

Binocular Deficits in Human Amblyopia are not as Permanent as Once Thought

1. Amblyopia is a developmental disorder caused by optical imbalance across the eyes during the critical period (approx the first 7 years of life). An uncorrected strabismus (squint) is one way this can happen. Amblyopic patients suffer a loss of sensitivity in the affected eye and have poor binocular vision and stereopsis, which can result in poor depth and distance perception.

2. The Conventional View

- Optical imbalance means that binocular cortical neurons do not develop
- Amblyopes cannot benefit from binocular vision
- Corrective surgery to the squint cannot overcome the neural deficit
- Standard treatment is to patch the good eye. This *monocular* solution is of only limited benefit: 3D stereo vision rarely recovers

3. Conventional Experimentation

- *Contrast detection threshold* is the lowest image contrast at which a stimulus can be just seen
- For normal observers, detection thresholds are lower with two eyes than with one because binocular cortical cells sum the contrasts from the two eyes
- For amblyopic observers, detection thresholds are the same with one eye and two



- Increase the contrast in the amblyopic eye so that stimuli are equally detectable in each eye!
- **Experimental Result:** Amblyopes now benefit from binocularity (*hurrah!*) (Baker, Meese, Mansouri & Hess, 2007, *IOVS*; Baker, Meese & Hess, 2008, *VR*)
- **Conclusion:** Perhaps it is better to attenuate the good eye rather than patch it—clinical trials needed
- **Why is attenuation better than patching?** It encourages normal binocular function (Hess, Mansouri & Thompson, 2010, *OVS*)

6. Local expertise

- Visual psychophysics and careful experimental designs guided by detailed quantitative modeling of the visual system

7. Links needed to develop the work

- Relevant clinical expertise and access to amblyopic patients

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5. Implications

- Binocular cells are *intact* but *latent* in amblyopia
- Binocular balance can be achieved by attenuating the amblyopic eye
- This *binocular* solution offers benefits over the *monocular* solution of patching