

## Studies on Sensory Deprivation: VII Part 4. Studies on three hours sensory deprivation

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# STUDIES ON SENSORY DEPRIVATION: VII

## PART 4. STUDIES ON 3 HOURS SENSORY DEPRIVATION

By

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The experiment of 3 hrs sensory deprivation (Exp. 1) of which procedures were the same as those of the previous study described in Part 1 was carried out to examine the experiences during the early period of confinement. The results indicated that the 3 hrs confinement had no obvious effects on the physiological and mental activity of Ss.

In Exp. II, the verbal communication between the experimenter and the subject through an interphone system was held during the confinement to examine subjective experiences in detail. All Ss, who had some knowledge of the sensory deprivation and experimental purposes, reported imagery or hallucination-like experiences. EEG of two Ss were manifestly influenced by the conditions of the present confinement. And the recovery process from it was examined.

In Exp. III, it was examined whether or not the Ss, who did not have any kind of information about the sensory deprivation, reported the same unusual experiences as those found in Exp. II. The same results were obtained. The analysis of EEG and ECG suggested some effects of sensory deprivation on physiological activity of Ss. The results of continual word association test, however, suggested that the present confinement had no influence Ss in flexibility of thinking.

### EXPERIMENT I

The results of the experimental studies on 18-48 hrs. sensory deprivation which have been carried out at Psychological Laboratory of Tohoku University supported the hypothesis in general that the isolation impairs the higher mental functioning and facilitates the lower one. There were, however, some inconsistent results such as those of size constancy test and the report of hallucination-like experiences (Kitamura et al. 1963, 1964, 1965a, 1965b, 1966, 1967, & the present article.). Furthermore, it was difficult to examine the experiences during the early period of confinement. For the most subjects lost time orientation in the earlier period of the sensory deprivation and they could not fix the experiences at the given time in the confinement. Moreover, they might be unable to recall all the experiences, if they were not impressive ones. Present experiment was carried out for the purposes of examining these problems.

## METHOD

The experimental procedures in this article were different from previous studies on the 24 hrs. sensory deprivation reported in Part 1, in about several points. (1) Subjects were not given any food or water. (2) They entered the confinement room with his usual clothes. (3) Although instruction was basically similar to the previous studies, they were asked not to fall asleep. For the most subjects who participated in the experiments of 24 hrs. sensory deprivation were observed to fall asleep within 2–3 hours after the beginning of confinement. When it was observed by polygraphic records and TV-camera that the subject fell asleep apparently, the instruction that he should not fall asleep was repeated.

The experimental confinement lasted 3 hours, beginning at 9.00 a.m. or 13.00 p.m. The tests which were administered in the present experiment were the size constancy test, the continual word association test, the chain word association test, and the test of synesthesia. These tests were given twice: at the beginning of confinement and at the end of it. Besides these tests, all the subject's behaviors during the confinement were observed through TV camera, interphone system, and polygraphic records (EEG, ECG, eye-movement). Each procedure of these tests will be described below.

**Polygraph:** Polygraph was recorded every fifteen minutes. EEG was taken from the electrodes on the scalp of L-FL and L-OL with monopolar recording.

**Size constancy test:** The same procedure was used in the present experiment that was described in detail in Part 2.

**Continual word association test:** The procedure was the same as one used in the previous study (Kitamura, *et al.* 1967, p. 33) except that the stimulus words used in the present experiment were limited only to "KOME (rice)" and "UME (plum)".

**Chain word association test:** The stimulus words used in the present experiment were two pairs of words; "SARU (monkey)"—"YARI (spear)" and "TORA (tiger)"—"YUMI (bow)". Subjects who were given "SARU"—"YARI" in pre test were given "TORA"—"YUMI" in post test, vice versa. Subjects were asked to respond to each stimulus word for 210 seconds.

