Alpha, contrast and the perception of visual metadata

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Overview

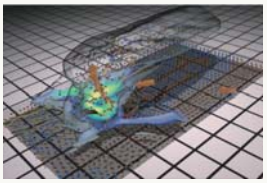
Our context
- Computer graphics "Visualization"
- Leveraging design practice

A specific set of experiments
- Overlaid grids
- Example of visual metadata

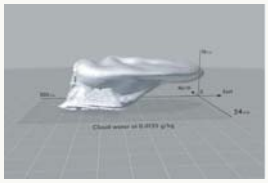
Relate results to perception
Discussion

Context

Grids and other *reference structures* should be visually unobtrusive and subtle relative to the data



Too obtrusive

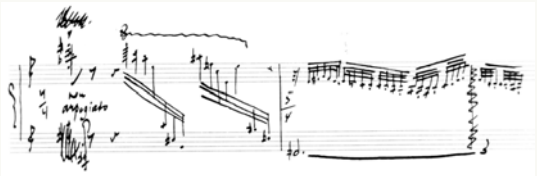


Appropriately subtle

Images from "After the Storm," by Bushell & Baker

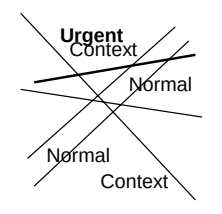
Attention hierarchy

Create visual "layers"
- Separable
- Legible
- Balanced



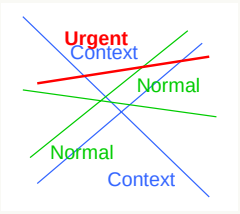
Tufte *Envisioning Information*, ch 3

How do we fix this?

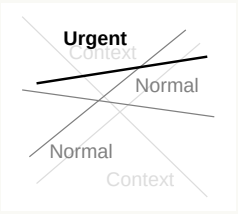


Create a visual hierarchy

Wrong



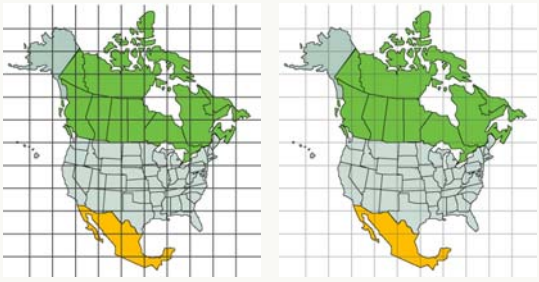
Right



Larry Arend colorusage.arc.nasa.gov

Get it right in black & white

Our design case



Too obtrusive

Visible, but subtle

Example by Diane Gromala

Our questions

How do we design a Great Grid?

Our questions

~~How do we design a Great Grid?~~

Our questions

~~How do we design a Great Grid?~~

How do we design a grid that isn't awful?

Our insight

We seek a **range**

Too faint: unusable

"Not bad" Grids

Too strong: a fence

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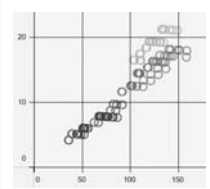
Experiments

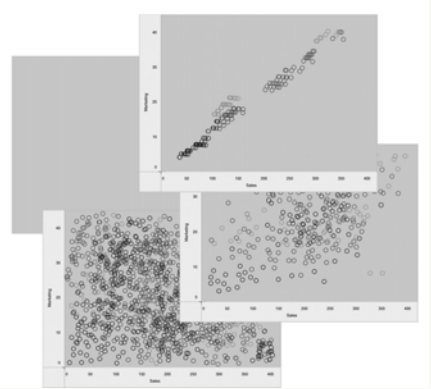
Design
- Fixed grid, fixed color, variable alpha
- Two boundary conditions: faint and strong
- 5 background values (grays)
- 4 images (scatter plots)
- 2 task blocks, 60 trials/block

Two sets of experiments
- Dark on light
- Light on dark

Same display, environment

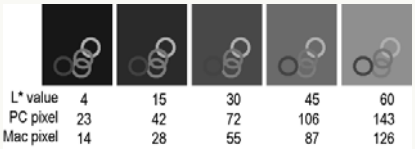


Images



Background Colors

L* value	96	87	78	69	60
PC pixel	243	217	191	167	143
Mac pixel	241	209	180	152	126



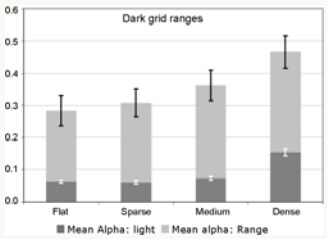
L* value	4	15	30	45	60
PC pixel	23	42	72	106	143
Mac pixel	14	28	55	87	126

Demo

Hypotheses

1. Faint boundary less variable than “the fence”
2. Faint setting would be very faint
3. Background would have an effect
4. Density would have an effect
5. Results would be symmetric

