Assessing color rendering in a 3d setup

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INTRODUCTION

CRI (Color Rendering Index) and its limits (proposed in 1965 – updated in 1974 – made minor adjustments in 1995)

•CRI: a measure of the capability of a light source to preserve color appearance of illuminated objects;
•Limits of the CRI with new types of lighting sources (three-band fluorescent lamps, LEDs)

Aim of this research activity

•Experiment with human observers to assess the appearance preservation of colors under a set of light sources
•Results are compared with a range of alternative indices

THE EXPERIMENT

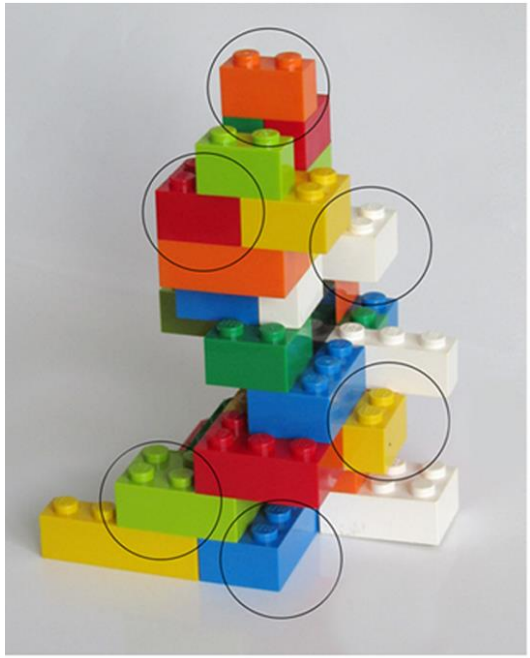
Goals

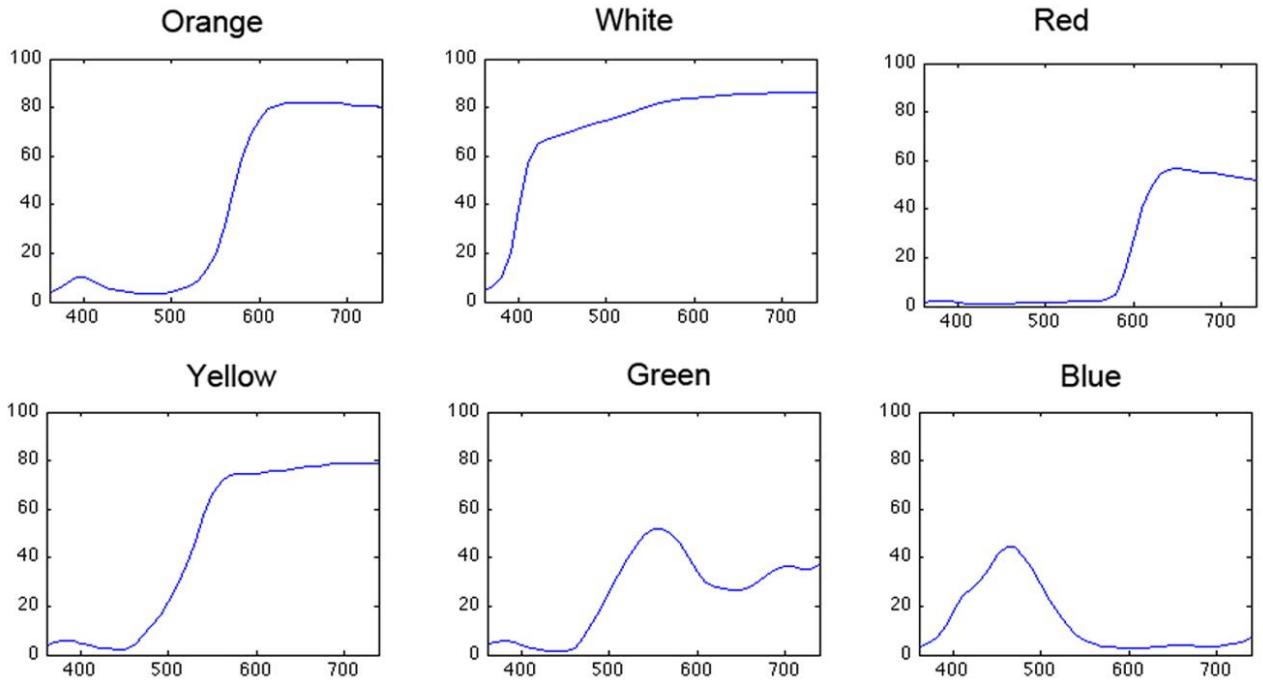
•To collect data about the color appearance variation according to the used light source
•To analyze the relation between a set of color rendering indices and the evaluation given by users

How and why

•Compare 3D color samples observed under a reference light source and under a test light source (6 test light sources in total)
•Building a 3D scene introduces shadows and inter-reflections as in everyday scenes.