**Subjects:** Subjects in the experimental group were 10 male undergraduate students of Tohoku University and Tohoku College of Pharmacy. Subjects in the control group were 11 male undergraduate students of Tohoku University.

## RESULTS

**EEG:** The histograms of the number of each cycle in 4 subject's brain waves taken from the occipital region were manually obtained by the Fujimori's method. One record showed the astringent tendency to the most dominant waves in pre-stage. Two records showed a slightly slow activity during the sensory deprivation. Another record showed an inconsistent fluctuation.

**Behavior observation:** Most subjects slept more or less during the confinement in spite of the instruction.

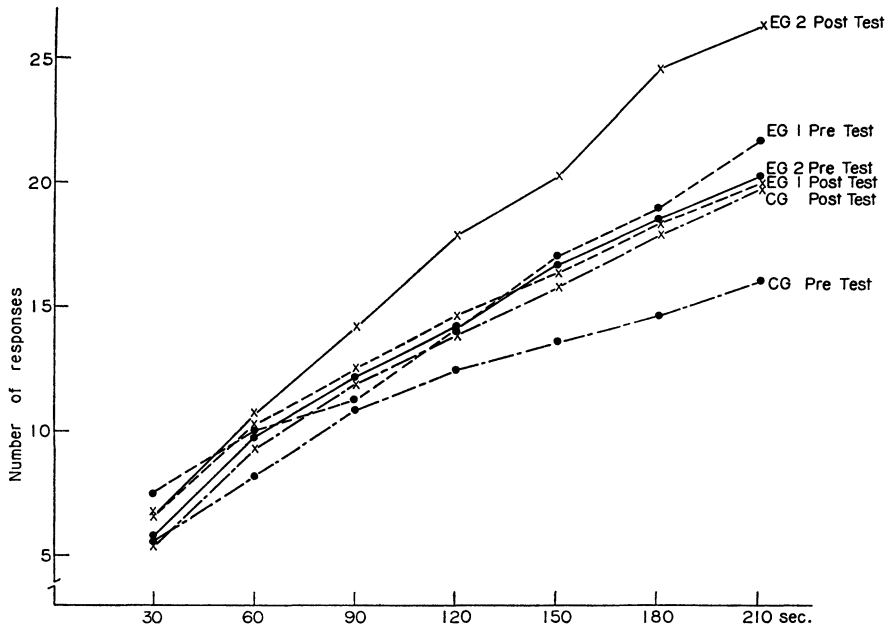


Fig. 1. The results of continual word association test. (EG. 1 means the group of 3 hrs. sensory deprivation without communication. EG. 2 means the group of 3 hrs. sensory deprivation with communication, which will be reported in Exp. III. CG means control group.)

Unusual experiences: Any imagery or hallucination-like experiences were not reported in the interview after the confinement.

Continual word association test: The results of the continual word association test were shown in Fig. 1. Though the insignificant differences were found between the experimental group and the control group, and between the score of pre test and that of post test, the subjects of experimental group gave more responses in post test than in pre test. Furthermore, three out of eight experimental subjects gave more responses in post test than in pre test, while eight out of nine control subjects gave more responses in the post test than in pre test. But these differences were not significant ( $\text{Chi}=2.75, 0.10 > p > 0.05$ ).

Chain word association test: Any differences were not found between the experimental group and the control group. (Fig. 2)

Size constancy test: The results of size constancy test showed no statistical differences between the sensory deprivation group and the control group, and between the results of 24 hrs. sensory deprivation and those of present experiment (Tab. 1. cf. page 79).

