

## ON THE HYPOTHESIZED PHYSIOLOGICAL CORRESPONDENCE BETWEEN PERCEPTUAL AND IMAGERY PROCESSES<sup>1</sup>

VEZIO RUGGIERI

*University of Rome "La Sapienza"*

*Summary.*—This research examined some aspects of the interaction between imagery and perception of 16 male and 84 female undergraduate students in psychology. The data indicate that, when a subject is imagining with open eyes, a modification in the external stimulation of the retina, produced by covering the eyes, strongly modifies the imaginative activity. The majority of the subjects observed a loss of mental image. In 54% of the subjects the loss of image was provoked by covering only one of the two eyes. Other subjects presented interesting alterations of the mental image. The observed differences among subjects are interpreted by hypothesizing a correspondence between perceptual and imaginative styles that could employ common neurophysiological structures at central and perhaps peripheral levels.

The aim of the present research was to investigate some aspects of the interaction between processes of imagery and of perception. The question was what happens in mental imagery when, while a subject is imagining with eyes open and looking at a white screen, one of his eyes is covered?

Prior research has shown that mental imagery can affect the perceptual processing of stimuli. In fact, Farah (1989) observed that imagery can facilitate detection of visual stimuli. In this experiment subjects mentally projected images of letters onto the visual field and detected visual stimuli that fell on or off the image. Stimuli falling on the image were detected more often than stimuli falling off the image. Such results can be interpreted by hypothesizing that there are neurophysiological mechanisms common to perceptual and imagery processes. In the present research I studied an opposite aspect of the hypothesized interaction by examining whether an interruption of the external stimulation of the retina can have inhibitory effects on imagery.

### METHOD

#### *Subjects*

The research participants were 84 female and 16 male undergraduate students in psychology who ranged in age from 19 to 25 years.

#### *Apparatus and Procedure*

Each subject looked at a white screen 1 m away through two holes of 1 mm each placed at the end of each of two cylindrical viewing tubes of 5 × 3 cm. Then the subject was asked to imagine a scene (freely imagining what he

<sup>1</sup>Request reprints from Prof. Vezio Ruggieri, Via dei Marsi 78, 00185 Roma, Italia.

likes) while looking through the viewers with open eyes and to say "yes" as soon as a clear and vivid image appeared. The subject was also informed that the experience of imagining would be repeated twice and that in the second experience he could imagine the same or another scene. Also, in this case he had to say "yes" as soon as a vivid image appeared. In both the first and second experiences, immediately after the subject's signal, the hole of one of the viewers (right or left) was occluded for 10 sec. The same procedure was then repeated for the contralateral viewer. Half of the group had the right and half the left eye covered first. The subject was asked, after the two imaginative experiences, to say whether, for each task, the imagined scene was relatively stable or any modification of the mental image appeared, considering as modifications the variations in clearness or sudden change of image, modifications of contours, partial or total loss of the image, or any other observed change.

#### RESULTS

The responses of the examined subjects can be described as follows. (1) When one eye was covered, the whole image disappeared for 54 subjects (54%). Of this group 32 subjects lost the image only when the right eye was covered, 5 lost the image when only the left eye was covered, and 17 lost the image when separately both the right and left eyes were covered. The difference among the three groups is statistically significant ( $\chi_2^2 = 30.5$ ,  $p < .01$ ). (2) Seven percent of the subjects showed, when one eye was covered, a loss of one part of the mental image (the right or left side of the image corresponding to the right or left covered eye). (3) For 14 subjects the mental image did not disappear but only became more dark; for 6 subjects this occurred only when the right eye was covered and for 8 only when the left eye was covered. The difference among these three groups was statistically significant ( $\chi_2^2 = 11.4$ ,  $p < .01$ ). (4) Seven subjects experienced mixed responses, such as losing the whole image when one eye was covered and losing one part of the image when the contralateral eye was covered. Also, (5) seven subjects showed other modifications of the image, such as spatial displacement or modifications of the contours. (6) Seven subjects showed no modification of the mental image, and (7) four subjects had difficulty in imagining.

