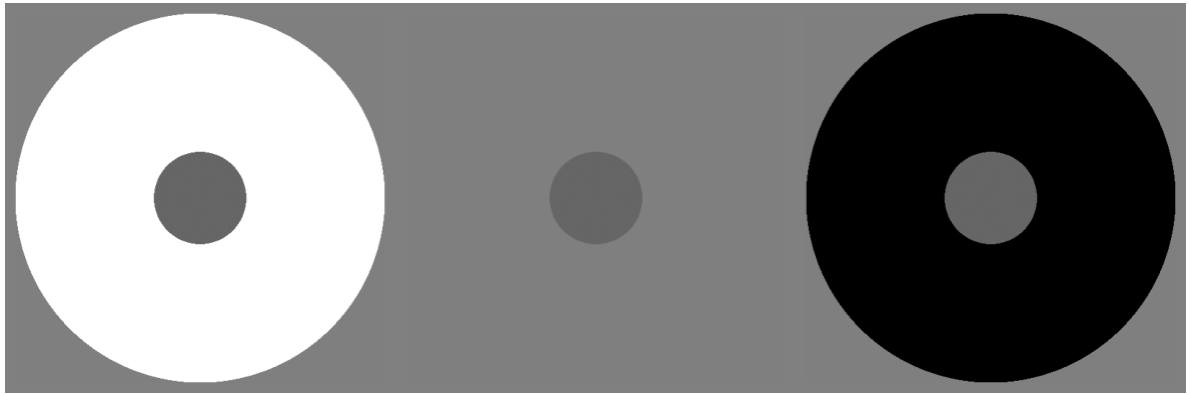
Chromatic Surround Suppression

Bachelor’s Thesis Leila Hafner

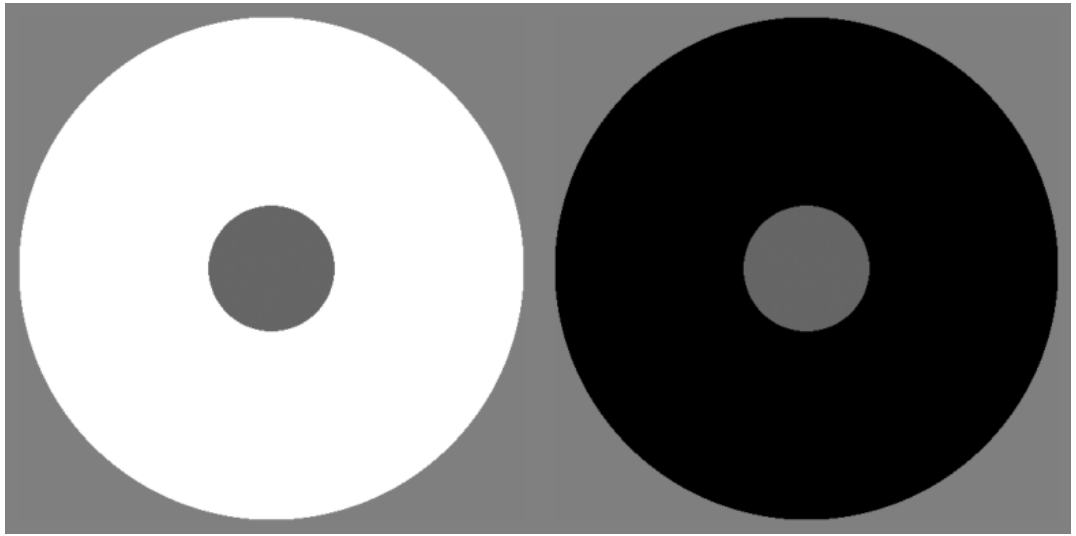
Simultaneous Brightness Contrast (SBC)

- Two centre discs that appear to differ in brightness (Right > Left)
- Physically: both centres have the exact same luminance
- Luminance: amount of light which stems from an object
- *Perceived* brightness of a centre depends not just on disk luminance, but also on surround



