The relationship between passively induced apparent movement and gaze direction

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Hershberger (1984) has argued that extraocular stretch receptors influence the perception of visual direction. The main basis for this argument stems from the well-known phenomenon that pressing upon the side of one's eye with a finger creates an impression of movement in the visual environment. For instance, if one fixates a visible target located straight ahead and passively moves the eye to the right, the target object appears to move to the left. This occurs even when one attempts to fixate the object (Stark & Bridgeman, 1983). However, according to Hershberger, if the eye being used in this task fixates nasally (i.e., the left eye looks to the right), the direction of apparent motion to which the eyepress gives rise is in the *same* direction as the movement of the eye. Hershberger offers a simple self-experiment to demonstrate this.

After several attempts to replicate Hershberger's experimental procedure with some variations, it became clear to me that the phenomenon of apparent movement of the environment with passive movement of the eyes was not as clear-cut as suggested by Hershberger. The direction of apparent movement is not simply a function of gaze direction. The first attempts to replicate Hershberger resulted in perceived movement in the same direction as the press, as reported by him. However, two variations were attempted. In the first, the relationship between gaze dependency and passive movement was investigated by pressing the eye on the nasal side. During this experiment, all perceived movements of the environment were opposite to the pressing of the eye regardless of gaze direction. Thus, apparent movement is not consistently gaze dependent. The results of this first experiment suggested an alternative explanation for the phenomenon for the gaze dependency obtained by Hershberger. It could be that when

the eye is directed nasally, pressure on the outside of the eye by a finger is doing two things. It is moving both the front and the back of the eyeball. This suggests that the perceived direction of movement is a function of the relative movements of both the pupil, through which the light enters, and the retina. If the movement of the retina is less than the movement of the pupil, apparent motion opposite to the pressure is perceived; if the pressure induces more movement of the retina than of the pupil, apparent motion in the same direction is perceived. Pressure on the temporal side of the eye when the eye is turned nasally could result in greater movement of the retina than of the pupil. To investigate this possibility, the point of pressure was changed so as to be approximately equal regardless of fixation. Thus, when the eyes were straight ahead, the point of pressure from the finger was at the side of the eye. When the eye fixated nasally, the point of pressure was moved approximately 30° towards the center of the head. Under these conditions, perceived movement is in the opposite direction, just as it is when the eye fixates straight ahead. Performing the experiment this way has the advantage that one is not poking more directly into the eyeball but rotating it with soft pressure on the eyelid itself. Under these conditions, apparent movement is not gaze dependent.

A third reason for questioning Hershberger's interpretation of this phenomenon can be seen under Hershberger's original conditions. With the eye turned nasally and finger pressure on the side of the eye so that the apparent movement of the environment is in the same direction as the gaze, it is clear that the fixation point changes. This further suggests that the macular moves in the same direction and more so than the pupil. Thus, while fixating nasally, pressure on the eye may be moving the entire eyeball in one direction as well as rotating it in the opposite direction. This is, of course, a testable hypothesis, given the appropriate equipment.

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