

INDIVIDUAL DIFFERENCES IN PERFORMANCE
ON AN AUDITORY VIGILANCE TASK

Thesis for the Degree of M. A.
MICHIGAN STATE UNIVERSITY
John Alfred Belton
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BY

JOHN ALFRED BELTON

A THESIS

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ABSTRACT

Vigilance may be defined as a state of readiness to react to the occurrence of a particular kind of signal over a period of time when the occurrence of signals is irregular and unpredictable. It has been found that there are wide individual differences in performance at tasks requiring vigilance. This thesis represents a study of such individual differences.

It has been suggested that the personality trait of introversion-extroversion is related to performance in vigilance tasks. This study is concerned with the relationship between introversion-extroversion and ability to detect signals in an auditory vigilance task. Another aspect of the present study is an exploration of relationships between retrospective reports given by subjects after working at a vigilance task and their signal-detection performance.

Two groups of subjects, an introvert group, and an extrovert group were selected on the basis of extreme scores (upper and lower 15 percent) on the introversion-extroversion scale of the Maudsley Personality Questionnaire. After a period of instructions and practice these subjects were tested on an auditory vigilance task that required listening to a 48-minute recording of single digits, coming at

the rate of one per second, in order to detect irregularly occurring signals defined as "any three successive different digits in the order odd-even-odd." Such signals occurred six times every 16 minutes at intervals varying irregularly from 15 seconds to 5 minutes. Performance was measured by the number of signals correctly detected. Subjects were tested in groups of about five. Each subject was alone in a cubicle, visually isolated from the other subjects, though aware of their presence. At the end of the vigilance task a 38 item questionnaire was administered. This contained statements to which agreement or disagreement had been shown to be related to signal detection in a previous investigation.

An analysis of variance of the signal detection scores (transformed) showed no significant difference between introverts and extroverts either in overall signal detection or in the trend of signal detection over time, though there was a tendency to greater decrement for the extroverts.

These findings were not in agreement with the results of a previous investigation of the relationship between introversion-extroversion and vigilance carried out by Bakan on a sample of English sailors. Differences between the experiments are discussed. The difference between testing subjects in isolation (Bakan's procedure) and testing them in groups is suggested as a possible explanation for the discrepancy.

The analysis of the relationship between retrospective reports and signal detection was in general confirmatory of previous results obtained on a sample of English airmen. In general, various types of reports of non-listening or non-attentive behavior and low motivation for the task were found to be related to poor signal-detection performance.

In the analysis of the data a number of incidental findings were made. These include the finding that

- a) The introverts in the sample were significantly more neurotic than the extroverts.
- b) The extroverts tended to make more errors of commission than the introverts, i.e. record signals that didn't actually occur, and
- c) There didn't seem to be any marked differences between introverts and extroverts in responses to the retrospective questionnaire.

ACKNOWLEDGEMENTS

The author wishes to express his most sincere thanks and appreciation to the Chairman of his committee, Dr. Paul Bakan, whose expert guidance and understanding helped make this study possible; to the other members of his committee: Dr. John Hurley and Dr. Charles Hanley for their friendly advice and assistance; and especially to those students who served as subjects.

the first of these is the fact that the system is not a simple one, but a complex one, in which the various parts are interrelated and interdependent. The second is the fact that the system is not a static one, but a dynamic one, in which the various parts are constantly changing and evolving. The third is the fact that the system is not a closed one, but an open one, in which the various parts are constantly interacting with the environment. The fourth is the fact that the system is not a linear one, but a non-linear one, in which the various parts are constantly interacting with each other in a non-linear fashion. The fifth is the fact that the system is not a deterministic one, but a probabilistic one, in which the various parts are constantly interacting with each other in a probabilistic fashion. The sixth is the fact that the system is not a simple one, but a complex one, in which the various parts are interrelated and interdependent. The seventh is the fact that the system is not a static one, but a dynamic one, in which the various parts are constantly changing and evolving. The eighth is the fact that the system is not a closed one, but an open one, in which the various parts are constantly interacting with the environment. The ninth is the fact that the system is not a linear one, but a non-linear one, in which the various parts are constantly interacting with each other in a non-linear fashion. The tenth is the fact that the system is not a deterministic one, but a probabilistic one, in which the various parts are constantly interacting with each other in a probabilistic fashion.

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INTRODUCTION

There are many tasks in the contemporary world which require that humans maintain a high state of alertness or vigilance over a period of time. The essential characteristic of a vigilance task is a state of readiness to react to a particular kind of signal when it is not known when such a signal will occur. An important example of a task requiring vigilance is that of the radar operator who must maintain a readiness to detect small brightness changes known as "pips" on a radar scope. The occurrence of a "pip" is unpredictable and yet failure to detect it may have catastrophic consequences. The state of alertness of a radar operator must be high even though the occurrence of a "pip" at any given time is highly improbable. Other tasks requiring vigilance, as defined above, are the tasks of the sonar operator listening for auditory signals, the assembly-line inspector looking for defective products occurring infrequently and irregularly, the proof-reader looking for errors in printed material, the monitor of a panel in an automated factory looking for signals indicating machine breakdown, and the driver being alert for dangerous traffic situations.

It was the practical problem of determining the optimum length of a radar watch which led Mackworth (26)

to initiate a series of studies of the vigilance problem during World War II. In order to bring the vigilance problem into the laboratory, Mackworth developed the Clock Test. This test was designed to simulate the characteristics of a vigilance task, namely the occurrence of infrequent signals at irregular intervals. The Clock Test consisted of a clock hand going around in front of a cardboard background at the rate of a single jump per second; the signal to be detected and reported was a double jump of the clock hand. Mackworth plotted the frequency of signal detection as a function of time and found that under conditions of continuous search for two hours, there was a decremental trend in performance with the greatest decrement occurring between the first and second half hours.

Since Mackworth's work on the problem of vigilance, there have been a number of other studies of the problem. Most of the experimental work in the area has been primarily concerned with environmental variables either in the work situation or in the general surroundings. In most experiments the level of vigilance is inferred from the performance of the subject in terms of the number of signals detected (1, 26) or the intensity to which signals have to be raised in order to get response (2, 13).

Experiments have been designed to evaluate the effects of task duration (2, 26), signal frequency (10),

signal intensity (1, 2), signal duration (1), inter-signal interval (7), noise (8, 22, 23, 24, 25), temperature (25), and isolation (17). In some instances the state of the subject has been varied, as in studies on the effect of drugs (26), sleep deprivation (28), rest periods (26), knowledge of results (19, 26), and reinforcement (19, 20).

One of the most persistent findings in results of vigilance experiments is the great extent of individual differences in performance. Individuals show great differences in performance at vigilance tasks, and there is some evidence of consistency in these differences (4). Though most investigators have reported wide individual differences in performance, there has been very little research aimed at discovering the correlates of these differences. Some workers have suggested the importance of personality factors in accounting for these differences (4, 9, 10, 16).

The exploration of the relationship between vigilance performance and personality variables appears to be a logical development of research in this area. Such a relationship, if it exists, would have important practical implications since it might lead to some rational criterion for selection of people to work at tasks requiring vigilance.

Eysenck has recently suggested a theoretical rationale for expecting a difference in vigilance

performance between introverts and extroverts. According to Eysenck (14, 15, 16) these personality types differ with respect to the build up of inhibition in monotonous or repetitive tasks. The extroverts are presumed to develop more inhibition and as a result should show an earlier decline in vigilance efficiency and poorer performance. The inhibition referred to is essentially that implied by the I_R concept in the Hullian system (21).

In a study performed by Bakan (4), an attempt was made to investigate the relationship between performance in a vigilance task and personality variables. An auditory task was used. Subjects were required to listen to a series of digits recorded at the rate of one per second. They were to listen for a signal defined as the occurrence of three consecutive odd digits which were all different. A record was kept of the number of signals detected in each of five 16-minute sub-periods. It was found that with a group of British sailors, tested one at a time in isolation, the extroverts did not perform as well as the introverts. Furthermore, there was no relationship between either neuroticism and vigilance or intelligence and vigilance. Introversion-extroversion, neuroticism, and intelligence were all measured by paper and pencil tests.

Bakan also made use of another approach to the study of individual differences (3, 6). This was an

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attempt to relate the subjects' retrospective reports given after a vigilance task to the signal detection performance in the vigilance task. At the conclusion of a vigilance task, subjects were given a retrospective questionnaire containing a set of statements to which the subject could respond Yes or No depending on the truth or falsity of the statement for the particular subject. For each of these statements a point-biserial correlation was then computed by correlating the Yes-No response dichotomy with the continuous variable of number of signals detected. In this way it was shown that response to a number of these statements was related to signal detection in the vigilance task.

