Supplementary material for

A new form of rapid binocular plasticity in adult with amblyopia

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Experimental procedures:

Binocular phase combination task

Two horizontal sine-wave gratings (0.3 cycle/°, 6.6°× 6.6°) with phase-shifts in opposite directions of the same magnitude (22.5°) were presented dichoptically. The perceived phase of the grating after binocular combination depends on the internal weighting of the two inputs. Therefore, any variations of the binocular sensory balance can be quantified by the change in the perceived phase. To account for any potential positional bias, two configurations were used for assessing the perceived phase: in configuration 1, the phase-shift was +22.5° in the unpatched eye and -22.5° in the patched eye; in configuration 2, the phase-shift was -22.5° in the unpatched eye and +22.5° in the patched eye. The perceived phase for each condition was then quantified by the half of the perceived phase difference between configuration 1 and configuration 2: (Phase_config.1-Phase_config.2)/2. Thus, if the patched eye provided a greater contribution to the binocular percept after patching, the perceived phase should be decreased, and vice versa if the unpatched eye becomes stronger. In a typical measurement session, each configuration was measured eight times using the method of constant stimuli. In all, there were 16 trials randomly interleaved in one measure (2 configurations × 8 repetitions). A short duration of practice was provide for each subject before the test, to ensure that one measure could be completed in three minutes and to ensure that performance was stable before patching.

The procedure for measuring perceived phase was similar to that reported in previous studies[1,2], in which observers were asked to adjust the height of a reference line to

indicate the perceived phase of the grating after binocular combination, defined as the location of the center of the dark stripe of the grating. The initial height of the reference line was randomly (-9 to 10 pixels) positioned relative to the center in each trial. The reference line was moved with a fixed step size of one pixel, corresponding to 4° phase angle of the sine-wave grating.

Monocular contrast response function

Monocular contrast response functions for a 0.3 cycle/° sinewave grating seen by the amblyopic eye (i.e, the patched eye) and fellow eye (i.e., the unpatched eye) were measured using an orientation discrimination (horizontal vs. vertical) task and the method of constant stimuli before and after patching, for subject S1 and S2. Performance at 5 cycle/° and 3 cycle/° were also measured for subject S2 and S3, respectively. Probabilities for correct discrimination were measured at six contrast levels, with each level containing 75 trials. Each measurement lasted for 15 minutes. We measured the contrast response function before the patching stage, immediately after the removal of patch, and 30 minutes and 60 minutes after the removal of patch. We fitted the data with Quick functions using a parametric maximum likelihood estimation [3]. The two parameters of the Quick function, alpha and beta, represent the threshold corresponding to 81.6% accuracy and the slope of the psychometric function at that point, respectively. The mean and variances of these two parameters were determined by using bootstrapping (500 iterations) [4]. An independent-samples Z-test was conducted based on the bootstrap results to statistically evaluate the changes after patching.

