

# Looking at Things and Stuff

SunS 2009

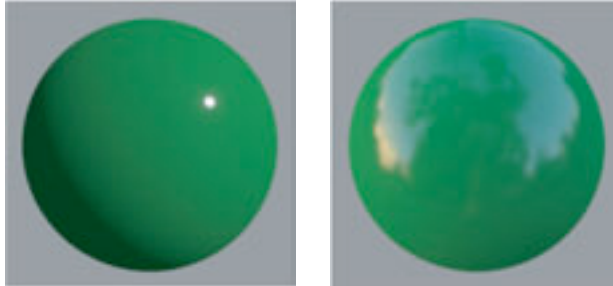
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(with **Lavanya Sharan**  
& Ruth Rosenholtz)

We can see objects, scenes, and the “stuff” (materials) they are made of.



- People can describe material attributes like color, translucency, etc. I.e., they can estimate parameters.
- People can name materials (plastic, wood, etc.) I.e., they can recognize categories.
- Most material research is about parameter estimation, not recognition/categorization.

# Parameter estimation research uses simple toy worlds.



*Rendered spheres (Glossiness)  
Fleming, Dror & Adelson 2003*



*Photographs of stucco (Albedo  
& Gloss) Motoyoshi et al 2007,  
Sharan et al 2008*

Judgments like albedo, gloss, color, translucency etc. have been studied.

*Beck & Prazdny 1981, Adelson 1993, 1999; Nishida & Shinya 1998, Bloj et al. 1999, Gilchrist et al. 1999, Pellacini et al. 2000, Singh & Anderson 2002, Boyaci et al. 2003, Brainard et al. 2003, Fleming et al. 2003, Maloney & Yang 2003, Fleming et al. 2004, Todd et al. 2004, Berzhanskaya et al. 2005, Fleming & Buelthoff 2005, Khang et al. 2006, Robilotto & Zaidi 2006, Ho et al. 2007, Motoyoshi et al. 2007, Vangorp et al. 2007, Sharan et al. 2008, Xiao & Brainard 2008.*

Let's study recognition in natural images.  
It can be very fast.

- Potter 1976 (gist in RSVP)
- Thorpe et al (many) (is there an animal here?)
- Greene & Oliva 2009 (what kind of scene is this?)
- Fei Fei et al 2007 (describe this picture)
- Grill-Spector & Kanwisher 2005 (what category object?)

How about material perception?

(Sometimes it's slow, e.g., deciding if leather is real or fake.  
But, we find, sometimes it can be quite fast.)

# What do people mean by “rapid perception?”

- You can see a lot with a short presentation. (But maybe processing continues for a long time)
- You can make judgments with short RT.

# Start with simple experiment: show a picture briefly, get description (cf. Fei Fei et al)

Subject's description after 320msec glimpse:

“A wool cupcake, a knitted wool cupcake, so the cupcake part was made out of light brown wool with small specks of yellow and maybe pink wool on top, so looked like sprinkles with a red wool cherry...”

Subject sees the thing (cupcake) and the stuff (knitting) quickly and separately.

Object and material perception are distinct.



# Can you convey material info verbally?

Make all objects have same shape, so shape is uninformative.

- Subject A views a “donut” shaped object for 40 msec or 320 msec, followed by mask.
- Subject A then describes the materials in words (no color words or object names allowed)
- Subject B reads the description, tries to match it with the correct picture.



Subject A describes materials.  
Subject B matches to images.

60 pictures



Etc.

60 descriptions

→ “Blah blah...”

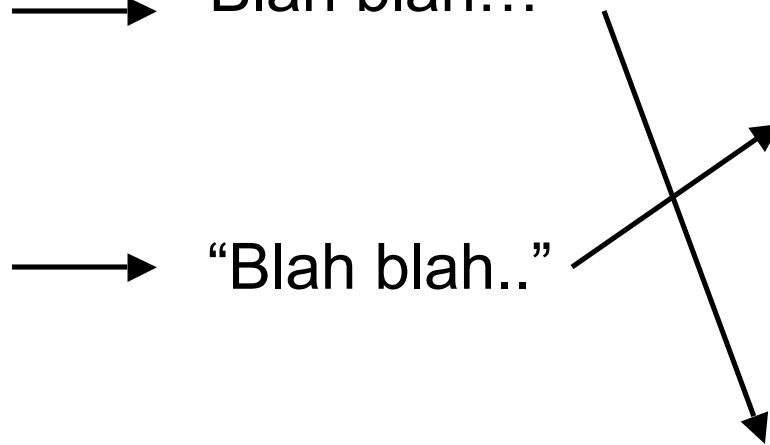
→ “Blah blah..”

