Supplementary materials

Figure S1. The images on the right show schematic examples of CFS displays that have been most frequently used in previous studies. Recreating the exact displays is difficult because some stimulus parameters were not specified in the publications (e.g. color range, size range, contrast) or widely varied across studies. Nonetheless, images were recreated as closely as possible based on figures and known stimulus parameters (see Table below for details). 100 examples of each type of CFS stimulus were generated, all being identical in size ($7^\circ \times 7^\circ$), mean luminance, and RMS luminance contrast (50%) after being scaled to gray. Plotted on the left is the average ($n=100$) power spectrum for each Fourier transformed image set as a function of spatial frequency (top) and orientation (bottom). Data corresponding to each stimulus type are denoted by border color. Lighter shades of colors denote the standard deviation.
Table S1. Summarizes the details of the six CSF stimuli shown in Figure A. Those details were sampled from specific studies (out of 52) that implemented a given CFS stimulus. Parameters include the range in size, luminance, and spatial location that were assigned to each element within a CFS image. When possible, we used the average of the values reported in previous studies; however, there were several cases where we had to estimate values since information was lacking (those cases are denoted by asterisk). The remaining studies (6) that were not accounted for in this table used drifting or counterphase-flickering stimuli of known orientation and spatial frequency, such as a checkerboard or a radial grating stimulus (e.g. Maruya et al., 2008; Shin et al., 2009; van Boxtel et al., 2010).

<table>
<thead>
<tr>
<th>CFS type</th>
<th># of studies</th>
<th>Example studies</th>
<th>Element size</th>
<th>Luminance values*</th>
<th>Spatial location</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>11</td>
<td>Almeida et al., 2008 &amp; 2010, Costello et al., 2009; Fang &amp; He, 2005; Jiang et al., 2006 &amp; 2007; Kaunitz et al., 2011; Cai et al., 2008</td>
<td>0.1°×0.1°</td>
<td>0-1</td>
<td>aligned</td>
</tr>
<tr>
<td>B</td>
<td>4</td>
<td>Sterzer et al., 2008, 2009, &amp; 2011; Stein et al., 2011</td>
<td>0.1°-1.2°*</td>
<td>0, 0.11, 0.3, 0.4, 0.59, 0.7, 0.89, 1</td>
<td>aligned by column*</td>
</tr>
<tr>
<td>C</td>
<td>24</td>
<td>Hesselmann et al., 2011; Jiang &amp; He, 2006; Mudrik et al., 2011; Tsuchiya &amp; Koch, 2005; Yang et al., 2007 &amp; 2010; Zhou et al., 2010</td>
<td>0.1°-1.2°</td>
<td>0-1</td>
<td>random</td>
</tr>
<tr>
<td>D</td>
<td>4</td>
<td>Bahrami et al., 2007, 2008, &amp; 2010; Harris et al., 2011</td>
<td>0.4°-1.8°*</td>
<td>0-1</td>
<td>random</td>
</tr>
<tr>
<td>E</td>
<td>3</td>
<td>Adams et al., 2010; Tsuchiya et al., 2009; Seitz et al., 2009</td>
<td>0.4°-1.8°</td>
<td>0-1</td>
<td>random</td>
</tr>
</tbody>
</table>

Figure S2. Depict examples of spatial frequency bandpass filtered Mondrian images used in Experiment 3. Values denote center spatial frequency (cpd) of each octave-wide bandwidth filter. Images are for illustrative purposes only: the actual contrast and spatial frequency of these images is dependent on your monitor parameters and your viewing distance.
Experiment S1: Chromatic versus achromatic CFS

To our knowledge, more than half of the many previously published studies used chromatic CFS displays, and the majority of those studies used chromatic displays to suppress achromatic images. It is unclear why chromatic CFS stimuli were chosen over their achromatic counterparts but one could surmise that the addition of color may have augmented the depth of suppression with CFS. We therefore performed an experiment to determine whether suppression of a luminance-defined stimulus was more effective when the CFS display was defined by luminance and color or by luminance alone.

Method

Participants

Six observers including one of the authors participated in each experiment. All had normal or corrected-to-normal acuity and good stereopsis. Participants (except the author) were naïve to the purpose of the study and provided written consent prior to participation.

Apparatus and stimuli

The apparatus was the same as the previous experiments. The target stimulus (achromatic sinusoidal grating) was identical to that of Experiment 3 with the exception that it was presented at a spatial frequency of 1 cpd. The CFS displays were Mondrian patterns (4° x 4°, 0.5°-1.4° rectangle length) generated in the identical manner as previous experiments and were normalized in mean luminance and RMS contrast. For chromatic Mondrian patterns, values of the red, green and blue phosphors were pseudo-randomly assigned with the restriction that the luminance of each pixel remained the same as the original achromatic version. Thus the mean luminance and RMS luminance contrast were identical for achromatic and chromatic CFS displays.

Procedure

On each trial, a grating stimulus was presented to one eye while the other eye viewed at the corresponding retinal position an achromatic or chromatic dynamic CFS display. The grating stimulus emerged gradually following a Gaussian ramp (750 ms) and remained at a set contrast predetermined by a staircase procedure for the remaining 250 ms of the trial. Once the trial ended, stimuli were immediately replaced by a mask stimulus (high contrast noise image). Observers performed a 2AFC orientation discrimination task, indicating whether the grating was oriented 10° clockwise or counter-clockwise relative to vertical. The chromatic and achromatic CFS displays were presented in separate blocks and 6 threshold estimates corresponding to 71% performance were obtained for each condition (Levitt, 1971). Baseline threshold estimates were not collected since the same thresholds would be used in calculating threshold elevation for both CFS conditions.
Results and Discussion

A paired sample t-test showed that observers’ mean threshold estimates were not significantly different ($t(5)=1.6$, $p=0.2$) when measured in the presence of a chromatic CFS suppressor ($0.21\% \pm .03$) or an achromatic CFS suppressor ($0.18\% \pm .03$). Thus, adding color to a luminance-defined CFS display does not enhance suppression of a luminance-defined achromatic stimulus. Our main findings would predict that chromatic features of a CFS display would only be influential if the suppressed stimulus displayed similar chromatic properties. Although we did not directly test this, Hong and Blake (2009) showed that color discrimination of equiluminant suppressed stimuli is indeed impaired by CFS displays solely defined by color (equiluminant) and not by CFS displays that were solely defined by luminance.