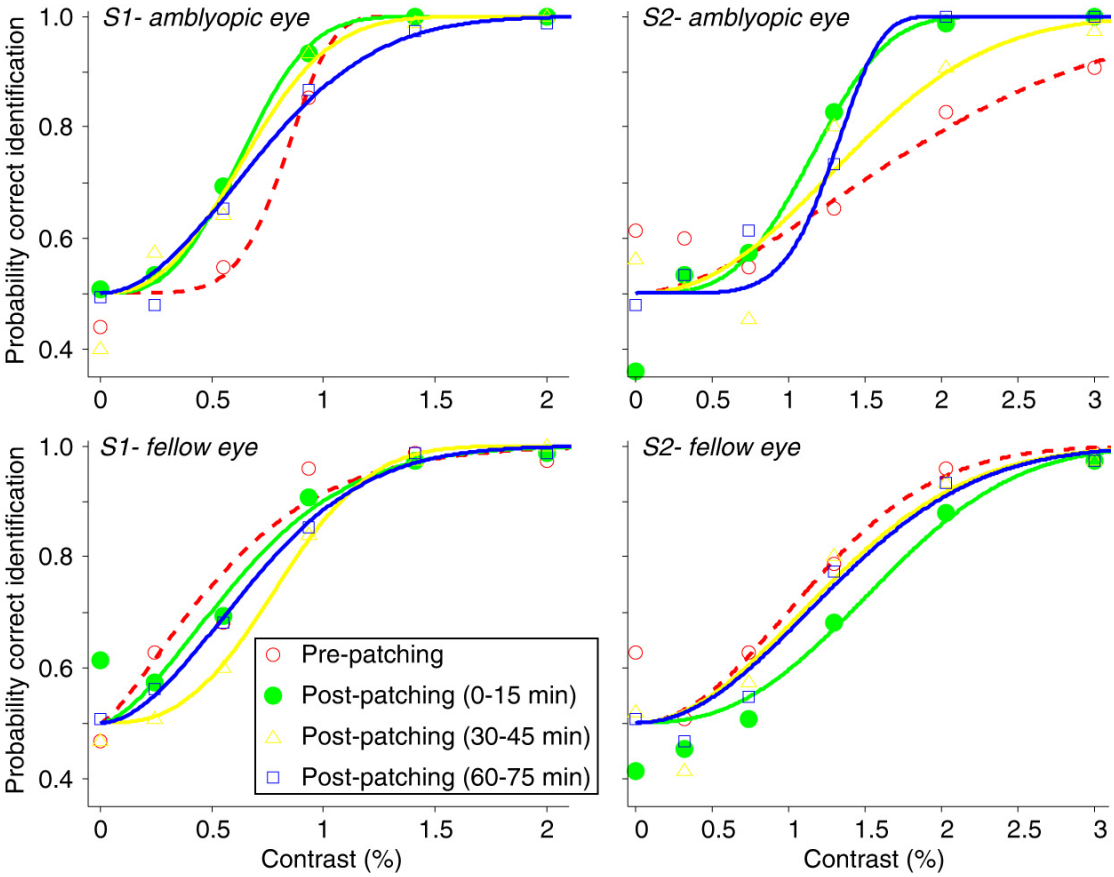

Figure S1. Contrast response functions seen by the amblyopic eye (upper panels) and fellow eye (lower panels) for subjects S1 and S2 at 0.3 cycle/° before and after patching. Each psychometric function was bootstrapped and refitted 500 times. The solid curves are drawn with the averaged alpha and beta from bootstrap resamples.