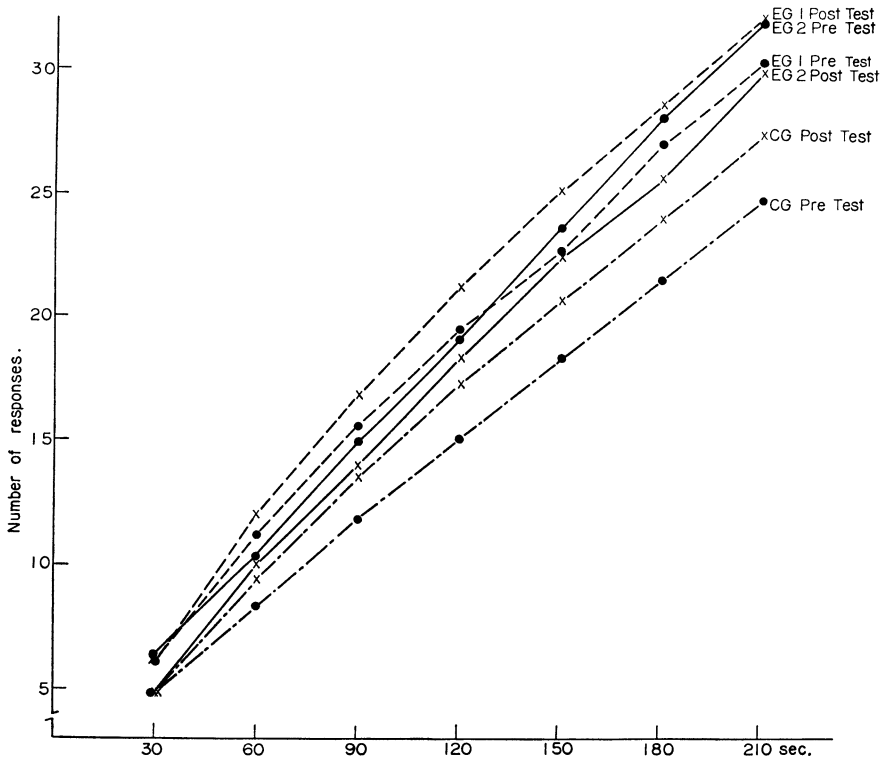


Fig. 2. The results of chain word association test. (EG. 1 means the group of 3 hrs. sensory deprivation without communication. EG. 2 means the group of 3 hrs. sensory deprivation with communication, which will be reported in Exp. III. CG means control group.)

Table 1. The mean scores of the estimated size of each group in the size constancy test

	Pre Test	Post Test	Difference	
Exp. G. (N=10)	120.8mm	117.9mm	-2.9mm	-2.4%
Cont. G. (N=11)	125.5	120.2	-5.3	-4.2

## DISCUSSION

The results of the experiment of 3 hrs. sensory deprivation indicate that the brief confinement in a semilightproof and soundproof room had no effects on the subject's mental and physiological activities except that the decreasing in the flexibility of thinking was suggested by the continual word association test.

## EXPERIMENT II

The results of the experiment of 3 hrs. sensory deprivation described just above did not show any obvious effect on subjects. It has been reported, however, that the brief perceptual isolation had some effects on subjects (Cohen et al. 1958, Hochberg et al. 1951, Hori et al. 1966, 1967, 1968). Cohen et al. gave their subjects in an hour sensory isolation the suggestion that the unusual perceptions were appropriate in sensory isolation, and they found that it caused the hallucinatory reactions, which were less elaborate and more commonplace than the phenomena reported in studies of prolonged isolation.

Hori et al. introduced the communication with their subjects by an interphone system during the confinement, which was similar to the psychiatric interviews, into their experiment of 4-6 hrs. perceptual isolation in order to depict the inner experiences of their subjects in detail as possible. Other conditions of confinement situation were substantially the same as ours. Most of their subjects, who were the psychiatrists, the schizophrenics and the patients of depression, experienced the unusual perceptions, which varied from imageries to proper hallucinations. All fifteen normal subjects who were the psychiatrists reported the visual hallucinations. Auditory ones were reported by 4 subjects and somat ones by 13 subjects. Hori et al., furthermore, analyzed EEG records and found that EEG of the normal showed a gradual increase of slow activity during the sensory deprivation.