The present study was designed so that two methods, the method of subject selection by personality traits and the method of analysis of retrospective statements (3), could be used in an analysis of individual differences in a vigilance task for the same group of subjects. The present experiment is, in a sense, an attempt to replicate Bakan's findings on a sample of American college students. But in actual fact the differences between the present study and that of Bakan are such as to make it inaccurate to call the present experiment a replication.

The present study was designed mainly to investigate:

- a) the relationship between introversion-extroversion and signal detection behavior in an auditory vigilance task; and

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- b) the relationship between retrospective reports and signal detection in an auditory vigilance task.

PROCEDURE

Subject selection

Subjects were drawn from the introductory psychology course. The manner of selection was somewhat devious since it was necessary for the experimenter to be able to identify a given introversion-extroversion score with the subject's name without the subject knowing that he was being selected on the basis of a personality test score.

All students in 11 sections were asked by their instructor to fill out a 3 x 5 card with the following information: name, age, sex, section, date of birth, previous psychology courses, instructor, home town, and major. A few days later the experimenter came to these same classes and administered the Maudsley questionnaire (16), which can be scored for introversion-extroversion and neuroticism. Subjects were told that they were to take the questionnaire anonymously but they were asked to fill in their section, sex, and date of birth. The subjects had no way of knowing of the existence of a relationship between this questionnaire and the 3 x 5 card they filled out previously. However, by matching the sex and date of birth information on the questionnaire with that on the card, it was possible to identify the subjects by name.

The Maudsley questionnaire was developed by Eysenck. It consists of a total of 80 items and yields scores for

for introversion-extroversion and neuroticism based on subject's responses (Yes-No-Undecided) to these items. The personality scales were machine scored and the names corresponding to scores in the upper and lower 15% on the introversion-extroversion trait were identified.

The experimenter then went to each class which contained students in either of the extreme groups and told them that their names had been randomly selected from a list of Psychology 201 students to serve as a random sample for the experimenter's M.A. thesis research. About 85% of the subjects, contacted in this way, agreed to serve as part of the sample, and were signed up for a two hour session. They were rewarded by points routinely given by instructors for participation in experiments.

In any given two hour experimental session a number of subjects ranging from 2 to 8 (with an average of about 5) was run. Subjects reported to the Psychology Building (B-3) on South Campus and were driven to the Experimental Psychology Laboratory where cubicles were available so that a group of subjects could be tested simultaneously and visually isolated from each other.

Instructions and Practice

Subjects entered the laboratory and were seated together in a corridor. Wrist watches were removed for

the duration of the experiment. Each subject was given a set of instructions, a pencil, and an answer sheet. The experimenter slowly read the instructions and the subjects were told to follow the text on their instruction sheets. The experimenter paused at a number of places in the instructions to enable subjects to ask questions about the procedure. Questions were also answered whenever subjects raised their hands or otherwise indicated a lack of understanding. A set of the instructions may be found in the Appendix.

There were three practice sessions before the beginning of the 48-minute vigilance task. Though the vigilance task was very similar to the auditory task used by Bakan (4), the first practice period was visual. In this visual practice period subjects look at a sequence of 63 digits reproduced on the last page of the instructions. They were told to look for sequences consisting of three successive digits, in the order odd-even-odd, which were all different. Upon finding such a sequence they were to write down the three digits on the answer sheet and continue to look for more sequences of the same type. In this sequence of 63 digits there was a total of seven signals. At the conclusion of this visual practice session, subjects were told what signals there were and had a chance to look at the sequence for any signals they missed. The main purpose of the visual practice session was to make sure that the subjects

understood the task. They were then told that the auditory task was like the visual except that there could be no back-tracking since when a digit passed it was impossible to go back over it.

The remainder of the practice was done with a portion of the recorded digits under conditions to be used in the test session. The main difference was that during the practice the subjects received knowledge of results when the experimenter called out each signal that occurred about two seconds after its occurrence. There were two auditory practice periods, the first about five minutes and the second about 10 minutes. There were two signals in the first auditory practice period and three signals in the second. During the practice periods subjects sat in separate cubicles visually isolated from each other.

At the end of each of these practice periods the experimenter checked with each subject to make sure the subject knew what to do and to answer any individual questions.

At the end of the second auditory practice period subjects were given a break of about five minutes during which they could leave the cubicle, relax, and talk with each other. At the conclusion of this rest period each subject went back to his cubicle; and when all subjects were seated, they were told that there would now be a long session of listening for signals as they had done in the practice period.

The Test Situation

The tape recorder was located in the corridor and the volume was set so that all subjects were able to hear it from their cubicles. The subjects were instructed not to smoke or chew gum during the test and their wrist watches had been taken away earlier. The length of the test period was 48 minutes. Though this was completely continuous as far as the subject was concerned, the tape was constructed in such a way that it could be considered as three equivalent 16-minute sub-periods for purposes of data analysis. The tone of voice and other sound characteristics of the tape were constant throughout since the tape was mechanically produced by splicing. The result was that the sound of any given digit was identical throughout the tape. Six signals occurred in each 16-minute segment of the tape and time between signals varied from 15 seconds to about 5 minutes. No knowledge of results was available to the subjects during the test. At the end of the listening period the answer sheets were collected and a retrospective questionnaire was distributed to each student.

Retrospective Questionnaire

The final stage of the experiment involved the collection of responses to a set of items relating to the subject's activities, attitudes, and emotional reactions to the vigilance task. Immediately after the answer sheets

for the vigilance task were collected the subjects, while still in their cubicle, were given a questionnaire consisting of a set of 38 statements to each of which the subject was to respond positively or negatively, i.e., agree or disagree.

The basis for selection of these items was that in a previous study carried out by Bakan (6, 7) on a Royal Air Force population performing in a similar vigilance task, response (agree-disagree) to each of these statements was related to signal detection. The evidence for this relationship was a point-biserial correlation significant at the 10% level or better. The 10% level was used as a selection criterion because it was felt that cross-validation of "near significant" items would be valuable, especially since most of the items included by Bakan were included with a directional hypothesis in mind. In these cases one-tailed significance tests would have been justified and the 10% significance levels would be 5% significance levels with one-tailed tests.

Instructions for answering the questions together with three practice items appeared on the questionnaire. The time required to respond to the items varied from about five to fifteen minutes. When completed the questionnaires were collected, subjects were given their watches, a credit slip and they were requested not to discuss the experiment with other students.

RESULTS

Signal Detection and Introversion-Extroversion

The primary purpose of this analysis was to determine whether there were differences between introverts and extroverts with respect to: 1) their overall difference in signal detection for the test period; and 2) their difference in the course of performance over time.

The data covering these comparisons have been summarized in Table 1 and are shown graphically in Figure 1.

Insert Table 1 Here

Visual inspection of these data gives the impression of a negligible difference between the two groups in their overall performance, and of a greater decrement over time for the extroverts after an initial superiority of the extroverts.

These data were analysed by an analysis of variance technique for repeated measures (11) performed on transformed signal detection scores. The $\sqrt{x + .5}$ transformation, suggested by Edwards for Poisson-like distributions with small numbers was used.

The results of this analysis are shown in Table 2.

Insert Table 2 here

The analysis presented in Table 2 shows the following:

- 1) There was no significant difference between introverts and extroverts in overall signal detection performance (insignificant between groups variance).
- 2) There was a significant decremental trend over time for the group as a whole (significant between trials variance).
- 3) The difference between introverts and extroverts performance trend over time (see Fig. 1) was not statistically significant (insignificant trials x group interaction).

Despite the fact that the Trials by Groups interaction was not significant, the difference between the introverts and extroverts in the course of performance over time as seen in Figure I is nevertheless suggestive. An analysis of the frequency of decrement for the introvert and extrovert groups was carried out. Decrement was defined as the detection of fewer signals in the third period than in the first period (minus) and increment as the detection of more signals in the third period than in the first (plus).

On the basis of these definitions Table 3 was constructed.

Insert Table 3 here

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From Table 3 it can be seen that of the 34 extroverts who had a change between periods 1 and 3, there were more than twice as many who had decrements (-) than there were extroverts who had increments (+) in performance. A sign-test for the significance of this decremental trend for the extroverts showed the decrement to be significant at the 10% level (2-tail). A similar analysis of differences between period 1 and period 3 for introverts showed an almost equal number of decrements and increments with no indication of a significant decrement for the introverts. It should be noted, however, that a chi-square analysis to test for the significance of a relationship between decrement and extroversion did not indicate a significant relationship.

