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STUDIES ON SENSORY OVERLOAD: II

PART 1. GENERAL METHODS AND RESULTS OF POLYGRAPHIC RECORDS

By

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The part reported here presents the general methods, and the results of polygraphic recordings out of a series of the experimental studies continued from the preceding studies on sensory overload. Although the general experimental procedures for controlling sensory input were much the same as those of Exp. 2 in the previous studies, it was particularly taken into consideration that the confinement periods of three hours duration in the previous experiments were replaced by those of five hours' and that as a control group was adopted the group imposed only the movement restriction for a given duration without the experimental confinement. 24 male undergraduate students were used as subjects.

The results obtained for the data of polygraphic recordings indicated that the *Ss* exposed to SO condition maintained the higher levels of arousal, compared with those of SD group. Within beta band, the pattern of changes in which dominant frequency presented a phasic "slowing" in the second half of the confinement seemed to be related to the temporary falling of levels of consciousness.

So far, the various effects of the experimental confinement by means of such experimentations as the reduction or deprivation of stimulation and the sensory overload (SO) presenting stimuli with higher level of intensity upon mental functions of organisms have been investigated in our previous studies. Dealing with and controlling appropriately many sorts of stimuli coming from the outer and inner world, man usually behaves with normality in his everyday life. The mental disturbances accompanied with reduction of the control functions would, however, manifest themselves in the situation with extremely reduced or restricted stimuli.

On the other hand, this will also hold true when the excess stimuli over the normal levels of intensity were given for a period, and it was impossible to process them adequately (Kitamura et al., 1970). For example, Gorbov et al. (1966), taking up a problem concerning adaptation of the human being to excess information in space flight environments, take the several examples showing that sudden occurrence of the state of information over-inflow during the functional states of organism produced by the prolonged decreased stimulation in space would result in disturbances of behavior like the tensions in biological functions or the manifestation of emotional states and the stricture of visual field.

In our preceding studies on sensory overload, we adopted the situation overloading the relatively simple stimuli, that is, the situation in which *S* has only to accept the experimentally operated sensory stimuli, without being requested to grapple with a given task. The above-mentioned situation has been established in our preceding experiments because, like the studies on SD up to the present (Kitamura, 1967a), it would enable us to examine not only each effect of SO condition upon the mental functions of organisms, but also the integrated changes of these functions or a pattern of their changes, and further, to explore the loading effects on the continuum from SD condition to SO in terms of the dimension of stimulus intensity.

From the results obtained for the previous three hours of SO experiment (Kitamura et al., 1970; Hatayama et al., 1970; Kikuchi et al., 1970; Sato et al., 1970), it was generally indicated that *Ss* under the SO condition, as demonstrated by EEG, ECG activities and body movements, maintained the higher levels of arousal than those of SD. The results of the psychological tests utilized in our studies revealed, however, that on SO group the effects of confinement were caused more variously than on SD group. Therefore, the studies on SO did not make clear the selective effects of SD — that SD deteriorated the higher order mental functions and facilitated the lower ones (Kitamura et al., 1967b).

In order to investigate further that as compared with the larger effects on, so to speak, “physiological levels”, the effects on “psychological levels” were relatively small, we took particularly the following two points into consideration in the present studies on SO.

First, the confinement periods were changed from three hours duration to five hours'. Hereby the experimental condition was made more severe, and so it was intended to examine closely the manifestation attitudes of the various effects on mental functions by comparison of the present data with the preceding.

Next, there is such a problem as indicated in the preceding report (Kitamura et al., 1970) concerning what group should be adopted as a control one. That is, the data of SD group can be regarded as the control of SO group. However, the group to which only the movement restriction was assigned within a given duration without the experimental confinement was adopted here as a control group.

METHOD

Subject: 24 male undergraduate students who accepted public subscription in Tohoku University were used as subjects, eight in each of SO, SD and control groups.

Procedure: The general experimental procedures for controlling sensory input and the tests utilized were almost the same as in Exp. 2 in the previous report (Kitamura et al., 1970) except the followings.