Etc.

60 pictures

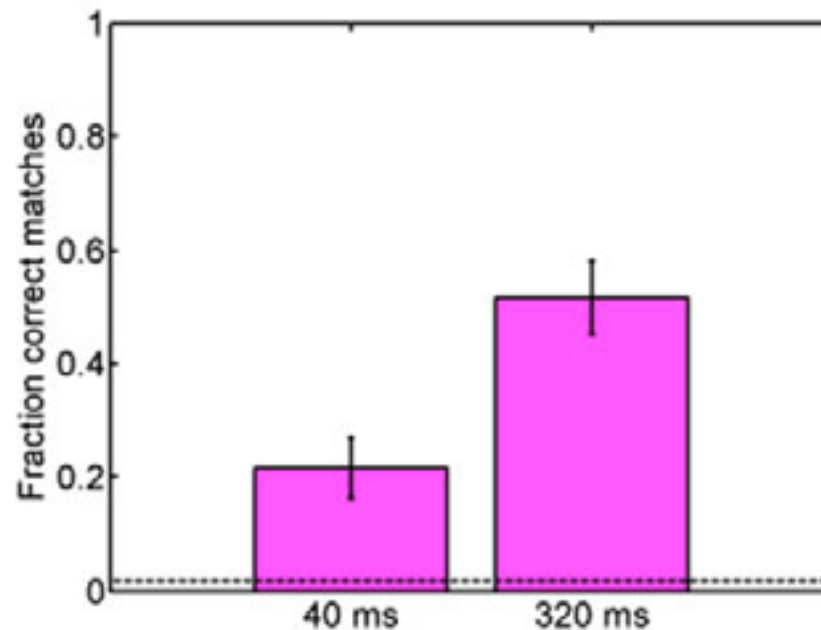


Etc.





Matching is above chance at 40 msec,  
improves at 320 msec.



Longer glimpses are better, but even short glimpses provide useful information.

# Let's do material categorization. Build database with nine categories:

Fabric, glass, leather, metal, paper, plastic, stone, water, wood.



Our images are diverse. (Here, fabric)