The data from the analyses carried out is inconclusively suggestive of a tendency toward greater decrement for extroverts than for introverts. Furthermore, there was hardly any difference between introverts and extroverts with respect to overall performance.

Relationship Between Introversion-Extroversion and Neuroticism

Subjects were selected for this experiment on the basis of their scores on an introversion-extroversion inventory. The inventory also had items which could be scored to give a neuroticism score. According to Eysenck (16) these two traits should be independent of each other (16), but inspection of the data suggested that in the sample used

in this experiment the introverts seemed to have higher neuroticism scores (Mean = 26) than the extroverts (Mean = 21). This was confirmed by a difference in neuroticism between the groups significant at the 2% level when tested by White's non-parametric test (12). This suggested a possible confounding of a neuroticism factor with an extroversion factor, making it unclear whether the vigilance results obtained were related to introversion-extroversion or neuroticism or some interaction between them.

In order to rule out the possibility of group differences in neuroticism for the subjects selected on the basis of introversion-extroversion, a selection of subjects was carried out to produce an introvert and extrovert group with subjects matched for neuroticism. These selected groups each had 31 subjects. The results for these 2 groups on the signal detection in the vigilance task are shown in Table 4. Comparison of results for the equated groups and the original groups (see Table 1) showed that no significant change had been introduced by eliminating the difference in neuroticism between the groups selected on the basis of introversion-extroversion.

An analysis of variance of transformed ($\sqrt{x + .5}$) scores for these groups showed no significant difference between the introvert and extrovert groups matched for neuroticism.

Moreover, the Trials by Groups interaction was not significant. This analysis is shown in Table 5.

 Insert Tables 4 and 5 here

Commission Errors and Introversion-Extroversion

So far the analysis has been confined to signal detection. The failure to detect a signal may be construed as an error of omission in the vigilance task. It was also found that subjects could make errors of commission, i.e., reporting the occurrence of a signal when in fact there was no signal. An analysis was carried out to determine whether introverts differed from extroverts in the frequency of commission errors. In counting commission errors for this analysis, it was decided to exclude commission errors which might really represent detection of signals written down wrong such as misplaced digits, e.g., writing 345 instead of 543, and groups of numbers with 2 of the 3 digits correct, i.e., writing 365 instead of 325.

The mean number of commission errors was 2.57 for the introverts and 3.59 for the extroverts. The significance of the difference was tested by White's non-parametric test and the difference was found to be significant at the 8% level (2-tail). The difference approaches significance and suggests that there is a greater tendency for extroverts to invent signals that are not in the tape.

Analyses of Retrospective Data

Relationship between retrospective reports and signal-detection. The purpose of this analysis was to investigate the relationship between performance in the vigilance task and retrospective reports given by subjects on the questionnaire immediately after the vigilance session. Bakan (6, 7) in a previous study of this type investigated the relationship between vigilance performance and responses (Yes-No) to a group of 78 statements made at the conclusion of the vigilance task. He found that, for 39 of these statements, the point-biserial correlation between the Yes-No response and the number of signals detected was significant at the 10% level or better (2-tail test).

In the present study the questionnaire given to subjects at the conclusion of the experiment contained 38¹ of these statements found to be related to vigilance performance in the study by Bakan. Point-biserial correlation coefficients were computed between the Yes-No variable and number of signals detected for each of the 38 items on the questionnaire. This analysis constituted a cross-validation of these items on a very different population than that used by Bakan. Bakan's sample consisted of enlisted men in the British Royal Navy whereas the present sample consisted of American College students. A list of the items is presented in Table 6.

¹One item was omitted in error.

 Insert Table 6 here

Table 7 presents the results of the analysis of these items and contains for each item the number of subjects who responded Yes and the number who responded No, the mean number of signals detected by those who responded Yes and of those who responded No, the point-biserial correlation coefficient between the Yes-No variable and the number of signal detections and the significance level of the point-biserial correlation (1-tail test).

 Insert Table 7 here

Despite the differences between the samples tested, the results of the cross-validation of the items were, in general, confirmatory of the Bakan study. First as to the direction of the correlations. Of the 38 items, there were 35 which went in the same direction in both studies, and none of the three correlations that went in the opposite direction were greater than .09.

There were 21 items which were significant at the 10% level or better (one-tail test) in the present study. These items are starred in Table 6. The one-tail test was considered appropriate here in view of the fact that directional hypotheses with respect to these items were derived from the results of the Bakan study.

Most of the items found significant were negatively correlated with performance, i.e., a Yes response to the

Variable	Q1	Median	Q3	Mean	Std. Dev.	Min.	Max.	Skewness	Kurtosis	Jarque-Bera	Prob. > Chi-Sq.	Shapiro-Wilk	Normal Q-Q
Variable	Q1	Median	Q3	Mean	Std. Dev.	Min.	Max.	Skewness	Kurtosis	Jarque-Bera	Prob. > Chi-Sq.	Shapiro-Wilk	Normal Q-Q

100% 90% 80% 70% 60% 50% 40% 30% 20% 10% 0%

100

[illegible]

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
1990	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100

2

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item was associated with poor performance. A study of these items which on two independent studies were significantly related to vigilance performance at the 10% level gives us some information about the relation between what subjects do and feel when engaged in a vigilance task and how they perform on the task.

There were a number of items which point to various ways of not listening to the digits and all of these were related to poor performance. Among those were reports of mind going blank (item 2), thinking about things other than the signals (item 4), taking rest periods (item 7), cessation of listening for long periods of time (item 8) and giving up (item 17).

Some of the items referred to motivational factors, both positive and negative. Subjects who reported that they enjoyed the task (item 23) and found it challenging (item 24) tended to detect more signals on the average. On the negative side, subjects who reported that they didn't care about getting signals (item 19), didn't try hard (item 25), felt that the task was a waste of time (item 22), and felt like giving up (item 20) tended to detect fewer signals on the average.

A number of the significant items refer to evaluations of their performance by the subjects. These evaluations were made in the absence of any knowledge of results given by the experimenter. Subjects who thought that they did

about as well as most people (item 29) detected more signals on the average. On the other hand, subjects who thought they did worse than most people (item 30) detected fewer signals. Subjects responding positively to the item "I think I missed at least five signals" missed an average of 5.57 signals whereas those who responded negatively to this item missed only 3.68 signals on the average.

Agreement with the remaining items was associated with poor performance. These included reports that subject probably missed one or more signals when a long period went by without a signal (item 10), that subject was less certain toward the end that the numbers he was putting down were correct, (item 11), that subject was tempted to write down any signal at all just to be doing something (item 13), that subject sometimes realized there was a signal but could not remember the numbers (item 15), that subject felt irritable (item 18) and that time seemed to drag (item 38).

Relation between retrospective reports and introversion-extroversion. Since the two experimental groups were differentiated on the basis of introversion-extroversion and since there was a suggestion of differences between these groups in the course of signal detection over time, an analysis was carried out to determine whether the responses to the retrospective questionnaire items differed for the 2 groups.

For each of the 38 items on the questionnaire a chi-square was computed to test for the relationship between introversion-extroversion and the response of Yes or No to the item. There were only 2 items for which there was a relationship significant at the 5% level or better. In view of the fact that only 2 of 38 items showed significant correlations, it was difficult to draw any positive conclusions from this analysis since one would expect about 2 significant statements through chance alone at the 5% level.

The statements significant at the 5% level or better were the following:

3. After hearing a signal and writing it down I would take a short break and stop listening for a while.

24. I found this task quite challenging.

The contingency data corresponding to these statements are presented in Table 8.

 Insert Table 8 here

Frequency analysis of responses to retrospective questionnaire items. There were considerable differences in the Yes-No response splits for the different items. Some items were responded to by almost all subjects in the same manner. These items can be said to have high unanimity of response. For other items there was less unanimity indicated by smaller discrepancies between the

Yes and No frequencies. A tabulation of the items in terms of the degree of unanimity appears in Table 9. Table 9 lists the item numbers in order from highest to lowest unanimity, together with the dominant response (Yes or No) and the frequency of occurrence of the dominant response for the total sample of 88 subjects. The wording of the items can be found in Table 6..

 Insert Table 9 here

The seven items producing the greatest inter-subject agreement in response and the seven items producing the least inter-subject agreement provide the following information relevant to the subjective reactions to the task. Most subjects agreed that they could not continue the task for 5 hours without a break (item 35); their concentration was not continuous and that they took some breaks (item 6); but that they did not take long breaks (item 8); they were not annoyed with the whole business (item 28); that they could not have done better if they had been permitted to talk to someone (item 33); they tried to do their best (item 27); that it was easy to miss a signal (item 1).

