Ramachandran and Hirstein’s “The Neurological Basis of Aesthetic” for Computer Graphics

Bruce Gooch

University of Utah
Why does art work?
Why does art work?
Why Does Art Work?

• Do Rules exist, What are the Rules?

• How did these Rules come about?

• What Brain mechanisms are involved?
“The Neurological Basis of Aesthetic” by Ramachandran and Hirstein

- Studies of the Human Visual System
- Artistic Technique & Art History
- Organize Results and Advocate Testing

Ongoing fMRI, Galvanic Skin Response, BP & Heart Rate, Eye Tracking, Etc, …
Ramachandran and Hirstein’s Eight “Laws” of Art

- The Peak Shift Principle
- Perceptual Grouping and Binding
- Isolation of a Single Visual Cue
- Problem Solving
- Contrast Extraction
- Symmetry
- Generic Viewpoint
- Use of Metaphor
Exaggerated elements are attractive.

The Peak Shift Principle

- Exaggerated elements are attractive.
Peak Shifted Photograph
Peak Shifted Color
Peak Shifted Color
Peak Shift in Form
The Peak Shift Principle

- **Exists Across Visual Modalities**
  Outline, Color, Form, Motion, Highlight, Depth are all susceptible to Peak Shift.

- **Reward and Non-Reward Stimulus**
  Must be Close
Learning Speedup Via Peak Shift

10 Training Passes

1-2 Training Passes per Condition
Applying the Peak Shift Principle to CG

- Contact Cues in Animation
- Distance Perception in VR
- Perceptually based Anti-Aliasing
- Limit Geometric Complexity
- Temporal Anti-Aliasing
Perceptual Grouping

- **Similarity**
  
  Items that are the same are grouped. (Shape)
Perceptual Grouping

- **Similarity**
  Group by intensity.
Perceptual Grouping

- **Similarity**
  intensity overcomes shape.
### Perceptual Grouping

- **Proximity**

  Items that are physically close are grouped.
Perceptual Grouping

- **Common Fate**
  
  Items that move together are grouped.
Perceptual Grouping

- **Continuity**
  Items that form or are joined by a line are grouped.
Perceptual Grouping

- **Continuity**
  
  Items that form or are joined by a line are grouped.
Perceptual Grouping

- **Closure**
  
  Items that form closed regions are grouped.
Perceptual Grouping

- **Past Experience**
  Items are interpreted based on surrounding items.
Perceptual Grouping

- Center item appears as the Letter B.
Perceptual Grouping

- Change the Surround
Perceptual Grouping

- Center item appears as the number 13.

Images courtesy of Professor Charles Schmidt, Rutgers University
Perceptual Binding
Perceptual Binding
Perceptual Binding

Bev Dolittle
Perceptual Binding
Perceptual Binding
Isolation of a Single Visual Cue

• Helps focus a viewers attention.

Based on the observation that differentiated brain cells exist for the perception of, color, depth, form, etc.

Grinvald et al.
Photograph
Single Visual Module
Peak Shift applied on Single Visual Module
Peak Shifted Line Art Faces
Herman Grid, Count Black Spots at Intersections
Apparent Movement
Op Art

Bridget Riley
Idea of Movement

Duchamp
Applying Visual Cue Research to CG

- Take advantage of new computational models of Human Vision
- Tone Mapping
- Motion planning
- Anti-Aliasing
Problem Solving

- Perceptual “problem solving” is reinforcing.
In Scene Elements

Arcimboldo
Problem Solving in the Subject Matter

Wyeth
Sometimes the Problem is Obvious
Contrast Extraction

- Contrast is reinforcing.

- Color

- Size

- Position
Contrast (Intensity)
Contrast (Size and Number)
Contrast (position)
Symmetry

- Symmetry is attractive.
Symmetry
Generic Viewpoint

- Unique Vantage Points are Suspect.
Generic Viewpoint
Generic Viewpoint in CG

- **Choosing a Viewing Angle.**
  Blantz et al., Perception 99

- **Avoiding confusing self occlusion.**
  Gooch et al., EGRW 01
Use of Metaphor

- **Visual puns and metaphors enhance art.**

  Metaphor: an implied comparison between two things of unlike nature that still have something in common.
This is Not a Pipe

Magritte

Leci n’est pas une pipe.
This is a Pipe Knot

Gooch
Conclusion

- This is just a Frame Work
- Not Everything is Included
- Look for more & better results in the future
Thanks

- NPR BOF, Tuesday 7:00, Menger Hotel

www.cs.utah.edu/~bgooch
Broadway Boogie-Woogie

Mondrian
Three Hotels on Broadway Boogie-Woogie

Caywood
Format

- One
- Two
- Three