Our subjects of Exp. I however, did not report such hallucinations or hallucination-like experiences after the confinement. Furthermore, *vivid* hallucinations had not been also reported in studies on relatively prolonged isolation (Kitamura et al. 1963, 1964, 1965a, 1965b, 1966, 1967 and the present article).

It would be considered that this difference between the results of Hori's experiment and those of ours occurred from the differences of the subject's attitude toward the experiment, which might be made up by the experimenter's instruction and the communication during the confinement. Therefore, the purpose of the present experiment was to determine whether or not the unusual phenomena were obtained from our confinement room and our procedures similar to those of Hori et al. Additionally the recovery process of EEG was examined.

## METHOD

The conditions and the period of confinement were substantially the same as those in Exp. I. In the present experiment, however, the conversations between the subject and the experimenter by an interphone system were held 5-7 times during the confinement of 3 hrs. The experimenter questioned the subject on his mental and physical states and hallucinatory reactions each time.

Polygraph (EEG, ECG and eye-movement) was recorded at every fifteen minutes during confinement. Subject was given free association test for 5 min. immediately before the cessation of confinement. Thereafter, the polygraph was recorded.

And again, the subject was asked to exercise lightly in bending and stretching (2-3 times) and to relax his body within 2-3 minutes. And then, the polygraph was recorded.

All subject's behaviors were observed through a TV-camera.

Two female and two male graduate students of the Department of Psychology, Tohoku University, participated as subjects in the present experiment. They had some information on the sensory deprivation and on the purposes of the present experiment.

## RESULTS

### EEG

The method of EEG recording and the analysis of EEG were the same as those in Exp. I. Two records were eliminated from the final data, for the pattern of one record showed too drowsy to analyze and another record could not be analyzed by the technical errors. Therefore only two subjects' records were analyzed. These results were shown in Fig. 3 & 4. The former shows that when the record immediately after the confinement was compared with that immediately before the cessation of it, 10 cps waves which were the most dominant at the beginning of confinement showed a marked increase, that is to say, it astringed to the most dominant wave of the first record. And it shows also that the EEG record immediately after the five minutes' free association did not recover to the first, but that the EEG record after three minutes' physical movements recovered almost to the original record.

The latter shows the histograms of the number of each cycle in EEG records on every an hour after the beginning of confinement, after the free word association, and after the physical movement. It shows a gradual slow activity within alpha band during the confinement. It shows, moreover, that the process of recovery was almost the same as that of the former.

### Sleeping

All the subjects fell asleep, in spite of talking with experimenter every about 30 minutes during the confinement.

### Thinking

It was found in the verbal communication between the subject and the experimenter during the confinement that only one subject tried to think about his own experiment, but other subjects wasted the period of the confinement without thinking about special matter.

### Imagery and hallucination-like experiences

\* Visual experiences: Visual imagery or hallucination-like experiences were reported by one male subject. He saw vivid and bright landscapes during the first an hour

