



---

# AIC2015 TOKYO Color and Image

Midterm Meeting of the International Colour Association (AIC)

19-22 May 2015, Ochanomizu sola city Conference Center, Tokyo, Japan

## Proceedings

Editors: Hirohisa Yaguchi  
Katsunori Okajima  
Taiichiro Ishida  
Kikuko Araki  
Motonori Doi  
Yoshitsugu Manabe



---

## Proceedings

© 2015 Color Science Association of Japan (CSAJ)

### DISCLAIMER

Matters of copyright for all images and text associated with the papers contained within the AIC 2015 Proceedings are the responsibility of the authors. The AIC and CSAJ do not accept responsibility for any liabilities arising from the publication of any of the submissions.

### COPYRIGHT

Reproduction of this document or parts thereof by any means whatsoever is prohibited without the written permission of CSAJ - Color Science Association of Japan. All copies of the individual articles remain the intellectual property of the individual authors and/or their affiliated institutions.

Published May, 2015  
by the Steering Committee of AIC2015 TOKYO  
The Color Science Association of Japan  
3-17-42, Shimo-ochiai, Shinjuku-ku, Tokyo 161-0033, Japan

Graphical design by Kikuko Araki  
Printed by Tsujino Planning Office, Inc.

# Influence of Surface Properties on Material Appearance

Ming-Kang LAN<sup>1</sup>, Tien-Rein LEE<sup>1</sup>, Vincent C. SUN<sup>2</sup>

<sup>1</sup> Department of Information Communication, Chinese Culture University, Taiwan

<sup>2</sup> Department of Mass Communication, Chinese Culture University, Taiwan

## ABSTRACT

Color Research has developed prosperously in these years, particularly on “color appearance”, which had made a significant breakthrough. Among them, textures, which is intimately related to color appearance, has got few attention. Features of textures possess enormous influences on surface color perception. Interactions between colors and surface materials have big stake on the accuracy of color display. Recently, the uprising of “material perception” researches have gradually filled up the insufficiency.

This research aims to explore the influences of material properties on the appearance of colors. By adopting the Cesia’s theoretical mode (Caivano, 1996), based on three elements of material properties: Permeability, Lightness, and Diffusivity, with the utilization of a rotary color mixer device, in adjustment with properties combined of various ratios of mirror surface, matted surface, and transparent surface, we investigate each element’s influences on objects’ surfaces’ color appearance and inspect influences of various texture on subject’s psychological feelings. The aim is to know how those influences perform? What are the influences formed on people’s mentality?

The purpose of the present research 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. The findings can provide advises on experimental operation, and broaden knowledge about influences of surface features on color appearance.

**Key Words: Color Appearance, texture, Cesia, Permeability, Lightness, Diffusivity, material surface**

## 1. INTRODUCTION

Color Research has developed prosperously in these years, particularly on “Color Appearance”, which had made a significant breakthrough. In order to make out effectively, several business corporations have adopted colors as tool for marketing. However, most domestic research focuses on colors’ influences on human mentality, and few has focused on texture’s influences.

Texture, which is intimately connected to color appearance, has got rare attention. Features of texture possess enormous influences on color. Interactions between colors and surface material have big stake on the accuracy of color display. If we figure out patters of connection between texture and color, it’s not only beneficial to our future generations in texture research; also, it can be practically applied to business commodity.

Regardless of the color, different textures have different effects on human mentality when people are looking at certain objects. Smooth and reflective objects like mirror, glass, etc. make people feel tough, heavy, and cold; whereas objects with rough surface like wooden furniture and fabric give people feelings of softness, lightness and warmth, and other uncountable emotions. Feelings aroused by objects are also experiences accumulated within human's mind.

Studies demonstrate that, surface material of products directly affects sales consequences, which indicates besides color, texture is another important factor affecting user's psychology. Texture itself is a huge research issue, and it will be bigger and intriguing when adding into color factor. There are thousand kinds of combinations as objects are composed of different colors and textures, but no previous research had figured out the variation or tendencies of this phenomenon. In this research, we intend to figure out patterns of connection by probing into mutual influences between colors and textures and contribute to advanced studies.

## 2. MEASUREMENTS ON SURFACE FEATURES

Former chairman of International Color Association (AIC) and Dr. Caivano in 1991 quoted "cesia" in his thesis available in the journal *Color Research and Application*, which refers to the system describing the optical property of texture, and the system was initiated by Jannello in the 1960s.

