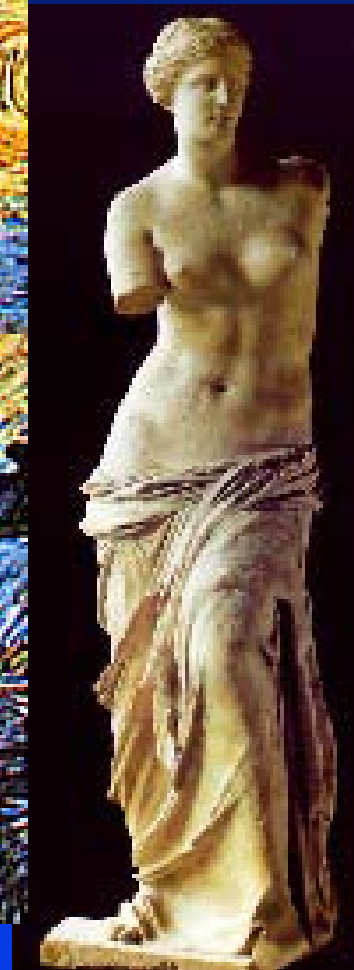
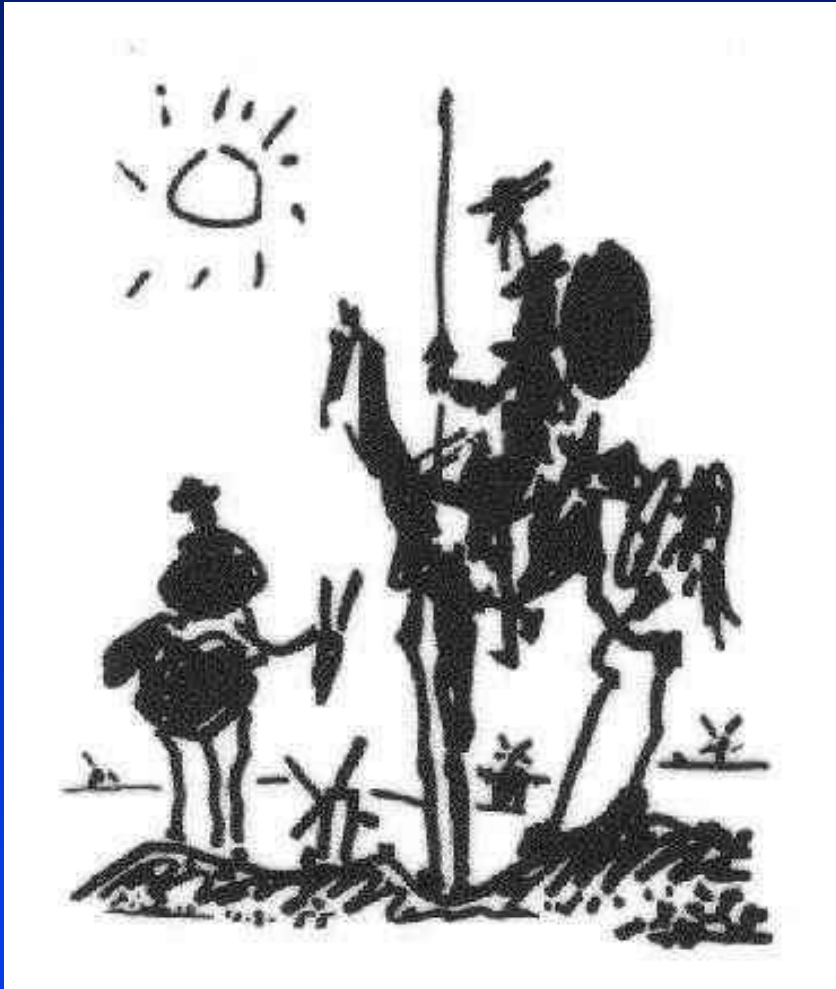

Ramachandran and Hirstein's
“The Neurological Basis of Aesthetic”
for Computer Graphics

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

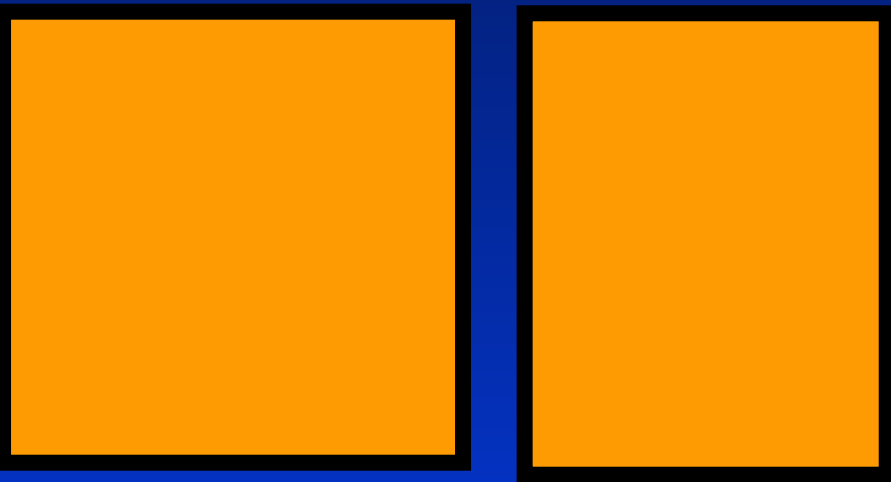
- **Studies of the Human Visual System**
- **Artistic Technique & Art History**
- **Organize Results and Advocate Testing**
Ongoing fMRI, Galvanic Skin Response,
BP & Heart Rate, Eye Tracking, Etc, ...

Ramachandran and Hirstein's Eight "Laws" of Art

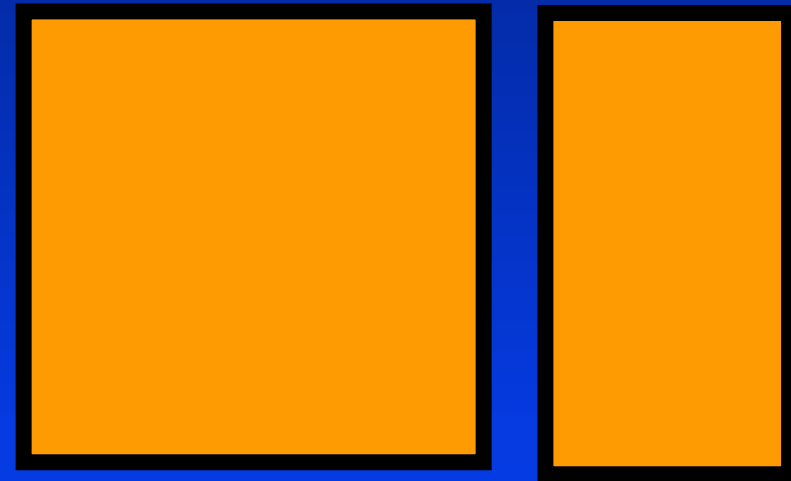
- **The Peak Shift Principle**
- **Perceptual Grouping and Binding**
- **Isolation of a Single Visual Cue**
- **Problem Solving**
- **Contrast Extraction**
- **Symmetry**
- **Generic Viewpoint**
- **Use of Metaphor**

The Peak Shift Principle

Exaggerated elements are attractive.



Training Set



Testing Set

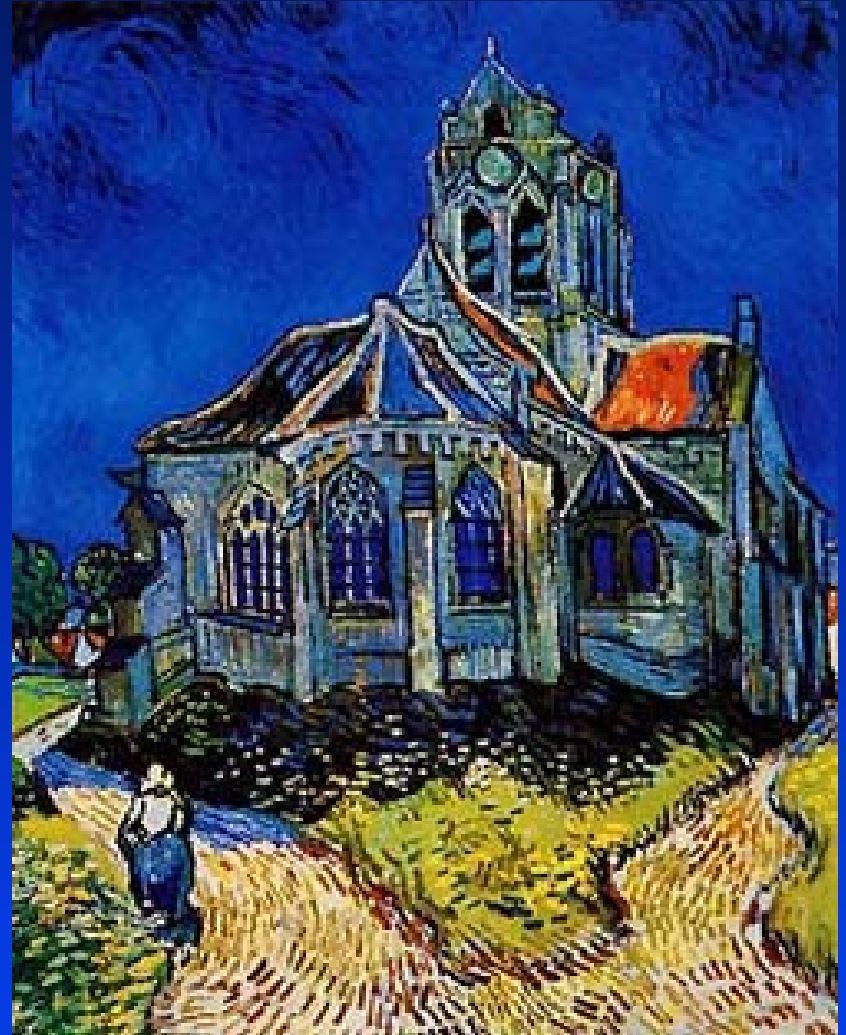
Photograph



Peak Shifted Photograph



Peak Shifted Color



Peak Shifted Color



Peak Shift in Form



TheMcN

THE MARION KOOGLER MCNAV ART MUS

The Peak Shift Principle

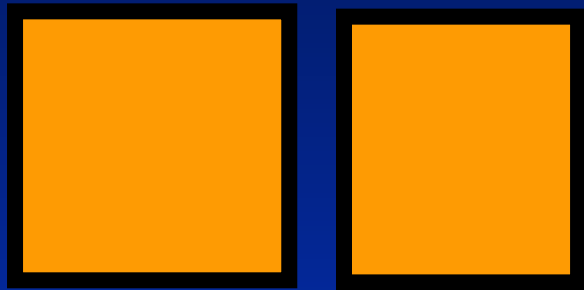
- **Exists Across Visual Modalities**

Outline, Color, Form, Motion, Highlight, Depth are all susceptible to Peak Shift.