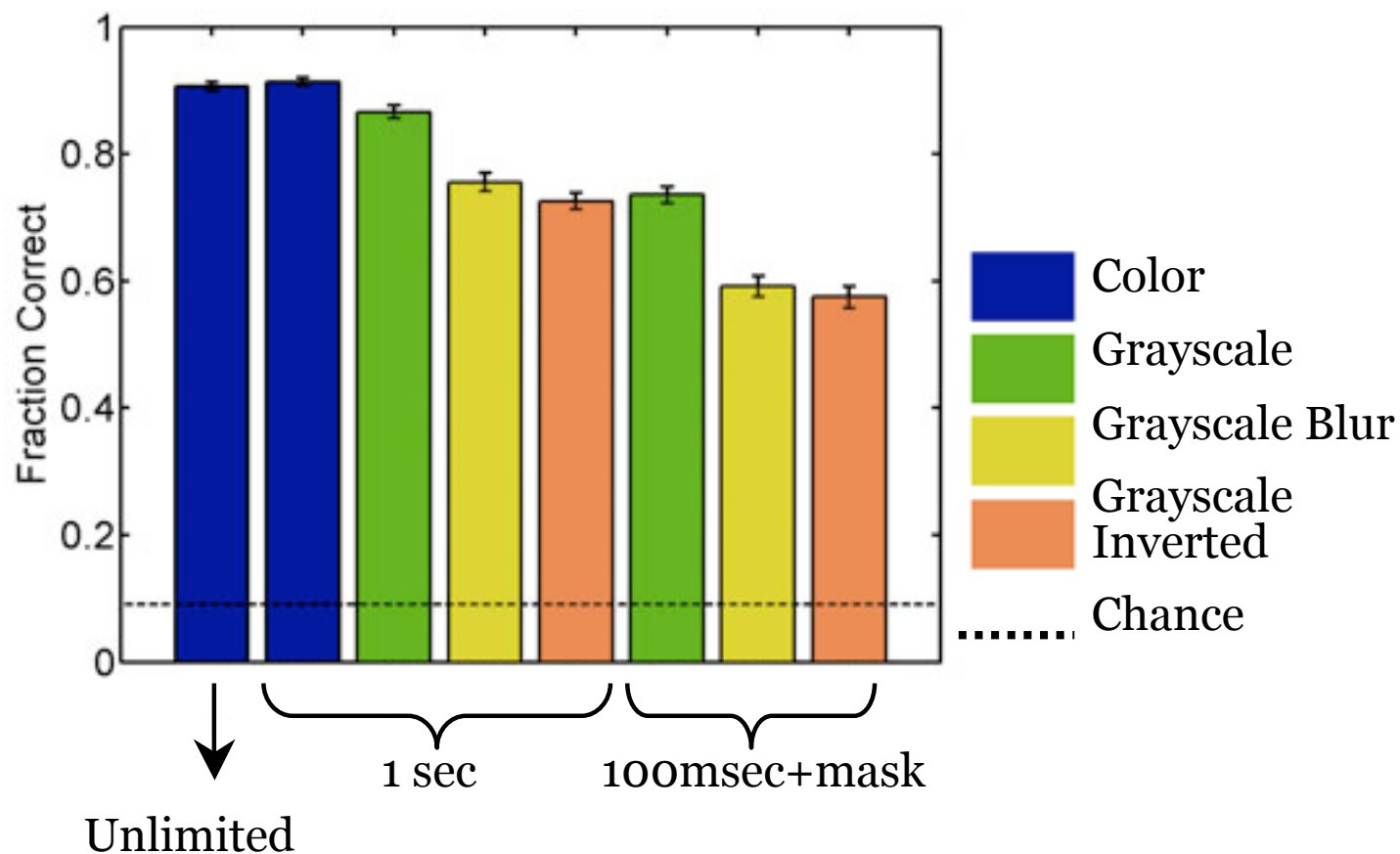
Our images are diverse. (Here, plastic)



Image diversity means no simple  
“tricks” let you do the task.

- You can't just use low-level features like color and texture.
- You can't just do object recognition.

# Categorization (9 categories) of single images, under various conditions.



Surprisingly robust!

# Make it really hard: RSVP stream

40 or 160 ms  
per image

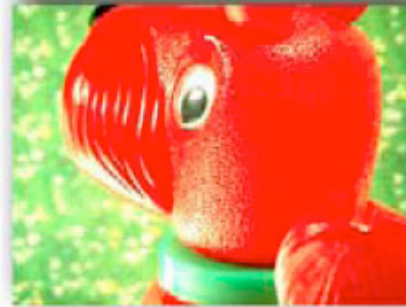


Position 1



Position 2

...

