A Sensory Conditioning: Application to UCR of the Rise of Visual Sensitivity Induced by Intersensory Tone Stimulation

A SENSORY CONDITIONING: APPLICATION TO UCR OF THE RISE OF VISUAL SENSITIVTY INDUCED BY INTERSENSORY TONE STIMULATION

by

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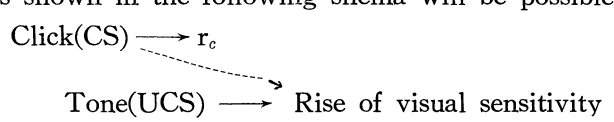
In sensory conditioning, sensory processes, e.g., the absolute threshold to light (UCR), are conditioned to certain irrelevant sensory stimuli, such as a tone (CS), that have previously been presented many times with the light. There are several investigators who regard that intersensory facilitation and inhibition, color-hearing, or hallucination may be produced through such type of conditioning. Bogoslowski (1), Howells (6), Ellson (5), Brogden (2), and Brogden and Gregg (3) have demonstrated that the actual sensation is never induced dramatically, but the sensitivity or the excitability of sensation can be slightly changed by the conditioning. However, there is still room for doubt as to the availability of sensory conditioning, since Kelly (7) and Cason (4) have described negative reports.

Recent experiments of the present investigator (8, 9) have concerned with the problem of sensory interaction between vision and audition. The results indicated that the visual sensitivity measured by the absolute threshold on a light patch subtending a visual angle of 50′ in central or peripheral vision, is enhanced by high pitch tones (facilitation effect) and is reversely lowered through low pitch tones (inhibitory effect). Time courses of these intersensory effects of tones were expressed as "$\varepsilon\%$-time curves" which were obtained through the measurement of aasolute threshold on the light patch of 50′ exposed for 280 ms. at the several time points during tone delivery for 4 sec.

The findings indicate the fact that there exists certainly some intersensory association between vision and audition, i.e., the visual sensation suffers a change in the sensitivity by the mere presentation of tone (70-80 db). Thus, the tone as CS might not be regarded as an irrelevant stimulus to the visual sensation (UCR), if the control group which is employed to test whether the tone affects the visual sensitivity or not, is omitted in the experiment on sensory conditioning. Such a control group was arranged in the articles of Cason (4), Brogden (2), and Brogden and Gregg (3).

The above data of the present investigator also suggest that such sensory conditioning as shown in the following shema will be possible.



The tone which was used as CS for the visual sensation in the articles of Kelley (7), Cason (4), and Howells (6), is employed as UCS to the same visual sensation in the shema, and a click is provided as CS. The rise of visual sensitivity is not given by light but tone. Testing whether such a type of sensory conditioning can be accomplished or not is the purpose of present study.

Procedure

As a detailed information on method and apparatus has already been given in the previous papers (8, 9), only major procedure is described here.

A tone of 1000 cps, 80 db was employed as UCS which was presented for 4/5 sec. through receiver (DR-305). A click as CS (about 60 db in intensity) was produced by inductorium and was presented through the same receiver with the tone.

The visual sensitivity was measured on foveal vision. A round test patch subtending the visual angle of 50′, was adjusted at the center of visual field in the left eye. A small deep red fixation point which was to be maintained at a just visible level during the experiment, was set beneath the circle of test patch. S looked at the position slightly above the fixation point where the test spot was to appear, through a 3mm, artificial pupil. The test spot was flashed during 280-msec.

$\varepsilon\%$-time curve of previous report (8) indicated that the sensitivity of foveal vision was sharply enhanced by the presentation of 1000 cps tone at the initial moment of tone delivery, but it ran down soon to a level of quiet within nearly 4 sec., though the tone had continuously been delivered. On the basis of the data, the foveal sensitivity (absolute threshold) was measured in the present study at the time point where the facilitation effect of tone was most dominant. That is, the test spot lasting 280 msec. was exposed at a time point of 1/7 sec. after the tone onset and the descending thresholds were determined by the usual method of limits. A light source for the test spot was induced by a fluorescent white neon tube lamp, and the duration of lighting was arranged as lasting 280 mesc. by a relay of electronic chronoscope. The steps of light intensity in the descending series of the method of limits had irregular intervals with one another which were adjusted at E's option by rotation of a polaroid diverted from photometer.