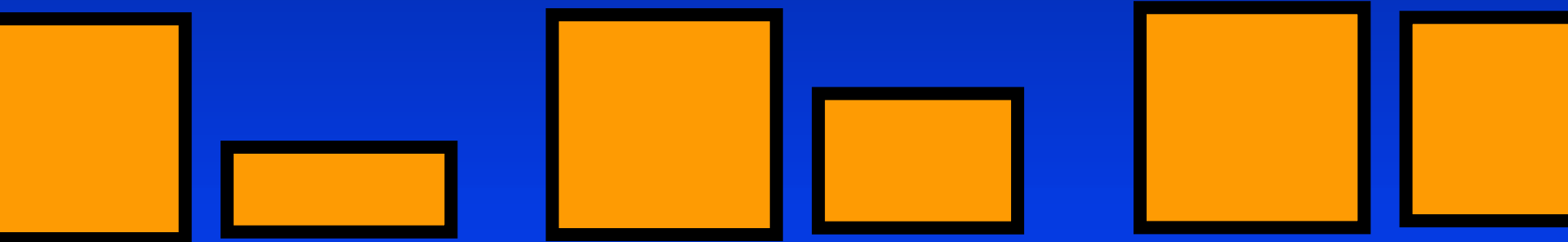
- **Reward and Non-Reward Stimulus**

Must be Close

Learning Speedup Via Peak Shift



10 Training Passes



1-2 Training Passes per Condition

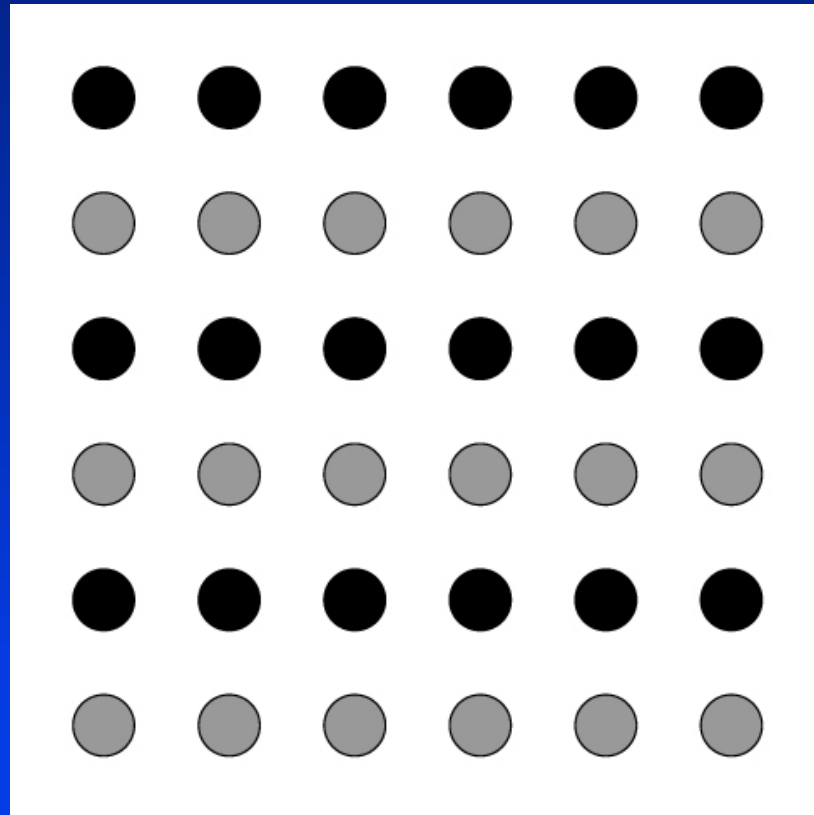
Applying the Peak Shift Principle to CG

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

Perceptual Grouping

Similarity

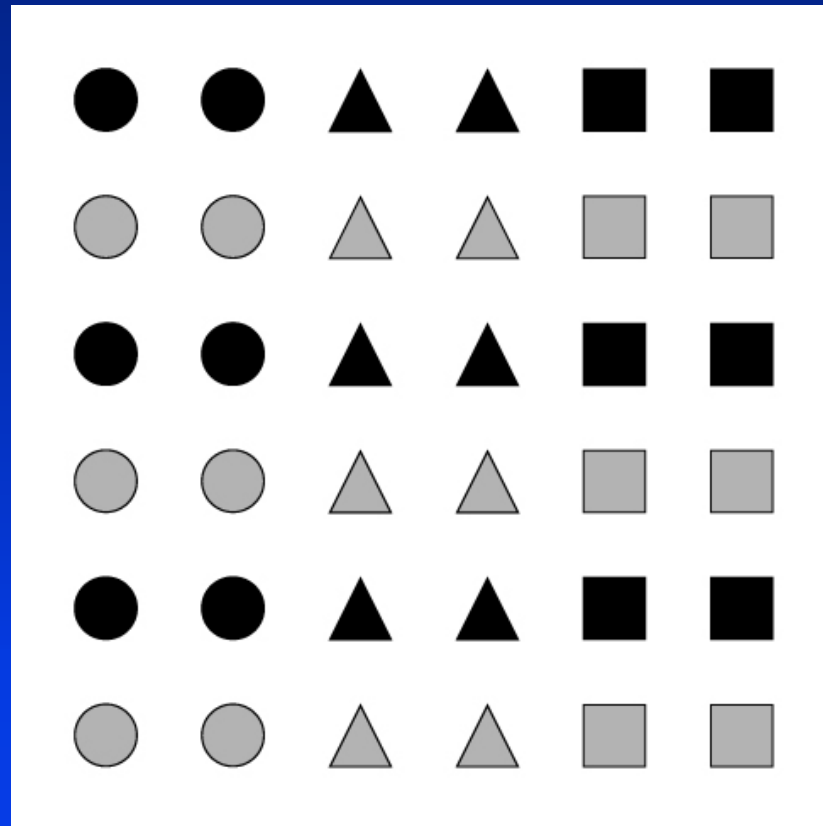
Group by intensity.



Perceptual Grouping

Similarity

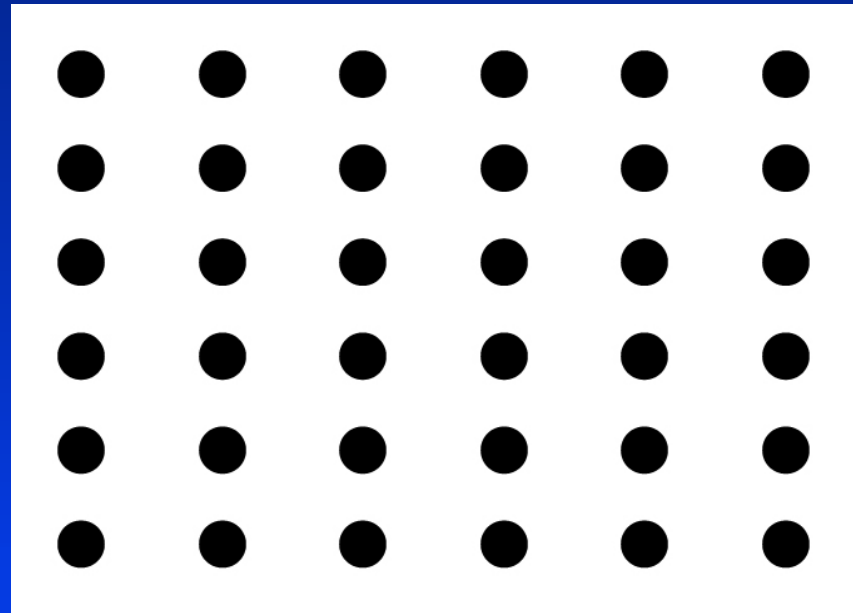
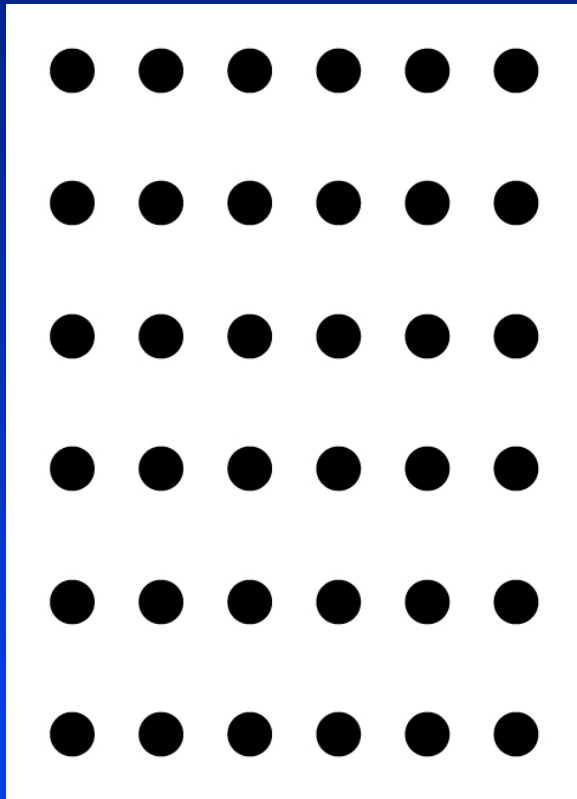
intensity overcomes shape.



Perceptual Grouping

Proximity

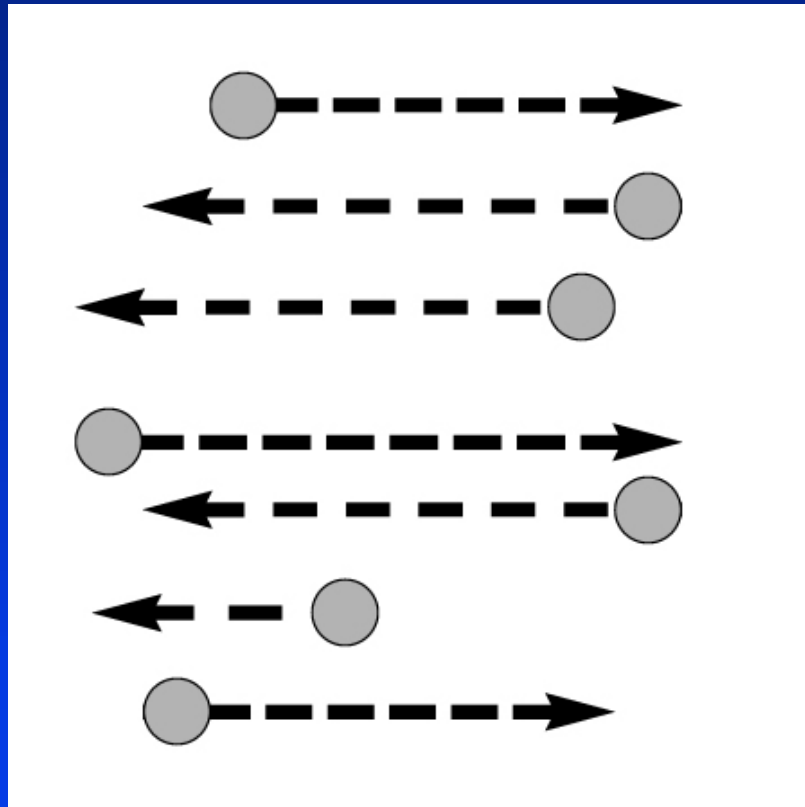
Items that are physically close are grouped.



