

Studies of the Intensity of the Projected After-Image: I. Method and the Influence of Stimulaion Time

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STUDIES OF THE INTENSITY OF THE PROJECTED
AFTER-IMAGE: I. METHOD AND THE
INFLUENCE OF STIMULATION TIME

by

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The intensity of the projected negative after-image is operationally defined as the intensity of the projection ground which just erases the after-image. Apparatus and method to measure the intensity were described. The experiment to ascertain the influence of varying stimulation times upon the intensity of the after-image was carried out and the validity of this method was tested. Significant differences of the influence upon the intensity of the after-image show that the method is valid.

A. Problem

This is the first paper of serial studies of the intensity of the negative after-image and will present the methodology of these studies and also show the influence of the various stimulation times upon the intensity of the after-image. This influence will be taken up as the subject matter to ascertain the validity of this method to measure the intensity of the after-image.

In the laboratory it can be easily observed that the more the intensity of the after-image increases, the longer the duration of the after-image becomes and the less the intensity decreases, the shorter becomes the duration. This phenomenon seems for us to lead to a way of determining the intensity of the after-image through the measurement of the length of the duration. In observing the after-image in the course of its decay, however, dark intervals which are interspersed in the last phase of the decay are usually seen; in other words, the periodical alternations of appearances and disappearances of the after-image are noticed just before the image vanishes completely. This indicates that it is extremely difficult for the subject to determine and tell the precise time when the after-image comes to the vanish. Now it can be said that the length of the duration of the after-image is no good measure of the after-image.

It is also well known that the more intensity of the after-image increases, the stronger the color of the after-image grows, and the less the intensity decreases, the more the color fades, so far as the nature of the projection is kept constant. In relation to this, Busse's study (1) is very suggestive to define the intensity of the after-image. He formed his idea of intensity in term of "the weight". He says that the projected after-image is in state of rivalry against

the nature of the projection ground: When the after-image is comparatively intense, the details of the ground are inhibited by the after-image and consequently the after-image appears, and when the after-image is comparatively weak, the ground inhibits the after-image and it does not appear. So-called "the Franklin experiment" should also be mentioned here. This experiment shows how the after-image may be positive in its color on the dark field and negative on the field of white paper. Logically speaking, we should have the after-image as the result of any kind of retinal stimulation, no matter how long in the duration or how weak in the intensity. However, this after-image does not usually appear in our sight because we have a constantly changing projection ground in which other scenes of equal brightness and forms follows immediately after the prior stimulation. Now we understand that the after-image becomes apparent and intense according to the nature of the projection ground and that the intensity of the after-image should be determined in relation with the nature of the ground.

The color of the projected negative after-image has a certain influence upon the color of the projection ground immediately after the prior stimulation; in other words, the sensation of the color of the after-image is changed by the color of the projection ground as the result of the additive color mixture or the successive color contrast. If the color of the projection ground is the same as the color of the prior stimulus, and is complementary to the after-image, the achromatic after-image will be seen. This achromatic after-image should fade away and disappear at last if we can adjust the intensity of the projection ground to a certain level. When the low intensity of the projection ground is presented behind the after-image, the after-image looks grayish and the image gets thinner and thinner according as the intensity of the ground increases. If the after-image is weak in intensity, the less intensity of the projection ground is enough to erase the after-image, and if the after-image is strong, the more intensity of the ground is needed to do so. Now the intensity of the projected negative after-image is operationally defined as the intensity of the projection ground which just erases the after-image.

B. Methods and Apparatuses

The stimulus is a ten centimeters square transluminated milk glass which is placed on one side of the wooden box, in front of which the subject is to sit on a bench. The light source is a 100-watt frosted bulb, which is placed inside the box. Variations in the brightness of the square glass are obtained by the adjustment of the autotransformer which is connected between the bulb and the source of electricity in series. A voltmeter is also connected between them in parallel. Calibrations are made to convert the voltage into the brightness of the stimulus. The stimulus set is placed on the table. The subject is seated at the edge of the table with his head fixed in the head and chin rest. Distance between

the stimulus and the subject's eye is 120 centimeters. This distance is movable in accordance with the planned experiment. Both monocular and binocular visions could be employed through this device.