To determine an absolute threshold, the test spot was exposed with the click as many times as the number shown under each threshold of the figures of result (3–15 steps). As the step advances, the intensity of spot was decreased, and "seen" reports from S turned to "not seen" finally. This intensity of step reported as "not seen" was recorded as an absolute threshold. The number of step presentation which was necessary for the threshold determination was written in under each threshold of the figures of result.

Time schedule of pairing the stimuli was shown in Fig. 1. The click as CS was presented at first at the time point of 1/2 sec. before the onset of 1000 cps, 80

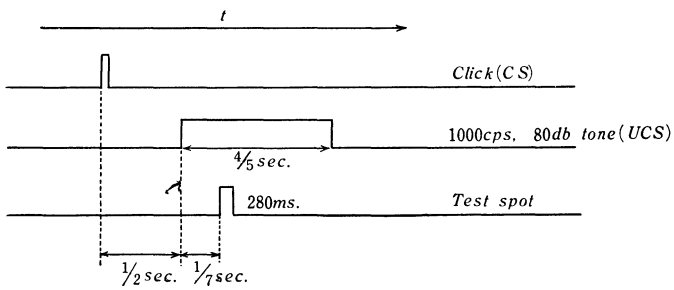


Fig. 1. Time schedule of pairing of the stimuli.

db tone (UCS) which lasted 4/5 sec. Being delayed 1/7 sec. from the onset of tone, the test spot was flashed during 280 msec. In the series where the tone was absent, the time interval between click and test spot was 1/2 sec. + 1/7 sec. This time relations were controlled by the relays of electronic chronoscope.

Two groups of Ss took part in thit study—— an experimental group and a control group. The only difference between the two groups was that during the conditioning series the tone (UCS) was given in the experimental group, but it was absent in the control group. The two groups consisted of three series respectively as shown in Table 1. After the dark adaptation for 15 min. was completed, the control series was begun. The pair of click and test flash was presented repeatedly and

Table 1. Three series in the control and experimental groups in the sensory conditioning.

Progress of series / Groups	(1) Control series	(2) Conditioning series	Rest interval	(3) Test series
Control group	Test flash with click	Test flash with click	3 min.	Test flash with click
Experimental group	Test flash with click	Test flash with click and tone		Test flash with click

10 thresholds were obtained as the level accompanied by the click in the control group as well as in the experimental.

The second sessions were the conditioning series, which involved the rise of foveal sensitivity by the interpolation of tone in the experimental group. The 1000 cps, 80 db tone came on for 4/5 sec. at 1/2 sec. interval from the click and followed immediately by the test flash having duration of 280 msec., which was presented 1/7 sec. after the tone onset. The conditioning series included both the acquisition of conditioning of the rise in foveal sesitivity by tone to the click and the check of the rise of sensitivity. No equivalent number of conditioning trials

(i.e., the number of pairing of click and tone, or the sum of presentation of test flash) could be given to each S, and the numbers are attached to the figure of result. As the tone was omitted, the conditioning series of control group was equal to the control series in procedure.

After the conditioning series were completed, the third session (test series) followed after the rest interval of 3 min. The procedure was the same as the control series in both groups. In the series, the results of conditioning were tested and the extinction procedure was included.

A main reason for using the control group in this study was to prove that the conditioned change of foveal sensitivity to click was not evoked by the light of test spot, but through the 1000 cps tone. It was to be expected in this study that the foveal sensitivity is changed by the tone as well as by adaptation to the supraliminal light in the test spot caused by the descending series for threshold determination. Although the direction of change in sensitivity induced by the adaptation may be reverse to the one evoked by the tone, the effect of adaptation should be checked in the control group.

3 Ss were assigned to the control group and 5 Ss to the experimental group. All Ss were male students of psychology and none of them had experienced the experiment of conditioning.

