An Order System Based on Material Perception which Adds Dimensions to Surface Color Perception

Tien-Rein Lee and Vincent C. Sun
Center for Visual Communication and Color Research
Chinese Culture University, Taipei, Taiwan

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Introduction

The present research aims to explore the influences of material properties on the appearance of surfaces.

Based on authors' previous study (Lee et al. 2015, 2016), and adopting the Cesia's theoretical model (Caivano 1996), which proposed three elements of material properties: Permeability, Absorption, and Diffusivity (P-D-A scale), with the utilization of a rotary color mixer device, in adjustment with properties combined of various ratios of mirror surface, matte surface, and transparent surface.

Prof. caivano

The aim is to build a workable cesia scale for a series of representative building materials, and is to perform a quantitative survey on perceptions about material surface features in systematic ways, and to deliver results of practical data for subsequent researches on Cesia theory.

Cesia

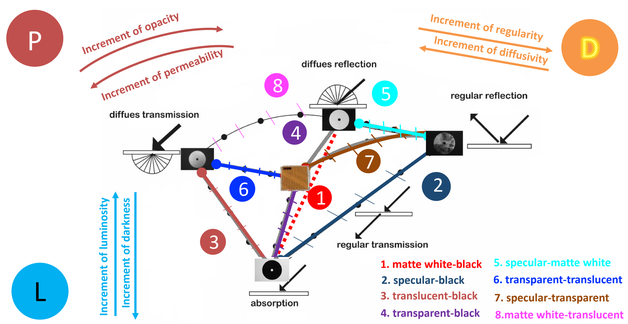
The word "cesia" has been coined to refer to the visual sensations aroused by different spatial distributions of light: sensations of transparency, translucency, matte opacity, specularity, glossiness, darkness, etc.

Color sensations are always accompanied by sensations of cesia; the same opaque color may have a glossy or matte aspect.

Five primary interactions between matter and light (physical stimulus)

Absorbed	Re-emitted	
	Diffusely	Regularly
different distribu-tions of light in space		
Reflected	diffuse reflection(matte)	Regular reflection (mirror-like)
Trans-mitted	diffuse transmission (translucent)	Regular transmission (transparent)

The solid model of cesia with the five primary sensations and the three kinds of variation



- P (permeability): Light passing through the object so that incident and emerging radiation are in opposite semispaces divided by the object.
- D (diffuseness): Light scattered in infinite directions, or re-emitted regularly in only one direction so that the emerging ray is as even and direct as the incident one.
- A (absorbability): The incident radiation does not emerge from the surface or body in any visible way.
- R (reflectance): Incident and emerging radiation are in the same semispace in relation to the object.
- L (lightness): The degree of light emitting from a surface from the direction of observation.

However, the original cesia scales are based only on physical properties of material, and lack of psychophysical scaling data to relate the physical cesia values and perceived psychological sensations.

The authors' previous study (Lan, Lee et al. 2015) already suggests a workable psychophysical cesia scale based on magnitude estimation tasks and rotating disk references. The present research intends to figure out a systematic way to measure perception of surface properties for a variety of glass samples using similar psychophysical.

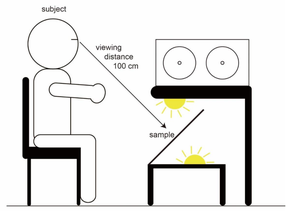
In the present study, the samples used to be rated are 23 glass plates provided by Taiwan Glass Inc., and five selected representative samples. Those glass samples have various permeability, surface reflectance, and translucency on physical scales as given by the manufacturer. They are chosen based on availability.

The experiments were conducted in a room with reduced illumination. The test samples and the references were illuminated by lamps positioned to generate the necessary effects for cesia rating purpose.

The experiment set-up

The test samples (plate glass) was placed on an slanting shelf (45°), covered by an black cardboard with an 3"x3" square opening, where samples can be observed. Observers were instructed to rate their perceived glossiness, mirror-ness, and transparency to the samples they looked through the square opening.

Two spinning disks on the table used as anchors for minimum and maximum references. The observers simply rate their perceived sensation by answering percentage values (0 – 100%) for the samples presented. Four observers joined the experiment, two of them rating all samples twice.



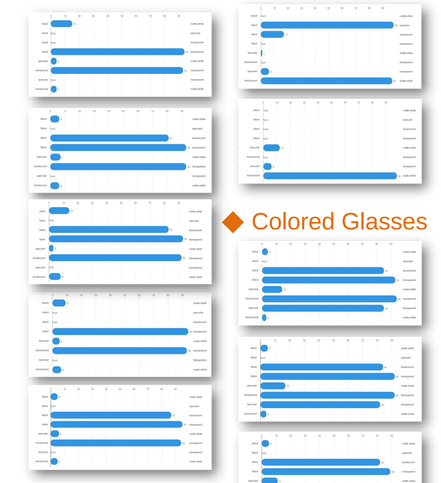
Results

The observers showed evidence that they could understand what the terms glossiness, matt-ness, mirror-ness, translucent and transparency mean, and made correspondent and relatively consistent ratings.

Totally eight scales were used for rating the 28 samples. However, participants did NOT show consistent and agreeable ratings on all scales for each samples respectively.

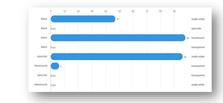
Only the ratings on scales agreeable among participants were averaged and displayed in the following plots for each of the 28 samples.

◆ Reflective Glasses ◆ Mirror Glasses ◆ Paint Glasses

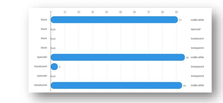


◆ Colored Glasses

◆ Black cardboard



◆ White cardboard



◆translucent

◆Clear Glasses

Conclusions

The present study provides practical data for Cesia, on both the system and theory.The study shows that the indexes in the Cesia system are understandable for human observers, and can generate rather consistent results for Cesia indexes.

The present research suggests that even for solid samples, such as the plate glasses used in experiments, Cesia is still a valid system to describe the material texture perception, and the use of spinning disks can also serve as a standard references for Cesia indexes.

Due to the material properties of various samples, only certain cesia scales are available for rating a specific sample and generating consistent results.

During the rating processes of the experiment, we noticed that observers could perceive all scales of cesia for a given sample. That is, we can provide references all together and ask the observer to rate all suitable cesia scales at a time. A improved rating procedure and display geometry are suggested.

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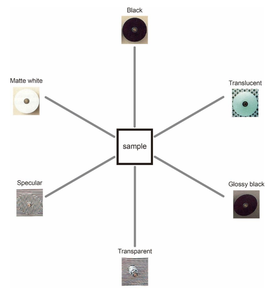

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