8-1962

The Effects of Sensory Deprivation upon the Wechsler Adult Intelligence Scale

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THE EFFECTS OF SENSORY DEPRIVATION UPON THE WECHSLER ADULT INTELLIGENCE SCALE

by

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A thesis presented to the
Faculty of the School of Graduate
Studies in partial fulfillment
of the
Degree of Master of Arts

Western Michigan University
Kalamazoo, Michigan
August 1962

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ACKNOWLEDGEMENTS

The investigator wishes to express his sincere appreciation to the many persons for their assistance in obtaining materials and providing advice for the production of this research.

Special mention is due to Mr. Alvin Davis of the Constance Brown Hearing Society for the use of equipment.

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INTRODUCTION

As Zubansky (1961) states, the study of sensory deprivation and its effects are no longer of just theoretical or academic interest. Because of our technological advances in space craft and isolated radar stations, the problem of efficient psychological functioning in restricted and monotonous environments must be studied and evaluated. It is for this reason that the author feels it necessary to study the effect of deprivation upon not just one, but upon a number of the intellectual functions of human behavior.

In reviewing the literature on sensory deprivation, one finds that the experiments and their results differ widely. For example, the types of deprivation situations vary from a quiet room to a tank submerged in water. Few authors have duplicated experiments exact enough for a valid comparison of the data. While some research has yielded acceptable conclusions, few experiments have been similar enough for a true comparison.

What is the justification for research on sensory deprivation? If one were to go back hundreds of years to the popular and not scientific literature, he would find a number of stories about ship wrecked sailors who were forced to survive on deserted islands. For obvious reasons, few reports are in

existence on those who did not survive. Today we find man contemplating a space trip to the moon as well as other planets. Consequently, the men of today will be faced with many of the psychological problems resulting from a reduction of sensory environment as did the men who had to survive on deserted islands.

Sensory deprivation has also come to replace physical torture in many countries, for the purpose of "breaking down one's defenses" and obtaining information not previously admitted. In addition, isolation experiments are being used to carefully select crews for space flight (Ruff and Levy, 1959). However, the authors admit that many of the psychological stresses resulting from sensory deprivation cannot be simulated in the laboratory. Ruff and Levy (1959) also found that most subjects handled conflicts encountered under deprivation by their usual defenses. Most of the studies in this area have found some form of hallucinations in subjects during the period of deprivation. But Vernon, McGill, and Schiffman (1958) found in their studies that the greater the reduction of stimulation the less the likelihood of hallucinations.

Solomon, Kubzansky, Leiderman, Mendelson, and Wexler (1959) contend that the brain does not function well without constant stimuli, and that similar results might be obtained

with an overloading of the neural mechanisms. They feel that the effects of deprivation are varied and include boredom, restlessness, depression, mental inefficiency, and abberations in thinking. Grunebaum, Freedman, and Greenblatt (1960) point out three variables that seem to be prevalent in studies of sensory deprivation. They are as follows:

1. Experimental Variables - such as time, limit, and amount of sensory deprivation.
2. Subject Variables - motivation, education, etc.
3. Variables due to the interaction of the above - such as how subjects interpret instructions and the ability to change set.

In a study by Vernon and Hoffman (1956) it was pointed out that it is not possible to eliminate all stimulation, but it is possible to reduce input and variability of stimulation. In this study subjects had to learn a twelve item adjective list after a period of sensory deprivation. They were then compared with a control group. The conclusion was that the ability to learn adjective lists improves with continued sensory deprivation. However, these results seem to be opposed to some of the findings at McGill University (Vernon, McGill, Gulick, and Candland, 1961). Two explanations are offered for these differences; one, only a few subjects were used by Vernon

and Hoffman (1956) and two, there were differences in the confinement conditions. Rosenzweig (1959) reports cases of men on guard duty who came to the clinic manifesting many schizophrenic symptoms such as confusion in thinking, unresponsiveness, or hyperlability. Some also hallucinated and had paranoid ideation but these symptoms cleared up after a few days. This is the same type of behavior many authors have encountered with sensory deprivation. It is actually a restriction of meaningful stimuli rather than stimuli per se which produces these results.

Vernon, McGill, Gulick, and Candland (1961) report effects of sensory deprivation on a number of perceptual and motor skills. They found that a two day period of sensory deprivation produced the greatest decrement of performance. In many cases performance was better after three days rather than two days. A parsimonious answer to this might be that the subject "sleeps himself out" the first twenty-four hours of deprivation, and remains progressively more awake in forty-eight and seventy-two hours of deprivation.