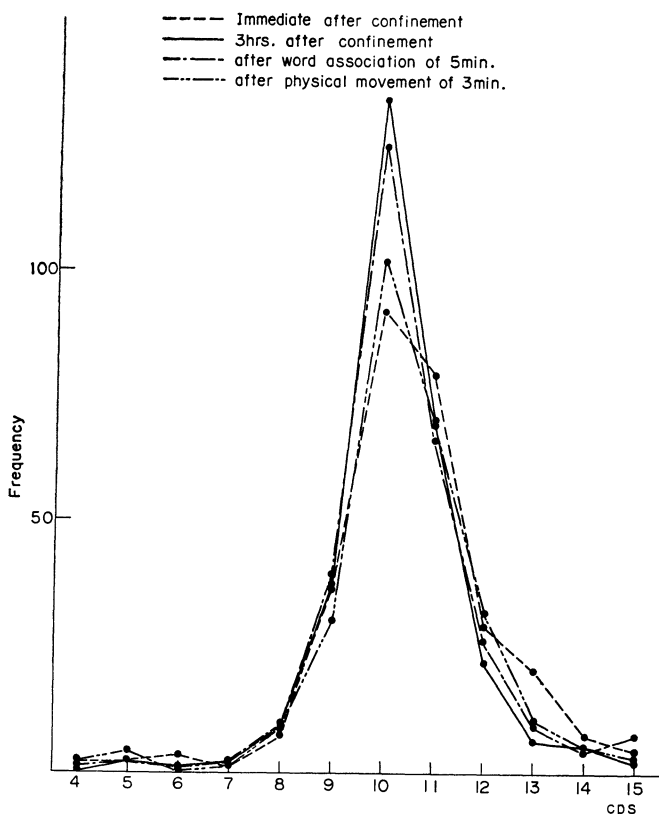


Fig. 3. Comparison of the histograms of the number of waves in each cycle at various stages.

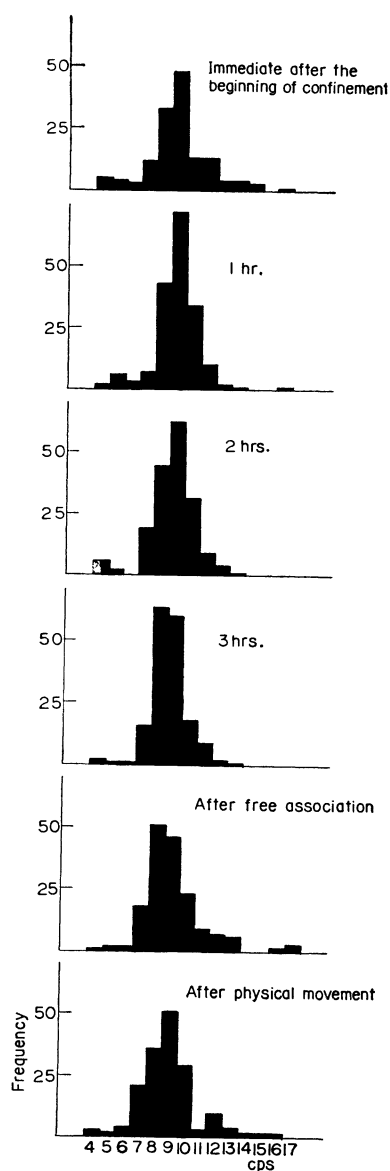


Fig. 4. Comparison of the histograms of the number of waves in each cycle at various stage.

of the confinement and he drew a picture of these scenes after the experiment (Fig. 5). Thereafter, he imagined intentionally the structures of ear and brain, and spent for a while on thinking about his own experiment. During this period, bright clouds appeared intermittently, only when thinking paused for a few minutes. After this thinking ceased, he became slightly sleepy, seeing a face of his friend whom he had not met a few years. As the face was distorted, he thought that it was curious. And he wondered if it was a dream. But he was sure that he was sleepy but did not fall asleep. He wondered if it





Fig. 5. An example of visual imagery experienced by male subject during the confinement of 3 hrs.

was a hallucination, after he came out of the confinement room. According to his introspective report, the imageries experienced in the present experiment were more vivid than those in his usual life.

\* Auditory imagery or hallucination: Two female subjects reported auditory experiences. The singing of many sparrows were heard by one subject after sleeping a few minutes. Another subject heard the sound of a warning horn and the singing of a cicada. The warning horn could not be found near the laboratory and the cicada was out of season, when the present experiment was carried out. Inquiry revealed that they were not the illusion of masking noise. She reported, however, that she had ever been reminded of the singing of a cicada in May every year prior to the season (This experiment was executed at 5 April), and that she had heard the sound of warning horn prior to this experiment.