There were considerable inter-subject disagreements in reports of writing down signals which were not in the recording (item 12), feeling as though subject would like to get up and walk out (item 21), not writing a signal

unless subject was positive (item 14), feeling that subject could have done better if he had tried harder (item 36), feeling less certain that the numbers he recorded were correct (item 11), being tempted to fall asleep (item 28), and giving up and just sitting there until it was all over (item 20).

DISCUSSION

This study was devoted to an analysis of individual differences in performance on an auditory vigilance task. Two different strategies were used in the study of individual differences. One involved the selection of subjects on the basis of a personality variable which previous research and theory had indicated would be related to vigilance performance (4, 16). The personality variable used was introversion-extroversion. The trait was measured by means of a personality inventory and the selection of subjects was such as to include those scoring in the upper or lower 15% of a large group that was tested. Another method used in the analysis of individual differences was response to a series of statements given to subjects at the end of the vigilance task. The intent here was to discover relationships between response to these retrospective statements and performance in the vigilance task. This might indicate how different attitudes and approaches to the task are related to performance in the task and thus throw some light on the problem of individual differences.

Introversion-Extroversion and Signal Detection

There was no significant difference between the introverts and the extroverts in overall signals detected; and though the Group by Period interaction was not statistically

significant, the data suggested that the extroverts started out better than the introverts and ended up worse thus indicating a greater decrement tendency over time.

These findings were not in agreement with a similar study by Bakan (4) who found that extroverts did worse than introverts, especially in the early part of a vigil. The number of differences between this study and that of Bakan are considerable and it is difficult to point to any single difference as the cause of the difference in results.

Differences between the two studies consisted of differences in sample, in vigilance task, in the personality measure used, and in testing conditions. Bakan used a sample of 40 sailors in the British Navy, assigned to either 2 or 6 weeks duty to serve as subjects in a number of psychological experiments being conducted at the Applied Psychology Research Unit in Cambridge. In theory they were volunteers for this duty. They were classified into an introvert and an extrovert group on the basis of a split at the median score of the Heron Personality Inventory (18).

In the present study the sample consisted of 88 undergraduates of both sexes. They were volunteers getting an incentive in points toward their course grade. The classification into an introvert and extrovert group was based on the selection of the top and bottom 15% extreme scores on the Maudsley Personality Questionnaire of which the Heron Inventory is a short version. Thus, in the present

study the classification was based on more extreme groups and a considerably larger sample was used.

Another difference between the two experiments lies in the vigilance task used. The Bakan study used a task generally similar to the one used in this experiment in that it was auditory and involved picking out signals consisting of three consecutive digits from a continuous series of digits. However, the signals in the Bakan experiment were a series of three odd digits, all different whereas the signals in this experiment were series in the order odd-even-odd which were all different. Signal frequency constituted a further difference between the experiments. In the Bakan study, the signals occurred 10 times every 16 minutes, whereas in the present study there were only 6 signals every 16 minutes. A further difference between the studies involved the length of the listening task. Bakan used an 80 minute task whereas the present study used a 48 minute task.

A difference between the experiments which may be especially significant in accounting for the difference in results appeared in the administration of the test. Bakan administered the test to only one subject at a time. The subject was in an experimental cubicle alone and the experimenter was not present in the test room. In the present experiment an attempt was made to ensure visual isolation by having each subject in a separate cubicle.

But the element of psychological isolation was missing. The subjects arrived at the laboratory together and went through an initial practice period as a group. This was followed by two further practice periods with subjects visually isolated from each other. Practice was followed by a break during which subjects could talk to each other about the task. During the test subjects were aware of other subjects taking the test with them and were aware of the presence of the experimenter. Thus there was a definite social factor in this experiment that was not present in Bakan's experiment.

It is suggested that there may be an interaction between the introversion-extroversion variable and the social isolation variable. Extroverts may do better with other people around than when in isolation. This hypothesis might account for the difference between the present study and the Bakan study. In the Bakan study where subjects were isolated the extroverts did worse than the introverts whereas in the present study, where there was less isolation, the extroverts did slightly better than the introverts, though this difference was not statistically significant. In both studies the difference between introverts and extroverts was greatest in the early part of the vigil.

There is one study in the literature which gives some support to the importance of a social variable in vigilance performance. In this study by Fraser (17), a comparison

was made between vigilance performance of subjects under two conditions: with the experimenter present, and with subject alone in the room. It was found that significantly more signals were missed with the experimenter absent than with the experimenter present. Fraser points out, however, that the burden of this significance rests on seven of eighteen subjects tested and that the results of this type of experiment may be due to the composition of the sample. Unfortunately, the introversion-extroversion status of these subjects was not available.

The considerations above and the results of this experiment and Bakan's experiment suggest the possibility of an interaction effect between introversion-extroversion and social isolation in vigilance performance. This hypothesis needs to be checked by further experimentation.

Eysenck (14, 15, 16) developed a typological postulate based on the introvert-extrovert typology and used this postulate to make deductions about the performance of introverts and extroverts in a number of experimental situations including conditioning, figural after-effects, and work decrement. Eysenck suggests a difference between introverts and extroverts in the tendency to build up inhibition. This inhibition is similar to Hull's I_R variable. Extroverts are alleged to build up more inhibition in a continuous task than introverts and therefore should be more likely to show decrement in a vigilance task. The results of the present experiment are inconclusive with

respect to Eysenck's hypothesis. There was a tendency toward greater decrement over time for the extroverts than for introverts but this was not statistically significant. Furthermore, the tendency for extroverts to do better early in the vigil, also insignificant, would not be predicted by Eysenck's theory. Furthermore, there was nothing in Eysenck's formulation which suggested the importance of a social factor interacting with the introversion-extroversion variable in determining performance.

Retrospective Response Analysis

The analysis of the retrospective responses was undertaken for several reasons. It was felt that the finding of a number of statements, responses to which were correlated with signal-detection in a vigilance task, needed to be cross-validated. Actually, the kind of sample used for the cross-validation (American college students on the extremes of the introvert-extrovert dimension) was a very different sample than the one used by Bakan (who used an unselected group of Royal Air Force enlisted men). Despite this difference in sample structure, there appeared to be considerable confirmation of the previous study since the relationships between item response and signal detection were in the same direction for 35 out of 38 statements used and three were non significant correlations in the opposite direction. Thirteen of the statements were significant at the 5% level or better

(one-tail test) and an additional eight items were significant at the 10% level (one-tail).

Most of the 13 statements significant at the 5% level in this experiment were of the type where agreement was related to poor performance. Five of these statements involved some report which can be classified as some form of not listening attentively, referring to things such as mind going blank, mental distraction, taking unauthorized short rest periods, taking unauthorized long rest periods, and giving up. Thus it can be concluded that subjective reports of non-listening behavior are related to poor performance in the signal detection task. Furthermore, subjects who did not do well were more likely to report feeling that the time was dragging and feeling irritable. On the other hand, subjects who reported that they enjoyed the task tended to detect more signals. Though it is difficult to assign cause and effect relations between subjective states and performance, nevertheless, the experimental detection of relations between subjective reports and achievement behavior is of considerable interest.

Another analysis carried out with the retrospective data was a purely exploratory attempt to determine whether the trait of introversion-extroversion, as measured, was related to the retrospective responses. This analysis involved looking for differences in response frequencies to the various items as a function of the introversion-extroversion variable. There were only two items of 38

where the relationship between introversion-extroversion and Yes-No response frequency was significant at the 5% level. In view of the possibility of chance factors producing two significant items out of 38, there was not much that could be concluded from this finding.

Table 1

Signal Detection Performance for Subjects Classified as
Introverts and Extroverts

Mean Number of Signals Detected

	<u>Period 1</u>	<u>Period 2</u>	<u>Period 3</u>	<u>Total</u>
<u>Introverts</u>	<u>4.34</u>	<u>4.43</u>	<u>4.21</u>	<u>12.98</u>
<u>Extroverts</u>	<u>4.73</u>	<u>4.55</u>	<u>4.07</u>	<u>13.35</u>
<u>Total sample</u>	<u>4.54</u>	<u>4.49</u>	<u>4.14</u>	<u>13.17</u>

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Table 2Analysis of Variance of Transformed Signal Detection Scores

	Degrees of			
	Freedom	Sum of Squares	Mean Squares	F
<u>Between Subjects</u>	87	215,728.53	2,479.64	--
Between Groups	1	136.74	136.74	NS
Between Subjects				
in Same Group	86	215,591.79	2,506.88	
<u>Within Subjects</u>	176	133,644.00	759.34	
Between Trials	2	6,290.03	3,145.02	4.33*
Trials x Groups	2	2,342.76	1,171.38	1.6 (NS)
Interaction	172	125,011.21	726.81	
TOTAL	263	349,372.53	1,328.41	

*Significant at 5% level.

