Shape, Color and Perception of Translucency

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Translucency is important
Translucency of unfamiliar objects

Pyrawax

Paraffin wax

Glycerin soap
Reflection from an opaque object
Subsurface scattering

Translucent material
Renderings with subsurface scattering

Opaque (BRDF)  Translucent (BSSRDF)

Rendered by Asher Dunn, Mitsuba Renderer
http://www.mitsuba-renderer.org/
Suggested cues for perception of translucency

- Highlights and shading relationship
- Luminance histograms
- Local luminance gradients
- Color saturation
- Lighting direction, such as backlighting
- RMS contrasts
There are many cues to translucency

- Thin edges
- Specular highlights
- Color gradients
How does translucency affects shape perception

Opaque (BRDF)  
Translucent (BSSRDF)

Rendered by Asher Dunn, Mitsuba Renderer  
http://www.mitsuba-renderer.org/
Question: How does translucency affect shape perception?
Experiment 1: Effect of translucency on perceived shape

Bun object: Constant physical shape

Increasing Physical Translucency

Rendered by Ioannis Gkioulekas
Models with different depths

Deep

Medium

Shallow
Task: Paired comparison

Which bun has the deeper cut?
Summary of Conditions

• 3 depth conditions (deep, medium, shallow)

• 5 physical translucency parameters

• Grayscale and colored “green” conditions (same luminance contrast)

• Environment map: Grove and Campus (From Debevec database)

• Ranking of depth was constructed from paired comparisons (L.L.Thurstone)
Results: Effect of translucency on depth ranking (across different depths)

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Results: Effect of translucency on depth ranking (across different depths)

Physical Translucency

N = 9

- deep
- medium
- shallow
Summary: Translucency affects 3D shape perception

Shallow physical depth

Deep physical depth
Questions

• How does translucency influence perception of 3D shape?

• How does 3D shape, especially sharp edges, influence perception of translucency?
Dramatic gradient at sharp edges

Material: Pyrawax
Effect of edge roundness on perception of translucency

Cube object: Constant physical translucency
Experiment 2: Effect of edge sharpness on translucency
Task: Paired comparison

Which cube looks more translucent?
Summary of conditions

- 5 edge roundness parameters
- 5 physical translucency parameters
- Environment map: Grove and Campus
- Ranking of translucency was constructed from paired comparisons (L.L. Thurstone)
Results: Effect of edge roundness on the ranking of translucency

N = 9

Translucency Ranking

Edge Rounding Radius ➔ opaque
Results: Effect of edge roundness on the ranking of translucency

N = 9

Translucency Ranking

Edge Rounding Radius

opaque
translucent
Summary

Shape influences the perception of translucency: objects with sharper edges look more translucent than ones with rounder edges.
Color variation is an important cue for translucency

No babies were harmed in the making of this talk!
Color variation is an important cue for translucency

Original

Constant Hue and Saturation

No babies were harmed in the making this talk!
Conclusions

• Physical translucency influences the perception of object shape: translucent convex objects look more shallow than opaque ones.

• Shape influences the perception of translucency: objects with sharper edges look more translucent.
Acknowledgement

Ioannis Gkioulekas
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Todd Zickler
Ted Adelson
Kavita Bala
end
Results: Effect of translucency on depth ranking (same physical depth)
Results: Effect of translucency on depth ranking (same physical depth)

Depth = “deep”
Depth = “medium”
Depth = “shallow”

Physical Translucency

N = 9

grayscale
green
Experiment 1: Effect of translucency on perceived shape

Bun object: Constant physical shape

Increasing Physical Translucency

Rendered by Ioannis Gkioulekas
Effect of translucency on depth ranking (including 3 depths)
Does color influence shape and material perception?

From Ted Adelson
Effect of edge roundness on the ranking of translucency

Subject = kae

![Graph showing the effect of edge roundness on translucency ranking. The x-axis represents edge rounding radius, and the y-axis represents translucency ranking. The graph includes a point labeled g = 0.](image)
Effect of edge roundness on the ranking of translucency

Subject = kae
3. Color Variation improves shape perception
3. Color Variation improves shape perception

Full color

Constant Chroma
Cues: Gradients of luminance and color

Pyrawax

Parafin wax

Soap
Translucent Materials
Experiment 1: Effect of edge sharpness on translucency

Rendered by Ioannis Gkloulekas
Different types of translucency

Source: flickr
Color variation in translucent materials

From Ionanis Gkiouslekas
Color variation in translucent materials

From Ionanis Gkiouslekas
Color variation in translucent materials

From Ionanis Gkiouslekas
Question: Does sub-surface scattering affect shape perception?

Opaque (BRDF)  Translucent (BSSRDF)

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