Estimation of gloss and shape from vision and touch

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magic leap

Outline

I. Context effects on perceived gloss

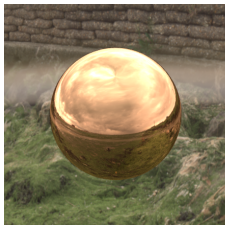
II. Perception of gloss and shape

III. Depth-cue influences on perceived gloss

IV. Haptic influence on bistable shape and gloss

Gloss constancy

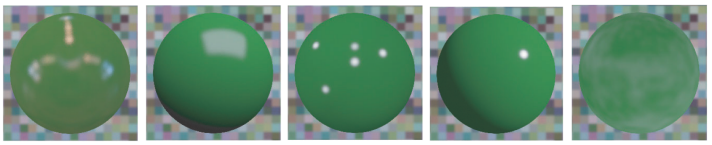
What information do we use to compensate for changes in illumination when estimating gloss?



Review

Same glossy sphere, rendered under different real and artificial light fields

Poor gloss constancy



Fleming, Dror, Adelson (2003)

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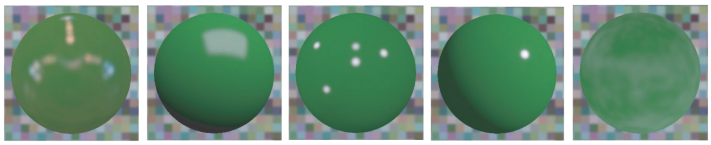


Fleming, Dror, Adelson (2003)

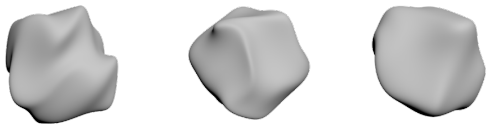
Do observers show gloss constancy when they have explicit information about the light field?

Experiment 1

Does contextual information about the light field have an effect on perceived gloss?

- Render an object in one light field
- Present it in the context of an incongruent light field
- Estimate gloss using a gloss-comparison task

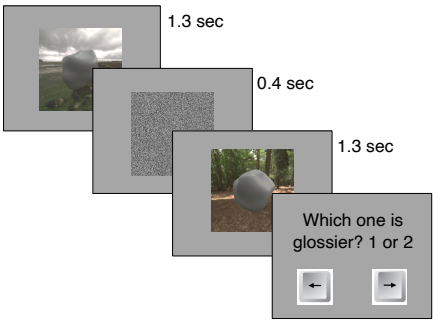
Shapes: bumpy “spheres”



