# Sine-wave grating adaptation selectively reduces the gain of the adapted stimulus

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Adapting to a sinusoidal grating selectively reduces contrast sensitivity to subsequent stimuli of the adapted stimulus orientation and spatial frequency (Blakemore & Campbell, 1969). Both pre-synaptic and post-synaptic suppression have been proposed as the cellular mechanism underlying reduced neuronal sensitivity in early visual cortex following adaptation (Finlayson & Cynader, 1995; Sanchez-Vives, et al., 2000). At the behavioral level, these two cellular mechanisms can be distinguished using an external noise method and a noisy observer model (Dao, Lu, & Dosher, 2003). We studied adaptation processes in two experiments; in the first, we measured adaptation effects at a full range of white external noise levels; in the second, we measured adaptation effects in orientation-filtered external noise. In both experiments, observers adapted to a 45 deg, 1 Hz counter-flickering sine grating of 0.8 contrast, then performed a two-interval forced choice detection of a sine-wave grating oriented 45 deg in the presence of external noise. In Experiment 1, we measured the impact of adaptation in six contrast levels of white external noise. Based on an analysis of full psychometric functions in multiple white external noise levels and at multiple stimulus contrasts, we concluded that adaptation reduces the gain to the adapted stimulus and we predicted that the perceptual template is changed about the adapted stimulus orientation. In Experiment 2, we tested this prediction by measuring adaptation effects using orientation-filtered noise. This allowed us to infer the impact of adaptation on the shape of the perceptual template. Nine different external noise bandwidths were tested: +/- 0, 1, 5, 10, 15, 30, 45, 60, and 90 deg about the center orientation of 45 deg. Compared to performance in unadapted control conditions, adaptation led to a general elevation in threshold in all noise conditions. Results from both experiments can be accounted for by the contrast gain control Perceptual Template Model (cgcPTM), which is mathematically equivalent to the Perceptual Template Model (PTM). The cgcPTM consists of perceptual templates in a signal path and in a contrast gain control path, non-linearity transducer functions, contrast gain control, pre and post gain control internal noise, and a decision structure. In this framework, adaptation selectively reduces the gain of the perceptual templates around the adapted orientation in both the signal and contrast gain control paths; adaptation does not alter pre- or post gain control internal noise; and adaptation does not change transducer non-linearity. These findings are consistent with post-synaptic changes following adaptation at the neural level.