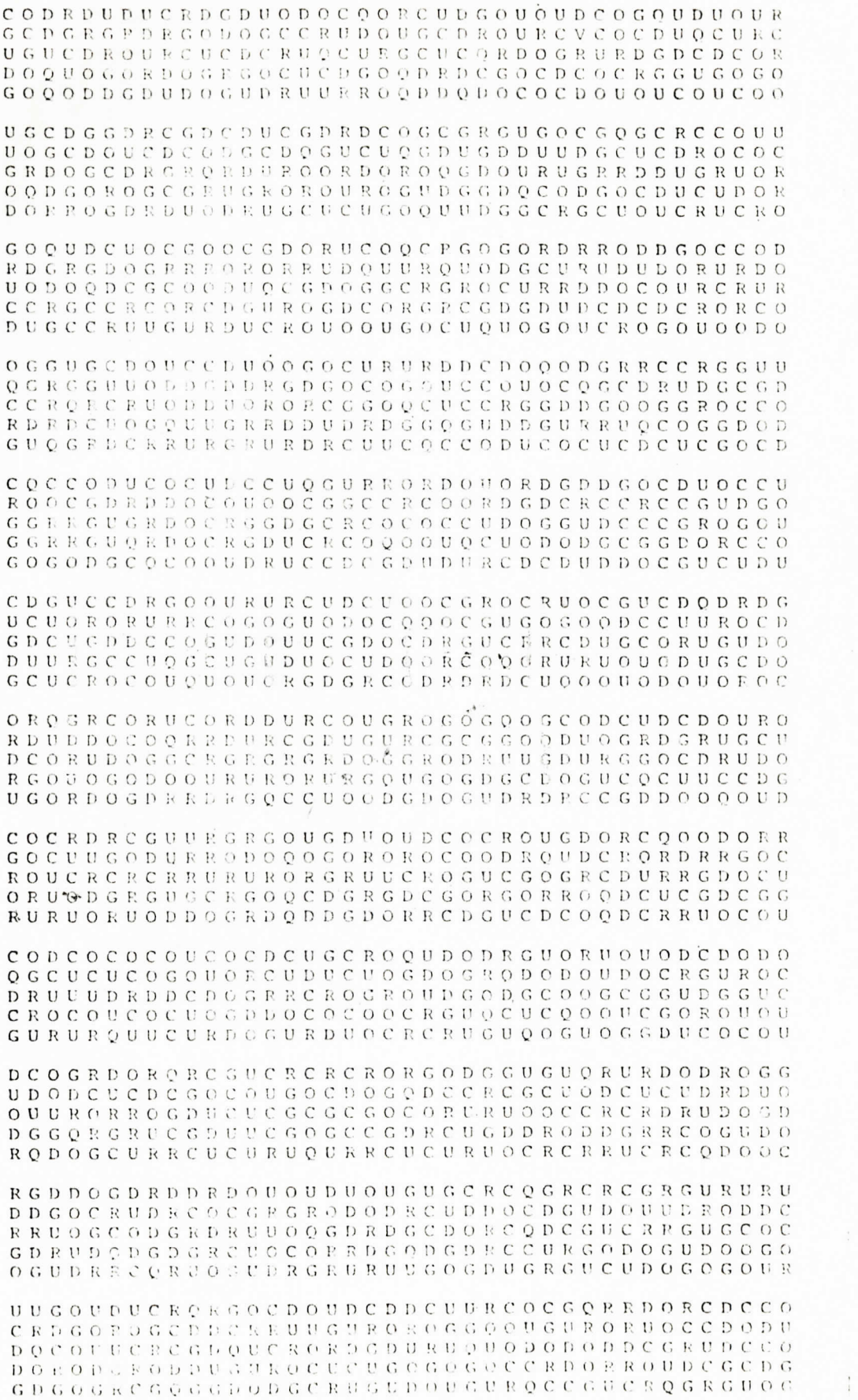
APPENDIX

Stimuli: High Similarity (S) and Low Similarity (D) of Target to Field



Stop

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E V W K V K V M K E Q E X E K X K X X K E W V E E K X X K Q V E W M V E W E W X
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X E V W Q E E M X V M K V M X V V E W X E K M K K E V W K X M V E M X V X W W X
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V E W K W X W X V E E X V X Q K E X V W V V E W K K X X E K W V W V W V W X W Q
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STop