Contrast

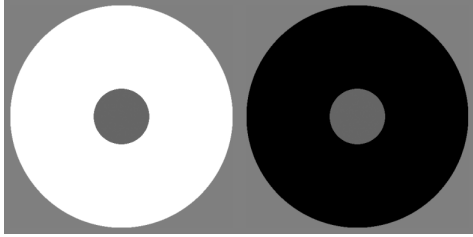
- Physical Contrast: Luminance relationship between two areas
- Contrast between centre and surround



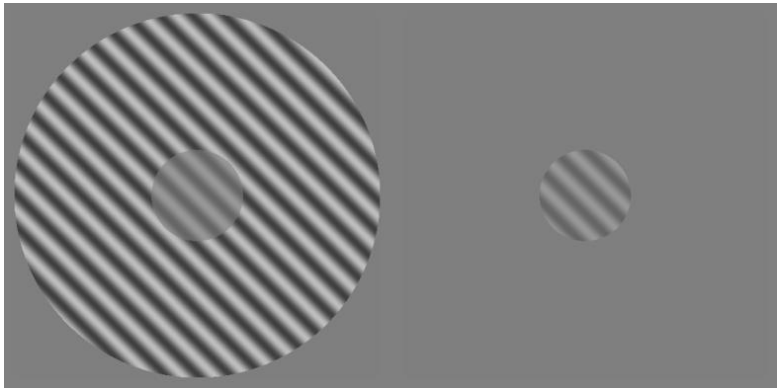
Contrast

- Physical Contrast: Luminance relationship between two areas
- Contrast between centre and surround
- Stimulus defined by contrast
- All regions have the same *average luminance*

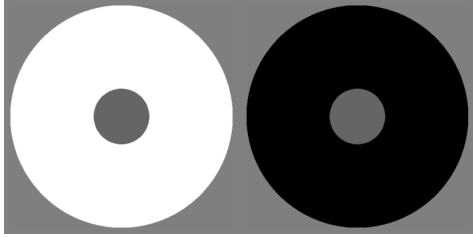
Surround Suppression



- Replace in SBC: centre and surround as gratings
- Two centre discs that appear to differ in *contrast* (R > L)
- Physically: both centres have the exact contrast
- Perceived Contrast: How does the difference in contrast appear?
- All regions have the same *average luminance*

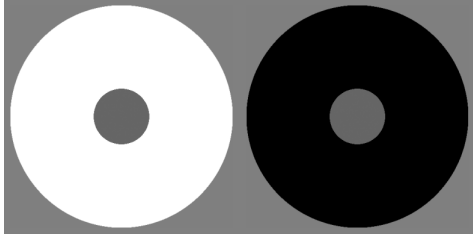


Surround Suppression

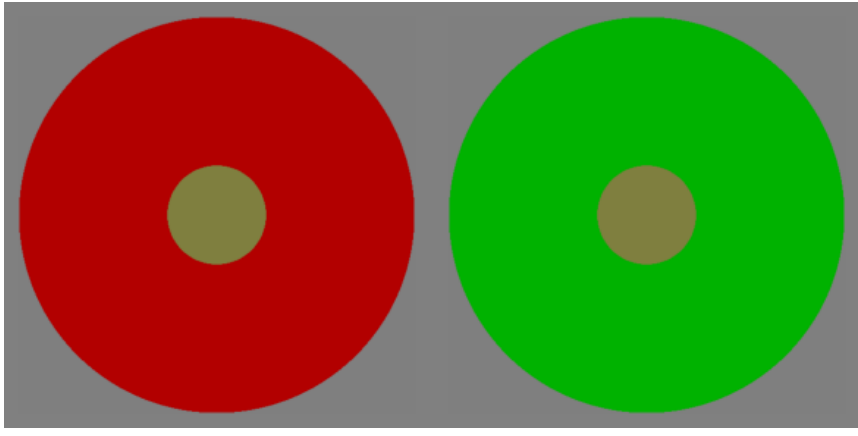


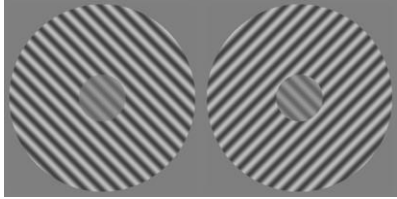
- Gratings can be oriented
- Surround suppression of perceived contrast is the strongest when orientation matches