Cohen, Silverman, Bressler, and Shmavonian (1961) report the effects of four hours of deprivation upon performance on the Wechsler Adult Intelligence Scale. There was an increase in performance on the Digit Span sub-test, and each subject

showed a decrease in arithmetical reasoning, ability to abstract and generalize, and reasoning ability. They found the "maximum difficulties occurred in the performance of tasks which required logical thinking or problem solving."

As was pointed out by Grunebaum, Freedman, and Greenblatt (1960) the length of time greatly influenced the post deprivation effects. It has been shown by Davis, McCourt, and Solomon (1960) as well as others that periods of deprivation of more than four hours do cause impairments of certain intellectual functions, but as yet no one has established the minimum amount of deprivation which will produce impairment. Therefore, the specific problem in this study is to see if there is any change in the intellectual function, namely IQ, after a three hour period of sensory deprivation. It is the intent of the author to study not only the change in total IQ, but to see which intellectual functions are more effected than others and in what way they are effected.

Inasmuch as sensory deprivation has had both positive and negative effects on tasks in different studies, it is felt that there may be some change in total IQ. It is also felt that there may be different effects on Verbal and Performance IQs. It is further thought that there may be a difference in

the effect of deprivation upon certain verbal tasks as well as certain performance tasks.

METHOD

Twenty volunteer students were selected from a men's dormitory at Western Michigan University. They were chosen by going to a few of the rooms on each floor and asking if any students would participate in a research project that was being subsidized by the United States Government. If they agreed, they were asked to give the experimenter a complete schedule of their classes and work hours in order that the experimentation might be worked around these schedules. The subjects were told that the project would require a maximum of five hours total, on not more than two separate occasions. No information was given to them as to the type of research project, except that it would be completely secretive and that they would not be able to discuss what they were doing with anyone else until the entire research was completed. The subjects were advised they would be contacted in advance and given the exact time and place and that all transportation would be provided.

Two different subjects were given the Wechsler Adult Intelligence Scale each day during the week except Friday and Saturday until all the subjects had been tested. The WAIS sub-tests were given in the same order as standardized by

Wechsler (1955). They were told that they would be required to meet again with the experimenter exactly three weeks from that date and that they would be notified a few days before and given the exact time. After all twenty subjects had taken the WAIS, it was necessary to divide them into an experimental and a control group. This was done by numbering the subjects from one to twenty successively from the first to take the test to the last. It was also necessary to have one experimental subject and one control subject for each day. Inasmuch as the groups were not matched in any way, a random selection had to be made between each day's two subjects to assign them to a group. Therefore, each day had an odd numbered subject and an even numbered subject or a control subject and an experimental subject. The table of random numbers was used by going down the list of numbers in order. If the third number in the first series was odd, the odd numbered subject for the first day went in the control group, and therefore placing the other subject for that day in the experimental group. It was the third number in each series in the table that decided between the control and experimental subjects, depending on whether it was odd or even respectively.

When all the subjects had been assigned to a group they

were phoned and given the exact time for their next appointment. The control subjects were given the WAIS a second time exactly three weeks after the first administration. They were given the test in the afternoon according to their schedules. The experimental subjects were seen in the evenings and told to plan to spend the entire evening with the experimenter. Each subject was picked up at the dormitory at approximately 6:00 p.m. and taken to a soundproof and lightproof room in the Constance Brown Hearing Society in Kalamazoo, Michigan. These subjects were told that the entire project would be explained to them when they completed their task that evening. They were told to make use of the toilet facilities as they would be occupied for a length of time. They were then placed in the soundproof and lightproof room. They were placed in a supine position on an air mattress. Watches were removed from them to prevent any auditory stimulation and shoes were removed for comfort. The subject's arms and legs were encased in a cotton lined piece of cardboard that extended from above the elbows over the hands and from the ankles to above the knees. Cotton gloves were also placed over the hands to avoid tactile stimulation. Small holes were cut in the gloves to keep down perspiration. The subjects were then told that they would be

left in this room for a period of time, but nothing more could be told to them except that they would not be harmed in any way nor would they be frightened. They were asked to lie as quietly as possible without moving or talking. They were told that a tape recorder would be going so any speech would be recorded. Each subject was instructed how to open the door of the room from the inside should he wish to terminate the experiment for any reason. They were encouraged not to terminate, however, unless they felt it absolutely necessary. Each experimental subject save one remained in this room under these conditions for exactly three hours. After three hours had elapsed the door was opened, the cardboard cuffs removed, and the subjects were immediately given the WAIS for the second time in the adjoining room.

RESULTS

After all the tests were scored, means were computed for each sub-test as well as Verbal, Performance, and Full Scale IQs, for both pre and post tests for each group. The difference between the pre and post means for each sub-test was computed for both control and experimental groups. Next the significance of the difference between the groups in mean change was computed. This was done by using the formula given by Downie and Heath (1959) as follows:

$$\bar{Z} = \frac{D_E - D_C}{\sqrt{S_{D_E}^2 + S_{D_C}^2}}$$

D_E = mean change in experimental group

D_C = mean change in control group

* See appendix for further details of statistical analysis.