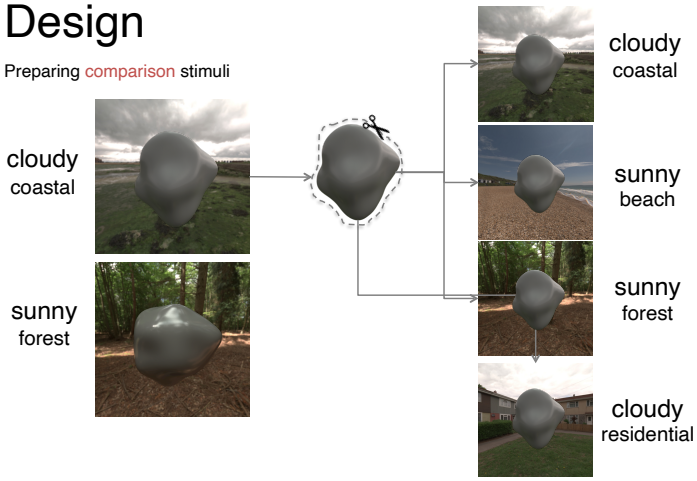
Light fields

Wendy Adams/James Elder

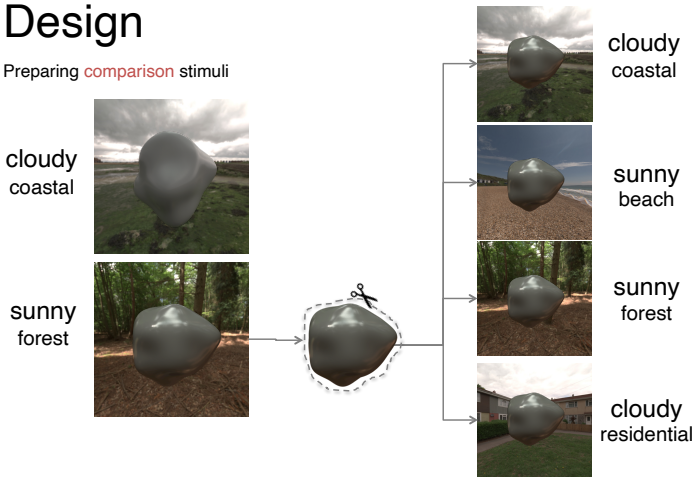
Task



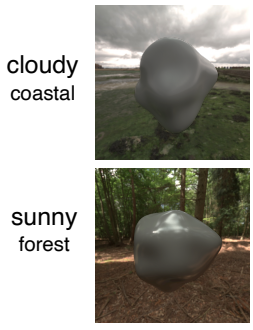
Design



Design

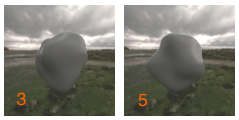


Design

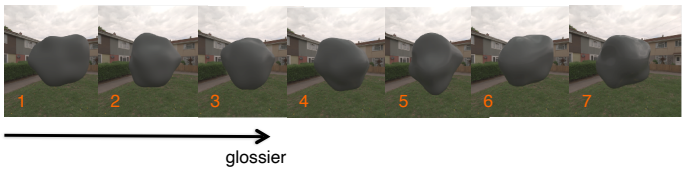


Design

Two gloss levels for standard stimuli

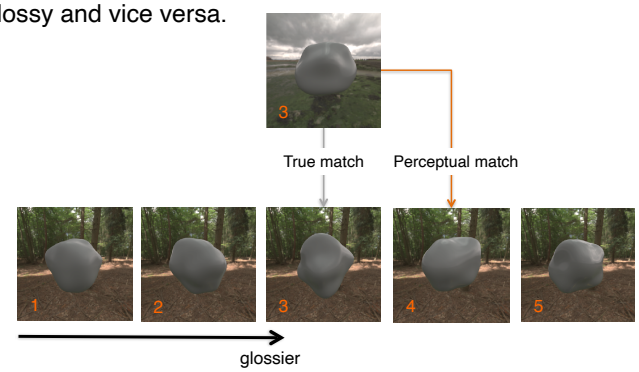


Seven gloss levels for comparison stimuli

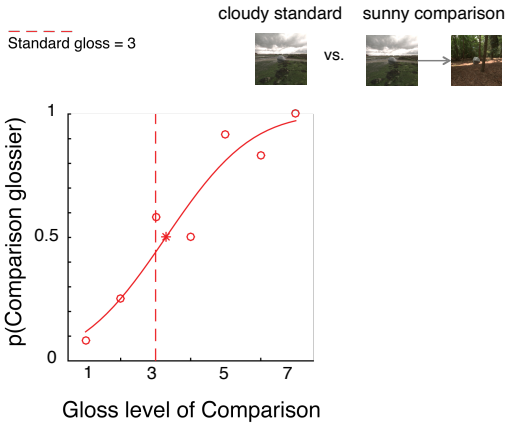


Predictions

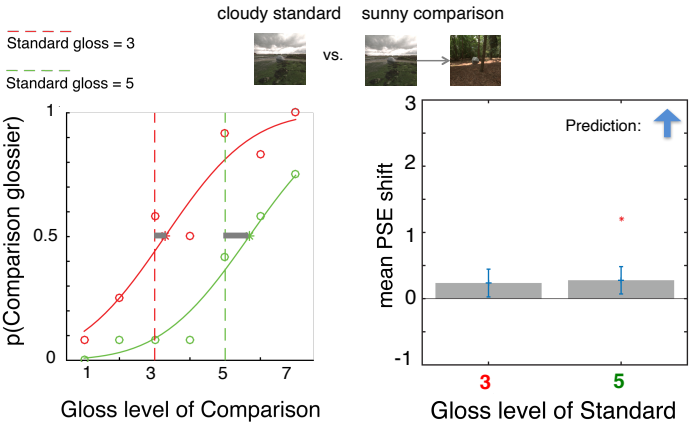
When an object is rendered in a cloudy light field and is shown in a sunny (high contrast) context, it will appear less glossy and vice versa.



