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## DURATION AS A MEASURE OF THE SPIRAL AFTEREFFECT

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*Summary.*—The purpose of this experiment was to study the reliability of duration as a measure of the spiral aftereffect. The results for 10 Ss indicate that duration is a highly reliable measure and that duration is a simple monotonic function of exposure-time.

The standard procedure for administering the spiral aftereffect test consists of rotating the spiral and then having S report whether or not he sees the aftereffect once the spiral has been stopped. This use of a categorical measure of the spiral aftereffect (SAE) presents a number of difficulties. Reports of the presence of the effect are highly subjective and often ambiguous. In addition, precise comparisons of results are not possible since weak responses cannot be differentiated from strong responses (3, 4).

Duration is a convenient measure of the SAE and appears to be the measure of choice except that its reliability has been questioned. Thus, the purpose of this study was to investigate the reliability of duration as a measure of the SAE.

Review of the literature reveals no systematic investigation on the reliability of duration. Duration has been used as a measure of SAE strength in a number of studies despite the reservations raised by Hoppe's (6) report of the tendency of the effect to wax and wane. This tendency would place doubt upon its reliability as a measure of intensity since Ss might experience difficulty in determining when the effect had finally stopped. Both Wohlgemuth (8) and Basler (1) conducted studies of the SAE using duration as a measure of intensity. More recently, Eysenck (2) used duration, as did Holland and Beach (5). Stern (7), however, seriously questioned the reliability of duration citing the same objections raised by Hoppe and, in his own study, used latency of the effect as the strength measure.

As part of the present experiment, data were also collected with which to evaluate duration of the effect as a function of exposure time. The purpose was two-fold. Of immediate concern was the selection of a stimulation period of sufficient length so as to produce a measureable effect under a variety of conditions and yet short enough to prevent S's being fatigued. It was also felt that in future clinical use of the SAE information concerning the relation between duration and fixation time would be of value in selecting optimal stimulation periods.

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## METHOD

*Subjects and apparatus.*—Ten Ss with visual acuity of 20/25 or better were used. The apparatus utilized a table upon which was mounted vertically a sheet of peg-board. Through the center of the peg-board protruded the drive-shaft of the standard spiral aftereffect apparatus with a  $920^\circ$  Archimedes spiral,  $7\frac{1}{4}$  in. in diameter, and connected to a DC power supply. Speed of rotation was fixed at 80 rpm by means of a Strobotac, and recalibration was done by adjustment of voltage and amperage readings on the power supply prior to testing each S. Starting and stopping of the spiral rotation was controlled by an X-ray timer built into the main control panel. Built into the frame surrounding the apparatus was a sliding door which, when closed by E after each trial, blocked the entire apparatus from S's view. All of the exposed portions of the apparatus, with the exception of the spiral disc itself, were painted a flat light gray. An interval timer was mounted on the main control panel and was controlled by a push button on S's table so that the timer started when S pressed and stopped when S released the button. By this means, S reported the duration of the effect. S was seated at a table 8 ft. from the spiral, with his head fixed in a chin rest which was mounted on the table edge and centered so that both eyes were focused equidistant from the center of the spiral.

*Procedure.*—S was given the following instructions: "Look at the center of the spiral. I am going to spin it and when it stops, I want you to tell me what you see." The spiral was then rotated for 15 sec. and after S responded with, "It's expanding," or a similar response to indicate that he had observed the aftereffect, he was told, "Now I'm going to spin the spiral again. After the machine has stopped, if you see it expanding in the same way as you just did, I want you to press this button and hold it down until the spiral stops expanding."

S was then given one trial for each of four different durations of exposure time, 5, 15, 30, and 60 sec. The conditions were presented in random order with a 1-min. rest between trials, and aftereffect-duration times were recorded. The entire procedure was repeated 48 hr. later to obtain the test-retest reliability.

RESULTS<sup>2</sup>

The Pearson product-moment correlation coefficients for the test-retest reliability of SAE duration for the periods 5, 15, 30, and 60 sec. were .63 ( $p < .05$ ), .86 ( $p < .01$ ), .93 ( $p < .01$ ), and .82 ( $p < .01$ ), respectively.

The test-retest group results of Table 1 show duration of SAE increasing as a monotonic function of exposure time and apparently approaching asymptote.

A simple analysis of variance was performed to test for the presence of a

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<sup>2</sup>Test-retest individual scores for duration of the spiral aftereffect have been deposited with the American Documentation Institute, Auxiliary Publications Project, Photoduplication Service, Library of Congress, Washington 25, D. C. Order Document No. 7691, remitting \$1.25 for 35-mm. microfilm or photocopies.

TABLE 1  
TEST AND RETEST MEANS AND STANDARD DEVIATIONS OF DURATIONS OF SAE SCORES

Exposure Time (Sec.)	Mean		SD	
	Trial 1	Trial 2	Trial 1	Trial 2
5	4.09	4.03	1.67	2.03
15	11.98	11.29	4.49	3.89
30	19.10	17.12	6.08	5.59
60	23.09	21.85	5.77	6.74

trend among the effects. Because of heterogeneity of variance, the data were first subjected to a square root transformation. The results of this analysis (given in Table 2) show a significant trend between fixation time and duration of SAE.

TABLE 2  
SUMMARY OF ANALYSIS OF VARIANCE OF DURATIONS OF SAE

Source	SS	df	MS	F	p
Treatments	25.68	3	8.56	5.94	<.01
Error	51.89	36	1.44		
Total	77.57	39			

This experiment demonstrates that duration of the SAE is a reliable measure. The correlation coefficients for the 15-, 30-, and 60-sec. fixation periods are all significant. The lower value of .63 for the 5-sec. period can be attributed to the restricted range. Even naive Ss experienced no difficulty in consistently reporting termination of the effect. Such high reliability with naive Ss indicates that duration of the SAE should prove to be a very useful measure for both experimental and applied purposes. In addition, the orderly progression of duration of SAE with increasing fixation time further adds to our confidence that duration is a stable measure.

The observed relationship between duration of SAE and fixation time suggests that a relatively short exposure is sufficient to produce a substantial after-effect. On the basis of these results, 15 sec. appears to be an optimal fixation period. This duration has the advantage over the standard 30 sec. used in clinical practice in that it keeps to a minimum both fatigue and testing time.

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