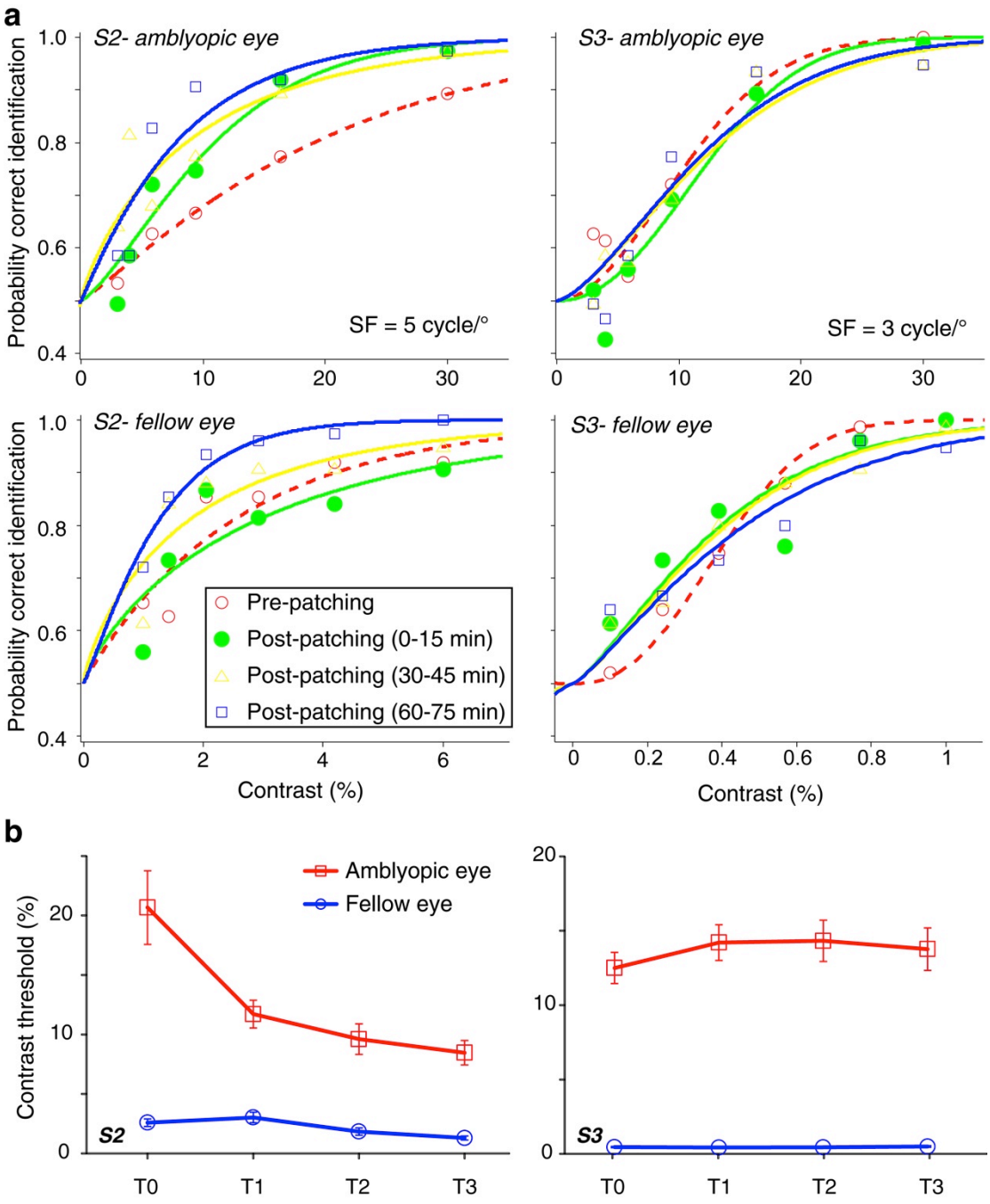

Figure S2. Contrast response functions seen by the amblyopic eye and fellow eye (a), and summary of the changes of contrast thresholds (b) for subjects S2 and S3 at high spatial frequency before and after patching. Each psychometric function was bootstrapped and refitted 500 times. The solid curves are drawn with the averaged alpha and beta from bootstrap resamples.