Simultaneous Colour Contrast



- Same concept as SBC
- An object’s colour is determined by its surround
- Difference of hue in surround
- Chromatic Contrast: Physical difference in colour between two areas



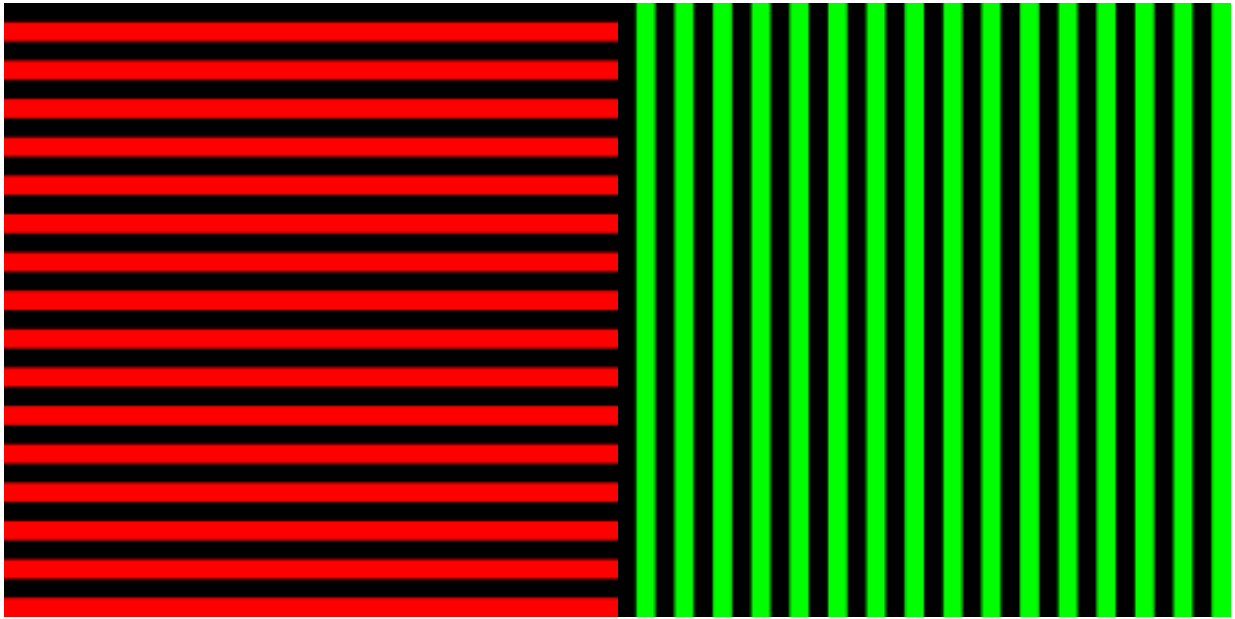


And Chromatic Surround Suppression?