With Dr. Caivano's effort, cesia has been used as the system to describe Visual Textures, especially features concerning gloss and brightness. From physical measurements perspective, cesia can be presented with light's permeability and diffusivity, plus luminosity factor, forms a three-dimensional cesia space composed of permeability, diffusivity, and absorption. Just like Color Order Systems such as NCS and Munsell, cesia is an Order System describing surface characteristics.

Dr. Caivano's "cesia" is basically a way of describing visual sensation. Under different illumination and observing conditions, different cesia PDA indexes will turn out, and representing different visual sensation toward surface characteristics. Under standard measuring conditions, cesia data can be used as surface sensation index, besides trichromatic theory.

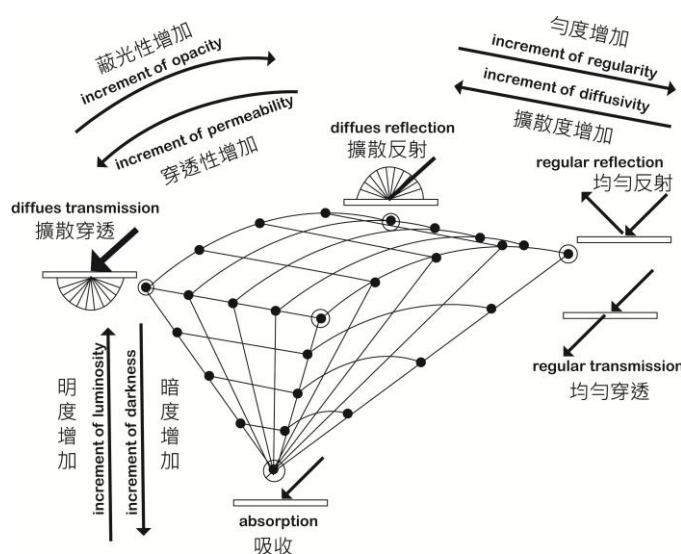


Figure 1: The solid of Cesia with the five primary sensations and the three kinds of variation. (Caivano, 1994)

### 3. EXPERIMENTAL METHODS

After entering experimental circumstances, experiment subjects will read the instruction first, and listen to the introduction of cesia system.

Experiment starts. The experiment includes five steps in response to five different combinations. These combinations are composed of different ratios of diffuse reflection, regular reflection, diffuse transmission, and regular transmission. In each step, a rotary table on the right side will be placed 100% texture, and another one on the left will be texture of different ratios in the random order (87.5%, 75%, 50%, 25%, 12.5%.....).

In the first step, as the machine runs, we will begin to ask questions to our experiment subjects. Suppose texture on the right side is 100%, what is the ratio of texture on the left side? For instance, when it is 100% regular reflection on the right side, how many percent of regular reflection is on the left side? After they finish the questionnaire, we will change textures into different ratios without informing our experimental subjects, and ask them to make judges again. In all the five steps, ratios of experimental textures are random and nonrepetitive in every single step. Experiment ends as we finish all five steps.