Perceptual Grouping

Common Fate

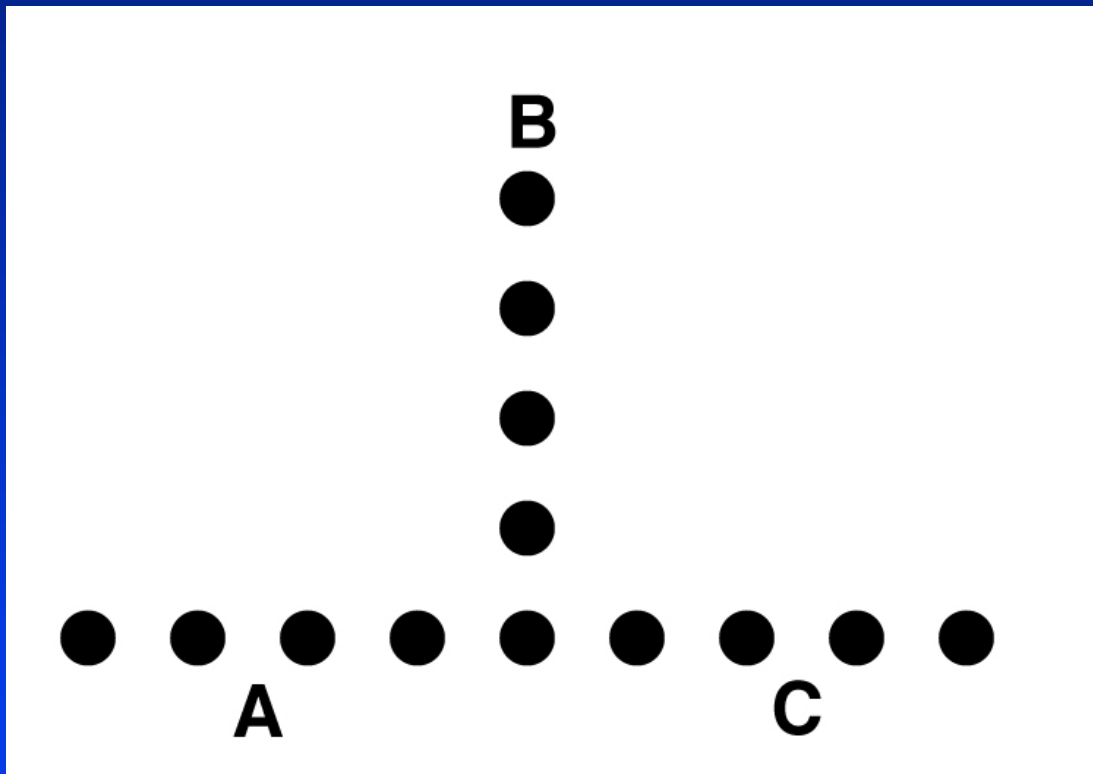
Items that move together are grouped.



Perceptual Grouping

Continuity

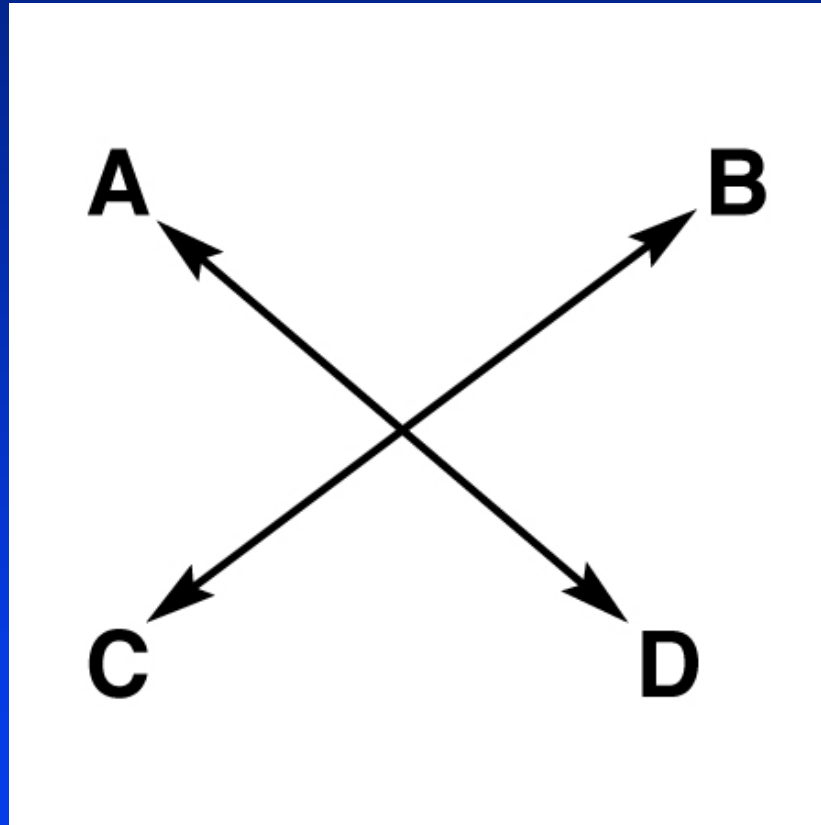
Items that form or are joined by a line are grouped.



Perceptual Grouping

Continuity

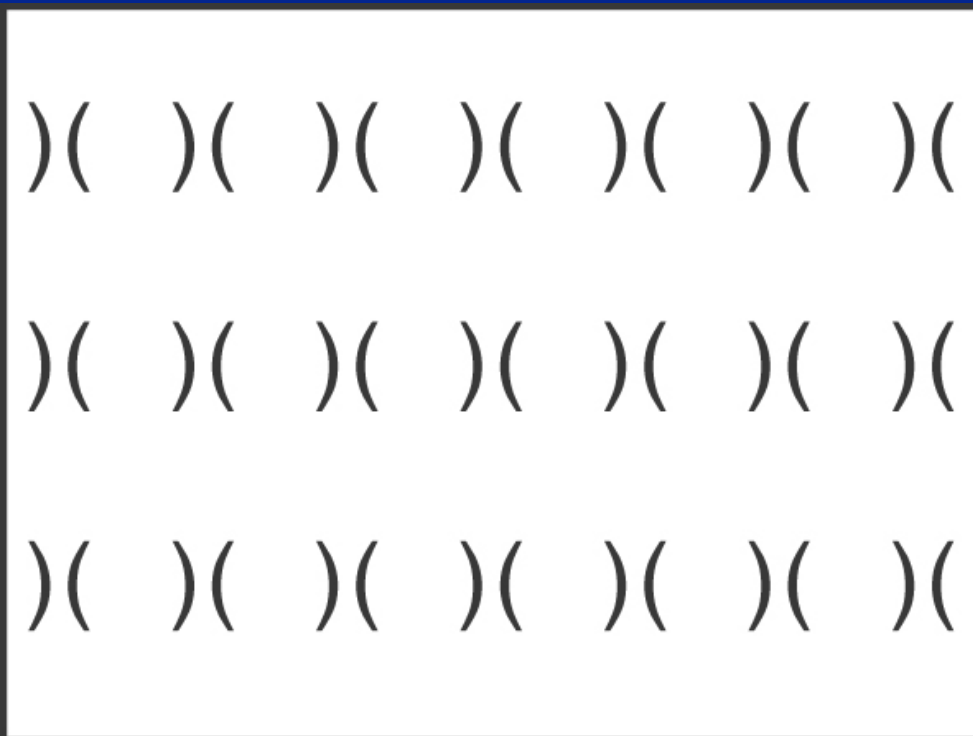
Items that form or are joined by a line are grouped.



Perceptual Grouping

Closure

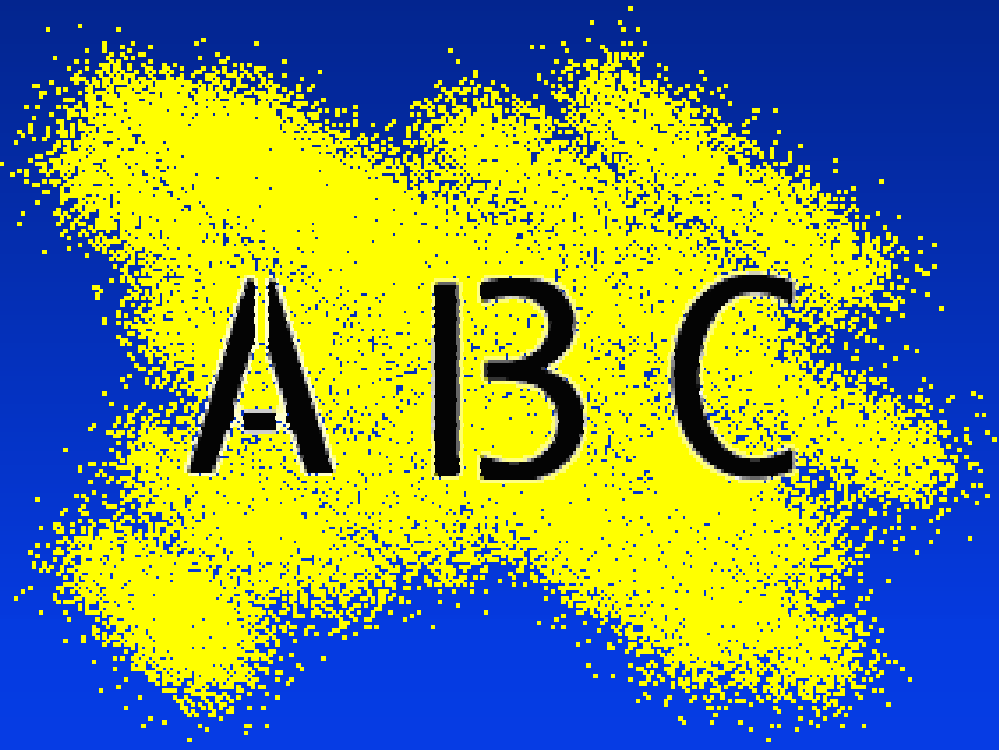
Items that form closed regions are grouped.



Perceptual Grouping

Past Experience

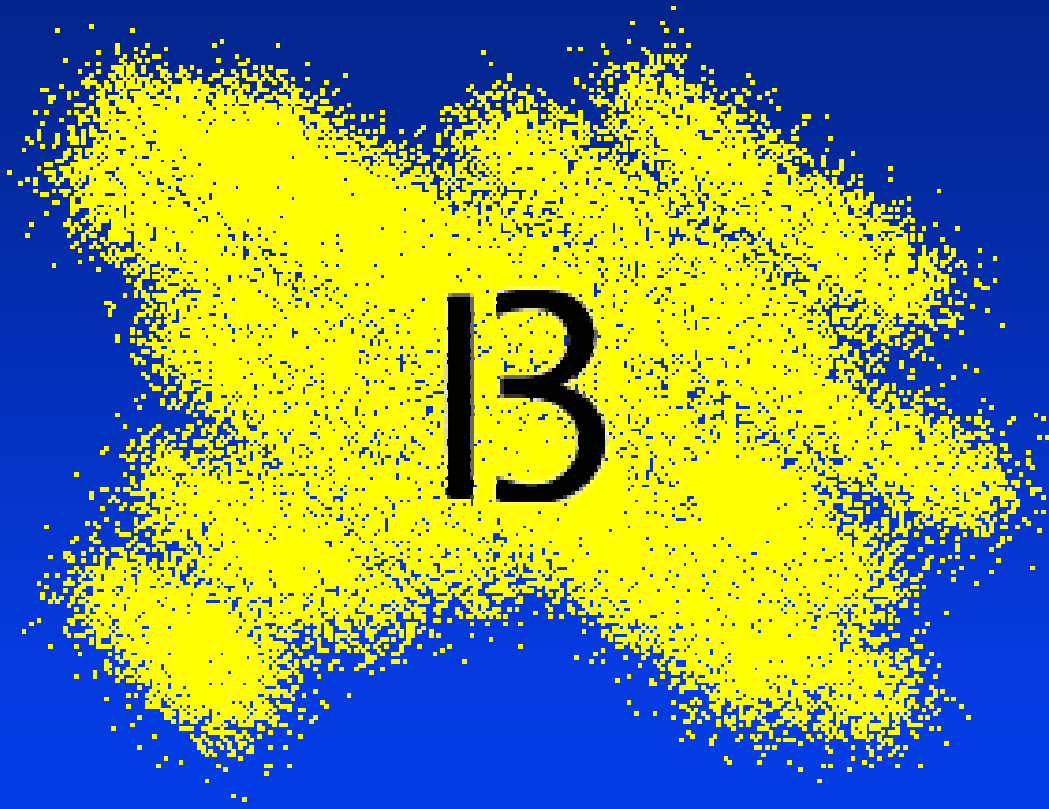
Items are interpreted based on surrounding items.