First, the confinement periods of three hours' duration in the previous experiments were replaced by those of five hours' in the present study. Secondly, since the CFF test and the BGT used in the previous study showed the larger variances than other

tests, these tests were removed. Instead, hearing loss measurement, dot detection time test and key tapping were added to other tests administered before and after confinement. Furthermore, in order to accustom *S* to the apparatus for measuring the dot detection time, several trials of training in its test were assigned to *Ss* of three groups the day before the experiment. At the same time, the experimenters could get useful information as to *Ss* through holding an interview with each *S* on that day, too.

On the day of the experiment, the pre-tests were given in following order of administration before five hours of confinement: 1) hearing loss measurement, 2) dot detection time, 3) short-term memory, 4) continual word association, 5) key tapping, 6) VER. Immediately after the termination of the experimental confinement too, were administered a series of the above-mentioned tests as the post-tests. In addition to these tests, *Ss*' behaviors of both SO and SD groups during the confinement were observed through TV-camera and polygraphic recordings.

RESULTS OF THE POLYGRAPHIC RECORDINGS

Purpose and procedure: Polygraph records were, in the first place, taken for the chief purpose of examining the influences of two confinement conditions of SO and SD upon arousal levels of organism; secondly, examining the presence of a "slowing" of dominant frequency within the band of fast waves at the second half of the confinement; furthermore, the sensory habituation as the waning of the amplitude in a late component of averaged photically evoked responses to light flash presented during SO condition.

The method for the polygraphic recordings was the same as ever (Kitamura et al., 1970; Hatayama et al., 1970). Throughout the experimental confinement period, were continuously made the polygraphic recordings for EEG, heart rate and left eye movement. Moreover, concurrent records of EEG, ECG and trigger pulse synchronous with the photic stimulation were placed on the magnetic tape every half an hour during the confinement.

I EEG

1) *Time course of each arousal level in two groups of SO and SD*

Using the EEG records with bipolar leading of parieto-occipital area during the experimental confinement, four arousal levels were, as ever, identified as four EEG patterns ranging from awakening through drowsiness and light sleep to deep sleep dominated by high voltage slow waves by visual inspection. Fig. 1 presents the transitions of each arousal level. These transitions were expressed by the distribution of number of *Ss* showing one of above-mentioned EEG patterns every ten minutes during five hours of SO and SD. Few *Ss* under SO condition showed, in general, sleep EEG patterns. Especially the slow wave sleeps were, with the exceptions of light sleep, not seen in any *Ss* during the confinement. Subsequent to the 3rd hr., almost all the *Ss* were in states of alertness.

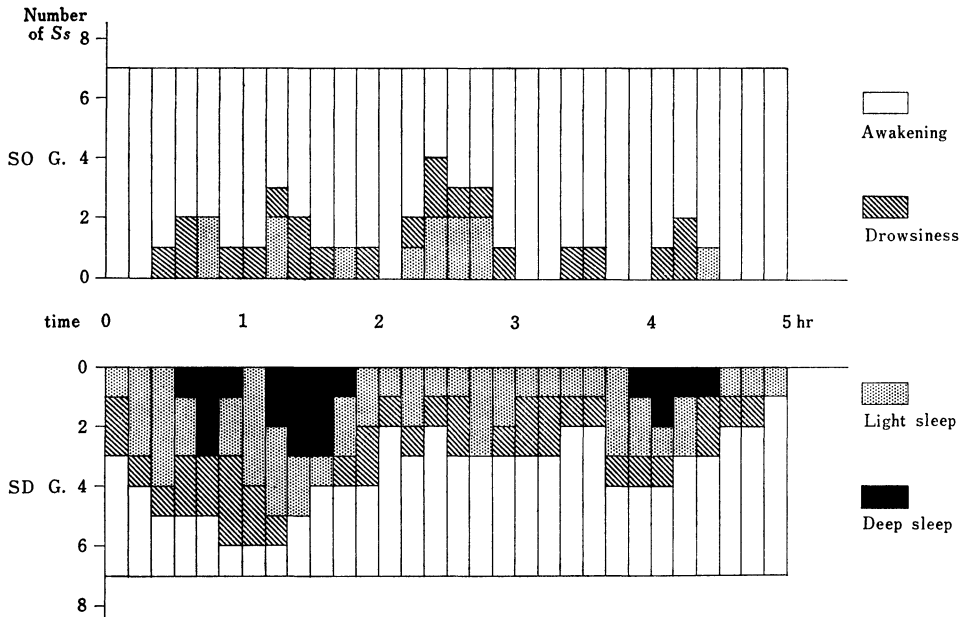


Fig. 1. Transition of each arousal level expressed by distribution of Ss during 5 hours of SO and SD.

