More about "Buffy adaptation"

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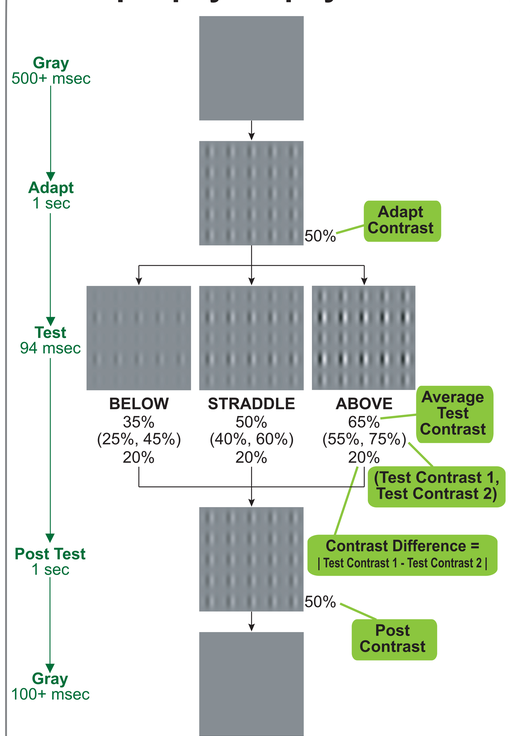
Introduction

Last year at VSS we introduced "Buffy Adaptation", a new kind of contrast adaptation in which a contrast-comparison-level is continually updated based on the recent average contrast. As this comparison level changes, some (second-order) test patterns become much more visible and some much less visible. Here we show this adaptation phenomena (in a few different contexts) and we sketch our modeling ideas in some detail.

Example psychophysical trial



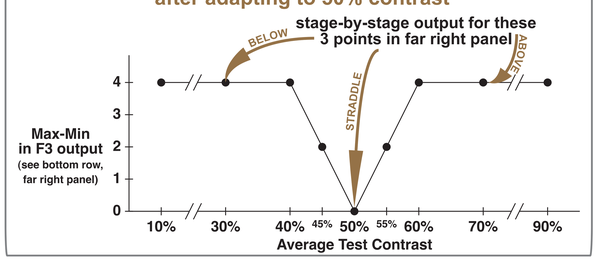
Task: identify the orientation of the contrast-defined stripes in the test

Some details of the methods

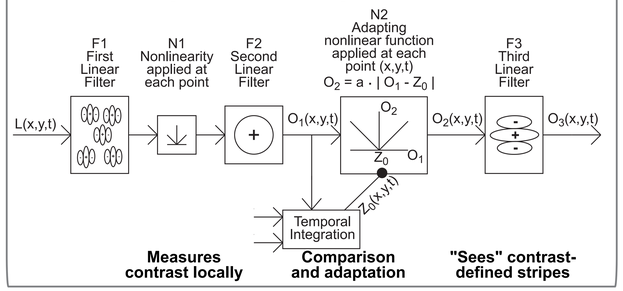
- Observers were paid Columbia University undergraduates with normal or corrected-to-normal vision.
- Second-order stripes could be vertical or horizontal and were composed of vertical or horizontal (first-order) Gabor patches. The example test stimuli above all have vertical first-order orientation and horizontal second-order orientation.
- Gabor element orientation was the same through a trial.
- Feedback was provided.
- Each Gabor element (except in the eccentricity experiment) subtended about 1 degree at the viewing distance of 1 yard (approx 0.9 meters).
- The Gabor element's spatial frequency was about 2 cycle per degree.
- In the example above, each stimulus is shown as a 5x5 grid of Gabor patch elements, but in the actual experiments the grid was 15x15 or 2x2.
- The grid was centered at fixation (except in the eccentricity experiment).

