Quick contrast sensitivity assessment in primates using an exploratory search task

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Introduction
Collecting high-quality psychophysical data to estimate contrast sensitivity in human and animal subjects is time consuming and requires extensive training. To address these issues, we have developed a task that only requires training the subject to track a target and makes eye movements toward visual stimuli as they appear on the screen.

Methods
Task
The subject was seated to acquire a small fixation target, with the resolution of 3 deg in diameter, to the center of the monitor to start a trial. After holding the gaze position for 100 ms, the stimulus appeared. The subject had 1.0-1.8 sec to acquire the target and indicated their response by holding gaze on the new position for 300 ms. The measured eye position using a non-invasive infrared eye-tracking system with a 1/10 sampling rate (Eyelink-1000, SR Research).

Subjects
We collected data binocularly for one non amblyopic juvenile macaque monkey (2 years old) and one amblyopic eye.

Stimuli
Stimuli consisted of circular sinusoidal gratings vignetted by a two-dimensional spatial Gaussian (Kiorpes et al., 1998). Grating contrast and spatial frequency varied randomly from trial to trial, using the method of constant stimuli (we used disproportionate amounts of high-contrast trials to keep animals engaged in the task). Grating size: 3 deg.

Possible contrasts: 0.1, 0.3, 0.5, 1, 3, 5, 10, 20, and 75%.

Spatial frequencies tested: 0.1, 0.3, 0.5, 1, 3, 5, 10, 20, and 100 c/deg

We placed stimuli on a 2 deg eccentricity for 3 or 7 deg away from the center of gaze.

Subjects
We collected data binocularly for one human adult and one anesthetized macaque monkey. We also collected data binocularly for one non-amblyopic juvenile macaque monkey (2 years old) and one infant macaque monkey (6 months old).

Analysis
We fit psychometric functions using cumulative Weibull functions, using a fixed slope, lapse rate, and guess rate for each eccentricity per session, and independent thresholds (Macham & Hill, 2001a). The contrast sensitivity curves were fit using a double-exponential function. Confidence intervals result from parametric bootstrap approach (Macham & Hill, 2001a), 100 repetitions.

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References