Results

1. *Results of control group*

The results of 3 Ss are shown in Fig. 2a~Fig. 2-c. In the figure, $\varepsilon\%$ of ordinate is percent decrease in sensitivity over or under mean level of the control series. Abscissa is the order of progress in the experiment. The $\varepsilon\%$ of

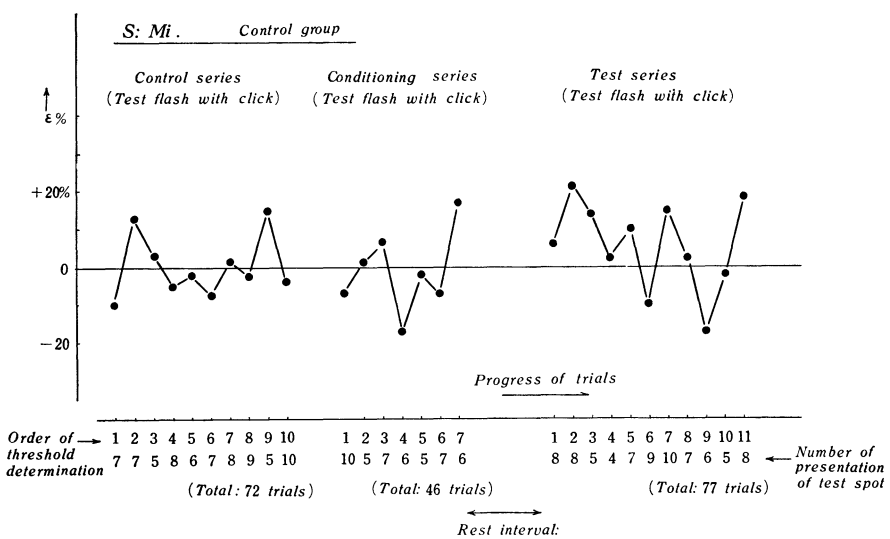


Fig. 2-a. Result of Mi (control group).

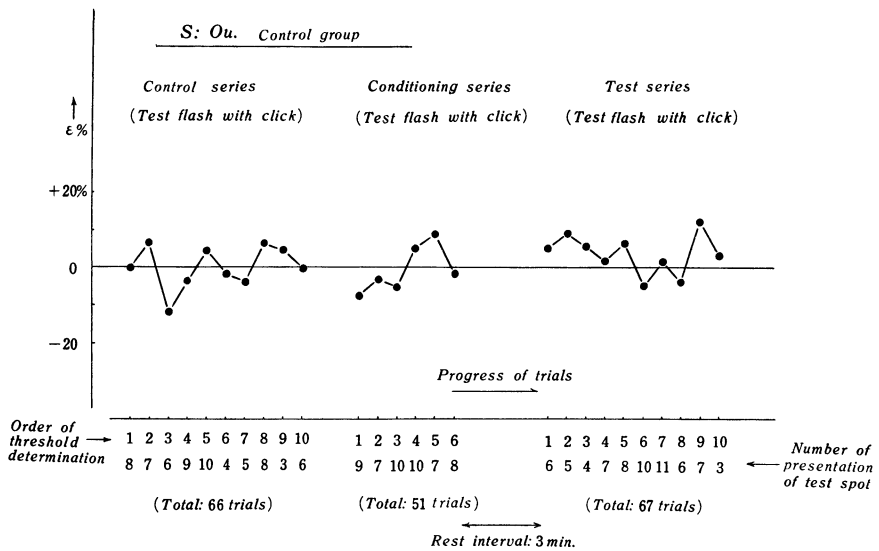


Fig. 2-b. Result of Ou (control group).