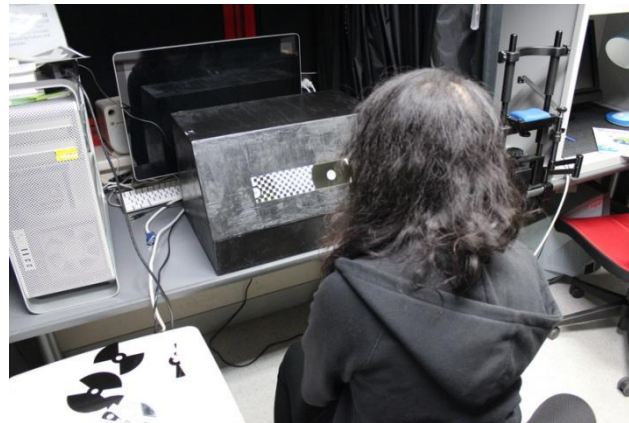


Figure 2: Experimental environment

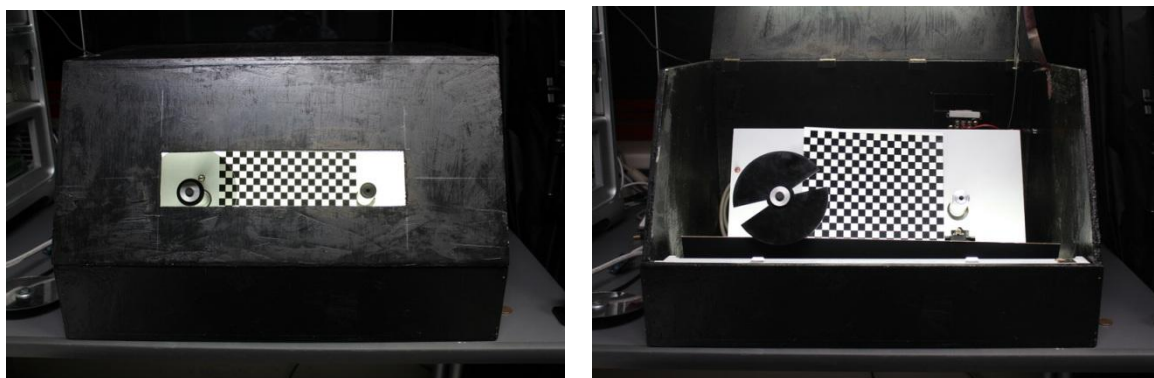


Figure 3: color mixer in special box

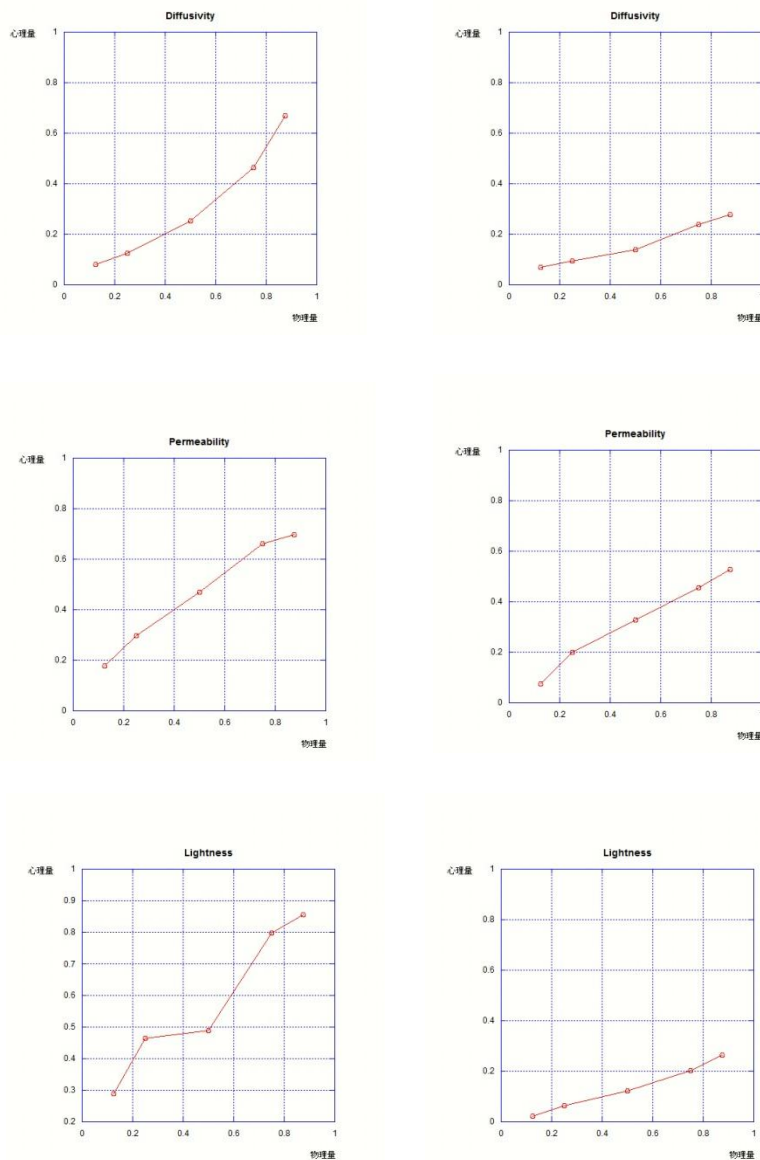


Figure 4 : The results of Permeability, Diffusivity and Lightness

## REFERENCES

1. Caivano, J. L. (1991). "Cesia: A System of Visual Signs Complementing Color." Color Research and Application **Volume 16, Number 4**: P258-268.
2. Caivano, J. L. (1994). "Appearance (cesia): Construction of scales by means of spinning disks." Color Research and Application **19 (5)**: P351-362.
3. Jannello, C. (1963). "Texture as a visual phenomenon." Architectural Design **33(8)**: 394-396.

*Address: Department of Information Communication,  
Chinese Culture University, No. 55, Hwa-Kang Rd., Taipei 11114, Taiwan  
E-mails: lanmk76105@gmail.com, trlee@faculty.pccu.edu.tw,  
csun@faculty.pccu.edu.tw*