Results: Dark on light



1. Faint is more stable
2. Faint is very faint
3. **Background no effect**
4. Density has an effect

Whisper, don’ scream

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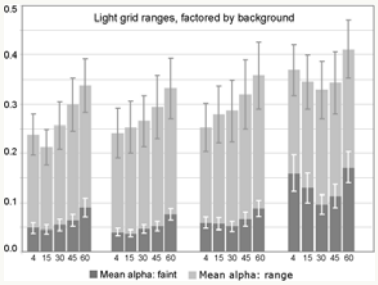
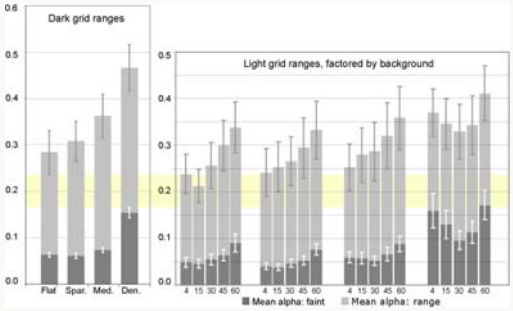
Results: Light on Dark

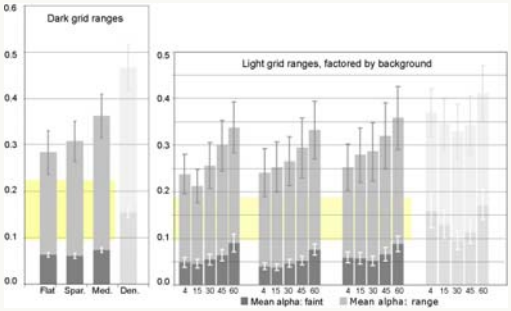


1. Faint is more stable
2. Faint is very faint
3. **Background effect**
4. Density effect
5. **Not symmetric**

There is a range



Ignore dense case



Results Summary

Two boundaries exist (faint and strong)
Range near alpha = 0.2 produces “good grids”
Light and dark results not symmetric

Dark on light
- No dependency on background
- Dense case different than other three

Light on dark
- Noisier data
- Some dependency on background
- Density dependency is larger

For a single display and environment

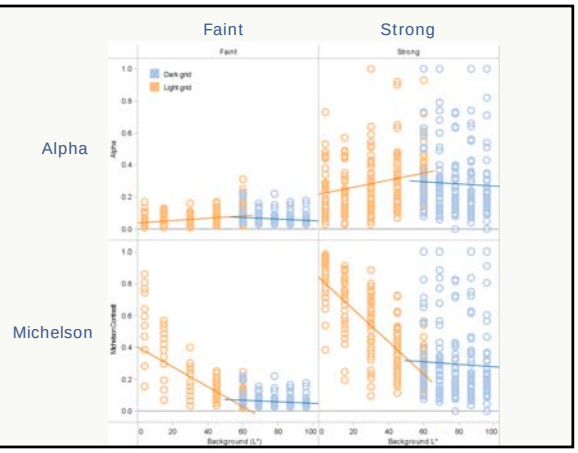
Look at contrast

Key component of legibility, readability, layering

Approach
- Compute luminance from display parameters
- Compute contrast with background
- Flat, sparse, medium, dense

