Introduction

- In a previous study on material matching (SPIE2015, JOV2016) we found material and light dependent perceptual interactions.
- Here we wanted to test material and light confounds and designed two tasks:
  - match optically mixed lighting modes for same and different materials
  - discriminate material differences and lighting differences (4AFC)
- Four materials (matte, velvety, specular, glittery) were used as basis images.
- The weights of three canonical lighting modes in the stimuli were selected from 15 observers.

Experiment 1: can people discount materials in matching optically mixed canonical lighting

- All 12 basis images were used for optical mixing
- 15 observers were asked to match the illumination of the robe (slider positions)
- The weighting of each lighting in the stimuli was selected from the table below:

<table>
<thead>
<tr>
<th></th>
<th>L1</th>
<th>L2</th>
<th>L3</th>
<th>L4</th>
<th>L5</th>
<th>L6</th>
<th>L7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambient light</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0.5</td>
<td>0.5</td>
<td>0</td>
<td>0.33</td>
</tr>
<tr>
<td>Focus light</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0.5</td>
<td>0</td>
<td>0.5</td>
<td>0.33</td>
</tr>
<tr>
<td>Brilliance light</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0.5</td>
<td>0</td>
<td>0.33</td>
</tr>
</tbody>
</table>

Analysis:
- The weights of the three canonical lighting modes in the probe (slider positions) and the weights of three canonical lighting modes in the stimulus images were fitted into a linear equation: P = X & S = R
- Solving the equation gives the linear factor matrix X and the Residuals.
- X is an Identity matrix if probing results are veridical, i.e. X = I when P = S.
- The ratio (r) between the sum of the diagonal values in X and the sum of X can be used to evaluate performance, ranging from 0 (unrealistic) to 1 (veridical), with 0.33 being the chance level.

Performance (r) per material combination

- Experiment 2: can people simultaneously discriminate material differences and lighting differences?
  - In each trial, observers were shown a pair of images and four options below the images: “same materials same lightings”, “same materials different lightings”, “different materials same lightings” and “different materials different lightings”.
  - All 78 possible pairs of 12 basis images were included.
  - The task was to ask the users to browse through all stimulus images in pseudorandom order to give them a brief idea about how different the images could be.
  - The numbers of trials were balanced with different numbers of repetitions for each setting to avoid biased results.
  - 8 inexperienced observers finished the task in around one hour.

Experiment 3: reduced version of Exp. 1 & 2

- We further tested another four inexperienced observers with a reduced version of both the matching experiment and the 4AFC experiment.
- Brilliance lighting mode was removed in the reduced version of experiments.
- We asked the observers in Experiment 3 to first finish the matching experiment and then after a short break finish the 4AFC task.
- We also found that in Experiment 2 and 3:
  - if materials are different, it is harder to match the optically mixed canonical lighting modes than when materials are the same.
  - Results from Experiment 1 showed that if materials are different, it is harder to match the optically mixed canonical lighting modes than when materials are the same.
  - which was confirmed in Experiment 2 and 3.
  - We also found that in Experiment 2 and 3:
    - if lightings are different, it is almost as easy to say whether the materials are different or not as when the lightings are the same.
  - Additionally, we found individual differences in both tasks.

Conclusions

Acknowledgements

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References