A B C


Perceptual Grouping

Center item appears as the Letter B.



Perceptual Grouping

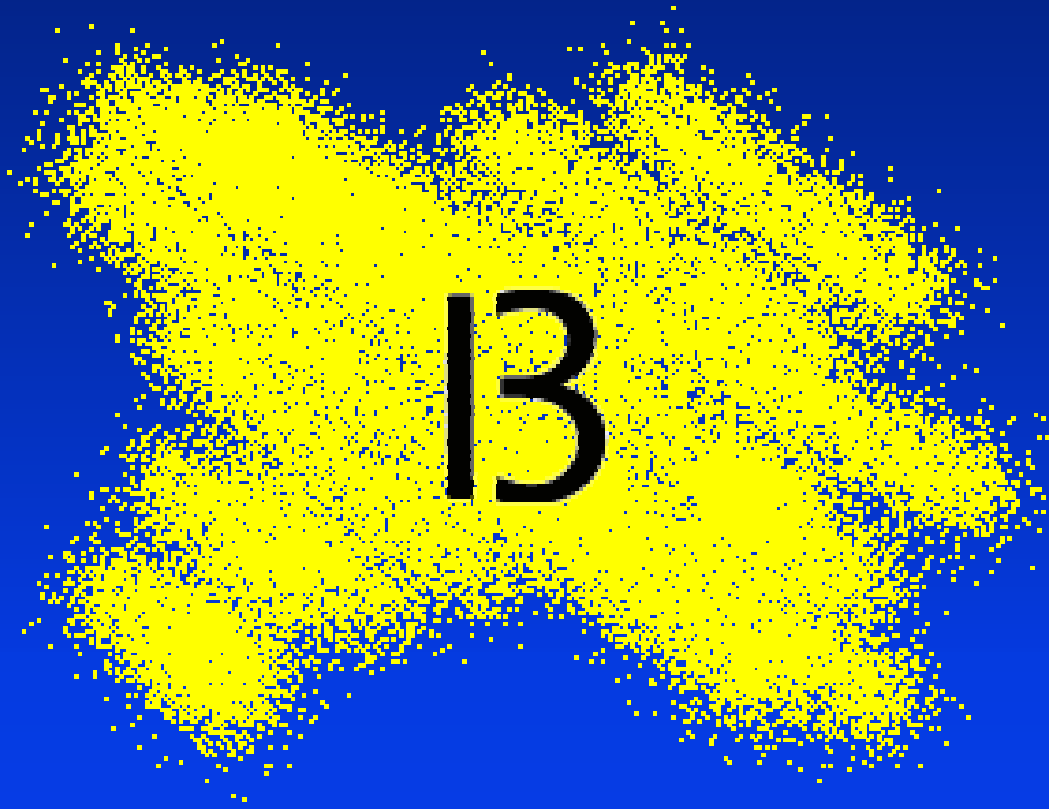
Change the Surround



12 13 14

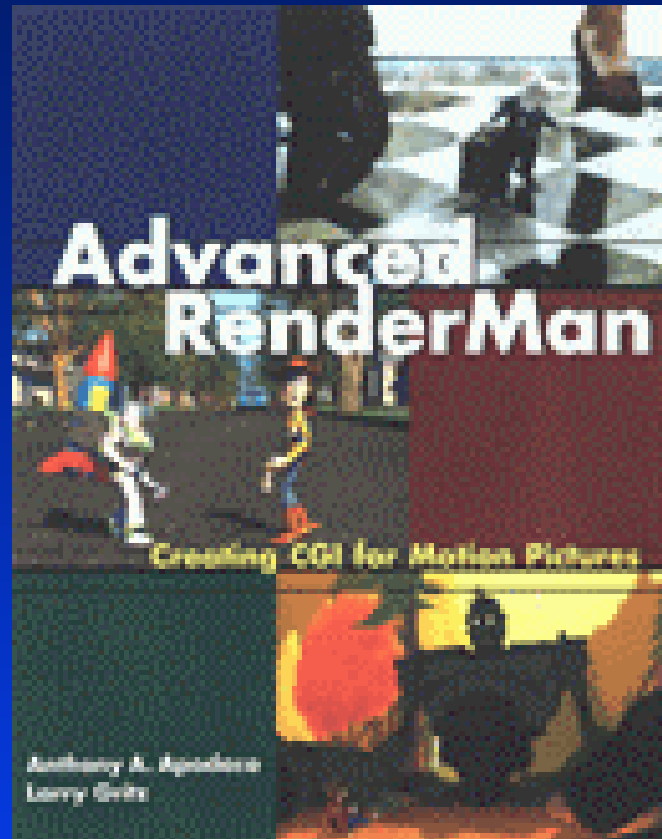
Perceptual Grouping

Center item appears as the number 13.