\* Somatic and other experiences: Unusual somatic phenomena were experienced by two female subjects. One subject reported that she felt to be rolled in hammock, when she awaked. Another subject felt the earthquake shock. One male subject reported that he felt someone opening the door and coming into the confinement room.

#### DISCUSSION

It was found in the present experiment that all subjects reported some unusual experiences in the meaning of perception without objects. Some of them, however, were typical imagery, some were obviously after-effects of experiences prior to the experiment, and some were experiences in usual life. But there were several unusual phenomena which could not be explained in terms of these reasons. And they seem to be facilitated in present experimental situation. Most of them seemed to be experienced in a state of low arousal level, i.e. before or after sleeping or drowsiness.

#### EXPERIMENT III

It was found in the previous experiment that the partial perceptual isolation in which the communication between the subject and the experimenter using an interphone system was held during the confinement, affected subject's physiological and hallucinatory activities. But the subjects who participated in the Exp. II had some knowledge of the sensory deprivation and the experimental purposes. The times and the contents of questions given by experimenter were changed in according to the reports of subject. Therefore, it was the purpose of the present experiment to confirm whether or not the same unusual phenomena as those described just above were experienced by subjects who did not know about the sensory deprivation.

#### METHOD

The conditions and the period of the confinement were the same as those used in the Exp. II, except that each subject was interviewed before entering the confinement

room, and inquired whether or not he had experienced hallucination in usual life. This procedure was adopted as it would serve to inform the subjects of what hallucination was. Therefore, they could report their imagery or hallucination-like experiences whenever they occurred and when they was questioned during the period of confinement, "Has anything occurred to you?". This calling to the subject were given every 15 minutes. Moreover, subjects were asked to report unusual matters whenever they occurred.

The test used in the present experiment were the continual word association test and the chain word association test. They were given twice: immediately after the beginning of the confinement and before the cessation of it. The procedures of these tests were the same as those used in Exp. I.

Polygraph (EEG, ECG, & RESP) was also recorded in the same way as in Part I. Subjects were 6 male undergraduate university students.

## RESULTS

### Continual word association test

The results of the continual word association test indicated that the number of the responses in post test was larger than in the pre test. (Fig. 1). And five of six subjects gave more responses after confinement than before it. But these scores could not be analyzed by the statistical method for the reason of small number of subjects.

### Chain word association test

Fig. 2 shows the results of the chain word association test, and that these results were not different from those of 3 hrs. sensory deprivation experiment without communication during the confinement and those of the control group.

### EEG

EEG records of four subjects processed by a Nihon Kohden ATAC-402 type medical processing computer were converted into the instantaneous values through band pass filter. Time interval histograms during a two minutes' period in each band (alpha: 8-13 cps, beta 1: 13-20 cps) were obtained from EEG recorded immediately after the beginning of confinement, at the first an hour, 2nd hour, immediately before the cessation of it, and after the word association tests of 12 minutes.

In general, it may be said that the waves seen in occipital region had higher frequency than in frontal, though its results in beta 1 band was not obvious.

It follows from the results of analysis that compared with the waves in the pre-stage of both occipital and frontal regions, those during the experimental confinement showed a gradual decrease in frequency (about 0.5 cps), and also that the waves after the post word association tests were in some degree restored to those in the pre-stage.

Within beta 1 band, the results of analysis were similar in tendency to that mentioned above in occipital region, but such tendency was not found in frontal region.

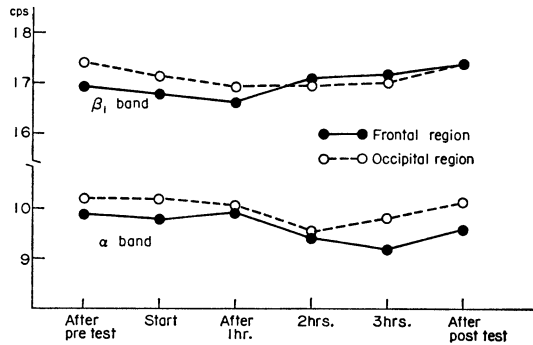


Fig. 6. Time interval histograms (non-sequential) of EEG—Shift of dominant frequency in both  $\alpha$  and  $\beta_1$  band.