3D COLOR SAMPLES

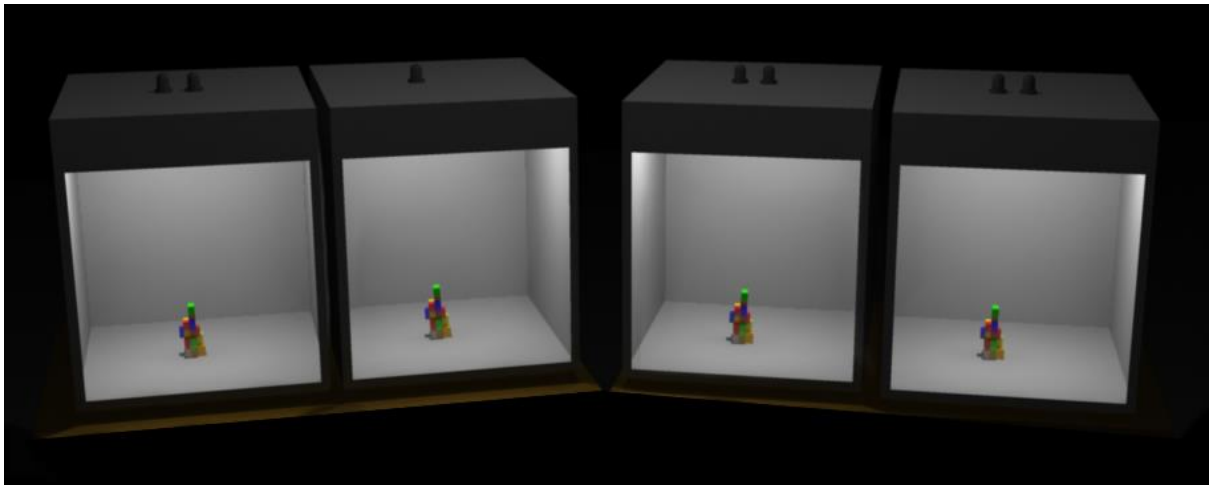




Objects composed by plastic brick toys

EXPERIMENT SETUP: THE BOXES

- Four wood boxes with size: 1 m × 1 m × 0.8 m.
- Four identical plastic brick constructions were placed inside the boxes.
- Two light sources were housed in each box, only one at a time was turned on.



EXPERIMENT SETUP: LIGHT SOURCES

- Test light sources: 3 fluorescent lamps, 1 halogen lamp, 2 LED lamps.
- Reference source: 1 halogen lamp

Type	Fluo	Fluo	Fluo	Halo	LED	LED	Halo irc
Power	20	11	11	42	8	3	30
Flux	1250	650	600	630	345	270	806
Illum.	913	546	457	390	338	171	470
CCT	2969	7566	4393	3050	3441	3178	3239