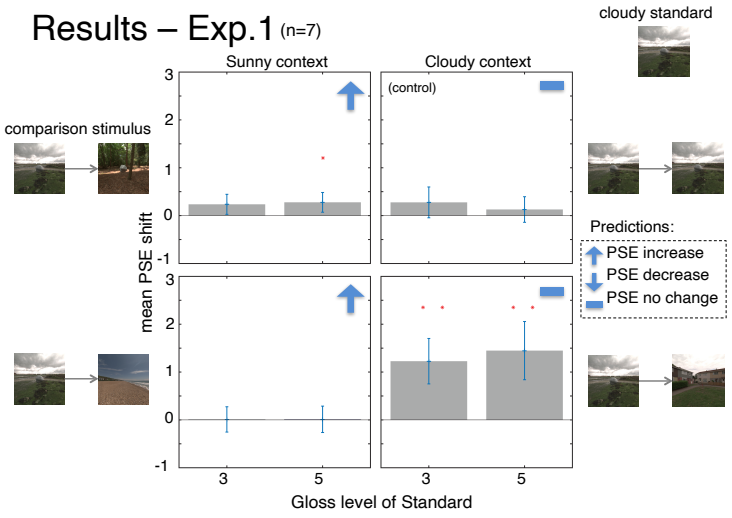
Results – Exp.1



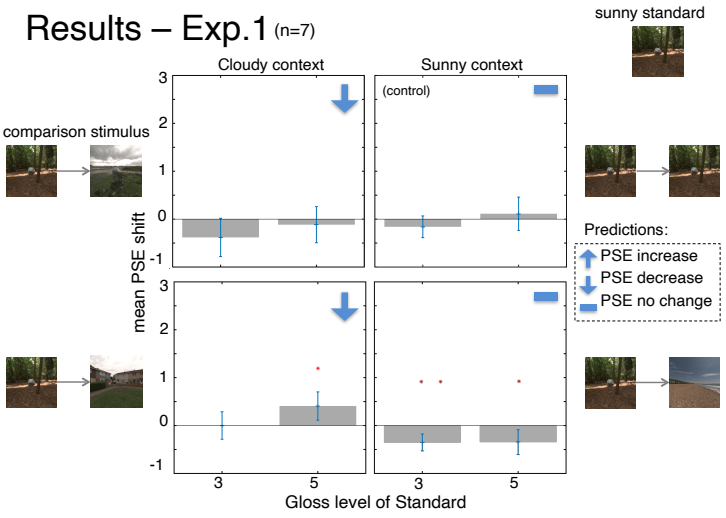
Results – Exp.1



Results – Exp.1 (n=7)



Results – Exp.1 (n=7)

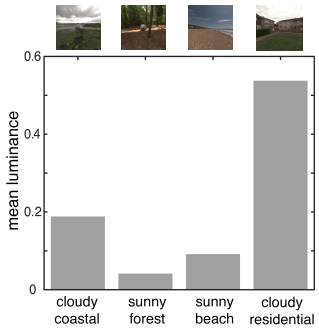


Interim summary - 1

Context affects gloss judgments, but not in the way we predicted.

Large PSE shifts with cloudy residential light field

- The cloudy residential had the highest mean luminance



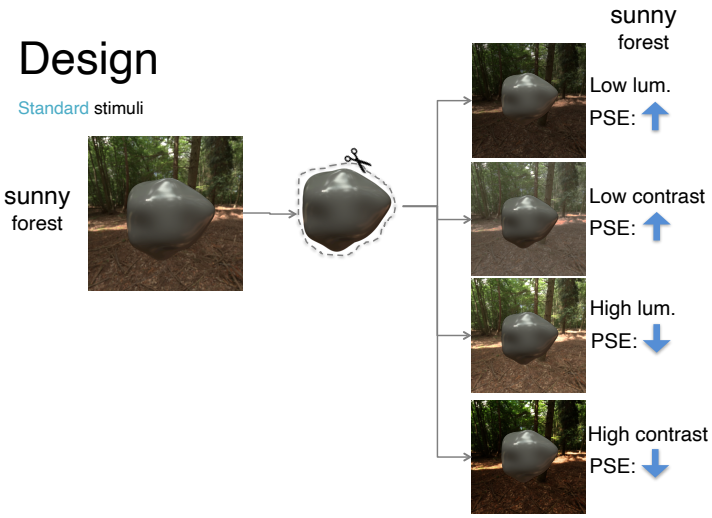
Experiment 2

Do observers use simple image statistics to compensate for changes in the light field?

