An analysis of aftereffects in the measurement of the correction effect

BENJAMIN WALLACE*

Western Illinois University, Macomb, Illinois 61455

and

LAWRENCE E. MELAMED and RONI R. COHEN

Kent State University, Kent, Ohio 44242

Ss, under prismatic viewing, aligned a spot of light to the apparent straightahead first in the dark and then under illumination. Ss made these judgments either by controlling the spot themselves or by directing E in moving it. For both types of alignment procedures, judgments were significantly more veridical in the illuminated room (correction effect). Aftereffects, measured after both the spot alignment in the dark and in the light, were found to be significant only when S moved the stimulus. These results contradict the argument that the egocentric localization processes involved in the production of the correction effect itself are the basis of the aftereffects obtained.

Rock, Goldberg, and Mack (1966) assessed visual adaptation to prismatic viewing following an exposure to a 20-diopter prismatic displacement that was preceded by four preexposure tests. The first of these preexposure tests was to align a spot of light to the apparent straightahead under normal vision in the light. Following this baseline estimate, Ss were required to align the spot of light under prismatic viewing, first in the dark and then in the light. In the light, Ss positioned the spot of light several degrees closer to the true straightahead. This difference in spot alignment in the two illumination conditions was referred to as the immediate correction effect. Following correction-effect assessment, Ss again aligned the spot of light in the dark under normal vision. In the Rock et al study, a 10-min prism exposure condition followed, after which Ss again aligned the spot of light to the apparent straightahead under normal vision in the dark. The exposure task consisted of the stationary S observing the visual field in the illuminated room. The difference between initial preexposure alignment and final alignment of the light source under normal viewing in the dark was the measure of adaptation. The measurement of this aftereffect was considered positive when it was in the direction of prismatic displacement. Rock et al felt that the correction effect indicated that sources of information about his egocentric orientation existed in the optical array that could serve as a basis for adaptation. The purpose of the exposure condition was to show the existence of that adaptation, given a suitable exposure period.

Melamed and Wallace (1971) found significant correction effects for prism displacement ranging from

10 to 30 diopters. However, no aftereffects were obtained following a 15-min exposure condition similar to that used by Rock et al. The major difference between the Rock et al procedure of spot alignment and the Melamed and Wallace procedure was that in the latter study, Ss directed E in spot alignment, whereas in the former study, S aligned the light source himself. With this procedural difference existing in the aforementioned studies, Wallace, Melamed, and Kaplan (1973) assessed adaptation to prismatic viewing using the Rock et al paradigm void of a correction effect measurement under either active alignment, as in the Rock et al procedure, or S-directed alignment, as in the Melamed and Wallace study. In addition, all alignments were made either in the dark or in the light. The results of this study showed adaptation in the direction of prism displacement occurring only when Ss aligned the spot of light under active control, with all alignments being made in the dark. Furthermore, adaptation was found before a prolonged exposure to prismatic viewing. These findings were interpreted as indicating a situation of viewed active movement where the light source becomes an extension of S's hand that is moving the projector, in which case an aftereffect would be expected (Held & Schlank, 1959). Thus, it appears that the correction effect is not directly related to adaptation to prismatic viewing.

Since Wallace et al found adaptation to prismatic viewing only under active control of the light stimulus in the dark, it is possible that adaptation in the Rock et al study took place under similar circumstances. Thus, the alignment of the spot of light in the dark under prismatic viewing during the correction effect manipulation in the Rock et al study is likely to be the place where adaptation occurred if the Wallace et al predictions are correct. If this is where adaptation took place, rather than following a prolonged exposure to

*Reprint requests should be sent to: Benjamin Wallace, Department of Psychology, Western Illinois University, Macomb, Illinois 61455.