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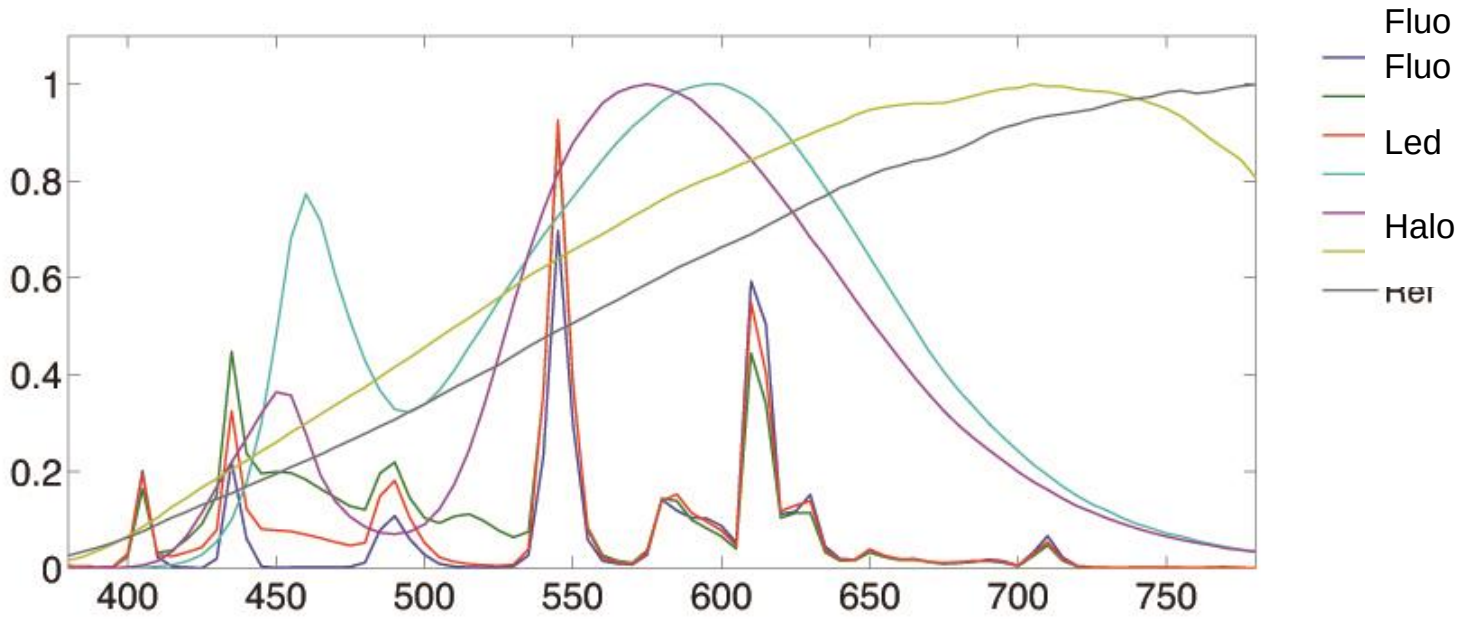


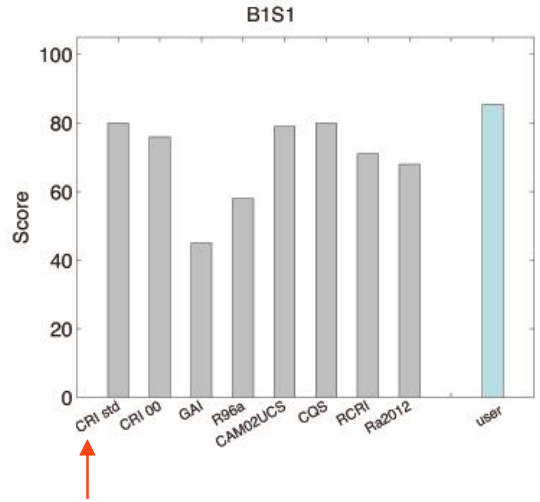
Normalized spectra of light sources used in the experiment

RESULTS: comparison between percentual rendering index and calculated indices

Std CRI	80	83	78	83	63	98
CRI00	76	86	80	84	63	98
GAI	45	98	79	61	40	57
R96a	58	79	78	84	62	75
CAM02UCS	79	85	80	84	67	97
CQS	80	85	80	82	71	96
RCRI	71	89	74	89	62	100
Ra2012	68	69	76	85	69	99
User 3D	86	78	82	80	70	91