#### DISCUSSION AND CONCLUSION

The majority of responses showed that an interruption of the external stimulation of the retina can also inhibit or strongly modify imaginative processes present at the moment of interruption. The inhibition is indicated by a loss of image for a large number of subjects. For the other subjects, the mental image became darker or modifications of the contours or spatial displacement or partial loss were reported. Only a few subjects observed no

modification of the mental image. Relevant are the individual differences in the responses of the subjects which need a psychophysiological interpretation. The most surprising result was that the phenomenon of inhibition (loss of image), for a large number of subjects, was provoked by covering only one of the eyes (34% the right and 5% the left) and that the interruption of the stimulation of the other eye showed no modification of the mental image. Also curious is the fact that 7% of the subjects experienced loss of one part of the image and that loss was on the same side as the covered eye (for example, the left side when the left eye was covered).

In conclusion, the data suggest specific modalities of inhibition that are not easy to explain. For example, why, in some cases, was covering the left eye followed by disappearance of the left side of the image? And, why for many other subjects was inhibition evoked by covering only one eye? What are the functional connections between the eyes and imagery? Farah (1984) suggested that the processes of imagery take place in the cortical areas of the brain and in particular in the occipital areas of the left side. If this were so, how, in this study, do the eyes for perception and the cerebral cortex for imagery interact? One possible interpretation is that the perceptual pathways are involved also in the imagery process. To understand this hypothesis it is necessary to introduce other elements for discussion. The first refers to the possibility that different forms of inhibition can be related to different visual perceptual styles. Differences in perceptual styles can be inferred by considering ocular dominance which Porac and Coren (1976) defined as (a) dominance of greater sensory activity in one eye than in the other; (b) sensory dominance in situations of binocular rivalry; (c) sighting dominance, i.e., the dominant eye is considered the one whose input is favored in behavioral coordination. Previous research (Ruggieri, Cei, Ceridono, & Bergerone, 1980) showed that there are four groups of sighting dominance composed of right or left eye-dominant subjects, subjects who do not show ocular dominance, and subjects with fluctuating dominance (alternating right and left). In situations of chromatic binocular rivalry three modalities of conflict resolution appeared: a visual field entirely occupied by only one of the two colors (in this case, the dominant eye plays a determining role); by a fusion of the two colors (for these subjects there was a new synthesis of the perceptual activity of the two eyes); or by division of the visual field into two parts of different colors (for these subjects the cortical image was composed by the input of the two eyes) (Ruggieri, Capozzi, & Clavenzani, 1989).

Differences in perceptual style are invoked because it is possible to observe similarity between sighting dominance and some asymmetrical forms of inhibition of imagery through perceptual modification. I hypothesize, for example, that in many cases the asymmetrical inhibition (i.e., the loss of image with covering only one eye) appeared when the researcher covered the eye

that was more activated at that moment. Is it not possible to hypothesize that the activation refers not only to perceptual but also to imaginative activity? Is the dominant eye (or some centers of the retina-cortex pathway) more involved in perception and in imagery? In other words, is there some similarity between the construction of a perceptual cortical image and the mental representation produced in imagery? If so, why must the relative correspondence be only cortical and not also subcortical and peripheral, involving hypothetically the eyes as well? For example, one may suppose that, when for some subjects there is a loss of image corresponding to the side of the covered eye, information from both eyes is involved in the elaboration of a mental image, while for subjects who lost the whole image when only one eye was covered, the receptors may be asymmetrically involved also in imagery. Naturally the initial results of this research alone are not enough to sustain the hypothesis. Further investigations are necessary to confirm or disconfirm it.

## REFERENCES

- FARAH, M. J. The neurological basis of mental imagery: a componential analysis. *Cognition*, 1984, 18, 254-272.
- FARAH, M. J. Mechanisms of imagery-perception interaction. *Journal of Experimental Psychology: Human Perception and Performance*, 1989, 15, 203-211.
- PORAC, C., & COREN, S. The dominant eye. *Psychological Bulletin*, 1976, 83, 880-889.
- RUGGIERI, V., CAPOZZI, R., & CLAVENZANI, G. Perceptual styles in chromatic binocular rivalry, hypnotic susceptibility, and cerebral dominance. In V. A. Gheorgiu, P. Netter, H. J. Eysenck, & R. Rosenthal (Eds.), *Suggestion and suggestibility*. Berlin: Springer-Verlag, 1989. Pp. 241-248.
- RUGGIERI, V., CEI, A., CERIDONO, D., & BERGERONE, C. Dimensional approach to the study of sighting dominance. *Perceptual and Motor Skills*, 1980, 51, 247-251.

Accepted October 28, 1991.