All experiments are carried out in the dark room. The general procedure is as follows: After the period of the desired stimulation time, the experimenter puts off the light source and gradually turns up the brightness of the projection ground by adjusting the autotransformer. This projection ground is simply the previous square milk glass on which the after-image is developed. The subject is asked to keep to watch fixation point on the projection ground all the time when the experimenter is adjusting the brightness. When the light is put off, the subject sees that the obvious negative after-image is on the ground and the image gets thinner as the adjustment goes. The subject is also asked to make a sign to let the experimenter stop his adjustment when the image completely vanishes. Immediately after this adjustment, the experimenter reads the voltage and knows the brightness of the projection ground, the intensity of the after image through the calibration table.

The duration of the time from the switching off of the light source to the finish of the adjustment should not be long and should be strictly the same in every measurement since the after-image decays. In our experiment, it took, say, three to five seconds in most cases to finish the adjustment.

Some trials are necessary for naive subject to be trained to this measurement before the experiment starts. The experimenter should also be skilful in the adjustment.

The time intervals from two minutes to fifteen minutes are put between the successive measurements. The length of these time intervals may be due to the intensity of the after-image and may be sufficient for the after-image to vanish. It does not influence the development and the measurement of the next after-image.

Two or three subjects were employed in these experiment. The subjects were male or female undergraduate students of psychology at Iwate University. One series of experiment for a subject was planned to finish within a day.

C. Experiment

The method mentioned above will be valid, if the similarity is seen between the influence of varying stimulation times upon the intensity of the after-image obtained through our experiment and the influence obtained by the former research workers. The stimulation times are set up; 5 sec., 10 sec., 20 sec., 60 sec., 120 sec., and 240 sec., The order of the presentation of the series of different stimulation times is randomized in order to offset the influence of the order of presentation upon the measurements. Twenty measurements are repeated for one subject. The apparatuses used in this experiment are identical with the outlined above. Two male students are employed in this experiment.

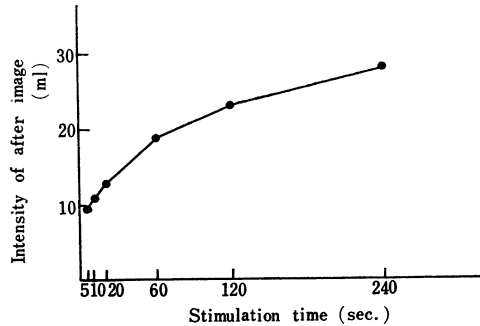


Fig. 1. The influence of the varying stimulation times upon the intensity of the projected after-image through the method of adjustment. The intensity of the stimulus is kept constant at 65 mL.

Figure 1 indicates that there are differences among the intensities of the after-image due to the stimulation durations of 5, 10, 20, 60, 120 and 240 seconds. The curve seen in Figure 1 agrees with the Obonai and Shibuya's result (2) and this shows that the method is valid.

If there should be the similarity between the figural after-effect and the after-image, as Obonai (2) and Yokose (3) point out, the curve which coincides with the curve of the relationship between the development of the figural after-effect and the inspection time indicates that the method has its validity.

References

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Zusammenfassung

Die operative Definition der Intensität des projizierten Nachbildes ist erklärt worden. Ferner wurden die Methode und der Apparat mit denen die Dauer des Nachbildes gemessen wird, auch behandelt. Das Experiment, das die Natur des Einflusses der wechselnden Reizzeit auf die Intensität des Nachbildes prüfen soll, ist angestellt worden, um die Gültigkeit dieser Methode festlegen zu können. Der signifikante Unterschied der Einflüsse auf die Intensität des Nachbildes beweist, dass diese Methode als richtig betrachtet werden darf.