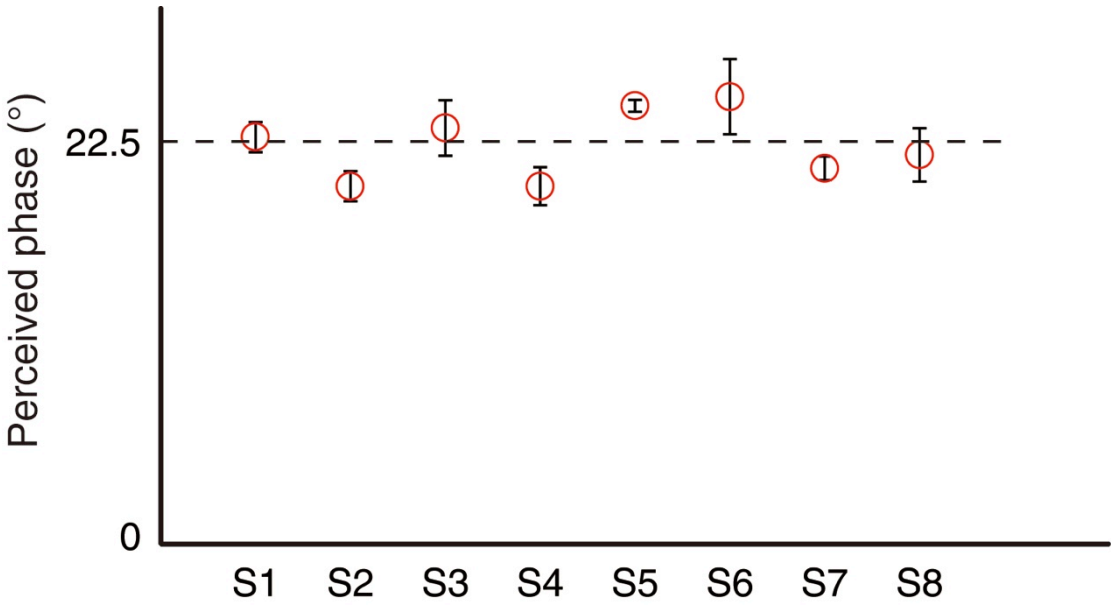

Figure S3. The perceived phase of the amblyopic eye when the fellow eye only sees the background. Each dot represents one subject. Error bars represent standard errors.

Table S1. Clinical details of the observers with amblyopia.

Obs	Age /Sex	Eye	Refraction	VA	Squint	History, stereo
A1	30/F	RE	Plano	20/25	XT 2°	Detected at 2 yrs, surgery at 2 yrs, eye patched for approximately 3 yrs, no stereopsis
		LE	Plano	20/20	Ø	
A2	50/M	RE	−1.00 + 0.75 × 30°	20/20	Ø	Detected at 11 yrs, no surgery or patching, eye exercises for 1–2 yrs, refractive correction since 12 yrs of age, no stereopsis
		LE	+3.00 −1.25 × 80°	20/63	XT 6°	
A3	23/M	RE	+1.50 DS	20/80	XT 1°	Detected at 15 yrs, no treatment, no stereopsis
		LE	+0.50 DS	20/20	Ø	
A4	42/M	RE	-1.00DS	20/63	ET 10°	Detected at 6 yrs, patched for 6 months, no surgery, stereo vision 200 arc seconds
		LE	+1.00DS	20/13	Ø	
A5	25/M	RE	-3.00 DS	20/13	Ø	Detected at 16 yrs, no surgery or patching, eye exercises for about 3 yrs since 22 yrs of age, stereo vision 40 arc seconds
		LE	+1.00 DS	20/33	Ø	
A6	25/M	RE	+2.00 + 3.00 × 70°	20/40	Ø	Detected at 19 yrs, no surgery or patching, no stereopsis
		LE	-0.50 × 165°	20/17	Ø	
A7	23/M	RE	Plano	20/20	Ø	Detected at 8 yrs, patched for 2 yrs, no surgery, stereo vision 80 arc seconds
		LE	+2.50 × 80°	20/33	Ø	
A8	24/M	RE	+2.50 + 1.50 × 100°	20/33	Ø	Detected at 23 yrs, no treatment, stereo vision 60 arc seconds
		LE	Plano	20/10	Ø	

Abbreviations: obs=observers; strab = strabismus; RE = right eye; LE = left eye; VA=visual acuity; ET = esotropia; XT = exotropia; DS = dioptre sphere, M = male, F = female; yrs = years of age.

References:

1 Huang, C. B., Zhou, J. W., Lu, Z. L., Feng, L. X. & Zhou, Y. F. Binocular combination in anisometropic amblyopia. *J Vis* **9**, 17, 1-16 (2009).

2 Huang, C. B., Zhou, J. W., Lu, Z. L. & Zhou, Y. F. Deficient binocular combination reveals mechanisms of anisometropic amblyopia: Signal attenuation and interocular inhibition. *J Vis* **11**, 4, 1-17 (2011).

3 Watson, A. B. Probability summation over time. *Vision Res* **19**, 515-522 (1979).

4 Efron, B. & Tibshirani, R. J. *An introduction to the bootstrap*. Vol. 57 (Chapman & Hall/CRC, 1994).