- User 3D: 48 Students (21F/27M), age: 14-18 years old

RESULTS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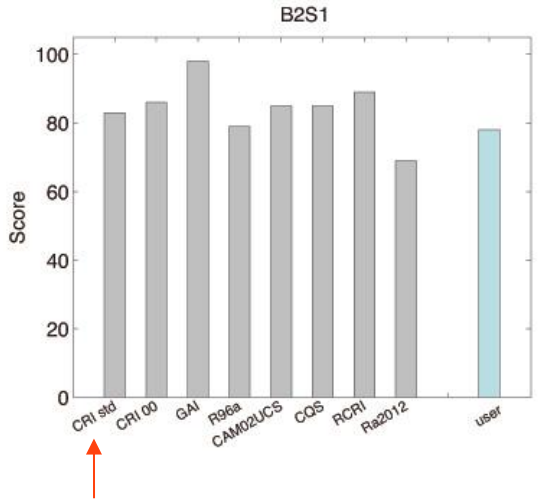
CRI std
CRI 00
GAI
R96a
CAM02UCS
CQS
RCRI
Ra2012
user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Ra2012
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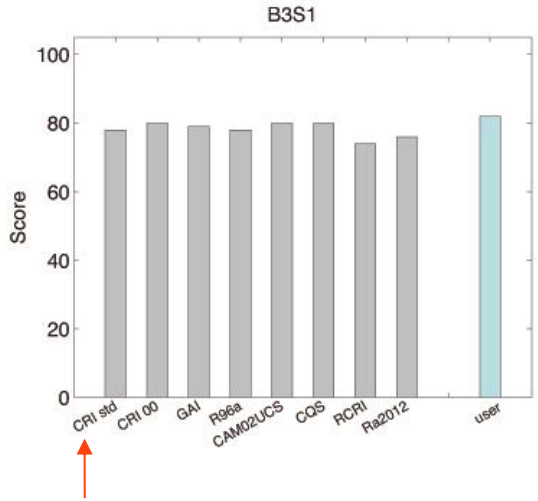
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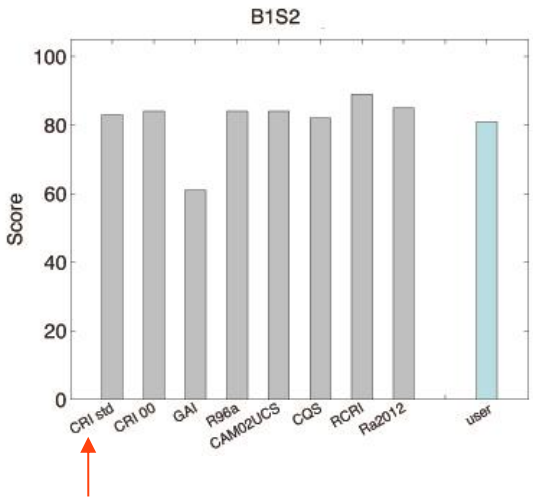
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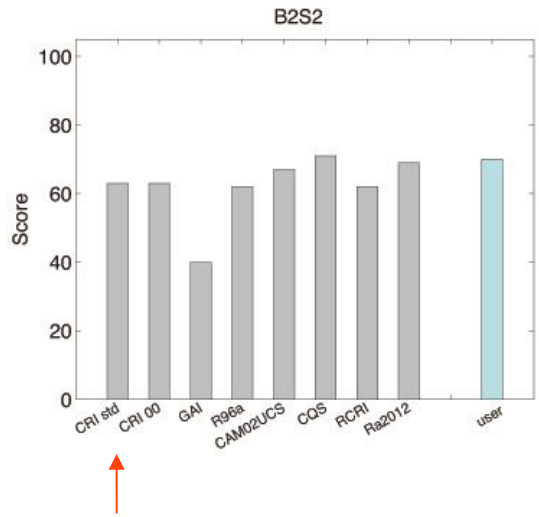
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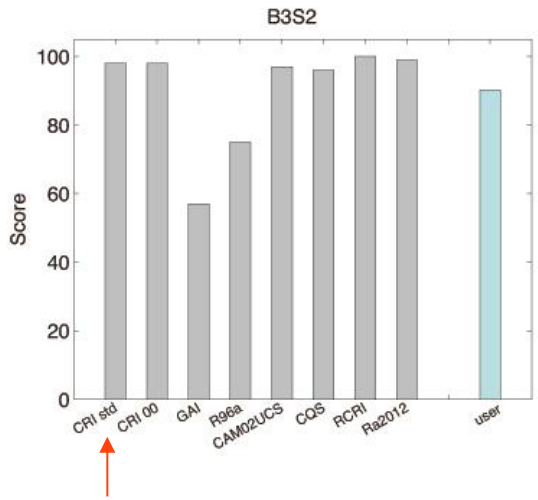
B3S2
Score
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CRI std
CRI 00
GAI
R96a
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CQS
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user

CONCLUSIONS

- In this experiment: best method to represents the observers sensation is the Standard CRI
- Far away to a definitive alternative color rendering index

- Assessing color rendering among various light sources is a complex task.
- Many aspects are involved: the colors under test, the user's experience, the context, etc..
- Color sensation derives also from the spatial distribution of the other stimuli
- Future challenge: to have methods able to deal with given contexts and within specific applications

Thank you very much for your attention!

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