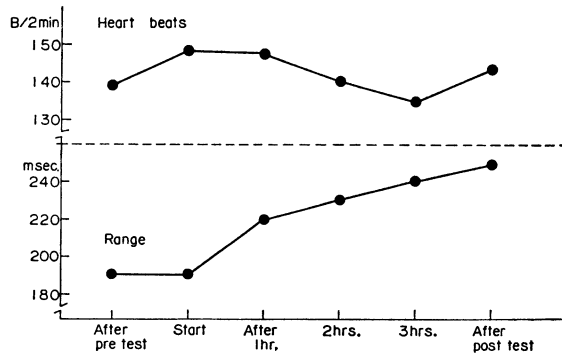


Fig. 7. Heart beats and ranges of the numbers of heart beats for a 2 minutes period.

### Heart rate

The time interval histograms non-sequential of five subjects for 2 minutes were obtained. The overall results show that the highest heart rate, followed by a gradual decrease, appeared until the 1st an hour of the confinement showing the lowest heart rate immediately before the cessation of it. It was found also that the range of the intervals between heart beats increased gradually after the beginning of confinement.

### Unusual experiences

The imagery or hallucination-like experiences which were reported by subjects were diagrammed in Fig. 8. Auditory experiences were reported by all subjects. The examples of them were the singing of grasshopper, cricket, cicada, and frog, the singing of a girl, rain sound and so on. Two subjects heard them throughout the period of confinement.

Two subjects reported visual experiences. Most of them were nonsense geometrical figures such as an eddy and a lightning. One subject saw landscapes surprisingly vividly

at 65 minutes after the beginning of confinement. He said, "A river is flowing. It is very large, so that I cannot find a stone. The river is flowing with roaring. I feel I am standing on the bank of the river. I can see it very near." Other visual hallucination-like experiences were given by the same subject. He said, "The figure of 2 appears for a while and then an arrow appears," and he continued. "A piece of hair appeared, and it changed into a pigeon. And then, it vanished." These reports were obtained at 120-135 minutes after the beginning of confinement. The visual experiences of another subject seemed to be not so vivid as those above mentioned.

Four subjects reported somatic unusual experiences, such as the feeling of being rocking and of an earthquake shock.

Olfactory hallucination-like phenomenon was also reported by one subject. It was a smell of woods.