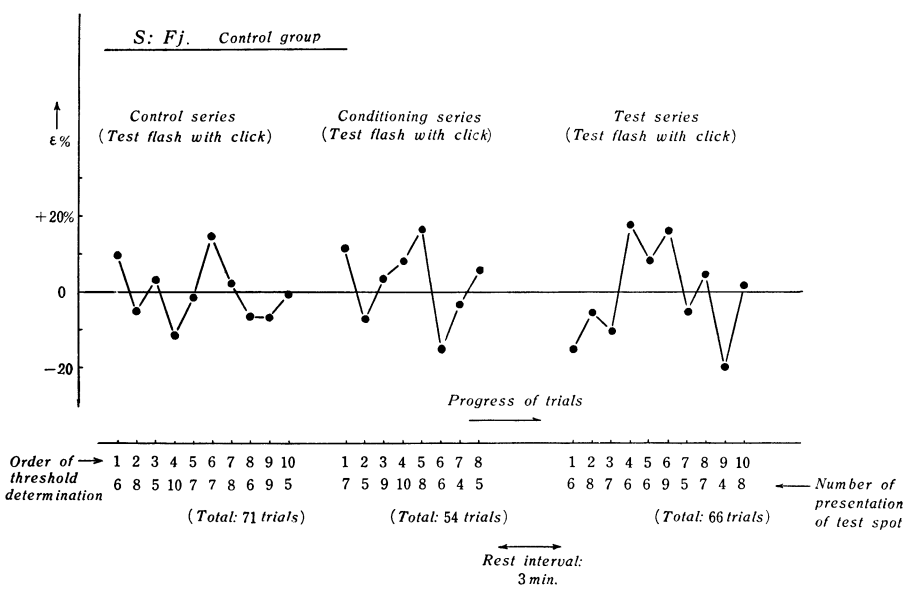


Fig 2-c. Result of Fj (control group).

plus indicates the increase of sensitivity and that of minus the reverse. Both the number of threshold and the number of presentation of the pair of click and test flash, which were necessary for determination of each threshold, are written on the abscissa.

The numbers of presentation of the pair of click and test flash in the experimental series of control group were 46 in Mi, 51 in Ou, and 54 in Fj, respectively, which were roughly equivalent to those of the experimental group.

The results of each S show that the threshold more or less retained its constant level throughout the experiment, and there one could not find any trend of association built up between the click and the visual sensation.

2. *Results of experimental group*

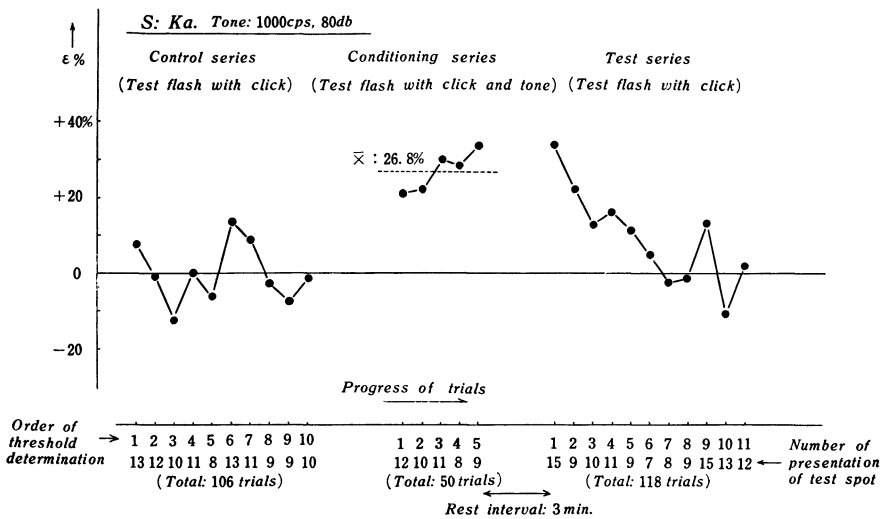


Fig. 3-a. Result of Ka (experimental group).