Output of adaptable complex channel

for test stimuli with equal Contrast Difference after adapting to 50% contrast

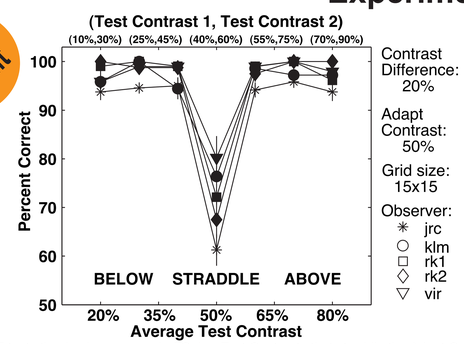


Adaptable complex channel



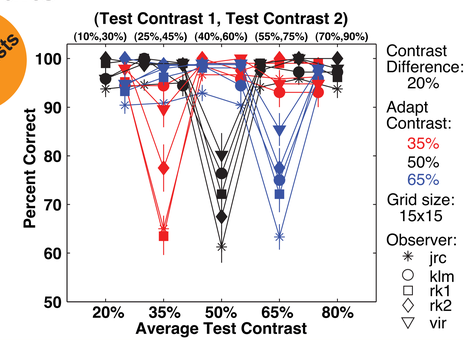
Experimental Results

Basic Result



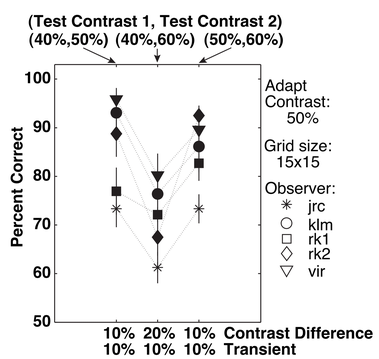
The STRADDLE test stimulus is composed of Gabor Test Contrasts that straddle the Adapt Contrast. In this case, since the Adapt Contrast is 50% and the Contrast Difference (between the two Test Contrasts is 20%) the Gabor element in the STRADDLE stimulus are 40% and 60%. BELOW stimuli are composed of Gabor Test Contrasts that are below the Adapt Contrast. ABOVE are composed of above contrasts. **Observers perform poorer on the STRADDLE than on the ABOVE and BELOW test stimuli when the Contrast Difference is constant.**

3 Adapt Contrasts



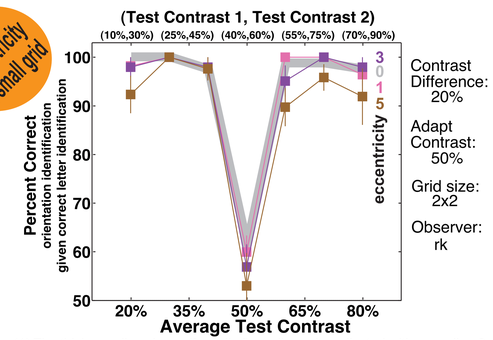
The same basic effect (poorer performance on STRADDLE test stimuli) holds true for other Adapt Contrasts. Consider the stimulus with an Average Test Contrast of 65%. When the observer has adapted to 35% contrast, making this an ABOVE stimulus (see red points above 65%), performance is good. Performance is much poorer when the observer has adapted to 65% contrast, making this a STRADDLE stimulus (see blue points above 65%).

Constant Transient



The Transient is the absolute value of the maximum change between the adapt stimulus contrast and the test stimulus contrasts. The Transient does not remain constant when the Contrast Difference is constant (as is true in the other panels). With a Contrast Difference of 20%, the Transient is just 10% for the STRADDLE stimuli but (at least) 20% for ABOVE and BELOW. Can this account for the poorer STRADDLE performance? No. **Observers still perform poorer on STRADDLE than on ABOVE and BELOW test stimuli when the Transient (not the Contrast Difference) is held constant.**