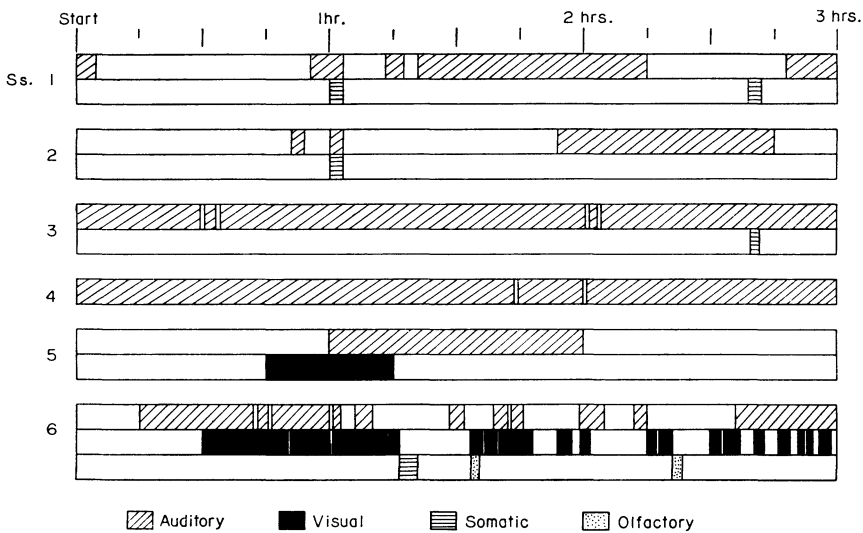


Fig 8: Imagery or hallucination-like experiences

## DISCUSSION

Although the statistical analysis was not executed concerning the results of the continual word association test for the reason of small number of subjects, it may be suggested by the results that the flexibility of thinking did not decrease. While the number of responses decreased in the experiment of sensory deprivation without the verbal communication between the subject and the experimenter during the confinement, it increased in the experiment in which the verbal communication was held. This fact may suggest that the communication during the confinement can prevent subject's mental activity from being affected by the isolation.

The inspection of EEG records showed the increment of slow activity in general,

though individual differences were found. And these results supported the findings of Hori et al.

It was found in the inspection of ECG that the range of the intervals between heart beats increased gradually after the beginning of confinement. This fact suggests the transient disturbance of autonomic activity.

Concerning the unusual experiences, all subjects reported some unusual phenomena. Most of them were not vivid, but some of them were so vivid, that one subject was surprised at them. These results coincided with those found in Exp. II, although the subjects in the present experiment had no knowledge about the sensory deprivation. Furthermore, they may be identified with the findings of Hori et al. (1967, 1968) and Cohen et al. (1958).

But these relatively vivid unusual phenomena were not observed in the experiment of the sensory deprivation in which verbal communication between the subject and the experimenter during the period of confinement was not held. These facts seem to mean that imagery or hallucination-like experiences could not be easily recalled or reported, if they were not so vivid that subject fell into the state of fear or anxiety or other emotional state. It would be considered, therefore, that those observed in the present experiment might be elicited by the experimental procedures that decreased the external meaningful stimuli as possible and let a subject gaze at his own inner world.

Futhermore, one subject who was a graduate student of psychology could image easily visual imageries in usual life, introspected his experiences in the confinement room and reproted that these visual images had been more vivid than those in usual life. Similar examples to the above were also found concerning the auditory experiences. These facts may suggest that the imagery or hallucination-like phenomena are not explained sufficiently only by looking into one's "mind eye." (Fiske 1961). They seem to make us to need the more efficient hypothesis that the sensory deprivation facilitates the process of subject's inner world.

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#### ZUSAMMENFASSUNG

Es wurden die Ergebnisse von der 3 Versuchen der dreistündigen sinnlichen Entziehung (Sensory Deprivation) berichtet. In diesen Versuche wurde der Einfluss von kurzer sinnlicher Entziehung auf die Vorstellungen oder die halluzinatorische Erlebnisse, kontinuierliche Wortassoziation, Kette-Wortassoziation, die Wahrnehmung von der Grössenkonstanz, EEG und EKG untersucht. Die Resultate des ersten Experiments zeigten, dass die kurze sinnliche Entziehung nicht den deutlichen Einfluss auf die physiologische und denkende Aktivierung der Person ausübt.

Im sekundären Experiment wurde die verbale Kommunikation zwischen der Versuchsperson und dem Versuchsleiter im Lauf der Entziehung gehabt, um die subjektiven Erlebnisse bis ins kleinste Detail zu examinieren. Alle Vpn., die wussten um die sinnliche Entziehung und experimentale Ziele, beobachteten die starken Vorstellungen oder die halluzinatorischen Phänomene.

Im dritten Experiment wurde es examiniert, ob Vpn., die nicht um die sinnliche Entziehung wussten, die gleichen ungewöhnlichen Phänomene, die mit denen im sekundären Experiment identisch sind, erlebten. Das Resultat war ganz gleich mit dem Befunde im früheren Experiment. Aber die Qualität des Reagierten in der kontinuierlichen Wortassoziation und Kette-Wortassoziation wurde durch die sinnliche Entziehung nicht beeinflusst.

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