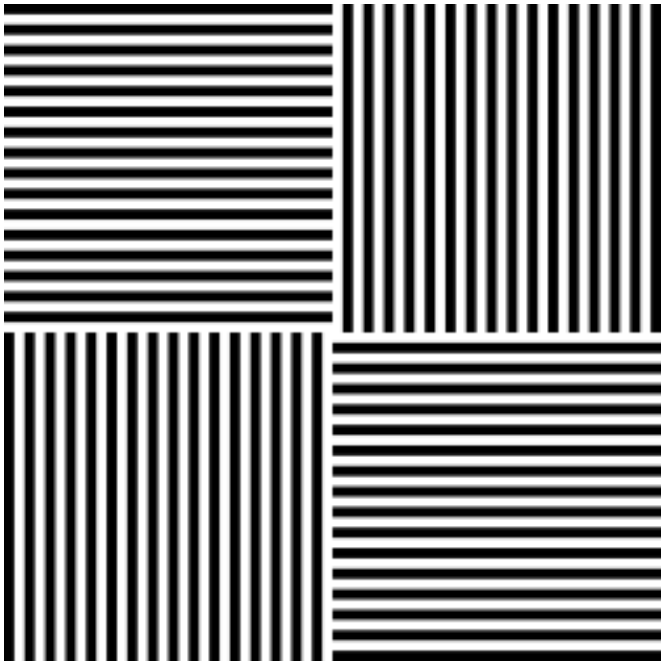
- Extensive research on luminance contrast and brightness perception
- But comparatively little on how principles apply to chromatic contrast
- Address gap by examining how chromatic contrast is perceived when both the central stimulus and its surround consist of colour grating

Research Question: How does the **chromatic contrast** of a **surrounding** colour grating influence the **perceived chromatic contrast** of a **central** grating?

Orientation and Chromatic Contrast: McCollough Effect



Orientation and Chromatic Contrast: McCollough Effect



Orientation and Chromatic Contrast: McCollough Effect

- Adaptation to chromatic grating
- Makes achromatic grating post-adaption look colourful
- Chromatic adaptation is *orientation specific*:
  - Adapting to red horizontal grating makes *horizontal* gratings look green
  - Adapting to green vertical grating makes *vertical* gratings appear red
  - Effect switches if screen is turned

Experiment

Stimuli

- Stimuli dimensions:
  - Surrounds: No surround, parallel, orthogonal
  - Surround colour: ~~Achromatic~~, Red-Green (RG), Blue-Yellow (BY), (no surround)
  - Centre colour: fixed, RG
  - Centre contrast: 6 different contrast values, 0.1 – 0.6
  - Surround contrast: fixed, 0.8

- All possible stimuli:
  (2 orientations x 2 colours + 1 no surround) x 6 centre contrasts = 30

Experiment

- Paired comparisons:
  - Two stimuli per trial, at the same time
  - All trials = possible pairs of stimuli = (30 * 29) / 2 = 435
- Participants judge perceived contrast:
  - If left centre has a higher or lower contrast than right centre
  - Forced choice
- ~ 12 repetitions of all trials, per participant
- Surround and colour contrast contribution to effect of chromatic surround suppression → Maximum Likelihood Conjoined Measurement

Hypotheses

- Higher physical contrast → higher perceived contrast, all else equal
- Surround suppresses chromatic contrast: central chromatic grating appears lower contrast when surrounded by similar chromatic surround
- Colour specific: surround suppression when centre and surround are same colors, but not when orthogonal colors (RG vs. BY)
- Orientation specific (McCollough Effect): when colour and orientation match, we get a stronger effect