The means for the sub-tests are as indicated in Table I. The mean changes for the two groups as well as the difference in mean changes are shown in Table II.

Using the above formula by Downie and Heath (1959) there was no significant difference between the two groups in mean

TABLE I

Mean Scores for the First and Second Administration of the WAIS for Each Group

Test	1 Control	2 Control	1 Experimental	2 Experimental
Information	12.0	12.9	13.2	13.4
Comprehension	12.5	14.6	14.7	15.1
Arithmetic	11.6	12.2	11.8	12.6
Similarities	11.0	12.9	12.3	12.5
Digit Span	10.2	10.2	11.8	12.6
Vocabulary	11.4	11.9	12.4	12.3
Verbal IQ	109.2	115.7	116.9	119.6
Digit Symbol	10.2	12.0	10.8	11.5
Picture Completion	12.2	13.3	12.0	14.1
Block Design	12.7	13.6	13.4	14.6
Picture Arrangement	11.2	12.0	12.7	13.7
Object Assembly	9.8	12.4	10.4	13.6
Performance IQ	107.9	117.2	111.8	122.7
Full Scale IQ	109.0	117.4	116.0	122.3

TABLE II

Change in Mean Scores for Each Group
and the Differences Between These Changes

Test	Control	Experimental	Difference
Information	.9	.2	.7
Comprehension	2.1	.4	1.7
Arithmetic	.6	.8	.2
Similarities	1.9	.2	1.7
Digit Span	.0	.8	.8
Vocabulary	.5	.1	.6
Verbal IQ	6.5	2.7	3.8
Digit Symbol	1.8	.7	1.1
Picture Completion	1.1	2.1	1.0
Block Design	.9	1.2	.3
Picture Arrangement	.8	1.0	.2
Object Assembly	2.6	3.2	.6
Performance IQ	9.3	10.9	1.7
Full Scale IQ	8.4	6.3	2.1

change on any of the sub-tests and consequently no significant difference in the changes of the Verbal, Performance, and Full Scale IQs. The greatest change occurred on the Comprehension and Similarities sub-tests, which was a difference in change scores of 1.7 each. The control group in both instances showed the greatest amount of change, although the change was not significant.

To determine if there was a significant change on the sub-tests between the first and second test administered for the same group, a student's t test was run. The formula for the student's t is as follows:

$$t = \frac{\bar{X}_1 - \bar{X}_2}{S_{D_{\bar{X}}}}$$

Using the above-mentioned formula it was found that the experimental group had a significant change from the first to second test on the Performance section at the .05 level of confidence. The control group had significant changes on the Verbal, Performance, and Full Scale scores, all at the .05 level of confidence. It was also found that the control group had a change significant at the .05 level on the Digit

Symbol and Similarities sub-tests. In addition, it was found that the control group had a change significant at the .10 level on the Object Assembly sub-test. The experimental group showed significant change on the Picture Completion and Object Assembly sub-tests, both at the .05 level of confidence.

Although there were no significant differences in the change scores between the two groups, it is still not possible to conclude that the three hours of deprivation had no effect on the experimental group. It is possible that there would have been a greater change in scores for the experimental group but that the change was actually depressed by the three hours of deprivation.

Upon inspection of the test scores after the first administration, there did not appear to be enough of a difference between the groups to warrant making a statistical comparison.

DISCUSSION

A total of twenty students were used because it was felt that groups of ten would be large enough to show significant differences. Although a larger number of subjects in each group would have been desirable, the amount of time needed for each subject and the difficulty in obtaining subjects for such an experiment made it necessary to limit each group to ten.

The reason for assigning the subjects to a group on a random basis rather than having matched groups was that it would be extremely difficult to make sure that the subjects were matched on all pertinent variables. Male subjects were used because it was felt that in such small groups as were dealt with in this study, sex differences would only add another variable to the data that could not be adequately handled at this time. Other investigators who have done research in the area of sensory deprivation also have avoided assessing sex differences in their data. As a result little has been written as of this date on the differences between males and females under sensory deprivation.

In this experiment sensory deprivation was defined as a minimal amount of auditory, visual, tactile, and kinesthetic

stimulation. The room that was used for the deprivation was actually a sound deadened room built specially for the purpose of conducting audiometric tests. No devices were placed either over the eyes of the subjects or in their ears to cut down stimulation, as the room itself held visual and auditory stimulation to a minimum.