1. Introduction

The purpose of this report is to analyze the data collected from the survey and provide a comprehensive overview of the findings.

The data was collected from a survey of 100 participants, who were asked to provide information about their demographic characteristics and their responses to a series of questions.

The first section of the report will provide a detailed description of the survey instrument and the data collection process.

The second section will present the results of the survey, including the distribution of responses for each question.

The third section will discuss the implications of the findings and provide recommendations for future research.

The fourth section will provide a conclusion and a summary of the key findings of the study.

The fifth section will provide a detailed description of the survey instrument and the data collection process.

The sixth section will present the results of the survey, including the distribution of responses for each question.

The seventh section will discuss the implications of the findings and provide recommendations for future research.

The eighth section will provide a conclusion and a summary of the key findings of the study.

The ninth section will provide a detailed description of the survey instrument and the data collection process.

The tenth section will present the results of the survey, including the distribution of responses for each question.

The eleventh section will discuss the implications of the findings and provide recommendations for future research.

Table 3

Frequency of Decrement, Increment, and No Change for
Introverts and Extroverts

	<u>Decrement</u>	<u>Increment</u>	<u>No Change</u>
Introverts	16	17	11
Extroverts	23	11	10

Table 4

Signal Detection Performance for 31 Introverted and 31
Extroverted Subjects Matched for Neuroticism

Mean Number of Signals Detected

	<u>Period 1</u>	<u>Period 2</u>	<u>Period 3</u>	<u>Total</u>
<u>Introverts</u>	4.16	4.42	4.19	12.77
<u>Extroverts</u>	4.71	4.48	4.10	13.29
<u>Total Sample</u>	4.44	4.45	4.15	13.04

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

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

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

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

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

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

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

Table 5

Analysis of Variance of Transformed Signal Detection Scores
for 31 Introverts and 31 Extroverts Matched for Neuroticism

	Degrees of Freedom	Sum of Squares	Mean Squares	F
<u>Between Subjects</u>	61	180,029.15	2,951.30	
Between Groups	1	192.05	192.05	NS
Between Subjects in Same Group	60	179,837.10	2,997.29	
<u>Within Subjects</u>	124	94,196.00	759.65	
Between Trials	2	3,170.71	1,585.36	2,159 (NS)
Trials x Groups	2	2,937.78	1,468.89	2,001 (NS)
Interaction	120	88,087.51	734.06	
Total	185	274,225.15	1,482.30	

The following table shows the results of the survey conducted in the year 2000. The data is presented in a table format with columns for the year, the number of respondents, and the percentage of respondents who answered "Yes" to the question "Do you have a car?".

Year	Number of respondents	Percentage of respondents who answered "Yes"
2000	100	75%
2001	100	75%
2002	100	75%
2003	100	75%
2004	100	75%
2005	100	75%
2006	100	75%
2007	100	75%
2008	100	75%
2009	100	75%
2010	100	75%
2011	100	75%
2012	100	75%
2013	100	75%
2014	100	75%
2015	100	75%
2016	100	75%
2017	100	75%
2018	100	75%
2019	100	75%
2020	100	75%

Table 6

Items Used in the Retrospective Questionnaire

1. I think it is very easy to miss a signal.
- *2. Quite often my mind would go blank for a few seconds and there was nothing I could do to prevent this from happening.
3. After hearing a signal and writing it down I would take a short break and stop listening for a while.
- *4. I tried to keep listening to the numbers but at times I could not help thinking about other things.
5. There were times when I was completely lost in my day dreaming.
6. My concentration was continuous, that is, I never relaxed my listening, not even for short periods of time.
- *7. Since the chance of getting a signal at any given moment was not too good, I took many short rest periods during the session.
- *8. I got to points where I stopped listening, and when I stopped, I stopped for a long time.
9. I found it easy to concentrate at the beginning, but after a while I didn't find it as easy.
- *10. When a long period went by with no signals I felt that I had probably missed one or more signals.
- *11. Toward the end I was less certain than I was at the beginning that the numbers I was putting down were correct.

(Table continued on next page)

12. I think there were times when I wrote down signals which were not actually in the recording.
- *13. Sometimes I was tempted to write down any signal at all just to be doing something.
14. I didn't write down a signal unless I was positive that I was right.
- *15. Sometimes I realized that there was a signal, but I just couldn't remember the numbers that I heard.
16. It was hard for me to keep in mind the last number or the last 2 numbers that I heard.
- *17. After a while I got to feeling hopeless and I sort of gave up.
- *18. This task made me feel irritable.
- *19. After a while I didn't care much about getting the signals.
- *20. At times I felt like giving up and just sitting there till it was over.
21. I felt as though I would like to get up and walk out.
- *22. I feel that the time I spent at this task was wasted.
- *23. I enjoyed doing this task.
- *24. I found this task quite challenging.
- *25. I didn't try as hard as I could have, since doing well would not do me any good.
26. I have to admit that I am quite annoyed with the whole business.
27. I tried to do my best.
28. At times there was a strong temptation to fall asleep.

(Table continued on next page)

- *29. I think I did about as well as most people on this task.
 - *30. I think I did worse than most people on this task.
 - *31. I think I missed at least 5 signals.
 - 32. I think I wrote down all the signals that there were.
 - 33. I could have done better if I had been allowed to talk to someone during the task.
 - 34. If the period were any longer I would certainly stop listening for signals.
 - 35. I think I could continue at a task like this for 5 hours without a break.
 - *36. I think I could have done better if I had tried harder.
 - 37. There were times when the time seemed to drag more than at other times.
 - *38. Time seemed to drag during the test.
-

*Items significant at 10% level in present study.

Table 7

Analysis of Responses to Items in

Retrospective Questionnaire

<u>Item</u> <u>No.</u>	<u>YES</u> <u>Frequency</u>	<u>NO</u> <u>Frequency</u>	<u>YES</u> <u>Mean</u>	<u>NO</u> <u>Mean</u>	<u>Point-</u> <u>Biserial r</u>	<u>P</u> <u>(1-tail)</u>
1.	80	8	12.99	14.88	-.164	.45
2.	77	11	12.91	14.91	-.199	.05
3.	52	36	13.00	13.88	-.132	.15
4.	71	17	12.83	14.50	-.199	.05
5.	34	54	12.74	13.43	-.101	.20
6.	4	84	11.75	13.23	-.093	.20
7.	25	63	11.76	13.71	-.265	.01
8.	6	82	9.00	13.44	-.337	.005
9.	67	21	12.93	14.00	-.059	.30
10.	77	11	19.97	14.45	-.147	.10
11.	40	48	12.58	13.65	-.160	.10
12.	45	43	13.42	12.86	.084	.25
13.	20	68	11.70	13.77	-.262	.01
14.	46	42	12.94	13.43	-.074	.25
15.	30	58	12.56	13.47	-.129	.10
16.	20	68	13.05	13.19	-.018	.45
17.	17	71	11.41	13.69	-.271	.01
18.	37	51	12.14	13.90	-.262	.01
19.	27	61	12.37	13.51	-.158	.10
20.	39	49	12.44	13.51	-.160	.10
21.	42	46	12.91	13.39	-.072	.30
22.	12	76	11.75	13.38	-.169	.10
23.	31	57	13.97	12.72	.180	.05
24.	68	20	13.43	12.25	.149	.10
25.	10	78	11.80	13.35	-.148	.10
26.	6	82	12.33	13.22	-.068	.30
27.	81	7	13.10	14.00	-.073	.25
28.	49	39	13.16	13.15	.014	.45
29.	74	13	13.77	10.08	.395	.005
30.	11	77	8.36	13.97	-.559	.005
31.	54	34	12.43	14.32	-.277	.006
32.	12	76	13.42	13.17	-.026	.45
33.	6	82	12.50	13.21	-.054	.35
34.	33	54	12.52	13.44	-.135	.15
35.	3	85	11.67	13.21	-.084	.25
36.	40	47	12.45	13.77	-.197	.05
37.	69	19	13.13	13.26	-.016	.45
38.	56	32	12.63	14.13	-.217	.03

Table 8

Contingency Data for Statements "significantly" Related to
Introversion-Extroversion at 5% Level or Better

Statement	Introvert	Introvert	Extrovert	Extrovert	χ^2	p
	YES	NO	YES	NO		
3.	31	13	20	24	5.69	.02
24.	9	35	22	22	4.21	.05

1. The first of the three main parts of the book is devoted to a general survey of the history of the theory of the origin of life. It begins with a brief review of the views of the ancient Greeks, and then proceeds to a more detailed examination of the theories of the 17th and 18th centuries. The author then discusses the work of the 19th century, and finally the modern theories of the origin of life.