Compare Michelson contrast and ΔL^* to alpha

Michelson contrast = $(Y_{max} - Y_{min})/(Y_{max} + Y_{min})$



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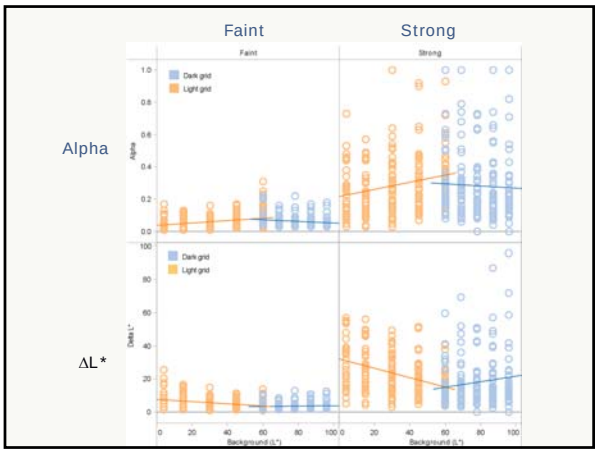
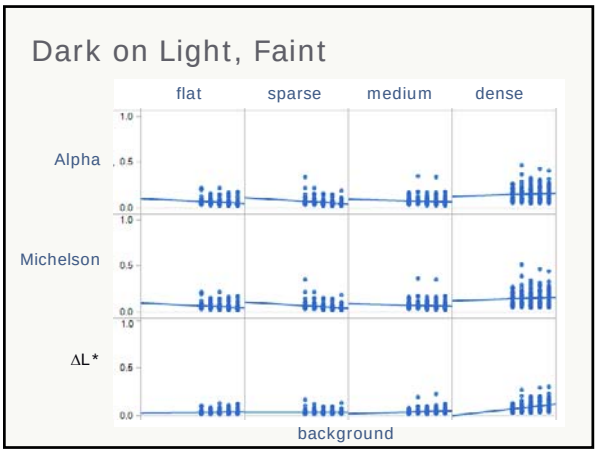
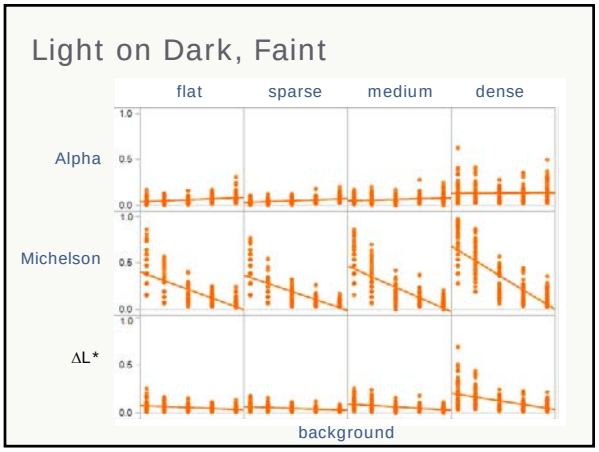
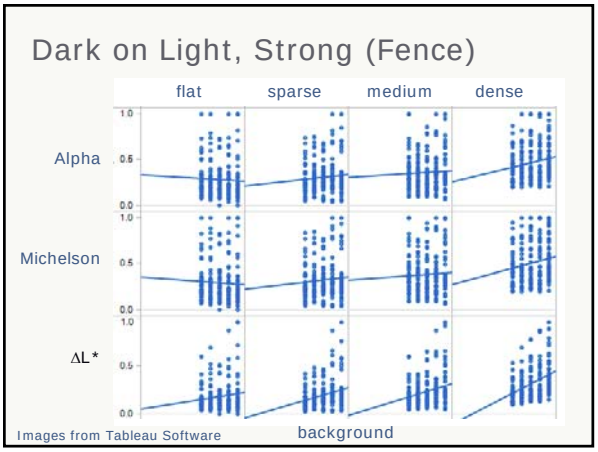
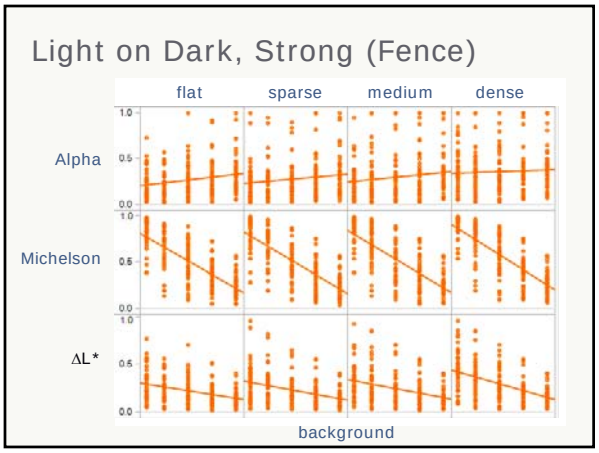










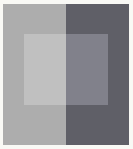
Transparency

Alpha is a transparency metric

- $c = \alpha f + (1-\alpha)b$, where f and b are pixel values

Metelli's spinning disk model

- Surface reflectances R_b and R_{disk}
- Spinning disk with missing wedge
- $R_t = \tau R_b + (1-\tau)R_{disk}$
- Where τ is the wedge size in 0 to 1



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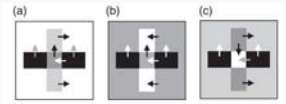
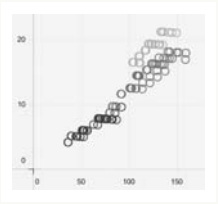
Not classic transparency

What makes it look transparent?

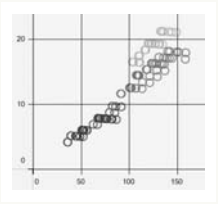
- View an edge (Metelli, Brill)
- View an X-junction (Cavanaugh, Kitaoka)



Manipulating transparency



"Not bad" Grids



Too faint: unusable

Too strong: a fence

Summary

Design, vision and visualization

Look for a range

- Eliminate the bad
- Bound the acceptable

Grid experiments

- Encouraging initial results
- Alpha range around 0.2

Not completely explained by contrast
Not classic transparency

The challenge

What type of metrics and models do we need?
JND too small, may not capture cognition
JAD?

Just Attendable Difference

Slides will be on www.stonesc.com