On the other hand, few Ss in SD group showed the fast wave EEG patterns characteristic to awakening until the 2nd hr. in comparison with Ss in SO group during the confinement. In a group of SD they showed more sleep EEG patterns involving deep sleep ones in the first half of the confinement than in the second.

The percentages of appearance per each of four EEG patterns are shown in Fig. 2. Concerning the rates of occurrence of EEG pattern during the state of awakening, they were higher in SO group than in SD group. On the contrary, the higher rates of occurrence of the EEG patterns from the states of drowsiness to those of sleep were seen in SD group.

From the results stated above, it may be said that for the Ss of SO group the higher levels of arousal were maintained throughout the whole course of the confinement period, while in a group of SD the number of Ss exhibiting the higher arousal levels increased in the second half of the confinement.

2) Analyses of average dominant frequencies

Average dominant frequencies within alpha band (8–13 cps) and beta band (14–20 cps) were examined. Fig. 3 illustrates the transition of average dominant frequencies during the waking, resting states, at the pre- and post-stages and every an hour during five hours of experimental confinement. It was found from this figure that within the band of fast waves a phasic “slowing” of dominant frequencies occurred in the second half of the confinement, i.e. at the 4th hr. in this study, with rapid restoration at post-stage. The degree of the “slowing” was larger in SO group than in SD. The pattern

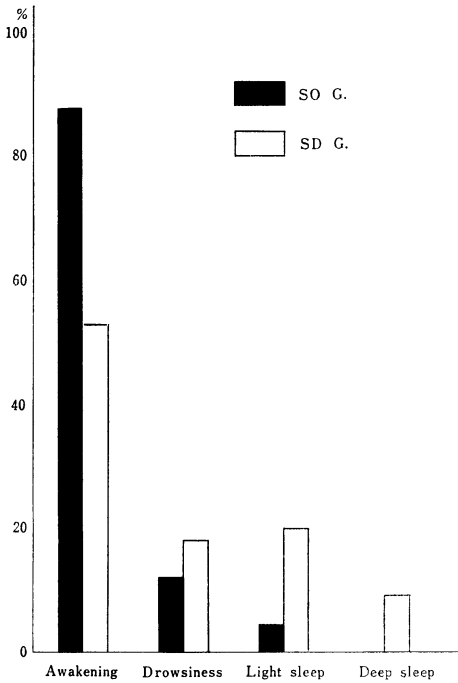


Fig. 2. Percentages of appearance per each of four EEG patterns in 5-hour SO or SD experiments.

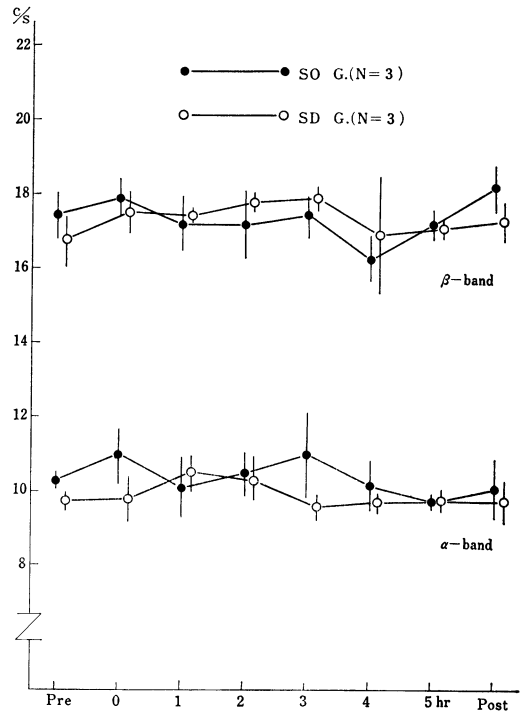


Fig. 3. Transition of average dominant frequencies within alpha and beta bands.

of this "slowing" was very similar to the result of the previous study (Hatayama et al., 1970). Within alpha band, no distinguishable changes were observed during five hours of confinement.