Table 1
Mean Displacements (Degrees) and Produced Aftereffects (Degrees) in the Direction of Prismatic Displacement as a Function of Exposure Manipulation With Either Active or S-Directed Movement in the Light or Dark

	Viewing Conditions									
	Preexposure 1 (Dark, Zero Displacement)		Exposure 1 (Dark, 20-D Displacement)		Postexposure 1 (Dark, Zero Displacement)		Exposure 2 (Light, 20-D Displacement)		Postexposure 2 (Dark, Zero Displacement)	
	Displacement		Displacement		Aftereffect		Displacement		Aftereffect	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Active Movement	0.2	.08	11.1	.14	1.2*	.57	11.0	.19	1.6*	.50
S-Directed Movement	0.1	.07	11.0	.24	-0.4	.19	10.9	.11	-0.6	.24

Note—Analyses were by two-tailed *t* tests for correlated measures.

**p* < .05

prismatic viewing, and if active control of spot alignment is necessary for adaptation, these results should be found in a replication of the Rock et al procedure. The purpose of the present study was to replicate the Rock et al procedure, including an assessment of the correction effect under two conditions: where S actively controls spot alignment (active) or where S directs E where to align the spot of light (S-directed).

METHOD

Subjects

Twenty undergraduate females from the introductory psychology sections at Kent State University served as Ss. Only Ss who did not wear corrective glasses were selected.

Apparatus

S was seated at a small wooden table, 60.8 x 121.6 cm, with her head securely positioned on a combination head- and chinrest. Ss wore Risley rotating prisms attached to the front surface of welder's goggles. To the right of S, on the table, was a partition, 91.2 cm high, attached to the table, preventing S from observing an Anscomatic II slide projector. The projector was the source of illumination for a 1-deg circular light projected on the far wall facing S, 3.7 m distant. The projector was placed on a wooden swivel container, allowing either E or S the ability to move the projector controlling the source of light. For half the Ss, a wooden handle was attached to the swivel container, allowing S to control movement of the light source. E moved the projector by simply moving the swivel container at a constant rate. In addition, a metal pointer was attached to the wooden container which, when moved, registered the number of degrees of displacement on a protractor. During all conditions in this experiment, S's hand was out of sight, even when S controlled movements. His hand was located far below eye level of the visual field.

Design

The primary factor in this design was the manner of movement used by Ss in positioning a spot of light to the apparent straightahead. Either active movement of S (active) or movement directed by S but performed by E (S-directed) was employed. Ten Ss were assigned randomly to each of the two groups. Only base-left prisms were used in this study, since Melamed and Wallace (1971) found no difference in the size of the correction effect or magnitude of adaptation as a function of direction of prism displacement.

Procedure

Each S was led into the experimental room blindfolded and

seated in a chair. Her head was then positioned in a combination head- and chinrest. The blindfold was then removed and replaced with welder's goggles, on whose front surface Risley prisms were attached binocularly. Using the method of adjustment, S was asked to align a 1-deg spot of light to the phenomenal straightahead four times, starting in a random order from the right or left of the visual field, in each of the following five conditions: *Preexposure 1*. A baseline estimate of straightahead was established in a preexposure alignment by Ss under zero prismatic displacement in the dark. *Exposure 1*. Under 20-diopter prismatic displacement, Ss then aligned the spot of light to the phenomenal straightahead in the dark. *Postexposure 1*. Under zero-diopter displacement, Ss aligned the spot of light in the dark. *Exposure 2*. Exposure 1 was repeated except that Ss aligned the spot of light under illumination. *Postexposure 2*. Prisms were then again set to zero prismatic displacement, and a measure of straightahead was again taken in the dark. In all five conditions, the spot of light was moved actively by half the Ss, whereas for the other half, movement was controlled by E. In the latter case, when adjustments to the apparent straightahead were required, Ss directed E's movements of the projector in aligning the spot of light.

RESULTS

Four analyses of variance were performed on the data of the present study. All analyses were concerned with active or S-directed movement. In the first analysis, the dependent measure was the placement of the spot of light to the phenomenal straightahead under the Preexposure 1 measurement, in which there was no prismatic displacement. No significant difference was found between active movement and S-directed movement in alignment of the light stimulus [$F(1,18) = 0.24$]. The means of this comparison plus the comparison of mean displacement for each of the remaining four viewing conditions are found in Table 1.

