LETTER TO THE EDITORS

EFFECT OF LENS ACCOMMODATION ON HOLDING THE EYE IN PLACE WITHOUT SACCADES

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FIORENTINI and ERCOLES (1966) and STEINMAN, CUNITZ, TIMBERLAKE and HERMAN (1967) reported that subjects could, voluntarily, suppress saccades during maintained fixation without increasing the variability of the eye about its mean fixation position. We have called this manner of maintaining the line of regard *holding* to distinguish it from *fixation* during which subjects typically make small saccades once or twice each second while they keep their eyes in place. The adoption of the *holding* instruction was not accompanied by any noticeable change in the appearance of point, disc or letter targets even when there were no saccades whatsoever throughout 10 sec trials. Drifts, "noisy" and "corrective", were apparently large enough to provide our subjects with fresh retina and prevent fading of the target-image. These informal observations encouraged us to believe that the suppression of fixation microsaccades was a central effect, perhaps reflecting a lack of attention to detail, or, the failure to search for detail in the target. Such search for detail, we felt, is normally induced by instructions to *fixate* a target and is discouraged, without adverse affects on eye position control, when subjects concentrate only on holding their eyes in place.[1]

Since our report was published, a number of scientists have asked whether the *holding* instruction induced our subjects to defocus the target by relaxing accommodation.[2] In this view, saccade-suppression under the *hold* instruction results from activation of a peripheral visual mechanism which degrades the error signal required to trigger fixation microsaccades. When subjects *hold*, they relax the crystalline lens and blur the target-image. The blurred image would not provide fine visual details and saccades would not, therefore, be elicited by small fixation errors. This "defocusing" interpretation of saccade-suppression would not explain the stability of the eye in the absence of fixation microsaccades, but, it could provide a peripheral mechanism by which subjects could, voluntarily, reduce their saccade rates. This interpretation did not, however, agree with the subjective reports of our experienced subjects who saw sharply-focused targets under both *fixation* and *holding* instructions. This note describes a confirmation of their subjective reports.

METHOD

The contact-lens optical-lever technique was used to make 2-dimensional eye movement records (each 10·1 sec long) while subjects attempted to maintain *fixation* or *hold* on small (4·2 min arc dia.) or large (15·8 min arc) tungsten-white discs located 0·75 m from the subjects in an otherwise dark room.[3] Target

[1] See CUNITZ and STEINMAN (*Vision Res.*, in press) for a more complete discussion of our hypothesized scanning function for fixation microsaccades.

[2] FIORNTEINI and ERCOLES (1966) also raised this possibility.

[3] The recording and stimulus apparatus is described elsewhere (STEINMAN, 1965).

luminance was 0·34 mL and recording was begun 30 min following instillation of 2 drops (spaced 10 min apart) of *Cyclogyl* 2% (Schieffelin & Co.) into the right eye. The left eye was covered and closed. Spectacle lenses were inserted in the target path to correct for loss of accommodative power and the subjects saw sharply focused targets whose appearance could not be altered by peripheral muscular mechanisms.[4] Subjects, *RS* and *AS* (the first and second authors), were highly experienced in *fixation* and *holding* and records were made at a single session where 40 trials with the small target and 20 trials with the large target were recorded. *Fixation* and *holding* instructions were alternated on successive trials.

RESULTS

Elimination of the capacity to defocus target objects had no effect on the degree to which our subjects could suppress fixation microsaccades. Saccade rates under each of the instructions with large and small targets are summarized in Table 1.

TABLE 1. MEAN NUMBER OF SACCADES/sec (RATE) AND STANDARD DEVIATIONS OF THE RATES (*S.D.*) OF SUBJECTS *RS* AND *AS* VIEWING SMALL (4·2 min ARC) AND LARGE (15·8 min ARC) TARGETS UNDER *fixate* AND *hold* INSTRUCTIONS AFTER ACCOMMODATIVE CHANGES HAD BEEN PREVENTED BY THE INSTILLATION OF "Cyclogyl 2%"

Subject *RS*	*Large* (N=20)		*Small* (N=40)	
	Rate	*S.D.*	*Rate*	*S.D.*
Fix	1·14	0·32	1·85	0·34
Hold	0·10	0·14	0·12	0·16
Subject *AS*	*Large* (N=20)		*Small* (N=40)	
	Rate	*S.D.*	*Rate*	*S.D.*
Fix	1·13	0·32	2·15	0·48
Hold	0·24	0·12	0·35	0·56

Both subjects showed much higher saccade rates (4–15 times) when they were asked to *fixate* than when they *held* their eyes in place. The differences in rates under the two instructions were statistically reliable (RS, t=5·17, df=29, P<0·001; AS, t=4·98, df=29, P<0·001). The performance of these subjects was very similar, in all respects, to measures made previously when the ciliary muscle was not paralyzed by a cycloplegic drug (STEINMAN *et al.*, 1967). Although we have not made exhaustive position measurements, *fixation* and *holding* stability of the eye about its mean position was essentially the same. Both subjects showed horizontal and vertical standard deviations of about 2–4 min arc when they *held* and about 3–4 min arc when they *fixated.* Eye position stability in this experiment was very similar to values recently reported for these subjects (PUCKETT and STEINMAN, in press). Saccade magnitudes under the *fixate* instruction were also normal (range about 2–10 min arc).

[4] Spectacle lenses were selected on two criteria, *viz.* clearness and magnification. Successive comparisons were made of the appearance of the target with the normal left eye and the drugged right eye until a lens was found that produced sharp targets which appeared to be the same size. *AS* required *a* +1 d. lens and *RS a* +2 d. lens, located about 6 in. from the right eye, to meet these criteria. The lens was located at this distance to keep it out of the way of our recording system.

We conclude that relaxation of the crystalline lens is not necessary for the suppression of microsaccades.

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