- Render an object in one light field
- Present it in the context of a similar, high/low luminance or high/low contrast light field

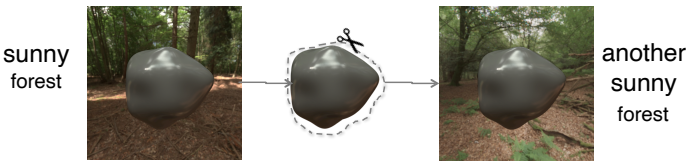
Design

Standard stimuli

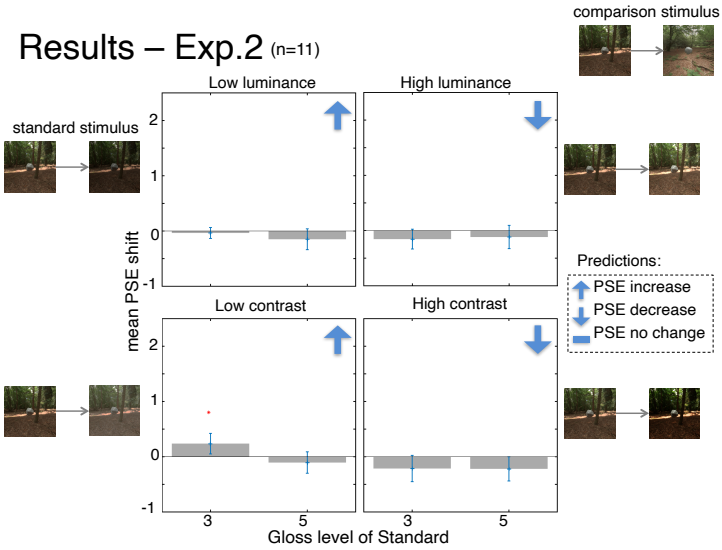


Design

Preparing comparison stimuli



Results – Exp.2 (n=11)



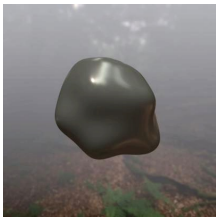
Interim summary - 2

No gloss constancy across changes in luminance and contrast

Observers use something other than mean luminance and contrast of the light field when estimating gloss

Experiment 3

What happens to gloss constancy when we reduce the structure of the light field?

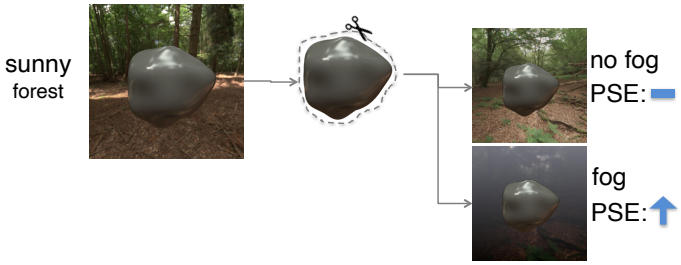


Foggy light fields

Binomial coefficient filter with a vertical gradient
(Simoncelli, Adelson 1990)

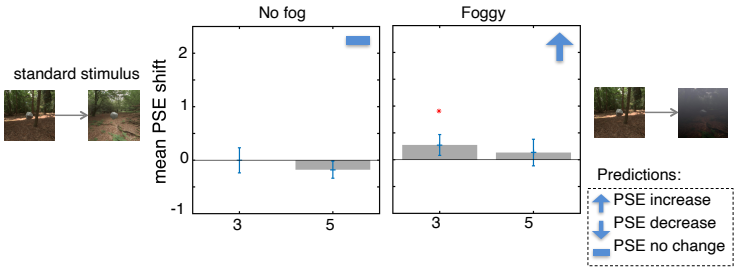
Design

Preparing standard stimuli



Results – Exp. 3 (n=10)

comparison stimulus



Conclusions

What information do we use to compensate for changes in illumination when estimating gloss?