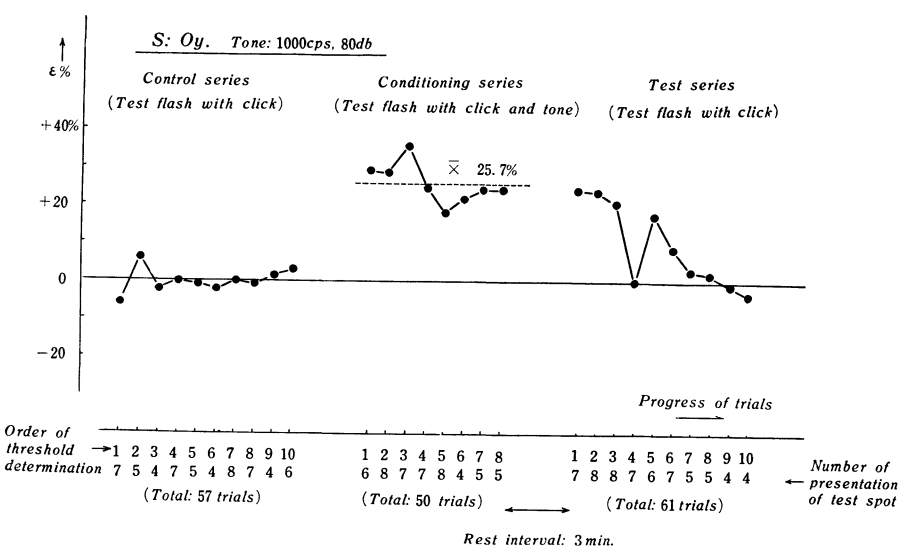


Fig. 3-b. Result of Oy (experimental group).

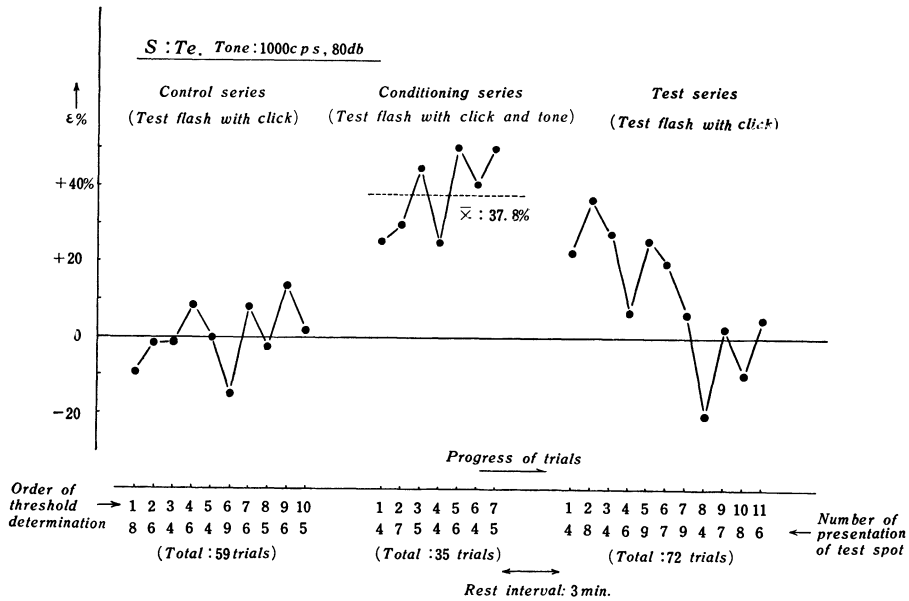


Fig. 3-c. Result of Te (experimental group).

Fig. 3-a ~ Fig. 3-e indicate the results of 5 Ss. In the conditioning series, the 1000 cps, 80 db tone brought a marked enhancement of visual sensitivity, about 20%~40% in ε%, without exception. The mean percentages ot this rise are appended in each figure. The rise of foveal sensitivity still remained in the test series, regardless of the absence of tone. That is, the results show that the association between click and visual sensitivity was acquired through the sensory conditioning. This association, however, decayed soon within about 20 trials of the extinction procedure. Progress of the extinction process is cleary exhibited in the figure.

Datum of Fu (Fig. 3-e), however, did not indicate the acquisition of conditioning turough 25 trials of pairing in the conditioning series, nor even by adding moreover 29 trials in the reconditioning series. Both Ka (Fig. 3-a) and Oy (Fig. 3-b) accomplished the conditioning by the reinforcement of 50 trials. Te (Fig. 3-c) also accomplished through 35 trials. In Ho (Fig. 3-d), the conditioning could not be built up until 57 trials had been added to the initial reinforcement of 66 trials.