The students were told that this was a research project subsidized by the United States Government because it was through that this statement in itself might serve as an incentive. It was also thought that the subjects would be more likely to keep secret the content of the experiment if they thought it was a government project.

The Wechsler Adult Intelligence Scale was chosen as a measure of intellectual function because it is one of the more widely used tests today, and also because of the way the IQ scores are broken down into Verbal, Performance, and Full Scale as well as the separate sub-tests. Another reason for the choice of the WAIS was because of its standardization on a well represented, clinically normal population. In addition, the test re-test correlation for all three scores, Verbal, Performance, and Full Scale, as reported by Coons and Peacock

(1959) was .96 or better. They also report that the "practice effect or at least increments in IQ scores at the time of the second testing were 2.6, 8.6, and 5.0 points for Verbal IQ, Performance IQ, and Full Scale IQ respectively.

As stated in the introduction, the purpose of the study was to determine the effects of a three hour period of deprivation on performance on the WAIS. Also, a period of three hours of deprivation was selected because when longer periods are required of the subjects one has to deal with the problem of toilet facilities as well as feeding. With the longer periods of deprivation one also encounters the problem of getting the subjects to stay under the deprivation conditions for the full length of time. In the majority of other reported deprivation experiments the subjects were paid an hourly rate for their time.

Although there were no significant differences between the groups in the change scores, the subjects did show certain behavior that was similar to what other experimenters have observed. For example, the subjects were asked to estimate the time of the evening after they had terminated deprivation and taken the WAIS. The majority of the subjects thought it

was earlier than it actually was. In fact, one subject estimated the time to be one and one half hours earlier than it actually was. Subjects were also asked to report any unusual experiences while under the deprivation. Three of the subjects reported what would be considered unusual experiences. One subject reported that he thought he was in a card game. He said that he knew very well that he was participating in an experiment but that "he just could not get it out of his head that he was playing cards." Another reported that he could see windows on the walls of the room. He contended that he really thought he could see them and that he felt like trying to get up and touch them because they seemed so real. One subject terminated the deprivation after forty minutes. He said that "he got the idea about coming out of the room in his head and just could not forget the idea so he had to get out."

One of the problems encountered in this experiment was that of discomfort during the actual deprivation. The fact that the subjects were asked to lie quietly in a supine position with their arms straight along their sides actually provided them with the stimulation of pain. It is felt that

a better body position could have been found for this experiment such as a sitting position with the back tilted or even a supine position without the instructions to lie still.

Although no significant difference between the groups in change scores was obtained, there were some unusual experiences reported as stated above so one could not really conclude that three hours of deprivation has no effect on the individual. All that can be said at this time is that the three hours of deprivation did not have any significant effect on the scores of the WAIS in this experiment.

It is felt that no difference in change scores from test to re-test between the groups might be explained in part because of the type of sensory deprivation used. It is possible that different effects might have been observed if diffuse light rather than darkness was used. It is also felt that the discomfort resulting from the directions to lie quietly became a stimulation which might have been avoided.

In future research care should be taken to note the difference in the types of sensory deprivation used, as it may not be the total deprivation that is producing the noted effects but rather only certain facets of the deprivation, such

as the existence of diffuse light or the ability to move. This author also feels that it is important to have careful duplication of experiments in order to make more valid comparisons.

SUMMARY

This study was made to determine the effects of three hours of deprivation on intelligence test performance as measured by the Wechsler Adult Intelligence Scale. Two groups of ten students each were used. These students were chosen from a men's dormitory at Western Michigan University. Each student was given the WAIS once and three weeks later given the WAIS again. The experimental group, however, underwent three hours of sensory deprivation just before the second test was administered. It was hypothesized that three hours of deprivation would cause a significant difference in change scores between the two groups. The hypothesis was not supported.

APPENDIX

Reliability Coefficients and Standard Errors of Measurement of the Tests *

Test	Age 18-19 N=200		Age 25-34 N=300	
	r_{11}	SE_m	r_{11}	SE_m
Information	.91	.88	.91	.86
Comprehension	.79	1.36	.77	1.45
Arithmetic	.79	1.38	.81	1.35
Similarities	.87	1.11	.85	1.15
Digit Span	.71	1.63	.66	1.75
Vocabulary	.94	.69	.95	.67
Verbal IQ	.96	3.00	.96	3.00
Digit Symbol	.92	.85	—	—
Picture Completion	.82	1.18	.85	1.14
Block Design	.86	1.16	.83	1.29
Picture Arrangement	.66	1.71	.60	1.73
Object Assembly	.65	1.65	.68	1.66
Performance IQ	.93	3.97	.93	3.97
Full Scale IQ	.97	2.60	.97	2.60

* Wechsler, David, Manual for the Wechsler Adult Intelligence Scale. 1955.

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