The light field context

What information do people <u>not</u> use to estimate gloss?

Simple image statistics (mean, variance)

Light field structure

Outline

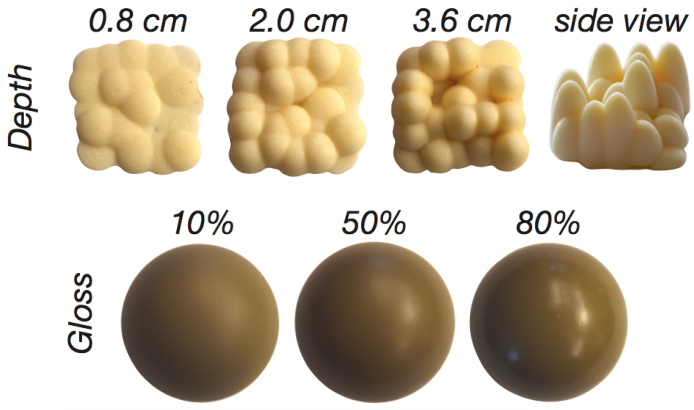
I. Context effects on perceived gloss

II. Perception of gloss and shape

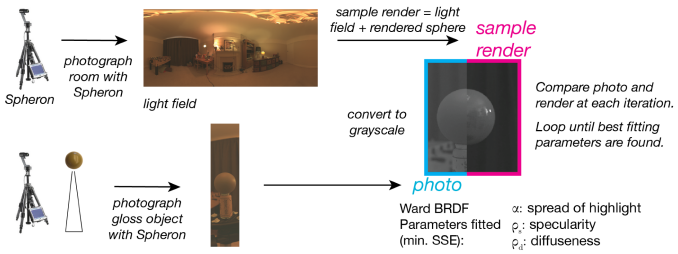
III. Depth-cue influences on perceived gloss

IV. Haptic influence on bistable shape and gloss

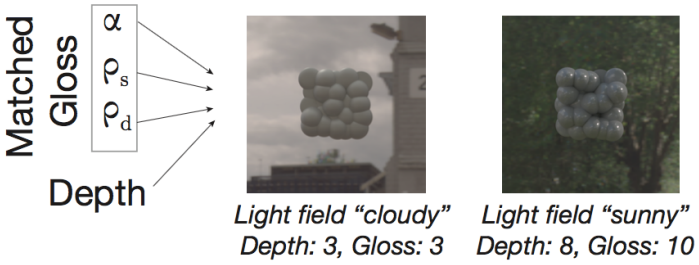
Physical comparison stimuli



Match rendered and physical gloss

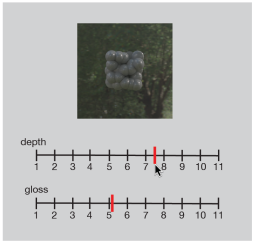


Rendered stimuli



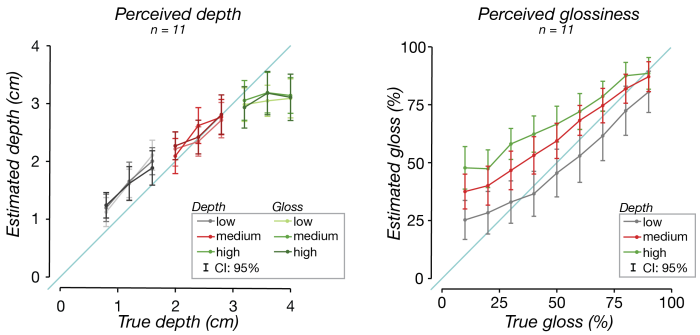
Task

Viewed binocularly



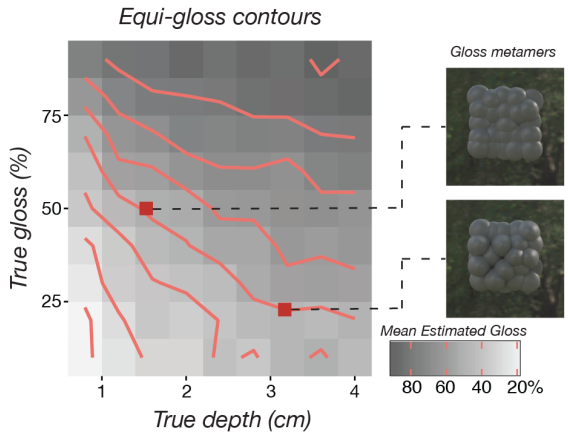
View monocularly

Results



- Small depths exaggerated; large depth underestimated
- More depth makes objects appear glossier