2. The second part of the book is devoted to a detailed examination of the modern theories of the origin of life. It begins with a discussion of the work of the 19th century, and then proceeds to a more detailed examination of the modern theories of the origin of life.

3. The third part of the book is devoted to a detailed examination of the modern theories of the origin of life. It begins with a discussion of the work of the 19th century, and then proceeds to a more detailed examination of the modern theories of the origin of life.

4. The fourth part of the book is devoted to a detailed examination of the modern theories of the origin of life. It begins with a discussion of the work of the 19th century, and then proceeds to a more detailed examination of the modern theories of the origin of life.

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Table 9Items Listed in Order of Response Unanimity

Item	Dominant	Dominant Response
Number	Response	Frequency
35	No	85
6	No	84
8	No	82
26	No	82
33	No	82
27	Yes	81
1	Yes	80
25	No	78
2	Yes	77
10	Yes	77
30	No	77
22	No	76
32	No	76
29	Yes	74
4	Yes	71
17	No	71
37	Yes	69
13	No	68
16	No	68
24	Yes	68
9	Yes	67
7	No	63
19	No	61
15	No	58
23	No	57
38	Yes	56
5	No	54
31	Yes	54
34	No	54
3	Yes	52
18	No	51
20	No	49
28	Yes	49
11	No	48
36	No	47
14	Yes	46
21	No	46
12	Yes	45

SUMMARY AND CONCLUSIONS

Vigilance may be defined as a state of readiness to react to the occurrence of a particular kind of signal over a period of time when the occurrence of signals is irregular and unpredictable. It has been found that there are wide individual differences in performance at tasks requiring vigilance. This thesis represents a study of such individual differences.

It has been suggested that the personality trait of introversion-extroversion is related to performance in vigilance tasks. This study is concerned with the relationship between introversion-extroversion and ability to detect signals in an auditory vigilance task. Another aspect of the present study is an exploration of relationships between retrospective reports given by subjects after working at a vigilance task and their signal-detection performance.

Two groups of subjects, an introvert group, and an extrovert group were selected on the basis of extreme scores (upper and lower 15 percent) on the introversion-extroversion scale of the Maudsley Personality Questionnaire. After a period of instructions and practice these subjects were tested on an auditory vigilance task that required listening to a 48-minute recording of single digits, coming at

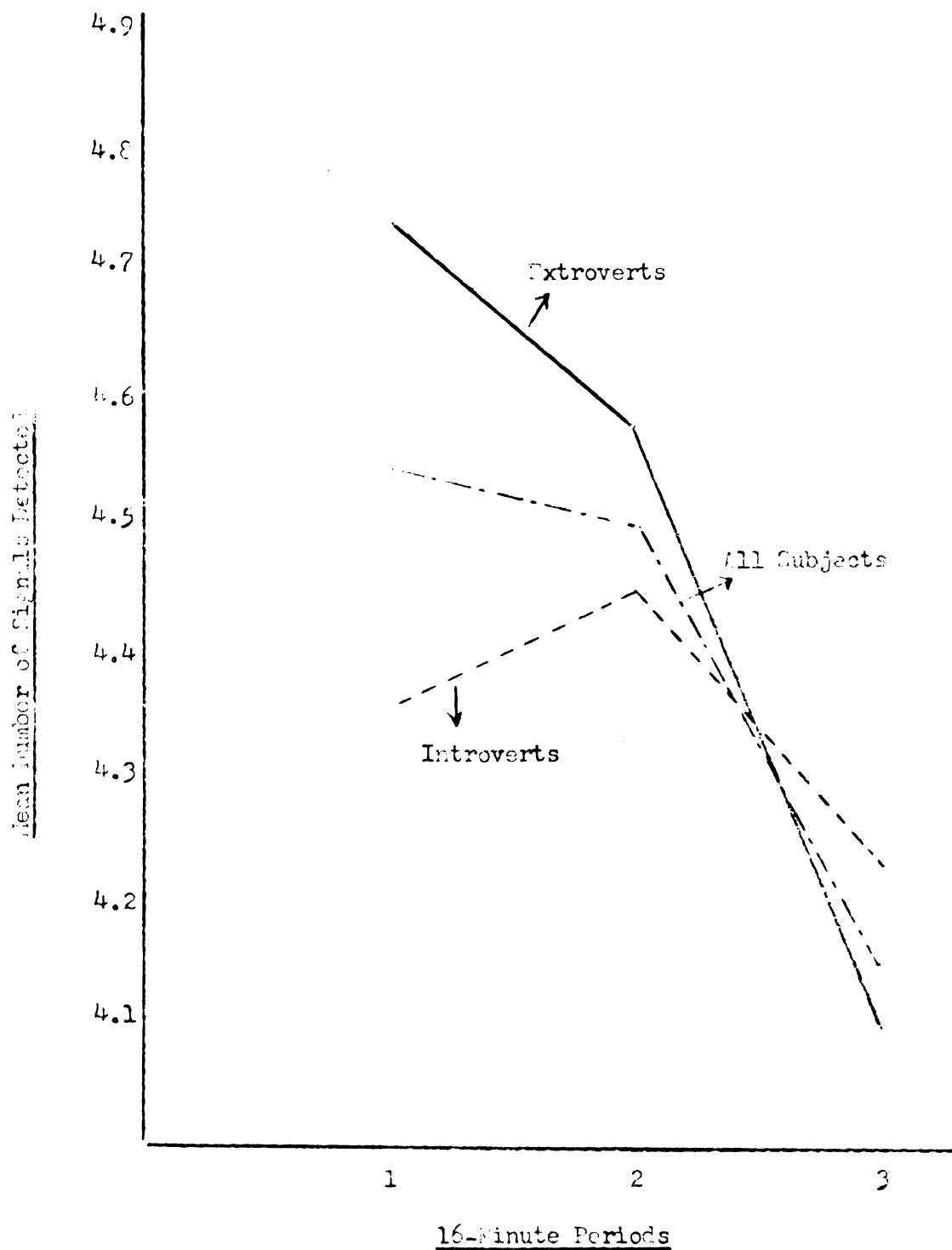


Fig. 1--Mean signal detection plotted against time for introverts and extroverts.