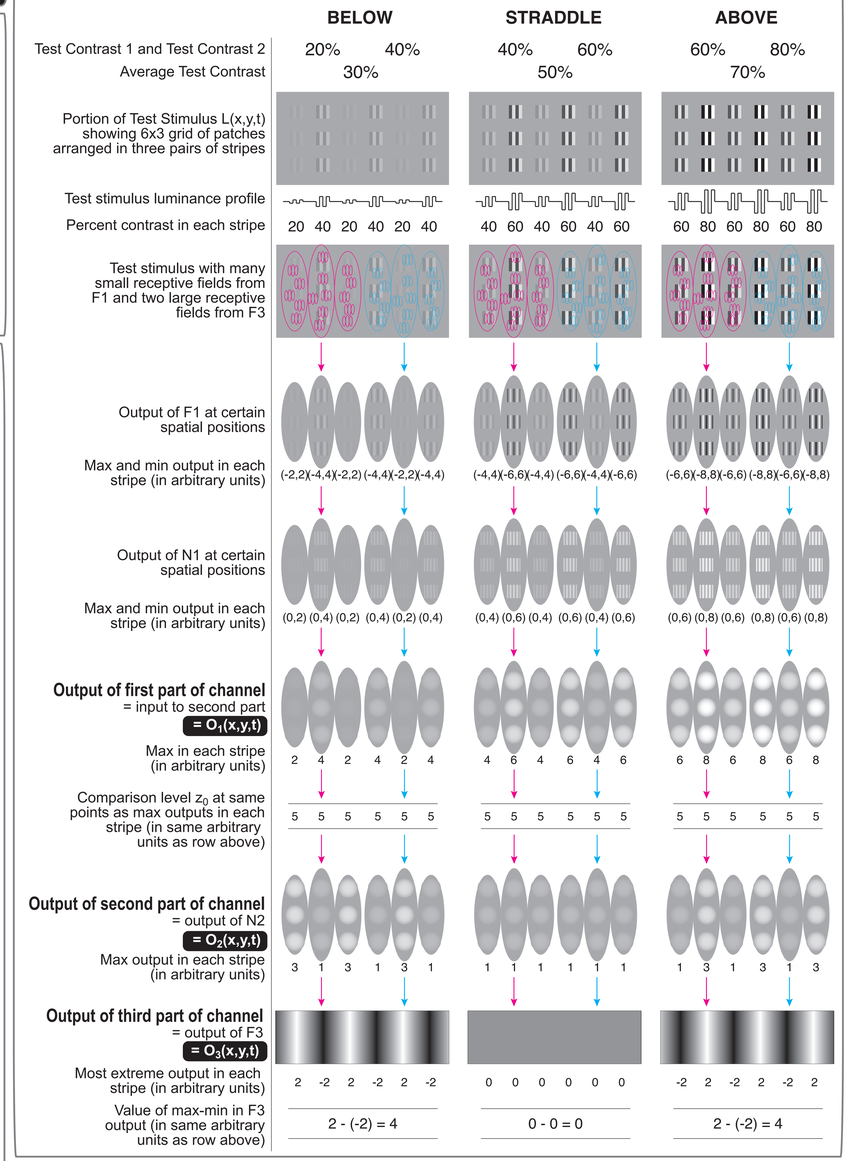
Varied eccentricity & small grid



(1) The thick gray line shows (foveally fixated) results collected with a smaller, 2x2, grid. **The same basic effect found with the 15x15 grid is seen with this 2x2 grid.** (2) To start looking for differences in foveal versus peripheral processing, we presented two identical 2x2 grids to the left and right of fixation. (Eccentricity values of 1, 3 and 5 are degrees to the inner edge of the grids from fixation. The Gabor elements were not scaled with eccentricity. We added a simple letter identification task at fixation.) **The same basic effect is also found in the periphery** as show by the pink/purple/brown results. (A second observer's results are very similar.)

Output at each stage of adaptable complex channel

to three test stimuli (with equal Contrast Difference) after adapting to 50% contrast



Conclusions

This unusual contrast adaptation causes STRADDLE patterns to be much less visible than ABOVE or BELOW patterns. This holds true with smaller patterns and in the near periphery (lower-right results). The transient change cannot account for the results (lower-left results), but adaptable complex channels can.

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An electronic version of this poster lives at www.columbia.edu/~sw354/conferences/vss_2007.pdf
Some of this data is in Wolfson & Graham (in press) "An unusual kind of contrast adaptation: shifting a contrast comparison level" Journal of Vision