According to the above results, it may be concluded that the sensory conditioning was accomplished by the reinforcement of 50 trials or so. But, for some Ss, further trials may be necessary for the formation of conditioning, or less than 50 trials may be quite enough for other Ss.

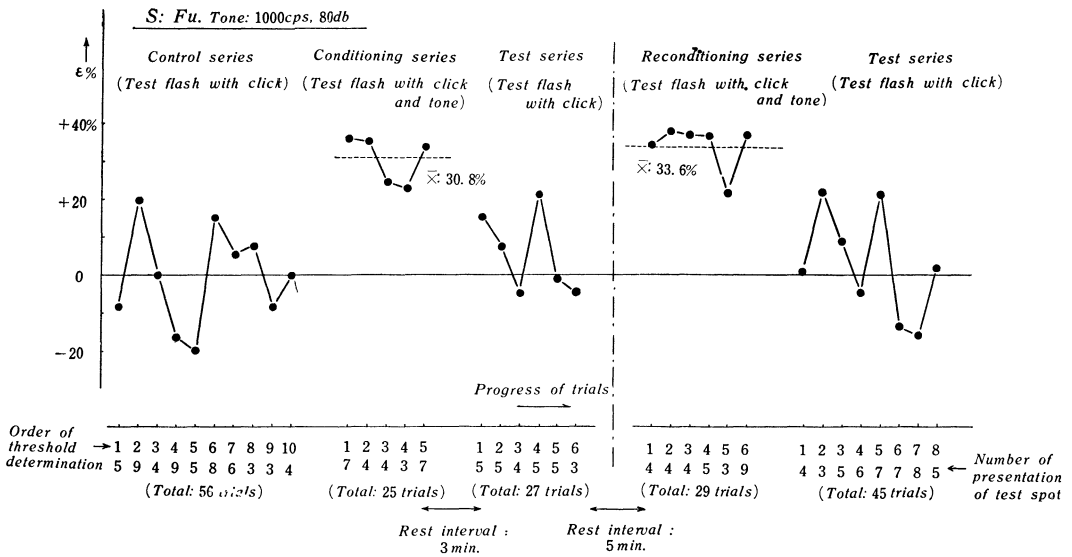


Fig. 3-e. Result of Fu (experimental group).

Discussion

The procedure by which the rise of sensitivity in vision was evoked not by a stimulus to vision but through the tone, marks this study off from others. It was sustained by the evidence of control group that the change of foveal sensitivity was induced not by the dim flash of test spot but through the delivery of 1000 cps tone. The result of control group also supports that the rise of foveal sensitivity in the test series of experimental group is not due to a formation of voluntary set or expectation but the formation of conditioning between the click and the visual sensation.

Moreover, set or expectation may not explain the results, if the following two procedures are added: (1) Replacement of the click to any stimuli other than click in the test series. (2) Application of a low pitch tone as UCS which brings decrement in the visual sensitivity.

3 min. of rest interval between the conditioning series and the test series might be insufficient for the elimination of a passing sensitization of reaction.

Thus there may be need for further investigation on the several problems noted above. Nevertheless, the results of present experiment are favorably disposed toward the availability of sensory conditioning.

The data also give the following advice to the experiment on sensory interaction studied in the previous papers (8, 9): When the measurement of standard level of visual threshold (control series) followed the experimental series where the tone was delivered and the effect of tone on the visual