Images courtesy of Professor Charles Schmidt, Rutgers University

Applying Gestalt Grouping to CG



Anthony A. Apodaca, Larry Gritz

Perceptual Binding



Perceptual Binding

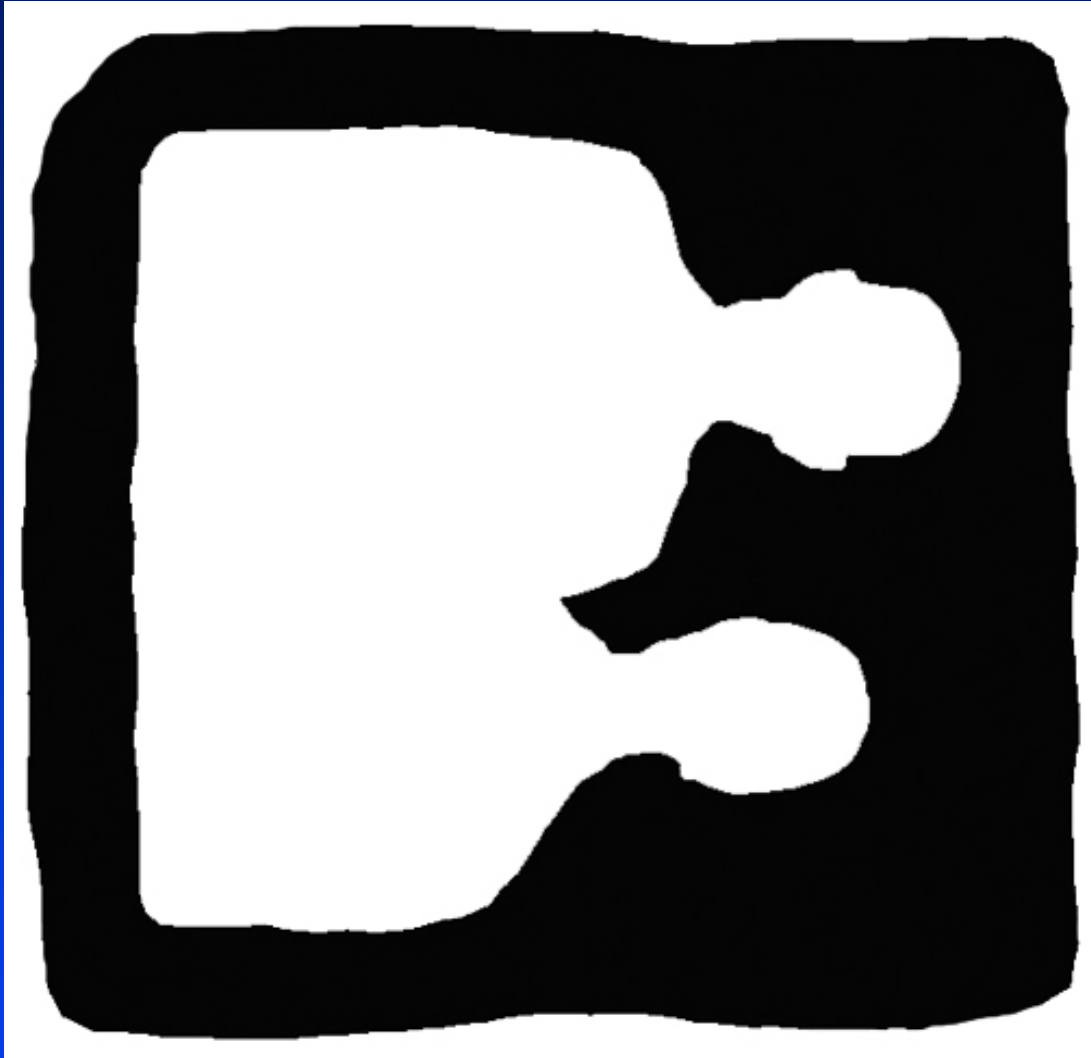


Perceptual Binding

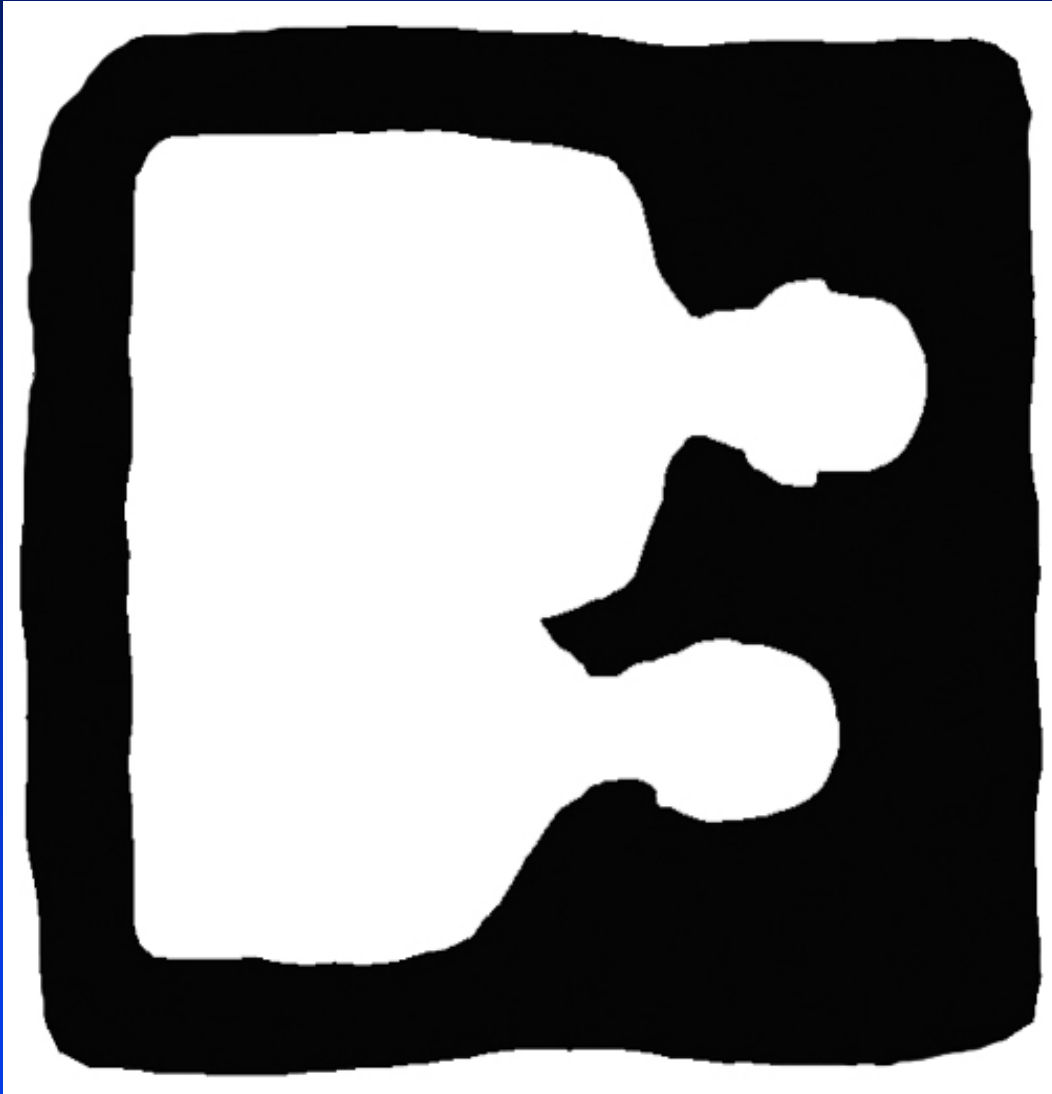


Bev Dolittle

Perceptual Binding



Perceptual Binding

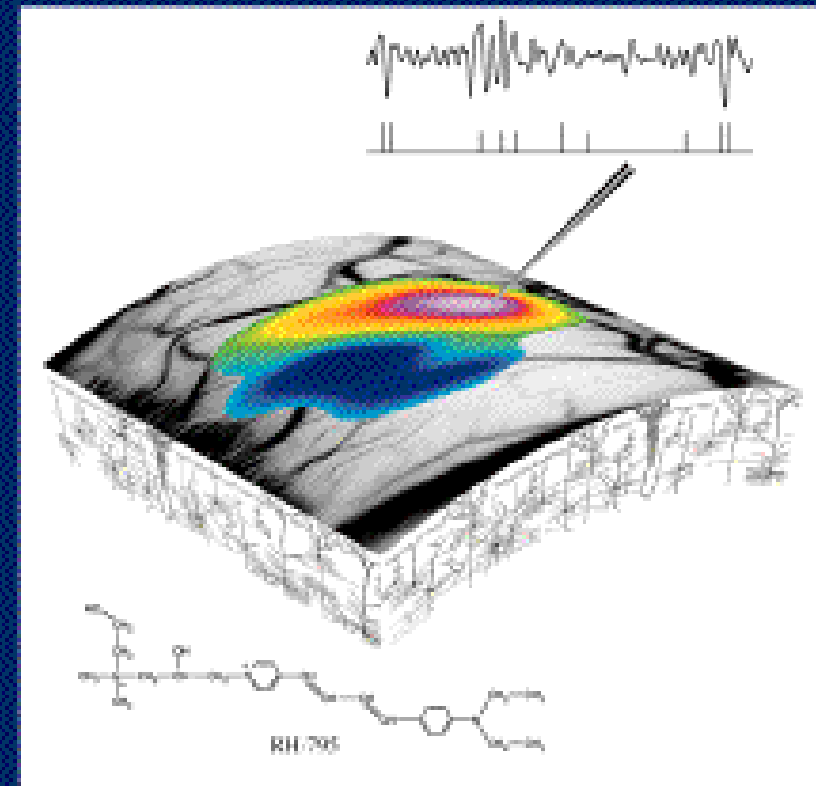


Isolation of a Single Visual Cue

- **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.



PUBLISHED BY THE AMERICAN PHYSIOLOGICAL SOCIETY
VOLUME 74 NUMBER 1
JULY 1995

Photograph



Single Visual Module



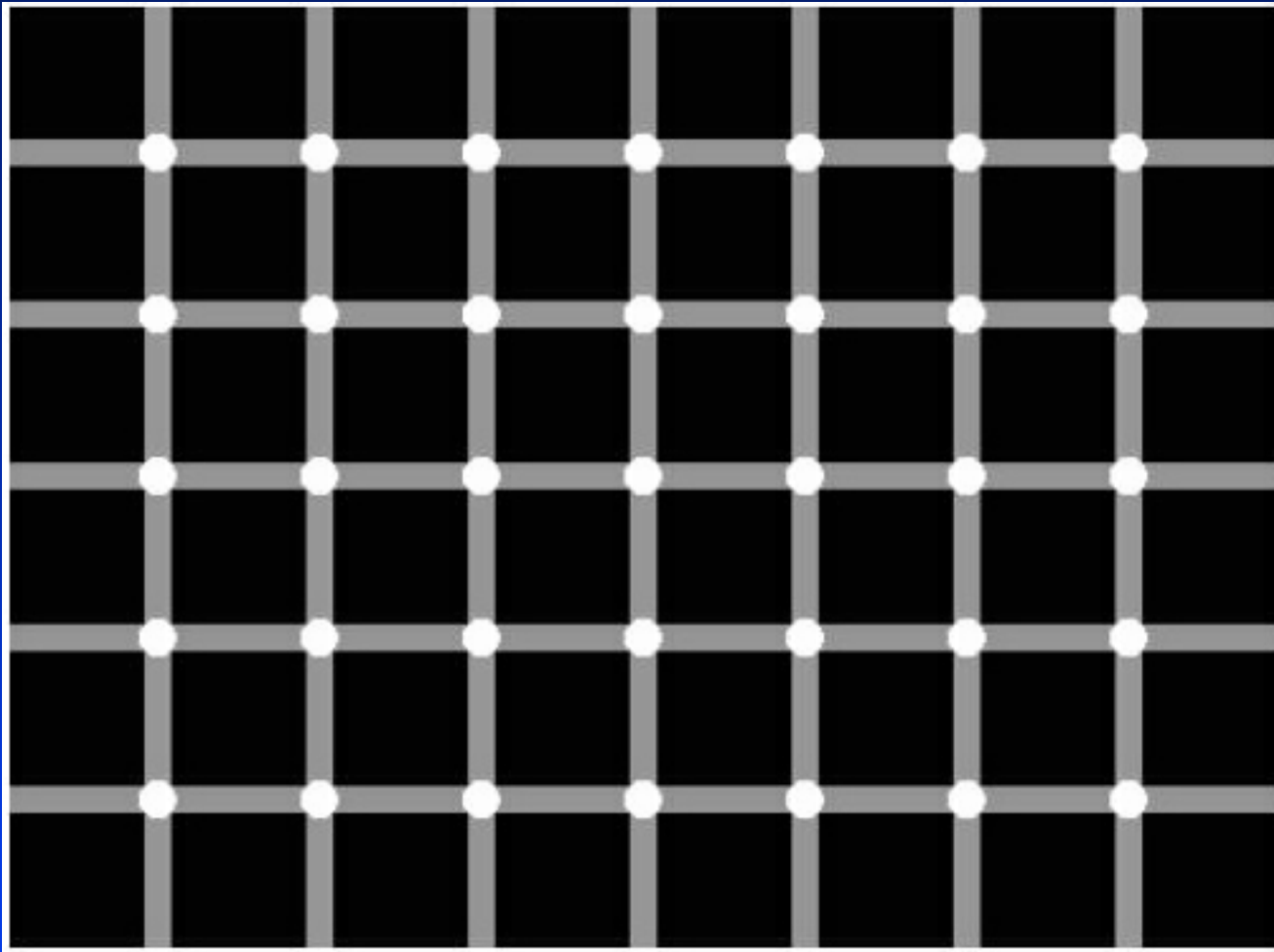
Peak Shift applied on Single Visual Modul