3) Averaged evoked responses to visual stimuli

Under the condition of 5-hr SO, it was examined whether the sensory habituation as the impairment of amplitude in a late component of evoked responses from parieto-occipital area for light flashes was present. An evoked response during the confinement was 30 consecutive responses averaged later by computer. Confirming the presence of evoked response to light flashes presented at intervals of 2 seconds at pre-stage, we searched for the changes of averaged photically evoked responses recorded every an hour during five hours of confinement. Fig. 4 shows these changes in a representative *S*. The evoked responses with a latency of about 50 msec after the light flash presented at the start of trace were, with the artifacts occurring from *S*' body movements, obtained immediately after the beginning of the stimulus presentation and after the 1st hr. From the 2nd hr. on, no remarkable responses were found out, however. These results also were much the same as those of the previous study (Hatayama et al., 1970).

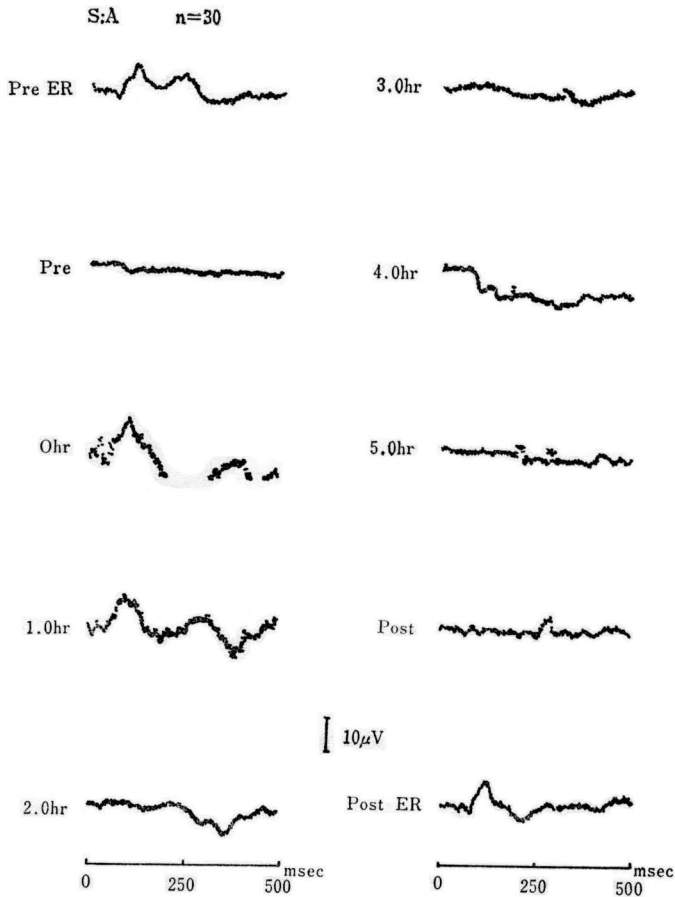


Fig. 4. Average photically evoked responses in a representative *S* during sensory overload.

II ECG

According to the preceding studies, it was designed to examine the effect of the difference between two conditions of confinement upon the ECG activity. Fig. 5 presents the percent changes in heart rates every half an hour during the confinement and at pre- and post-stages. As can be seen in this figure, compared with the results obtained for SD group, there was a decreasing tendency of percent changes of heart rates during five hours of SO. However, no marked changes were not seen in SD group throughout the experimental session.

III BODY MOVEMENTS DURING THE CONFINEMENT

Fig. 6 shows the number of average body movements every half an hour during the confinement. Here the sudden occurrence of muscle potentials in all tracings during polygraphic recording was treated as a body movement. In every period, the

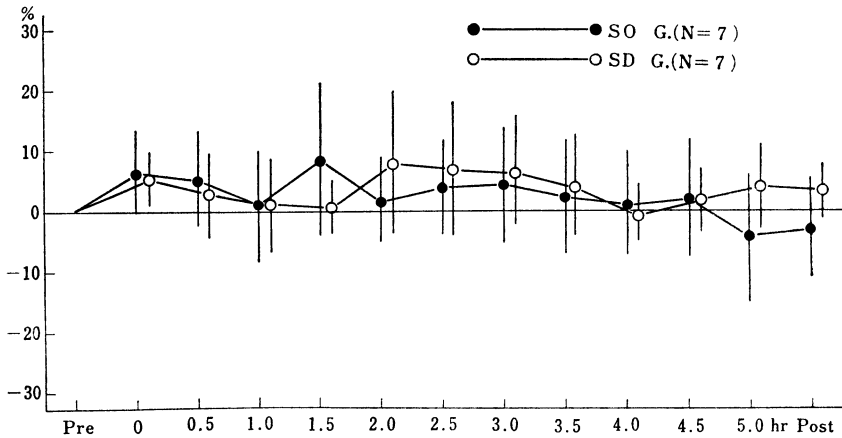


Fig. 5. Percent changes in heart rates during the confinement.