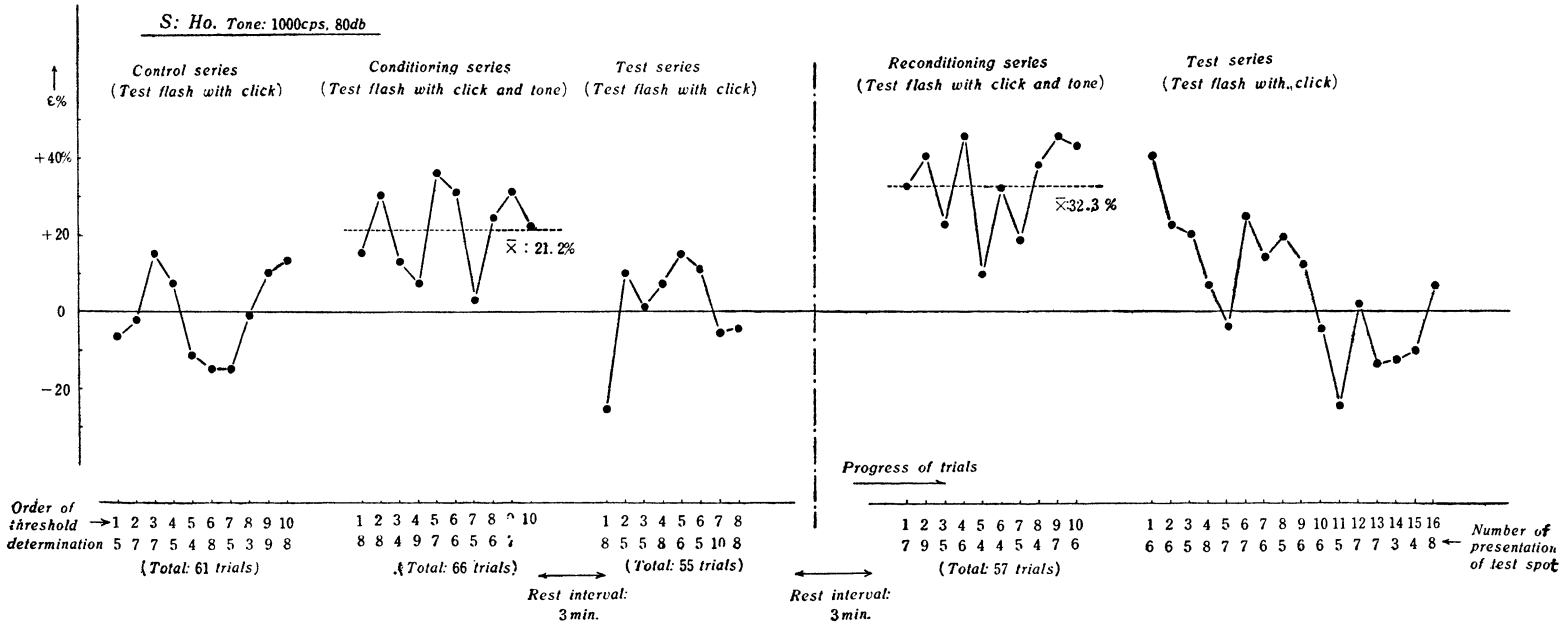


Fig. 3-d. Result of Ho (experimental group)

threshold was measured, initial 20～30 trials of extinction procedure are necessary at the beginning of measurement for standard level, in order that the effect of tone should not be included in the standard level.

Summary

Rise of foveal sensitivity in vision (UCR) induced by intersensory facilitation of a 1000 cps, 80 db tone (UCS) was conditioned to click (CS). Summarizing the results of 5 Ss in experimental group and 3 Ss in control group where the tone was absent, the sensory conditioning was accomplished through acquisition trial of about 50 pairing presentations of the click and the tone. But the association was extinguished by extinction procedure of about 20 trials.

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Zusammenfassung

Die Aufsteigung der fovealen Sensitivität im Gesichtssinn, die durch die wechselseitig-sensorische Wirkung des 1000 cps, 80 db Tons hervorgebracht wurde zu dem Klicken bedingt.

Aus den Resultaten von 5 Vpn. ging hervor, dass die Bedingung zwischen dem Klicken und der Aufsteigung der fovealen Sensitivität durch etwa 50 maliges Vorstellen des Klickens mit dem Ton erworben wurde. Etwa 20 maliges Vorstellen des Klickens ohne Ton aber losch die Verbindung aus.