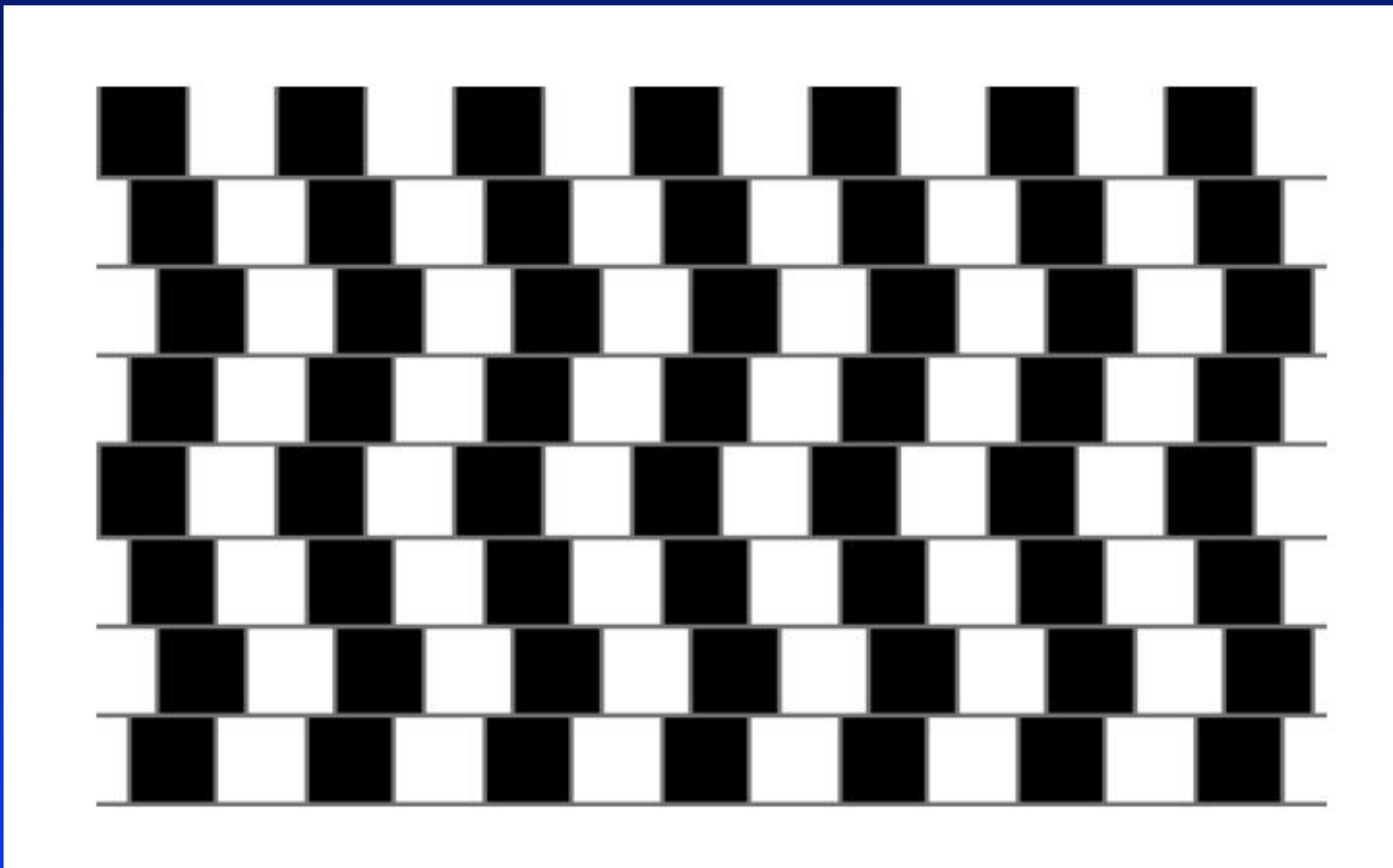
Peak Shifted Line Art Faces



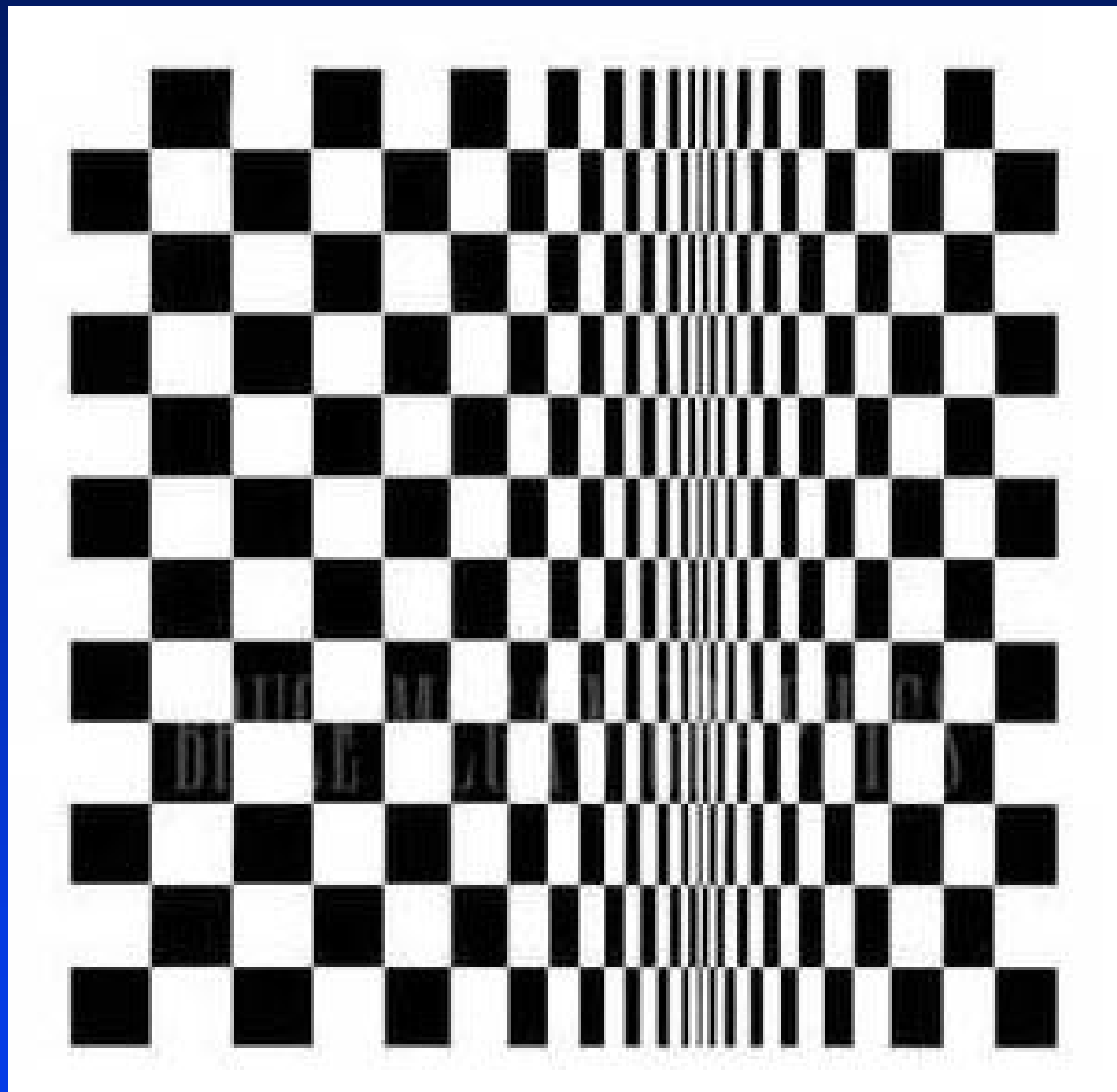
Herman Grid, Count Black Spots at Intersections



