Covering one eye in fixation-disparity measurement causes slight movement of fellow eye*

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Abstract. In the subjective measurement of fixation disparity (FD), the subject fuses contours presented in the peripheral macular areas of both eyes (fusion lock). The position of the eyes relative to each other is monitored by means of two haploscopically seen vertical lines presented in the central macular area, one above and one below a binocularly seen horizontal line. The subject is instructed to shift one of the vertical lines horizontally until the two are aligned, while fixating their intersection with the horizontal line. It has recently been questioned whether the foveolae really are pointed towards the perceived intersection. In this study, we monitored the position of one eye while intermittently covering the fellow eye, while the subject maintained fixation of the intersection of the remaining vertical line and the horizontal line. We found slight differences in position of the measured eye, depending on whether the other eye was covered or not, i.e. depending on the presence or absence of fusion in the macular periphery. These differences were more pronounced in the non-dominant eye.

Introduction

This study addresses the question where exactly the eyes are looking at in the subjective measurement of fixation disparity (FD). For better understanding of the complex mechanisms at work in the FD measurement, a brief review follows.

In the subjective measurement of FD, the subject sees and fuses contours presented in the peripheral macular areas of both eyes ('fusion lock', a square, for instance). The position of the eyes relative to each other is monitored by means of two haploscopically seen objects presented in the central visual field (Fig. 1a). These are usually two vertical nonius lines, one

Fig. 1. (a) A schematic view of the pattern seen by the subject during the subjective measurement of FD. The large square is seen binocularly and serves as a fusion lock. In our experiments, the inner size of the fusion lock was 2.5 × 2.5 degrees of visual angle. The horizontal line is also seen binocularly, but does not induce fusion. The right eye sees the top vertical nonius line and the left eye the bottom vertical nonius line. The subject is instructed to shift the top nonius line horizontally until the two appear aligned. (b) In reality, the two may well be out of alignment. For instance, when base-in or (c) strong base-out prisms are used. Although most of the fusion is accomplished by vergence, part of it is sensory, i.e. Panum's fusional area is utilized in the macular periphery to overcome a minimal diplopia, represented in this schematic diagram by doubling of the edges of the fusion lock. (d–e) In pathological (obligate or facultative) FD, the nonius lines are set out of alignment by the subject without fusional effort evoked by prisms. Although the fusion lock is fused perfectly, the foveolae are not looking at the same point on the screen. In other words, there is a slight incongruence between the correspondence in the foveolae and the correspondence in the macular periphery.

FD can be either physiological or pathological. Physiological FD occurs in normal subjects during fusional vergence evoked, for instance, by diverging or by converging prisms. The reason for the occurrence of physiological FD is probably that, during an excessive fusional effort, Panum's area [1] in the peripheral retina is used to fuse the fusion lock, i.e. a small portion of the fusion is not accomplished by a vergence eye movement but by sensory means (Figs. 1b–c). It has been found that this form of FD can change significantly if prisms are worn for longer periods of time. Even after periods as short as 30 seconds, changes do occur [2, 3].

Pathological (obligate or facultative) FD occurs spontaneously, without fusional effort evoked by prisms, i.e. although the subject fuses the fusion lock perfectly, the foveolae are not pointed towards the same point on the screen: A slight incongruence exists between the retinal correspondence in the peripheral macular areas and the retinal correspondence in the foveolae (Fig. 1d–e). In other words, perfect fusion of the fusion lock is obtained at a different angle of vergence than perfect fusion of objects in the central visual field. It has been suggested that this pathological FD may be causally