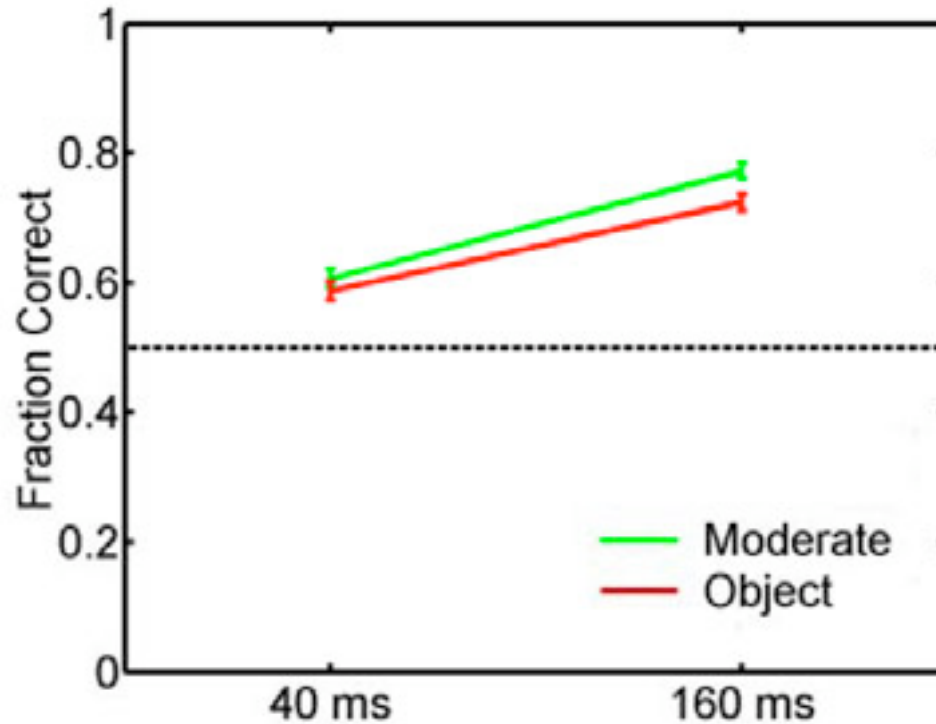


Position 9

*Target appears at Positions 3-7*

# Task: is there a picture of (e.g.) metal in the stream?

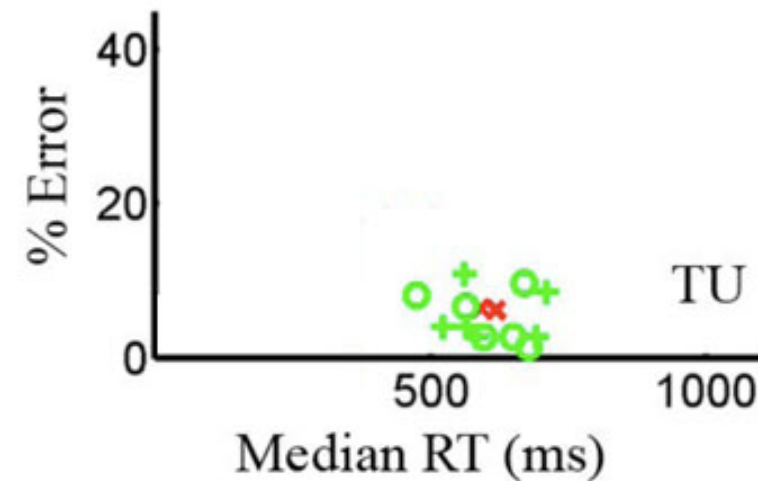
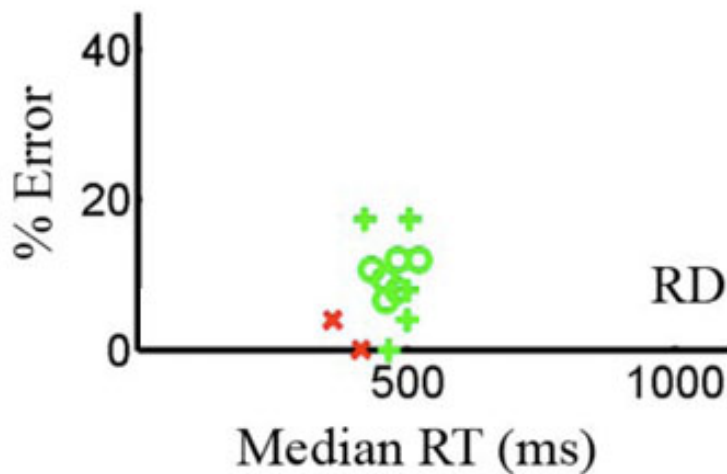
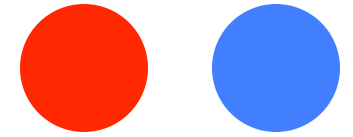
- **Forced choice. Chance = 50%**
- **9 images. Target only in positions 3-7.**
- **It's tough! But people are above chance.**





# Plain old reaction time. Almost as fast as baseline!

- Display a picture of paper, plastic, or fabric.
- Subject chooses category as fast as possible.
- For baseline RT, use categorization of red versus blue disk



- Baseline task
  - Categorization task
- (+ = BW, o = color)

# Conclusions

- Material perception is a distinct problem (not same as texture, object, scene recognition)
- Recognition can be fast and accurate in challenging conditions.
- We don't know how it works.