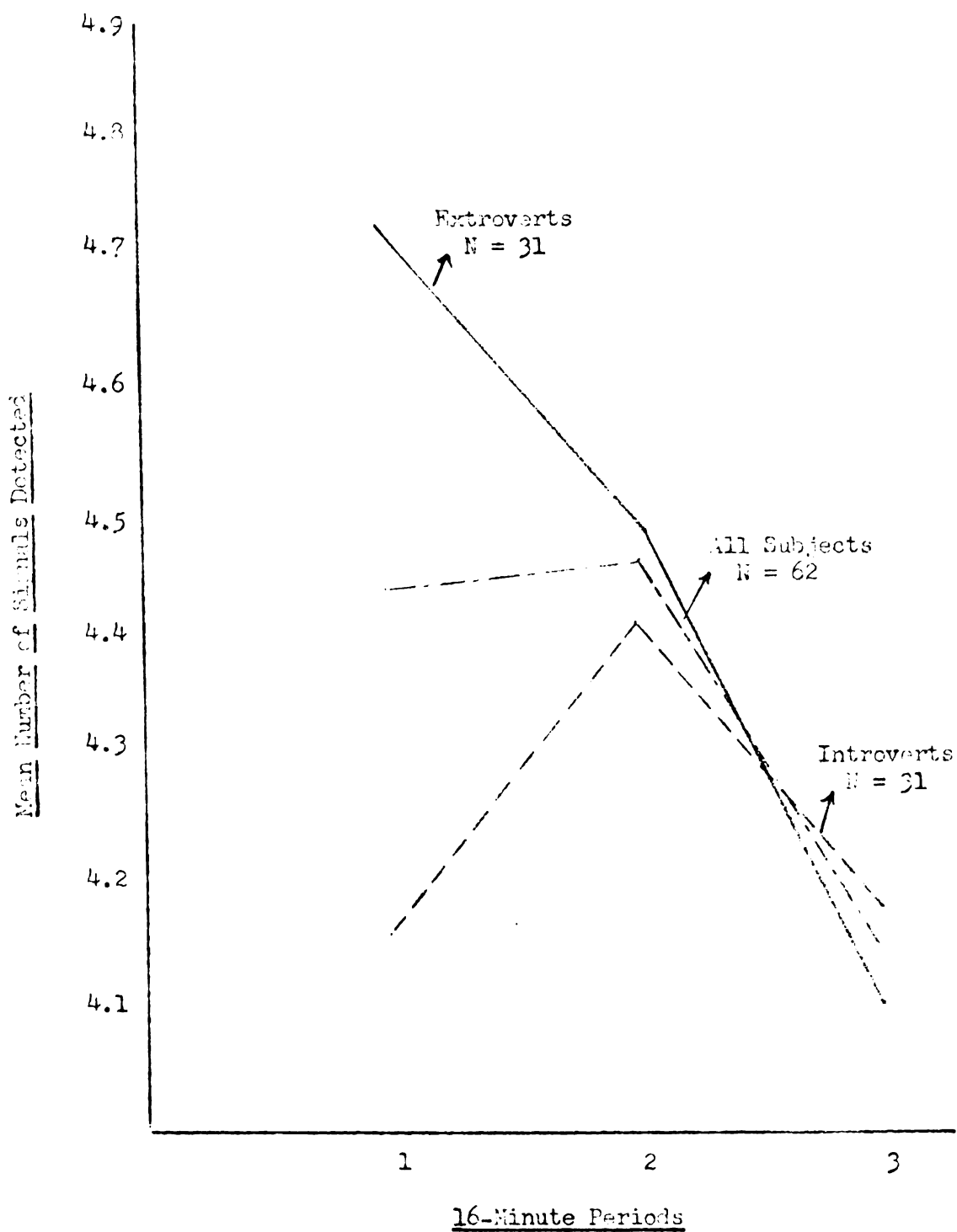


Fig. 2--Mean vigilance scores plotted against time for 31 introverts and 31 extroverts matched for neuroticism.

the rate of one per second, in order to detect irregularly occurring signals defined as "any three successive different digits in the order odd-even-odd." Such signals occurred six times every 16 minutes at intervals varying irregularly from 15 seconds to 5 minutes. Performance was measured by the number of signals correctly detected. Subjects were tested in groups of about five. Each subject was alone in a cubicle, visually isolated from the other subjects, though aware of their presence. At the end of the vigilance task a 38 item questionnaire was administered. This contained statements to which agreement or disagreement had been shown to be related to signal detection in a previous investigation.

An analysis of variance of the signal detection scores (transformed) showed no significant difference between introverts and extroverts either in overall signal detection or in the trend of signal detection over time, though there was a tendency to greater decrement for the extroverts.

These findings were not in agreement with the results of a previous investigation of the relationship between introversion-extroversion and vigilance carried out by Bakan on a sample of English sailors. Differences between the experiments are discussed. The difference between testing subjects in isolation (Bakan's procedure) and testing them in groups is suggested as a possible explanation for the discrepancy.



The analysis of the relationship between retrospective reports and signal detection was in general confirmatory of previous results obtained on a sample of English airmen. In general, various types of reports of non-listening or non-attentive behavior and low motivation for the task were found to be related to poor signal-detection performance.

In the analysis of the data a number of incidental findings were made. These include the finding that

- a) The introverts in the sample were significantly more neurotic than the extroverts
- b) The extroverts tended to make more errors of commission than the introverts, i.e. record signals that didn't actually occur, and
- c) There didn't seem to be any marked differences between introverts and extroverts in responses to the retrospective questionnaire.

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APPENDIX

1. Maudsley Personality Questionnaire--entitled
Biographical Survey
2. Instructions for Auditory Vigilance Task
3. Retrospective Questionnaire

BIOGRAPHICAL SURVEY

INSTRUCTIONS: Please answer each question by filling in one of the spaces on the answer sheet next to the number corresponding to the question number on the survey sheet.

If your answer is yes fill in the first space. If your answer is no fill in the second space. If you simply cannot make up your mind for a question fill in the third space.

Work quickly and do not ponder too long about the exact shade of meaning of each question. There are no right or wrong answers, and no trick questions.

All your answers should appear on the answer sheet. Do not make any marks on the sheet with the questions.

Do not put your name on the answer sheet.

REMEMBER TO ANSWER EACH QUESTION.

1. Are you inclined to limit your acquaintances to a select few?
2. Do you prefer action to planning for action?
3. Do you nearly always have a "ready answer" for remarks directed at you?
4. Are your daydreams frequently about things that can never come true?
5. As a child, did you always do as you were told, immediately and without grumbling?
6. Are you inclined to be quick and sure in your actions?
7. Do you have difficulty in making new friends?
8. Do you sometimes put off until tomorrow what you ought to do today?
9. Are you inclined to take your work casually, that is, as a matter of course?
10. Do you often feel disgruntled?
11. Are you inclined to ponder over your past?
12. If you say you will do something, do you always keep your promise no matter how inconvenient it might be to do so?
13. Do you like to mix socially with people?
14. Are you inclined to be shy in the presence of the opposite sex?
15. Do you sometimes get cross?
16. Do you often experience periods of loneliness?

17. Are you touchy on various subjects?
18. Do you often find that you have made up your mind too late?
19. Are you completely free from prejudice of any kind?
20. Are you inclined to be overconscientious?
21. Do you often "have the time of your life" at social affairs?
22. Do you ever change from happiness to sadness, or vice versa, without good reason?
23. Do you like to play pranks upon others?
24. Do you sometimes laugh at a dirty joke?
25. Does your mind often wander while you are trying to concentrate?
26. Would you rate yourself as a tense or "high-strung" individual?
27. After a critical moment is over, do you usually think of something you should have done but failed to do?
28. Would you much rather win, than lose a game?
29. Do you find it easy, as a rule, to make new acquaintances?
30. Do you ever have a queer feeling that you are not your old self?
31. Do you ever take your work as if it were a matter of life or death?
32. Are you frequently "lost in thought" even when supposed to be taking part in a conversation?
33. Do you always feel genuinely pleased when a bitter enemy achieves a merited success?
34. Do you derive more real satisfaction from social activities than from anything else?
35. Do ideas run through your head so that you cannot sleep?
36. Do you sometimes boast a little?
37. Can you usually let yourself go and have an hilariously good time at a gay party?
38. Do you like to indulge in a reverie (daydreaming)?
39. Have you often felt listless and tired for no good reason?
40. Are all your habits good and desirable ones?
41. Are you inclined to keep quiet when out in a social group?

42. Are you sometimes bubbling over with energy and sometimes very sluggish?
43. Do you always answer a personal letter as soon as you can after you have read it?
44. Would you rate yourself as a talkative individual?
45. Do you occasionally have thoughts and ideas that you would not like other people to know about?
46. Would you be very unhappy if you were prevented from making numerous social contacts?
47. Are you happiest when you get involved in some project that calls for rapid action?
48. Do you spend much time in thinking over good times you have had in the past.
49. Do you sometimes talk about things you know nothing about?
50. Have you ever been bothered by having a useless thought come into your mind repeatedly?
51. Do other people regard you as a lively individual?
52. Do you sometimes gossip?
53. Do you usually keep in fairly uniform spirits?
54. Are your feelings rather easily hurt?
55. At times, have you ever told a lie?
56. Do you generally prefer to take the lead in group activities?
57. Would you rate yourself as a happy-go-lucky individual?
58. Have you money worries at times?
59. Do you have periods of such great restlessness that you cannot sit long in a chair?
60. Are you usually a "good mixer"?
61. Would you rate yourself as a lively individual?
62. Have you ever been late for an appointment or work?
63. Do you ever feel "just miserable" for no good reason at all?
64. Are you often troubled with feelings of guilt?
65. Are you inclined to be moody?

66. Do you like to have many social engagements?
67. Once in a while, do you lose your temper and get angry?
68. Do you sometimes feel happy, sometimes depressed, without any apparent reason?
69. Is it difficult to "lose yourself" even at a lively party?
70. Are you ordinarily a carefree individual?
71. Do you have frequent ups and downs in mood, either with or without apparent cause?
72. Would you always declare everything at the customs, even if you knew that you could never be found out?
73. Do you like work that requires considerable attention to details?
74. Are there times when you seek to be alone and you cannot bear the company of anyone?
75. Are you inclined to keep in the background on social occasions?
76. Have you often lost sleep over your worries?
77. Of all the people you know are there some whom you definitely do not like?
78. Do you usually feel disappointments so keenly that you cannot get them out of your mind?
79. Do you usually take the initiative in making new friends?
80. Do you enjoy participating in a showing of "Rah Rah" enthusiasm?