Results



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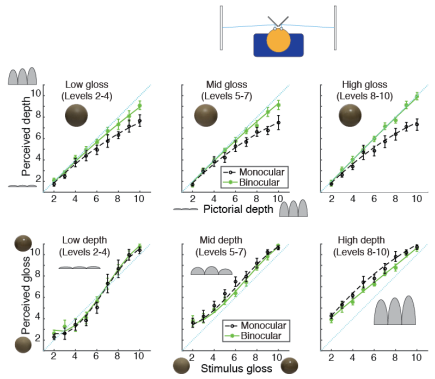
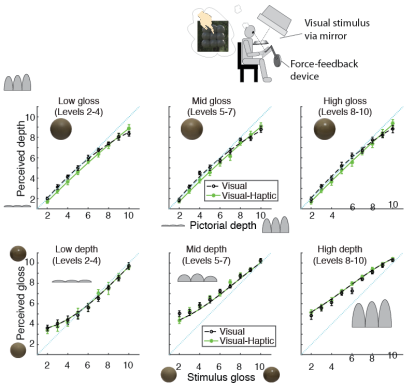
Add disparity consistent with pictorial cues



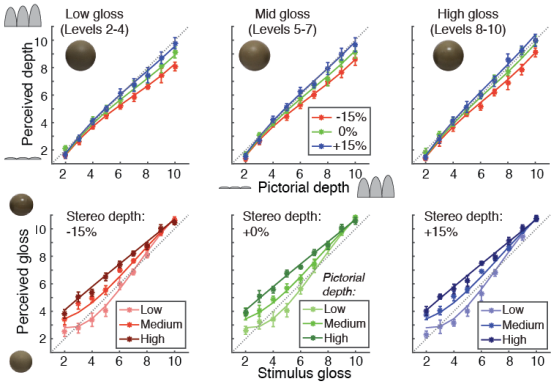
Depth estimates improve; gloss estimates unaffected

Add touch consistent with pictorial cues



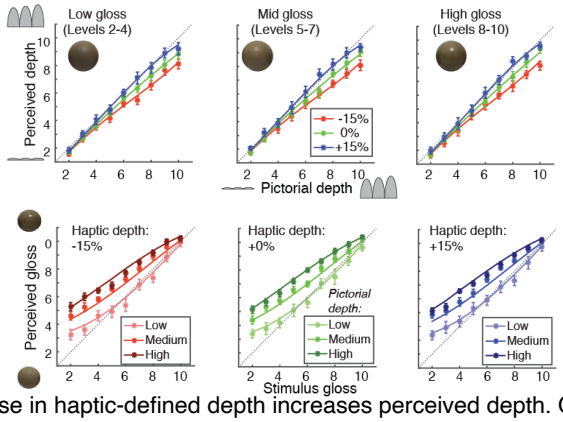
No improvement in depth or gloss estimates

Perturb disparity- relative to pictorial-defined depth



Increase in disparity increases perceived depth. Only increasing pictorial depth increases perceived gloss.

Perturb haptic- relative to pictorial-defined depth



Increase in haptic-defined depth increases perceived depth. Only increasing pictorial depth increases perceived gloss.

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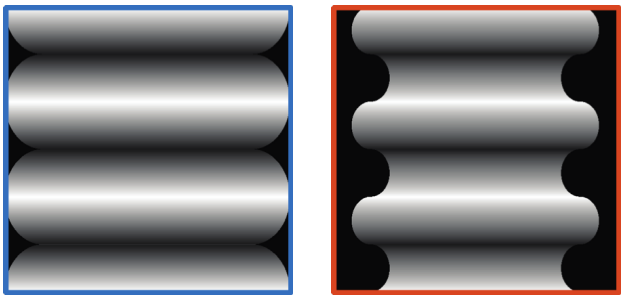
Visual-haptic materials

