WHITE'S EFFECT in

Brightness,

Color,

Motion

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Photo by Jacques-Henri Lartigue, 1913
From a conference at York University, 2003, honouring MARTIN REGAN
Unpublished photos of Martin Regan:
Simultaneous contrast
White’s Effect
Theories of White’s effect

1. Assimilation or contrast?  
   Level: Low

2. Geometry: T-junctions, elongated RFs  
   Level: Low

3. Belongingness  
   Level: High

4. Transparency  
   Level: High
Theories of White’s effect

Assimilation?  Contrast?
Geometrical theories of White’s effect

T-junctions?

Elongated receptive fields?
“Belongingness” theory of White’s effect

Benary 1924
Transparency theory
(Bart Anderson 1997)
Theories of White’s effect

1. Assimilation or contrast? ✓
2. Geometry: T-junctions, elongated RFs x
3. Belongingness ✓
4. Transparency ✓

Level:
- Low
- High
Results

White’s effect:

• increases with spatial frequency
• can generalise to colour
White’s effect increases with spatial frequency
Log ratio: Perceived/actual luminance

Spatial frequency cpd
Colored White’s effect

(All grays in the next four slides are the same)
All annuli are the same gray
Colored White’s effect: Why does grey test patch look yellow-green? Contrast (=negative induced hues) or assimilation (=positive induced hues) ?

Use non-complementary colored stripes
End-wise contrast from embedding magenta stripes (to minus-magenta = green)?
Or:
Assimilation (to orange) from flanking orange stripes?
Repulsion from Magenta
Attraction to Orange
Magenta stripes
Orange stripes
White’s effect increases with spatial frequency, for black/white and also for color.
Colored White’s effect increases with spatial frequency.

Grey stripes embedded in:
- ▲ Magenta
- □ Orange

Saturation of induced hues
CIE units

Spatial frequency cpd
Ratio of assimilation to contrast increases with spatial frequency.

Grey stripes embedded in:
- Magenta
- Orange

Equations:
1. $y = -0.844 + 0.797x \quad R^2 = 0.960$
2. $y = -0.044 + 0.233x \quad R^2 = 0.924$
Conclusion from coloured White’s effect:

• At low spatial frequencies
  Contrast > Assimilation
• At high spatial frequencies
  Assimilation > Contrast
  (& big overall effect)

So: Assimilation has smaller spatial range!
Why geometrical theories are WRONG

“Stuart’s Rings” in next slide are isotropic -- no bars or T-junctions -- yet give brightness illusions like White’s Effect.
“Stuart’s Rings”

3 rings in each column are the same grey
“Stuart’s Rings” stronger (=larger vertical gap) for dark rings

Rings contain:
- Gray + White pixels
- Gray + Black pixels

![Graph showing the relationship between luminance and selected/actual luminance with equation lines: y = -0.37 + 0.0039x (R^2 = 0.961) and y = 0.37 - 0.005x (R^2 = 0.923).]
Theories of White’s effect

1. Assimilation or contrast? ✓ ✓
2. Geometry: T-junctions, elongated RFs X X
3. Belongingness  ✓
4. Transparency ✓

Level:
- Assimilation or contrast: Low
- Geometry: T-junctions, elongated RFs: Low
- Belongingness: High
- Transparency: High
White’s effect and MOTION
Movie:

1 Footsteps illusion:

Contrast affects apparent speed
A black & a white bar exchange luminances. Do you see…

Two bars flickering in place?

NO; a “suspicious coincidence”, so brain applies Occam’s Razor:

What minimum hypothetical real world events can explain max no. of visual inputs?

Ans: Not 2 flickering, but one moving bar!
So WHICH bar jumps?
Ans: Bar with higher contrast.

Now: White’s effect and contrast…
Movie: 2 WhiteDemo
White’s effect and apparent motion
Movie:
3 WhiteDemo
White’s effect and apparent motion
Movie: 4 WhiteDemo
\[ y = 46.1 - 0.429x \]
\[ R^2 = 0.961 \]

Dark bar moves

Light bar moves
Slope = -0.429, so embedding bars are 2.33 (=1/0.429) times more important than surround in setting motion strength.
Movie:

5 WhiteJump
Conclusions

• Assimilation AND contrast
• NOT geometry [T-junctions, elongated RFs]
• White’s effect precedes motion perception

6 CogMovie

thank you
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the end

To be published in “Visual Processing of Spatial Form” (Conference Proceedings), Ed. Michael Jenkin & Laurence Harris