RETINAL AND CORTICAL CHANGES IN THE VISUAL SYSTEM
OF PATTERN-DEPRIVED RATS

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RETINAL CHANGES

Substantial electrophysiological changes in the visual cortex and lateral geniculate nucleus of cats result from unilateral pattern deprivation. The question arises whether these changes are secondary to those occurring in the retina. When retinal responses (ERG's) of visually deprived cats were examined, a diminution of the b-wave of the deprived eye was found in some studies. Baxter and Riesen (1961) showed a rapid recovery of the b-wave during exposure to normal light conditions in cats that had been dark-reared for 12 months. Similar depression and recovery of the ERG b-wave were obtained with adult cats visually deprived for a period of a few days to several weeks (Cornwell & Sharpless, 1968; Ganz et al., 1968; Hamasaki & Pollack, 1972). Also, Hamasaki & Flynn (1973) found that children monocularly deprived for 1-6 months by eye patching showed a depression of the ERG followed by recovery after removal of the patch. No effects were observed in other studies in the cat (Wiesel & Hubel, 1963; Sherman & Stone, 1973) or in the monkey (von Noorden et al., 1970). These inconsistencies led us to examine the effects of long term pattern deprivation on the rat retina. The rat was chosen as the experimental animal partially for technical reasons and because it is representative of a simple mammalian retina. A detailed report of our results is given elsewhere (Yinon et al., 1974).

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Eighteen rats were pattern-deprived by monocular lid suture between the eighth and fourteenth postnatal day, before natural eye opening, and were tested at 1.5 - 13.5 months of age. Twenty-one normal adult rats of various ages were used as controls. Animals were anaesthetized with urethane (135 mg/kg) and atropinized. The retinae were examined by ophthalmoscopy at the end of the deprivation period; no pathological conditions were noted. In most deprived rats, the dark adaptation period prior to testing was of 12 hours duration. A dim red light was used during opening of the sutures. Experiments were carried out in the dark. Stimuli consisted of white light flashes (Xenon, 10 µsec) with a maximum light intensity of $1.5 \times 10^6$ cp. Ag-AgCl ball electrodes of 1.0 mm diameter were used for corneal ERG recordings.

The deprived eye initially showed a considerable diminution in the b-wave amplitude of the ERG, followed by a slow recovery to near normal values (Fig. 1). These effects were noted for a wide range of deprivation periods between 1.5 and 13.5 months after birth and were not influenced by the duration of the deprivation. No differences in either a-wave amplitude or a- or b-wave latencies were found between the deprived and normal eyes (Fig. 2); nor were any significant differences noted in the b-waves of the control animals.

The above results are in accord with earlier data of Baxter & Riesen (1961) and Cornwall & Sharpless (1968), and Hamasaki & Pollack (1972).

**VISUAL CORTEX**

Since most of the optic nerve fibers cross in the rat optic chiasm, binocular interaction is likely to be small, in accordance with the limited binocular field of vision. Despite the existence of commissural fibers between the two hemispheres, communication between them is negligible (Creel & Sheridan, 1966). Behavioral experiments on interocular transfer showed that application of the visual input in rats to one eye is largely limited to the contralateral hemisphere (Nadel & Buresova, 1968). Since it has been suggested that the deprivation effects in the cat visual cortex depend upon competition between inputs from the two eyes (Wiesel & Hubel, 1965), the relative independence of the two cortices of the rat has a certain advantage for studies where unilateral effects are under observation. Thus we were able to examine the assumption that competition is needed to produce deprivation effects.

We describe here experiments on visual-evoked potential (Yinon & Auerbach, 1973), the properties of neurons of the rat visual cortex and the effects on these, of monocular pattern deprivation. Preliminary studies on neural properties and retinotopic organization