Face adaptation is reduced by binocular suppression

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Background

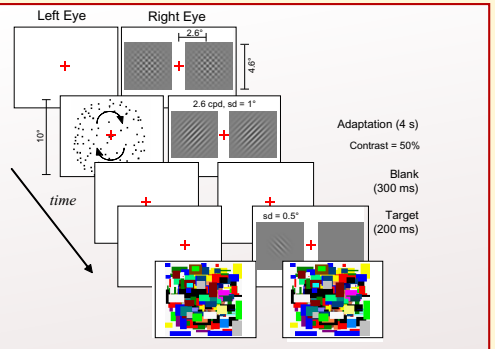
When two dissimilar images are presented to corresponding regions of each eye, one image suppresses the other one from visual awareness. Binocular-suppression has little effect on the build-up of several visual-after effects (tilt aftereffect, translational motion aftereffect, grating adaptation). Thus, invisible stimuli can penetrate some level of cortical visual processing. However, the global motion aftereffect is reduced in magnitude by rivalry suppression.

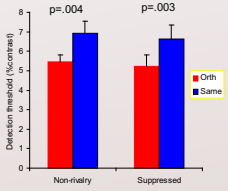
We used configural adaptation to images of human faces (Leopold et al. 2001) to investigate whether high-level aftereffects are suppressed by rivalry. Human fMRI and monkey electrophysiological studies demonstrate that rivalry modulates activity in cortical areas involved in processing faces and objects, although there is evidence from human fMRI that perceptually invisible images still can affect those areas.

Experiment 0

Low level adaptation:

Adapting stimulus was a sinusoidal grating and was presented to the non-dominant eye for four seconds. To minimize retinal and local adaptation the grating was slowly drifted. Contrast threshold was measured for a gabor patch with either the same, or orthogonal orientation. The phase of the test gabor patch was randomized. Threshold was estimated using the method of constant stimuli.



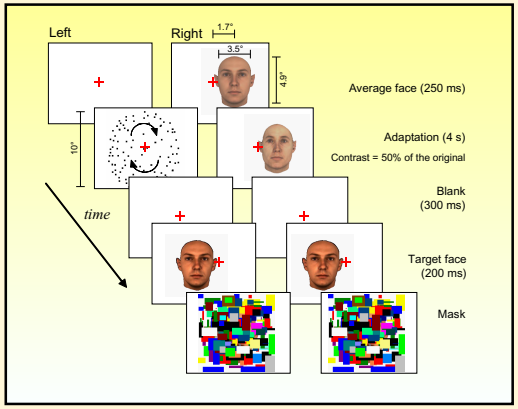


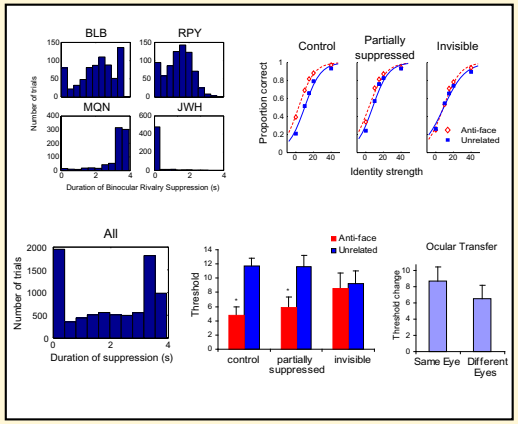
Binocular suppression has little effect on orientation selective adaptation to sinusoidal gratings

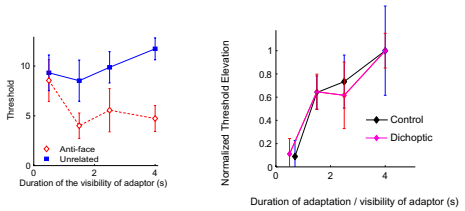
Experiment 1

Methods:

Participants were trained to identify four individuals. Different identity strengths were created by morphing the original stimuli with an average face (Leopold et al, 2001). Four seconds of adaptation in the non-dominant eye significantly shifts the psychometric function. Suppression was induced during adaptation by presenting a moving pattern to the dominant eye. Observers monitored the visibility of the face by holding a key down whenever it disappeared.







Discussion:

The magnitude of configural aftereffect reflects the duration of perceptual visibility of the stimulus, rather than the duration of physical presentation. There is almost no aftereffect when the stimulus is suppressed from visual awareness for more than 3 s.

Q: *Is visual awareness necessary for face-adaptation?*

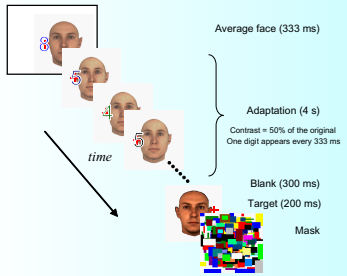
Attention and adaptation

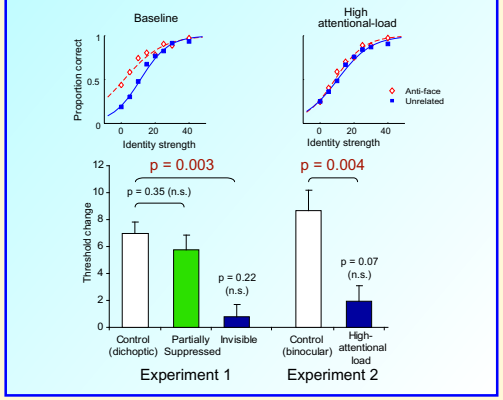
Without attention, we may not detect large changes to objects and scenes ("change blindness") or even perceive objects ("inattentional blindness", Simons & Chabris,1999). Julesz (1984) postulated that attention plays an important role in adaptation. It has also been shown that attention can modulate the magnitude of some aftereffects such as MAE (Chaudhuri, 1990), apparent motion in depth, etc. However, faces can be perceived in the near absence of attention (Reddy et al, 2003).

Experiment 2

Methods:

Participants were asked to attend to a stream of digits and perform a two-back memory task during adaptation. After adaptation, a target face was briefly displayed and observers had to identify it.





Summary

1 - Orientation Selective aftereffect following brief adaptation is not reduced by binocular suppression.

2 - Face selective adaptation is reduced or completely eliminated by binocular suppression and by inattention.

Implication

1- Neural activity in V1 is not directly accessible to consciousness

2- High-level aftereffects require awareness of the adapting stimuli

3- Both attentional selection and ocular suppression occur before the level of face specific processing

Our findings are in contrast to fMRI studies showing FFA/PPA activity in response to stimuli in the absence of visual awareness or attention, and suggest a close relationship between the Neural Correlates of Consciousness (NCC) and face-selective aftereffect.

References

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