number of mean body movements was larger in SO group than in SD. In a group of SO, the number of body movements showed a decreasing tendency at first, an increasing one next, with the 2nd hr. for the borderline. In SD group were seen gradual increases of its number.

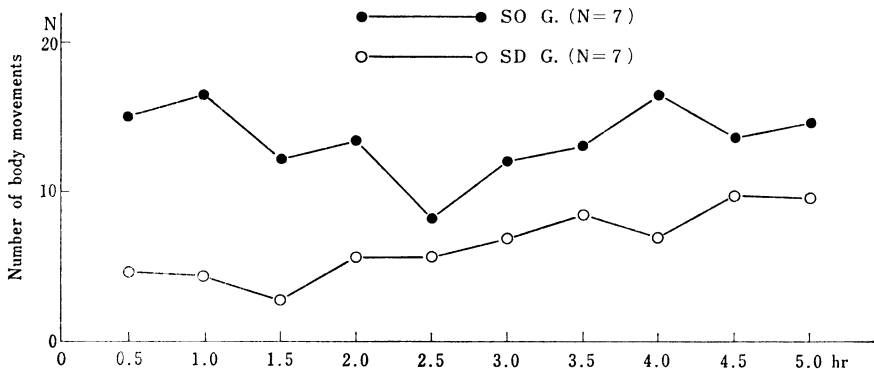


Fig. 6. Average body movements in each period.

DISCUSSION

The results of EEG data, especially changes of arousal levels, percentages of appearance per each of four EEG patterns and the data of body movements, indicated that the Ss exposed to five hours of SO maintained the higher levels of arousal, than those of SD group. These results held good with the previous study. From the analyses of dominant frequencies, it was demonstrated that the band which took more effects on dominant frequencies was that of fast waves, and that within its band a phasic "slowing" of dominant frequency occurred in the second half of the confinement in two conditions of it, particularly in SO condition, without any distinguishable change

within alpha band. Further, as inferred from a sensory habituation of photically evoked responses and the gradual decrement of percent changes of heart rates in SO group, the presence of a habituation to such an experimental environment was to some degree ascertained.

On the other hand, in a group of SD the enhancement of arousal levels was, as seen in increases of the EEG patterns characteristic to alertness, the values of heart rates and the number of body movements every half an hour, observed after the 2nd hr. . In particular, the fact that the number of body movements tends to increase gradually in the second half of the experiment in SO group may be related to the enhanced "emotional instability". Within beta band, the pattern of changes in which dominant frequency presented a phasic "slowing" may be, as pointed out also in the previous study, considered as the temporary falling of levels of consciousness.

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ZUSAMMENFASSUNG

In diesem Bericht wurden die allgemeinen Methoden, und die Versuchsergebnisse der polygraphischen Aufzeichnungen, die unter den zwei Arten der psychologischen Haft gemeldet wurden, beschrieben. Die beiden Arten der Haft dauerten 5 Stunden. Als Vpn dienten 24 Studenten. Die unter der Bedingung sinnlicher Belastung erhaltenen Daten wurden mit denjenigen der sinnlichen Entziehung und der Gruppe von der Kontrolle während der gleichen Zeit verglichen.

Aus den Ergebnissen der polygraphischen Aufzeichnungen zeigte sich, daß die Vpn, die sich der Bedingung sinnlicher Belastung ausgesetzt hat, im Vergleich mit denjenigen der Gruppe von der sinnlichen Entziehung ein höheres Erregungsniveau erhielt, und daß im Innern des Bandes der schnellen Wellen von der EEG-Aktivität eine "Verspätung" der herrschenden Frequenz in der zweiten Hälfte der Haft auftrat.

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