Apparent Movement



Op Art



Bridget Riley

Idea of Movement



Duchamp

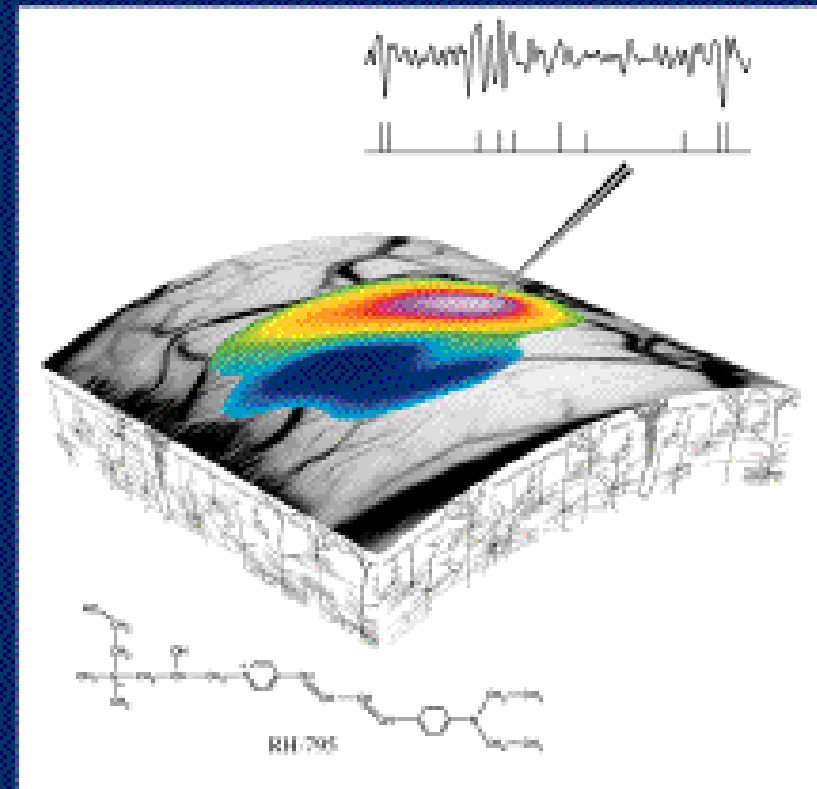
Applying Visual Cue Research to CG

Take advantage of
new computational
models of Human Vision

Tone Mapping

Motion planning

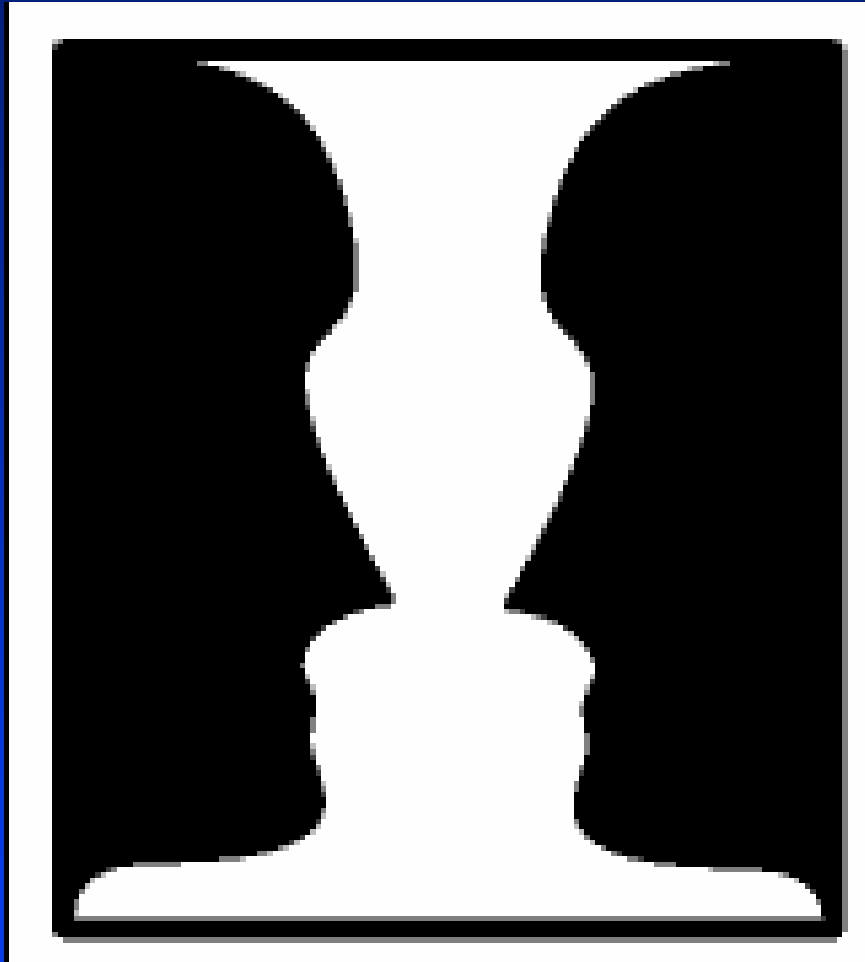
Anti-Aliasing



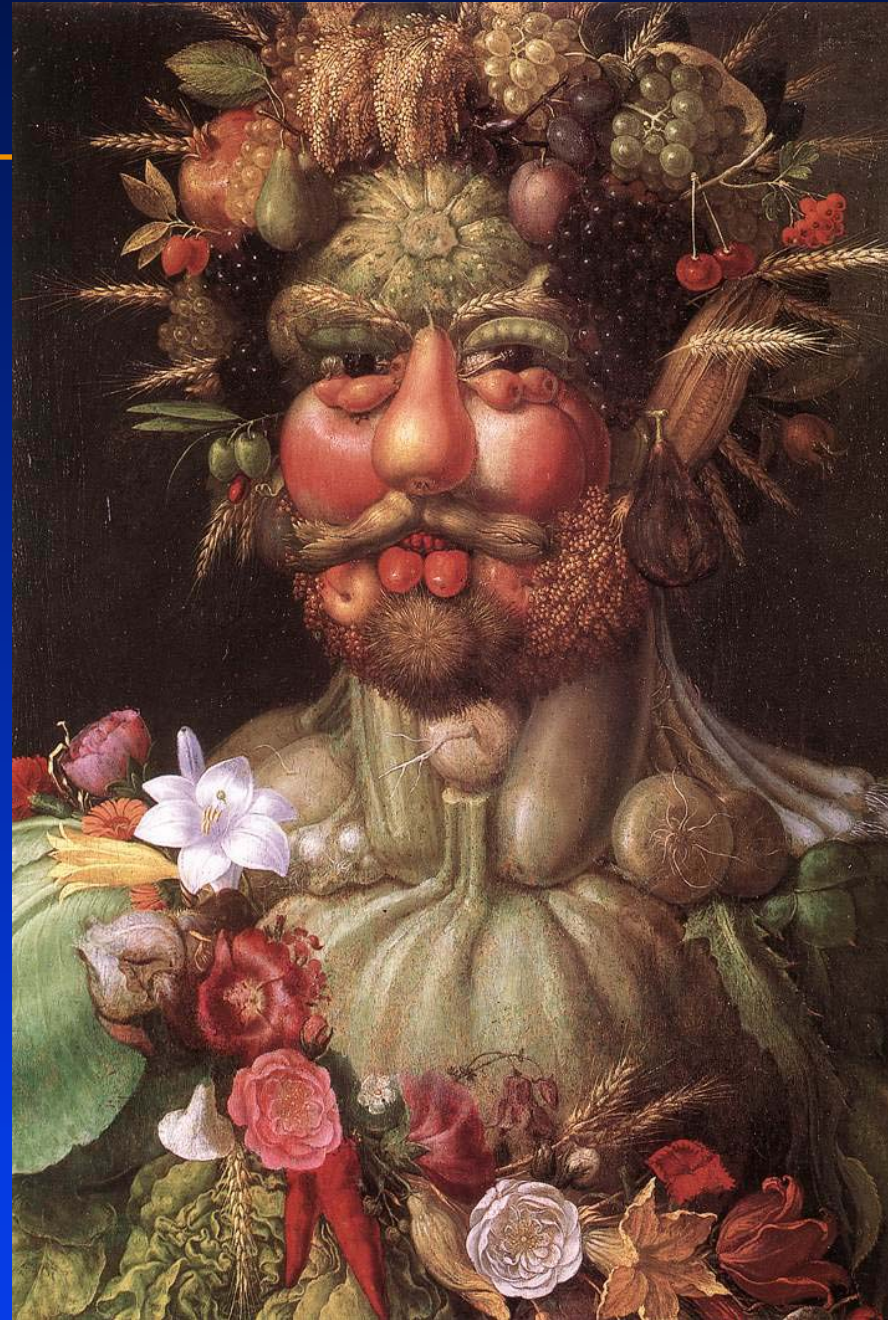
PUBLISHED BY THE AMERICAN PHYSIOLOGICAL SOCIETY
VOLUME 74 NUMBER 1
JULY 1995

Problem Solving

Perceptual “problem solving” is reinforcing



n Scene Elements



Arcimboldo

Problem Solving in the Subject Matter



Wyeth

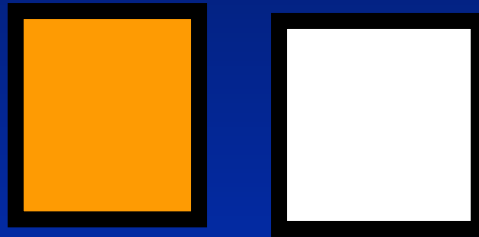
Sometimes the Problem is Obvious



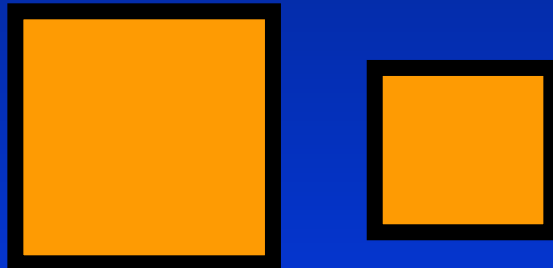
Contrast Extraction

- **Contrast is reinforcing.**

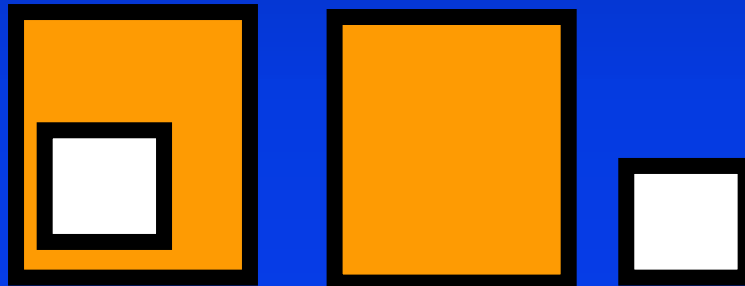
- **Color**



- **Size**



- **Position**



Contrast (Intensity)



Contrast (Size and Number)



Contrast (position)

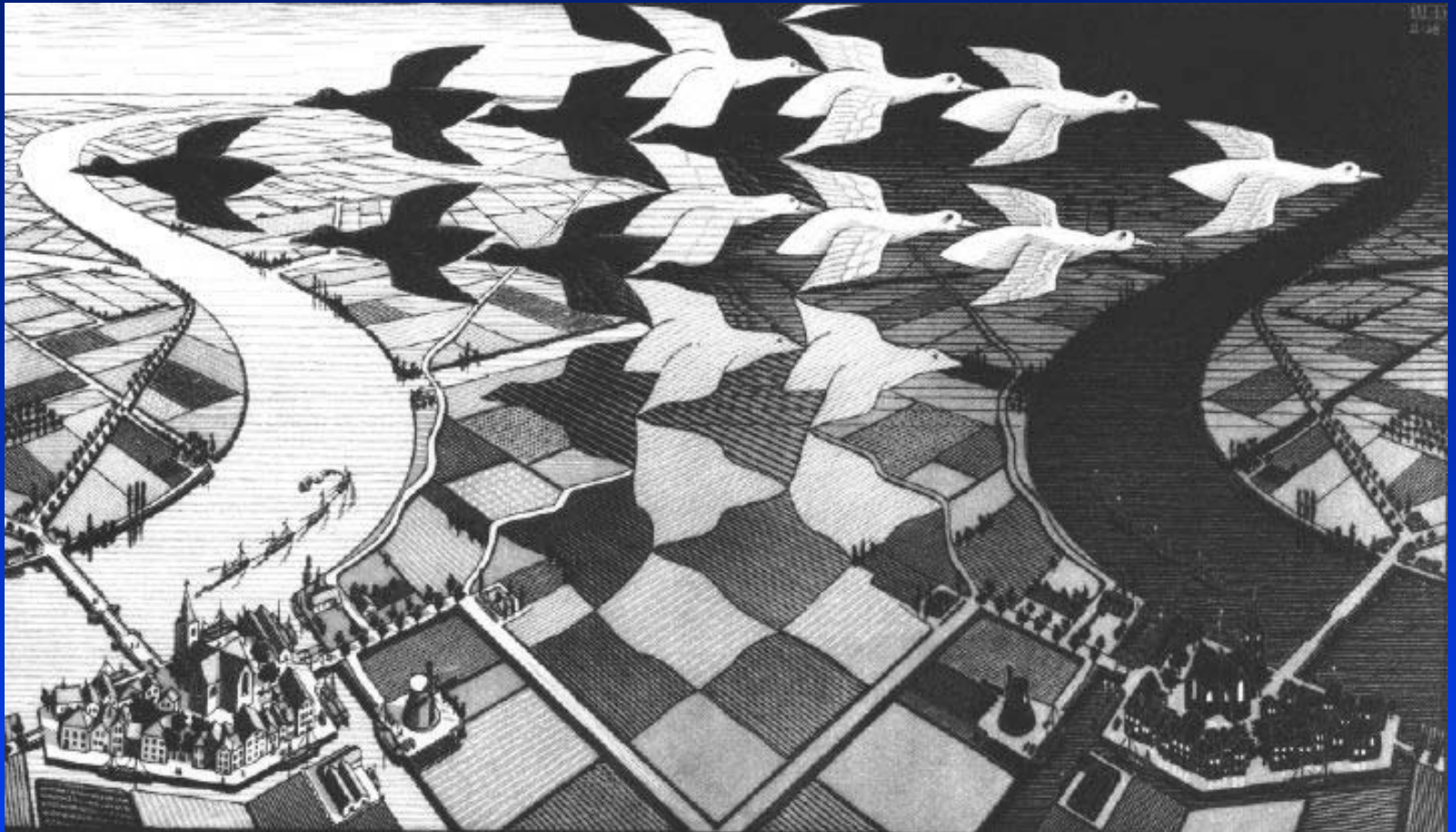


Symmetry

Symmetry is attractive.



Symmetry



Generic Viewpoint

Unique Vantage Points are Suspect.



Generic Viewpoint

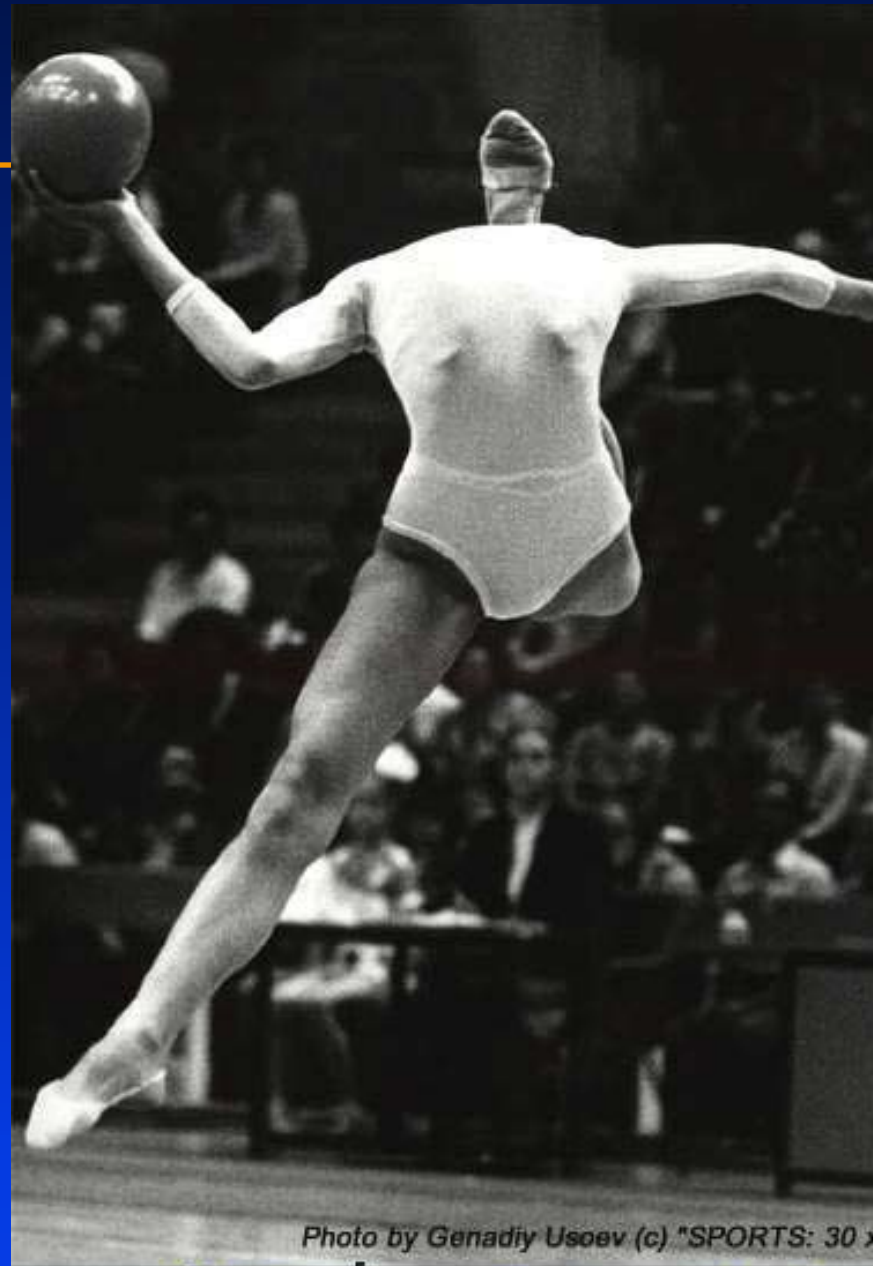


Photo by Genadiy Usoev (c) "SPORTS: 30 x



<http://www.multimania.com/ydog/>

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.



