Perceptual and Motor Skills, 1992, 75, 287-290.

THE EYES IN IMAGERY AND PERCEPTUAL PROCESSES: FIRST REMARKS [1]

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Summary.—Through an ecographic system we examined the activity of the crystalline lens of 10 men and women during real perceptual activity and during imagery. Subjects had to perceive near and far stimuli and to imagine reading a word on a page of a book (near imagined stimulus) or seeing a ship on the horizon (far imagined stimulus). Results showed that processes of accommodation (linked to the variations of the optical axis of the crystalline lens) occur in both real and imaginative conditions. The first results suggest an active role of the eye during imagery.

In previous research (Ruggieri, 1991) it was hypothesized that the eyes play an active role in the process of imagery. Now we hypothesize that during mental imagery of a near or far figure the process of accommodation of the crystalline lens occurs as well as during a real perceptual process. In other words, we suppose that in mental imagery the peripheral mechanism of focusing (activity of the crystalline lens) is activated as well as during "real" perceptual processes. In particular we hypothesize that in imagining a near figure the bending of the crystalline lens increases, and it reduces when the image represents a far figure. We sought to verify this hypothesis using an ecographic system of measurement of the activity of the crystalline lens during mental imagery of near and far perceived figures.

Method

Subjects

Research participants were seven men and three women who ranged in age from 18 to 25 years. All subjects had normal vision (10/10).

Apparatus and Procedure

The accommodation of the crystalline lens was measured through an ecograph Model MINI that employs the standard ecograph technique. The apparatus that utilizes Immersion Scleral Shells is comprised of sound of 8-MHz frequency with an ultrasound beam that is amplified, digitalized, and projected onto a screen. On the subjects' corneal surfaces are placed the immersion scleral shells that are cylindrical transparent structures of 2 cm in length and 2 cm in diameter. One base of the cylindrical structure (the shell) is placed on the cornea. The other base is open and filled with a transparent substance (hydrossy-propyl-metyl-cellulose) into which the sound is focussed.

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On a screen two peaks corresponding to the anterior and posterior surfaces of the crystalline lens appear. As soon as the peaks appear, the image is blocked and the distance between the two peaks is measured.

During this procedure the subject lay prone on a couch. One of the two eyes was covered while on the surface of the other eye was put the anaesthetic substance, the shell, the transparent substance, and the sound. Half of the group had their right eyes covered first.

The length of the optical axis (i.e., the distance between the two surfaces of the crystalline lens) was measured in five different stimulus situations: (1) basal, i.e., without any perceptual or imaginative stimulation, (2) during perception of a real stimulus, a 30-mm tall letter (A) placed perpendicular to the eye at a distance of 10 cm or a 2-cm circle placed on the ceiling at a distance from the eye of 3 m, and (3) during imagery, when the subject was invited to imagine a ship on the horizon or to imagine reading a word on a page of a book. The instructions were for the "far" condition please to imagine being on a beach and seeing a ship on the horizon. As soon as you see a vivid image, please move the right hand. For the "near" condition the subject was asked "please to imagine reading a book and to try to see a word clearly. As soon as the image of the word is clear, please move your right hand." At the signal from the subject the image of the screen was blocked and photographed. The experimental situations were presented in a random order, and for each situation the length of the optical axis of the crystalline lens was calculated. Immediately after the measurement in the imaginative condition, the subject was asked to say what he was imagining during the basal condition, if he was imagining something. He was also asked about the vividness of the "mental" image, rating the image on a 10-point scale on which 10 corresponds to the maximum of vividness.

RESULTS

The length of the optical axis of the crystalline lens and the standard deviations are indicated in Table 1. In Table 2 are indicated values of Student t for dependent means between the two imagery conditions (far versus near imagined figures) and between the two real perceptual conditions (with near and remote stimuli). In this table are also values for the Student t for dependent means between basal values and the other situations considered. All measurements were made for the left and the right eyes. The length of the optical axis was measured in millimeters. The length is greater for the "near" than the "far" conditions for both real and imagined situations. The differences were statistically significant ($p < 0.05$). There were statistically significant differences between basal values and the "near" condition of both imaginative and real situations ($p < 0.05$). The length of the axis of the lens was greater in the "near" conditions. No differences between the imagined

TABLE 1
MEANS AND STANDARD DEVIATIONS OF LENGTH (IN MM) OF OPTICAL AXIS OF THE CRYSTALLINE LENS OF RIGHT AND LEFT EYES FOR FIVE CONDITIONS

		Right Eye		Left Eye	
		M	*SD*	*M*	*SD*
Imagery	Near	4.02	.32	4.05	.29
	Far	3.90	.32	3.95	.34
	t*	5.17		5.45	
Perception	Near	4.07	.31	4.24	.36
	Far	3.76	.34	3.80	.34
	t*	5.17		5.45	
Basal		3.86	.36	3.92	.34

*Student t for dependent means between the situations near and far in imagery and in perception ($p<0.05$, df 9).

"far" condition and the basal values appeared while the differences between the real "far" condition and basal values indicate higher values for the perceptual situation.

TABLE 2
STUDENT'S t FOR DEPENDENT MEANS BETWEEN VALUES OF LENGTH OF OPTICAL AXIS OF CRYSTALLINE LENS FOR FOUR PERCEPTUAL AND IMAGINATIVE SITUATIONS WITH BASAL VALUES

	Basal Values ($df=9$)	
	Right Eye	Left Eye
Near Imagery	5.60†	1.94*
Perception	2.33†	4.41†
Far Imagery	.43	.48
Perception	−2.04*	−2.25†

*$p<0.05$. †$p<0.01$.

DISCUSSION

In the psychophysiological literature on imagery, some authors (Farah, 1984, 1989; Finke, 1980) have tried to show that both activities of imagery and of visual perception take place substantially in the same cortical areas. Developing the concept of the physiological correspondence between perceptual and imaginative processes, previous researchers (Ruggieri, 1991) indicated that modification of the retinal input also modifies a simultaneously present imaginative activity.

The present results suggested also a relationship between the perceptual styles of the subjects and the forms of the observed modifications of imagery. On the basis of these results, the author hypothesized that the eyes could play an active role in imagery. This hypothesis was partially tested in the present experiment. Analysis indicates that in both perceptual and imaginative situations the eyes show similar behavior, namely, focusing. In fact, the crystalline lens shows, in the imagery situations, modifications of the length of the optical axis that correspond to the processes of accommodation which occur in the real perceptual activity. When the subjects are invited to imagine a figure placed near, the length of the optical axis of the crystalline lens increases as in perception of near stimuli, and the length reduces in both imagery and perceptual experiences for "far" imagined or perceived stimuli. Besides, the length of the optical axis increases (as in accommodation) for near imagined or perceived stimuli with respect to the basal condition.

These first results require further investigations to interpret the physiological contextual meaning of the modifications of the activity of the crystalline lens we have observed during imagery.

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Accepted June 26, 1992.