The second analysis concerned aftereffects produced during the first exposure procedure, in which S positioned the spot as viewed in the dark under 20-diopter displacement. The aftereffect was obtained as the difference between the Preexposure 1 and Postexposure 1 determinations of the apparent straightahead taken under normal vision in the dark. The aftereffect was considered positive when the placement of the spot of light was shifted in Postexposure 1 towards the direction of prismatic displacement in Exposure 1. This is the direction of the aftereffect predicted by Rock et al. A significant difference was found between the aftereffects produced by the active

and S-directed movement conditions [$F(1,18) = 4.23$, $p < .05$]. A mean aftereffect of 1.2 deg was found for the active movement condition as compared to -0.4 deg for S-directed movement. Using a two-tailed t test for dependent measures, the aftereffect produced for active movement was found to be significant from zero at the 5% level.

The third analysis concerned the comparison of produced aftereffects as a function of prismatic exposure in the dark (Exposure 1) and prismatic exposure in the light (Exposure 2). Adaptation to prismatic displacement in the light was determined by taking the difference between alignment of the spot of light in Preexposure 1 and Preexposure 2. The aftereffect was considered positive when the placement of the spot of light was shifted in Postexposure 2 towards the direction of prismatic viewing in Exposure 2. Only the active-movement condition produced a significant aftereffect from zero (1.6 deg), as assessed by a two-tailed t test for dependent measures. The aftereffect for S-directed movement was -0.6 deg. The difference between these two aftereffects was significant [$F(1,18) = 5.18$, $p < .03$]. No significant difference [$F(1,18) = 0.01$] was found between the measure of adaptation obtained after prism exposure in the dark under active movement (Preexposure 1 minus Postexposure 1) and prism exposure in the light under active movement (Preexposure 1 minus Postexposure 2).

The final analysis was concerned with the assessment of produced correction effects under active and S-directed conditions. The correction effect was assessed as the difference in spot alignment in the dark under prismatic viewing (Exposure 1) and alignment in the light under prismatic viewing (Exposure 2). Under active alignment, a mean correction effect of 2.4 deg was found. Under S-directed alignment, a mean correction effect of 1.7 deg was found. A two-tailed t test for dependent measures showed both correction effects to be significant from zero at the 1% level. However, no significant difference was found in the produced correction effects as a function of active or S-directed alignment [$F(1,18) = 0.63$].

DISCUSSION

A significant aftereffect in the direction of prismatic displacement was found to result from S aligning a spot of light to the phenomenal straightahead under active movement in the present study. The results indicated that this aftereffect could be measured following a brief prismatic exposure in the dark (Exposure 1). In addition, this aftereffect did not increase in magnitude

following a prismatic exposure in the light (Exposure 2). Therefore, it appears that adaptation resulted from prismatic exposure in the dark (Exposure 1) and was maintained by exposure in the light (Exposure 2). Since Exposure 1 and Exposure 2 were the two measurements used by Rock et al to assess the correction effect, adaptation would be expected under both active and S-directed alignment of the spot of light if the correction effect served a function in production of adaptation to prismatic viewing. The results of the present study do not find this to be the case. In fact, adaptation resulted only from active alignment of the light spot, although a correction effect was produced under both active and S-directed alignment. Thus, the results of the present study are in agreement with previous research (Wallace, Melamed, & Kaplan, 1973) which argued that adaptation in the Rock et al procedure occurred under active movement in the dark. Furthermore, Melamed and Wallace (1971) found the correction effect unrelated to the production of adaptation to prismatic viewing, and the present study agrees with this conclusion.

The finding that aftereffects were obtained with active movement only when the visual field was dark may relate to how S performs the task of aligning the spot of light to the phenomenal straightahead. Wallace, Melamed, and Kaplan argued that since, in the darkened room, the prismatically displaced spot is the only available stimulus that S can relate to his own egocentric localization, it would clearly serve the purpose of the viewed arm in the Held paradigm (Held & Schlank, 1959). Under illumination, there are a multiplicity of external cues for indicating spatial orientation that may be attended to. Although Wallace et al did not find adaptation in such a situation, the present study does show adaptation to be maintained during this illumination exposure.

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