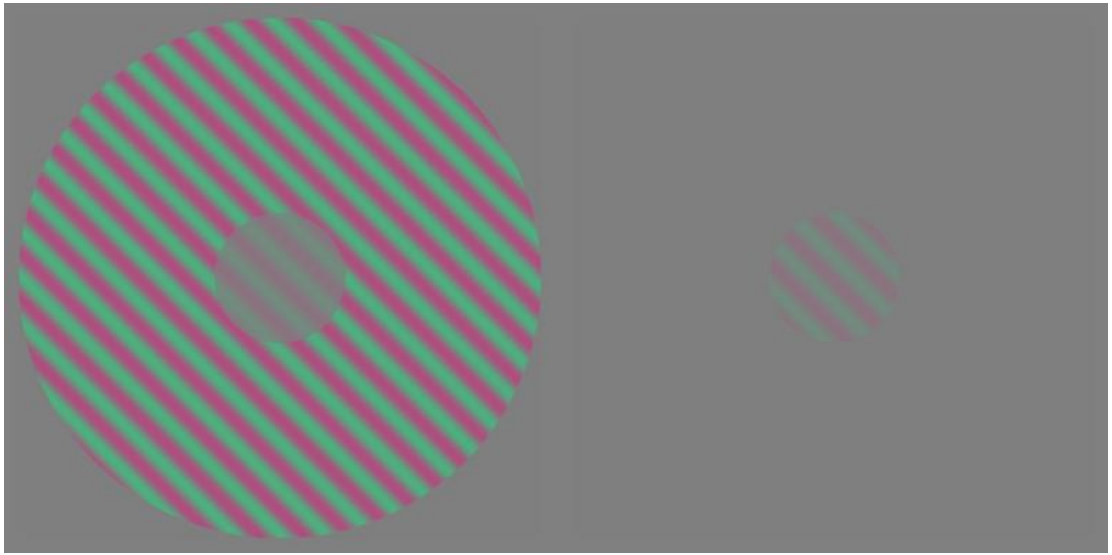
RQ: How does the chromatic contrast of a surrounding colour grating influence the perceived chromatic contrast of a central grating?

Hypotheses

Higher physical contrast → higher perceived contrast

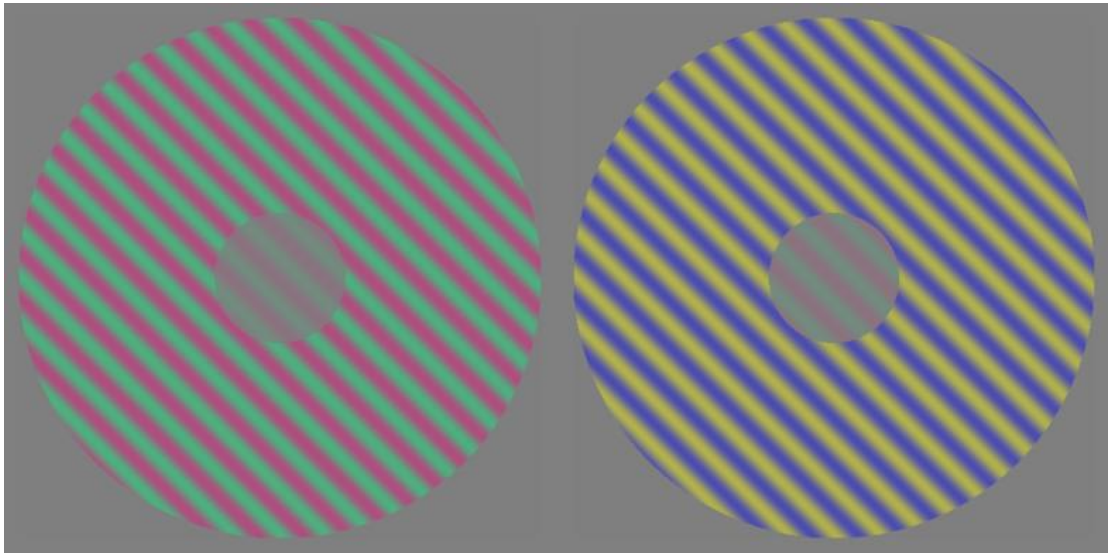
RQ: How does the chromatic contrast of a surrounding colour grating influence the perceived chromatic contrast of a central grating?

Surround suppresses Chromatic Contrast



RQ: How does the chromatic contrast of a surrounding colour grating influence the perceived chromatic contrast of a central grating?

Colour specific Surround Suppression



RQ: How does the chromatic contrast of a surrounding colour grating influence the perceived chromatic contrast of a central grating?

Orientation specific (~ McCollough Effect)

RQ: How does the chromatic contrast of a surrounding colour grating influence the perceived chromatic contrast of a central grating?

Expectation