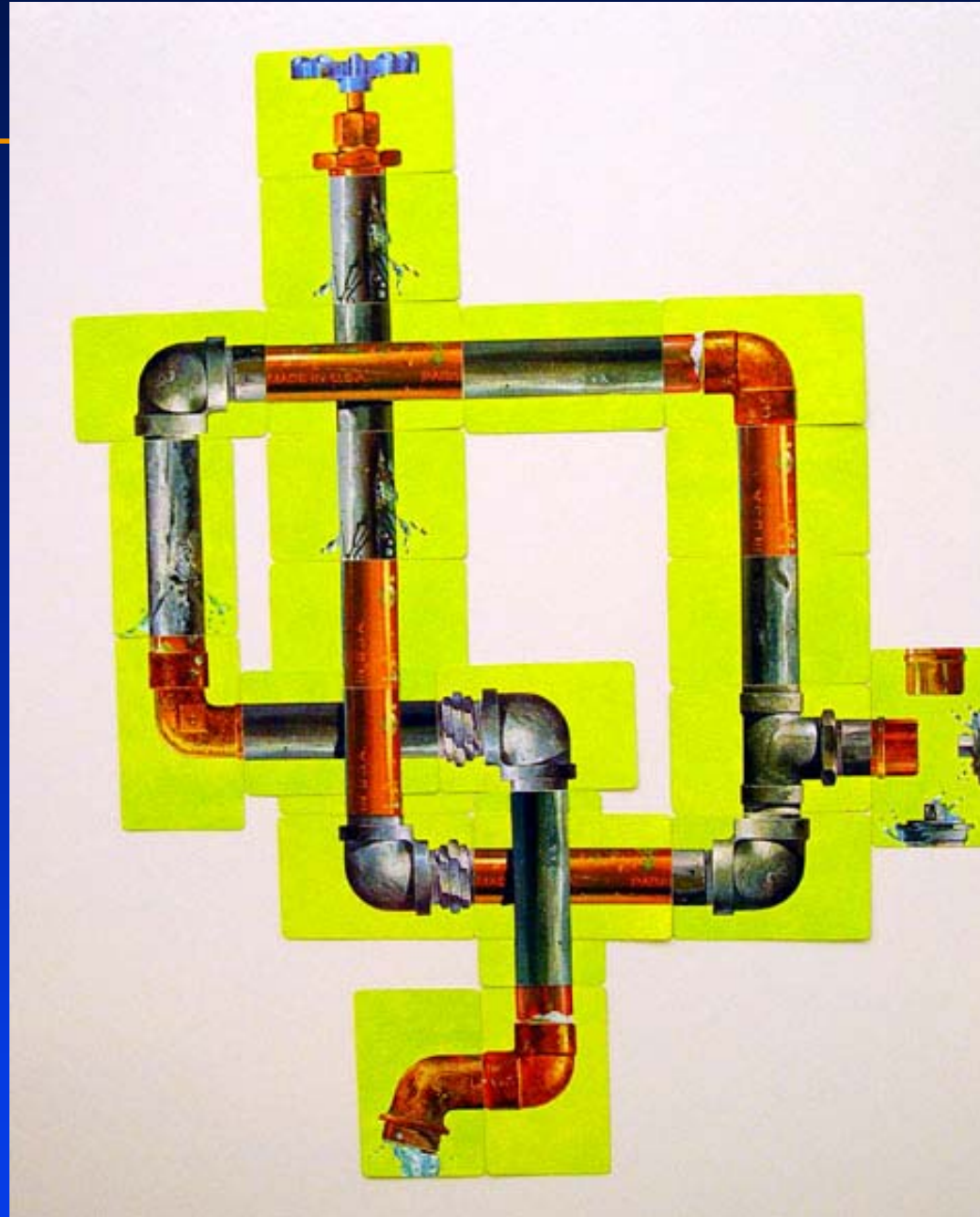
This is Not a Pipe



Ceci n'est pas une pipe.

Magritte

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

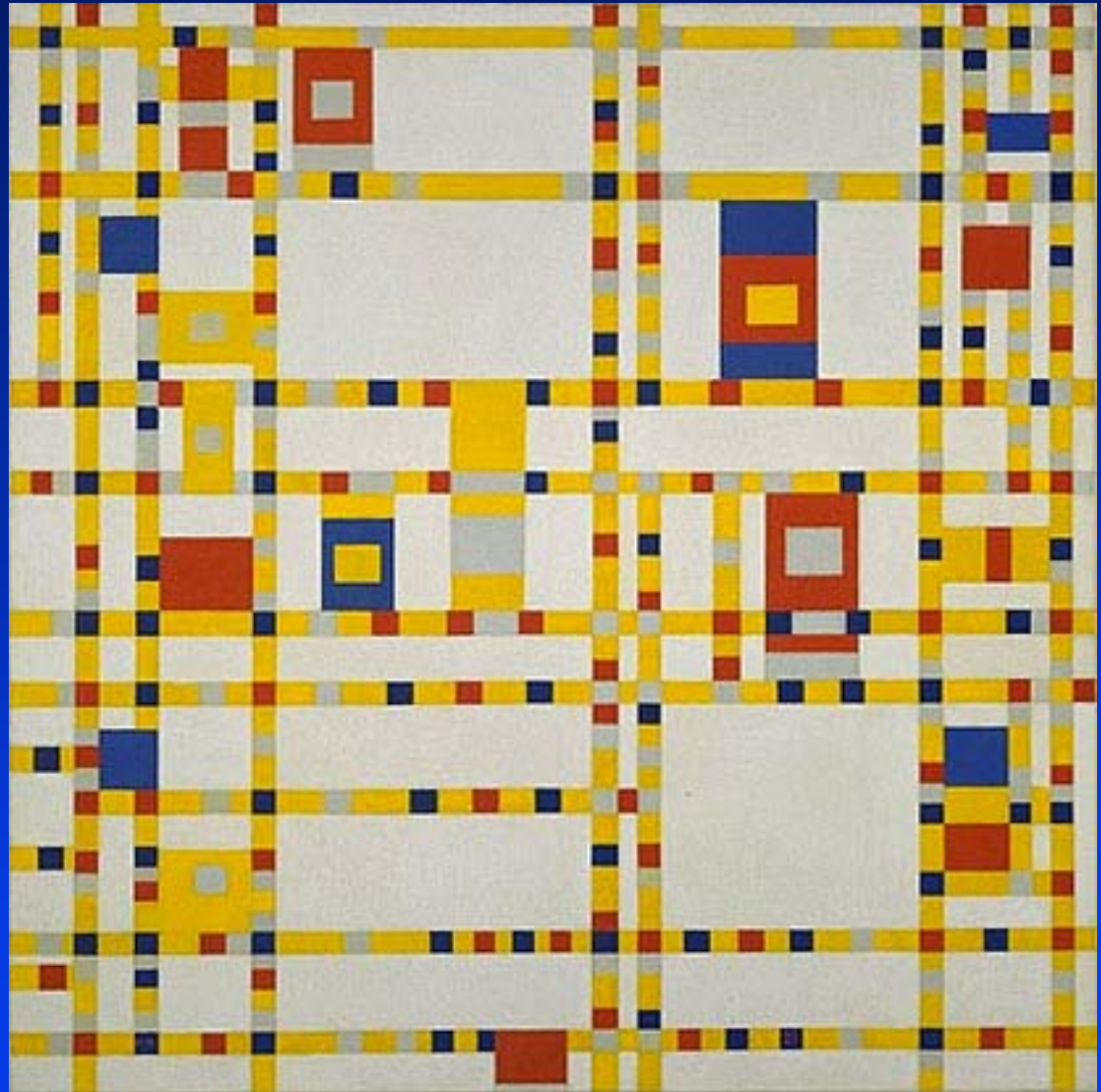
Thanks

- NPR BOF, Tuesday 7:00, Menger Hotel

[***www.cs.utah.edu/~bgooch***](http://www.cs.utah.edu/~bgooch)

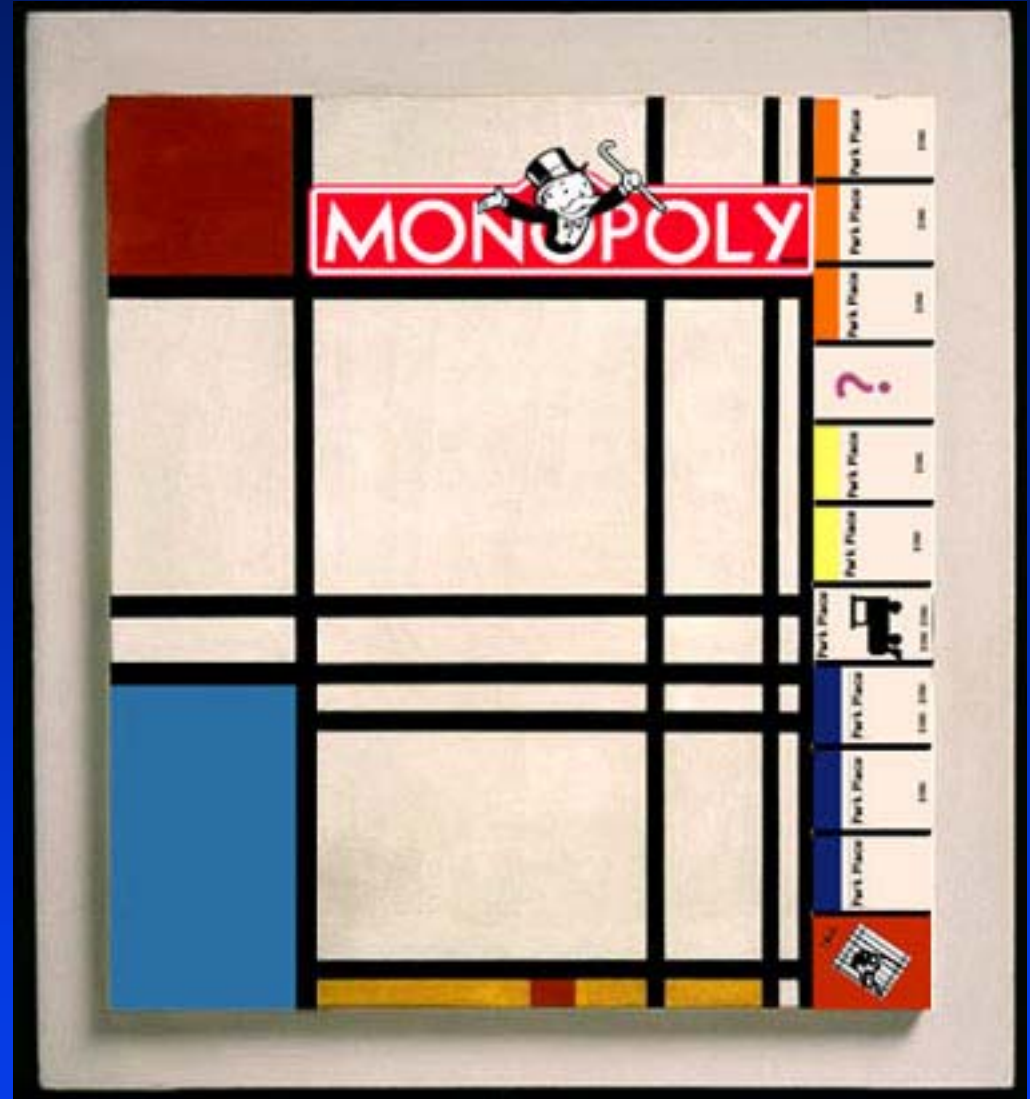


Broadway Boogie-Woogie



Mondrian

Three Hotels on Broadway Boogie-Woogie



Caywood

Format

- One
- Two
- Three