It is not always possible to correctly estimate glossiness from vision

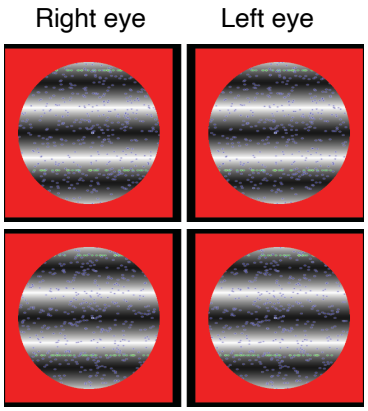
➔ *Does touch inform gloss perception?*

Visual-haptic shape & gloss



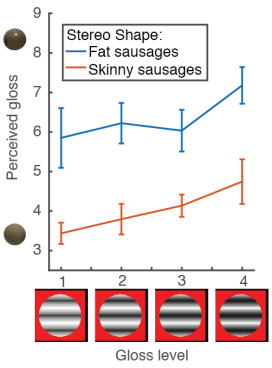
Shiny and fat or matte and skinny?

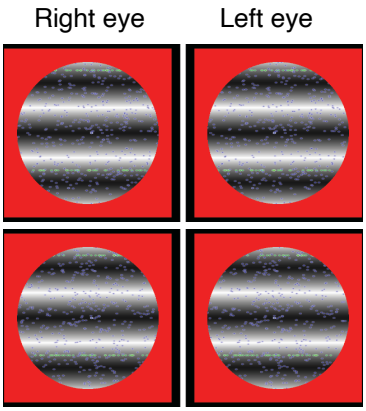
Vary shape with disparity



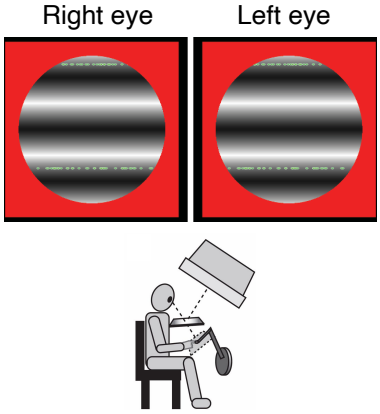
Vary shape with disparity

Group 1





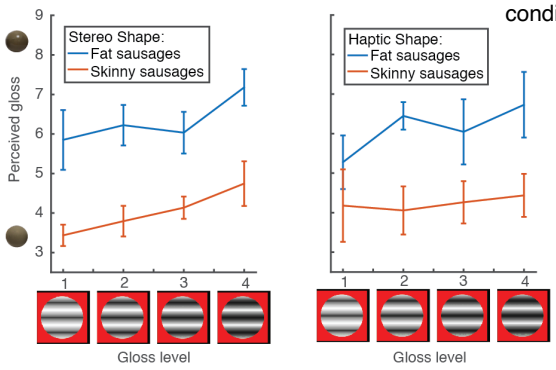
Vary shape with touch



Vary shape with touch

Group 1

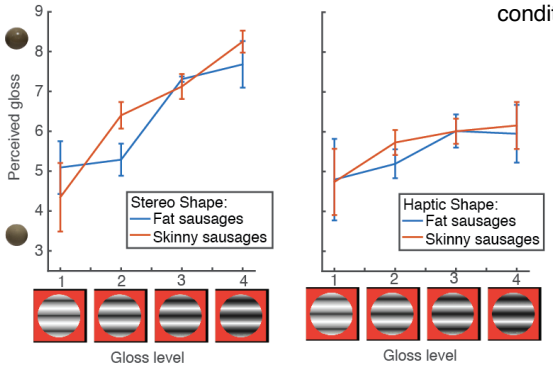
Defined by performance in the stereo condition



Vary shape with touch

Group 2

Defined by performance in the stereo condition



Conclusions

- Context affects the perception of gloss, but the rules by which it does so remain elusive.
- Depth and gloss are jointly estimated; surfaces with greater depth appear to be more glossy.
- Adding/modulating additional depth cues (disparity, haptic) modulates perceived depth but only pictorial depth modulates perceived gloss.
- However, touch can inform (in this case, disambiguate) shape and, in turn, affect perceived gloss, at least in some subjects.