1. The first part of the document is a letter from the President of the United States to the Congress, dated January 3, 1862. It is a very long letter, and it contains a great deal of information about the state of the country at that time. The President talks about the war with Mexico, and about the relations with Great Britain and France. He also talks about the internal affairs of the country, and about the progress of the Union.

2. The second part of the document is a report from the Secretary of the Treasury, dated January 3, 1862. It is a very long report, and it contains a great deal of information about the state of the Treasury at that time. The Secretary talks about the revenue of the country, and about the expenses of the government. He also talks about the progress of the Union, and about the relations with Great Britain and France.

3. The third part of the document is a report from the Secretary of the Interior, dated January 3, 1862. It is a very long report, and it contains a great deal of information about the state of the Interior at that time. The Secretary talks about the land of the country, and about the minerals of the country. He also talks about the progress of the Union, and about the relations with Great Britain and France.

4. The fourth part of the document is a report from the Secretary of the War, dated January 3, 1862. It is a very long report, and it contains a great deal of information about the state of the War at that time. The Secretary talks about the army of the country, and about the navy of the country. He also talks about the progress of the Union, and about the relations with Great Britain and France.

5. The fifth part of the document is a report from the Secretary of the Navy, dated January 3, 1862. It is a very long report, and it contains a great deal of information about the state of the Navy at that time. The Secretary talks about the ships of the country, and about the sailors of the country. He also talks about the progress of the Union, and about the relations with Great Britain and France.

6. The sixth part of the document is a report from the Secretary of the State, dated January 3, 1862. It is a very long report, and it contains a great deal of information about the state of the State at that time. The Secretary talks about the foreign relations of the country, and about the internal affairs of the country. He also talks about the progress of the Union, and about the relations with Great Britain and France.

7. The seventh part of the document is a report from the Secretary of the War, dated January 3, 1862. It is a very long report, and it contains a great deal of information about the state of the War at that time. The Secretary talks about the army of the country, and about the navy of the country. He also talks about the progress of the Union, and about the relations with Great Britain and France.

8. The eighth part of the document is a report from the Secretary of the Navy, dated January 3, 1862. It is a very long report, and it contains a great deal of information about the state of the Navy at that time. The Secretary talks about the ships of the country, and about the sailors of the country. He also talks about the progress of the Union, and about the relations with Great Britain and France.

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10. The tenth part of the document is a report from the Secretary of the War, dated January 3, 1862. It is a very long report, and it contains a great deal of information about the state of the War at that time. The Secretary talks about the army of the country, and about the navy of the country. He also talks about the progress of the Union, and about the relations with Great Britain and France.

This experiment was designed to learn something about how people behave in a situation where they have to listen for signals over a period of time and where they do not know just when a signal will occur. There are many situations in real life where it is necessary to watch for or listen for certain signals which come irregularly. Even though one does not know just when a signal will come it may be very important for him to be paying attention so that when a signal does come it is seen or heard. Examples of jobs where it is important to detect signals which may come at any time are: the radar operator watching for pips on a radar scope which may mean enemy planes, the sonar operator listening for signals which may mean submarines, the factory inspector looking for tiny faults in some product coming off the assembly line, the schoolteacher looking for errors and many others.

In this experiment you are going to listen to a long series of one-digit numbers from 1 to 9, played on a record at the rate of one every second. Here is an example of what it will be like ... 1-5-6-3-2-1-4-9-8-6 and so on for the entire test period.

Your job is to pick out of this long series of digits certain sequences or groups of digits. Specifically, you will listen for groups of three digits, all different, and coming one after the other in the order odd-even-odd. Examples of the kinds of sequences of digits you are to listen for are 347 or 921 or 763. Note that each of these sequences has three digits, all different, and in the order odd-even-odd. Every time you hear such an odd-even-odd group on the tape you will write the three digits on your answer sheet.

The digits that you will hear do not come in groups of three but in one long continuous chain, so you will have to listen carefully to get these groups when they come. What makes this task a bit tricky is that you never know when an odd-even-odd sequence is coming since they do not come at regular intervals. An odd-even-odd sequence may come at any time and the only way to notice it when it does come is to listen closely all the time.

Now for some examples: Suppose you were to hear the following digits coming off the recording - 5-2-6-3-3-7-4-8-9-2-7 ... What should you write down on the answer sheet? You will note the last three digits 9-2-7 make up a sequence of the kind you are listening for because:

- a) The order is odd-even-odd.
- b) The three digits are all different.
- c) They come one after the other.

If sometime later you heard these digits - 6-2-3-5-1-4-6-2-3-6-1.. What should you write on the answer sheet? Here you note the sequence 3-6-1 meets the requirements:

- a) odd-even-odd
- b) all different
- c) one after the other

You would therefore write 361 just beneath the 927 and continue listening for the next groups.

But now suppose you heard these digits: 5-2-6-3-5-7-4-8-9-2-9. Should you write down the group 929? --- No! --- Because even though the digits are odd-even-odd and one after the other, they are not all different because the digit 9 appears twice. Groups like 929, or 363, or 545 are not good groups because the three numbers are ^{not} _{all} different.

You are to listen for and write down groups like 1-2-3, 3-2-1, 5-4-3 and so on, i.e., whenever you hear three successive, different digits in the order odd-even-odd.

Now to tell you about a few listening tricks that will make this task a bit easier. These tricks are concerned with when you remember numbers or keep them in mind and when you can forget them. The first rule is to always remember the last digit you hear if it is odd, i.e., if it is 1,3,5,7 or 9, since any odd digit may be the start of an odd-even-odd group.

If the odd digit which you are remembering is followed by an even digit, for example if a 7 is followed by a 4, remember both digits, that is, 7-4 and listen for the next digit which may complete a group. You do not have to remember an even digit unless it follows an odd digit.

To summarize:

1. You remember the last digit you heard whenever it is an odd digit.
2. You remember the last two digits you heard whenever they appear in the order odd-even, e.g. 3-8.
3. You need never remember an even number which follows another even number.

While you are writing signals, the numbers will not stop so keep listening. Remember, an odd-even-odd sequence may come at any time and the only way to notice it when it does come is to listen closely all the time

Write on answer sheet

~~Practice--Underline~~ the groups of three successive and different digits in the order odd-even-odd as they appear in the following sequence of digits:

3-3-9-6-8-3-7-2-7

2-6-2-7-7-4-2-2-1

2-4-8-3-4-9-7-3-4

9-6-6-3-8-5-4-5-6

1-6-7-2-2-2-4-6-8

3-4-6-7-4-7-6-7-9

5-4-4-8-7-3-4-5-6

...the
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Read each statement carefully. To the right of each statement
you will find the words Yes and No. If you agree with the state-
ment, or if you think it is true, your answer should be Yes. You
answer Yes by drawing a line under the word Yes at the right of the
statement. If you disagree with the statement, or if you think it
is not true, your answer should be No. Answer No by drawing
a line under the word No at the right of the statement.

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1. I think it is very easy to miss a signal. Yes No
2. Quite often my mind would go blank for a few seconds and I would be unable to hear the signal. Yes No
3. I would hear a signal and wonder if it was a signal or if it was just a sound coming from the machine. Yes No
4. I tried to keep listening to one number at a time but I could not help thinking about other things. Yes No
5. There were times when I was completely lost in my day dreaming. Yes No
6. My concentration was continuous, that is, I never relaxed my listening, not even for short periods of time. Yes No
7. Since the chance of getting a signal at any given moment was not too good, I took many short rest periods during the session. Yes No
8. I got to points where I stopped listening, and when I stopped, I stopped for a long time. Yes No
9. I found it easy to concentrate at the beginning but after a while I didn't find it as easy. Yes No
10. After a long period with no signal I felt that I had probably missed one or more signals. Yes No
11. Toward the end I was less certain that I was beginning that the number I was getting down was correct. Yes No
12. I think there were times when I wrote down signals which were not actually in the recording. Yes No
13. Sometimes I was tempted to write down any signal at all just to be doing something. Yes No
14. I didn't write down a signal unless I was positive it was right. Yes No
15. Sometimes I realized that there was a signal, but I just didn't write it down. Yes No
16. I was told that I was to keep in mind the number of the signal and write down the number. Yes No
17. After a while I got to feeling like I was just going up. Yes No
18. As time went on I had to work harder in order to hear the signals. Yes No

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