Adaptation to invisible gratings in Troxler Filling-in

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Motivation

Under strict fixation, a stationary or slowly changing peripheral stimulus gradually disappears from awareness (Troxler 1804). This phenomenon is often attributed to early sensory adaptation at the level of retinal ganglion cells or LGN [1-3]. However, we recently suggested that Troxler filling-in is one end of a continuum of disappearance phenomena that includes ***cortical*** mechanisms [4].

induced			spontaneous
Binocular rivalry	Motion Induced Blindness	Transient Induced Disappearance	Troxler Filling-in
cortical			??

Here, we examined if fading of a peripheral target occurs before or after stages of orientation processing.

-If visual input is suppressed before it enters the mechanisms that selectively adapt to a particular orientation, then if the stimulus is suppressed (that is, it is invisible) observer should recover from adaptation.

-If suppression occurs after the site of orientation-selective adaptation, then the aftereffect should not correlate with the visibility of the adaptor.

In binocular-rivalry [5] *and motion-induced blindness* [6], *orientation-selective adaptation does not depend on seeing the adaptor.*

Experiment

Seven volunteers (6 naive) with normal or corrected vision participated in the experiment.

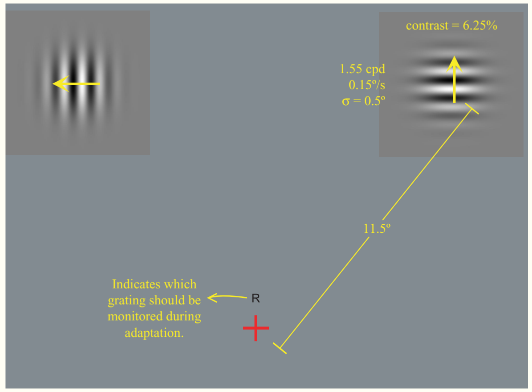
Observers were instructed to monitor one of the two Gabor signals during adaptation, and press and hold a key while it was invisible.

Whenever the key was down, the second adaptor was erased from the screen.

Each observer performed 2-4 blocks (40 trial each). Location and orientation of the target adaptor was randomized between blocks.

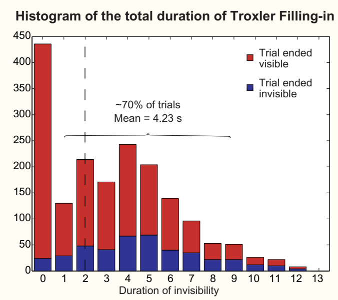
After adapting for 15 s, a low-contrast test Gabor (contrast = 2.3%) appeared briefly (200 ms) at one of the two locations. Observers were instructed to report the location and orientation of the test pattern by pressing one of the four keys.

A short beep indicated end of adaptation, followed by a 200 ms blank interval before the test pattern appeared.



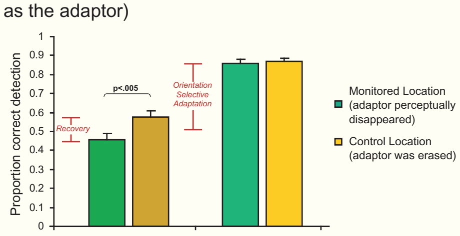
Results

On the average, the monitored adaptor disappeared for 3 s.



In 57% of the trials, the target adaptor was invisible for more than 2 s (Fading). In contrast, in 30% of the trial the target adaptor was invisible for less than 0.5 s (No-fading).

Robust orientation selective aftereffect (reduced visibility of a subsequent low-contrast target that has the same orientation as the adaptor)



Results (cont.)

Performance for the same orientation was better when the test stimulus appeared at the control location. That is, erasing the adaptor in a pattern that matched perceptual disappearances reduced the orientation selective adaptation.

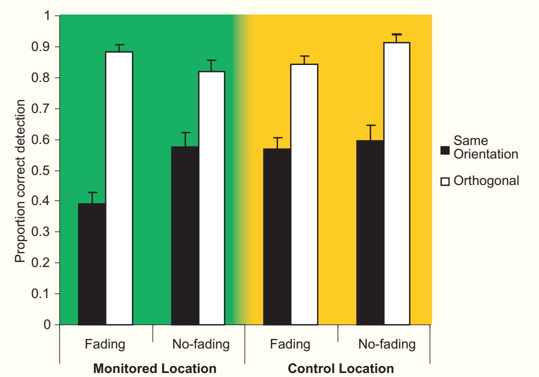
☆ Can be explained by attention (monitoring)? No. (control experiment on two subjects)

Stronger adaptation to invisible stimulus

In Fading trials, orientation-selective aftereffect in the monitored location was significantly stronger than in no-fading trials, or in the control location (p<.003). ☆

Performance for the same orientation in the control location was similar in Fading and No-fading trials.

It is possible that the recovery from adaptation has a slow time course relative to duration of each trial.



Discussion

In Troxler fading, orientation selective adaptation is inversely correlated with visibility of the adaptor.

In other instances, visual aftereffects either decrease or are not affected by invisible adaptor.

Fading may reflect fluctuations in sensitivity for a particular orientation)

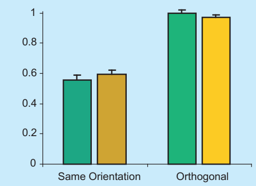
Troxler fading occurs either at or after stages of visual orientation processing.

Filling-in presumably occurs at a later stage (since it does not disrupt adaptation).

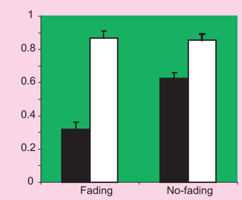
We believe orientation-selective aftereffect originates in V1. Therefore, Troxler fading is probably, at least in part, cortical.

Retinal/LGN adaptation was minimized by slowly varying the phase of the Gabor during adaptation, and randomizing the phase of the test. The observed aftereffect is mostly due to phase-independent adaptation (presumably not earlier than complex-cells in V1)

Monitoring (attending) did not increase the aftereffect. If the non-monitored adaptor was not erased, there was little difference in adaptation between monitored and control locations.



Same results were obtained if trials that adaptation ended with Troxler filling-in were excluded (p<.002).



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