日本色彩学会第43回全国大会要旨集
会期：2012年5月25日-27日
会場：京都大学吉田南キャンパス
照明新時代シンポジウム：5件
口頭発表：51件
ポスター発表：35件
International Symposium：6件
International Conference：23件
会場案内
プログラム
協会認定 パーソナルカラー・アドバイザー

2012年 7月 8日（日）
第19回 モジュール1（初級・中級）マークシート
第15回 モジュール2（上級）マークシート

2012年 11月18日（日）
第19回 モジュール1（初級・中級）マークシート
第15回 モジュール2（上級）マークシート

第4回 モジュール3（技能認定試験・一部筆記）～モジュール3は年1回
モジュール2合格者に向けて実施・・・2012年4月1日（日）

最上級資格所得者に対し協会より
パーソナルカラー・アドバイザーの称号を認定します。

特定非営利活動法人（NPO）
日本パーソナルカラー協会

URL : http://www.p-color.jp

E-mail : info@p-color.jp

色彩技能パーソナルカラー検定
色の理論を実戦の場に活かす検定です！
日本色彩学会
第43回全国大会 京都'12

2012年5月25日（金）－27日（日）
京都大学吉田南キャンパス（主会場）
＜そのほか 京都大学百周年時計台記念館＞

日程
冷泉邸見学会
シンポジウム：照明新時代－色彩のサイエンスとデザイン
研究発表：口頭・ポスター カラーデザイン発表：口頭・ポスター
国際コンファレンス：ポスター・ショートプレゼン 企業プレゼン
総会
特別講演：日本人の色彩－冷泉流歌道と年中行事をめぐって
冷泉為人氏（財団法人冷泉家時間亭文庫 理事長）
懇親会 ＜関西日仏学館＞

日程
国際シンポジウム：Color Science for Our Better Life
国際コンファレンス：口頭・ポスター
研究発表：口頭・ポスター
式典

◆ 企業展示：カラーデザイン作品展示・研究会特別展示：26－27日
研究発表：109件（国際コンファレンスを含む）

THE COLOR SCIENCE ASSOCIATION OF JAPAN
THE 43rd ANNUAL MEETING

May 25 (Fri)－27 (Sun), 2012
Kyoto University (Yoshida South Campus)

● International Symposium ＜May 27 (Sun)＞
“Color Science for Our Better Life”
Guest Speakers：Prof. Haisong Xu of Hangzhou University, China, Prof. Miho Saito of Waseda University, Japan, Prof. Lee Tien-Rein of Chinese Culture University, Taiwan, Prof. Young In Kim of Yonsei University, Korea, Prof. Pantawee Pungrassamee of Chulalongkorn University, Thailand, and Prof. Ken Sagawa of Japan Women’s University, Japan.

● International Conference: 23 presentations
<table>
<thead>
<tr>
<th>CONTENTS</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Foreword</strong></td>
<td>Tailichiro Ishida</td>
</tr>
<tr>
<td><strong>Abstract for the Symposium of A New Era of Lighting - From Color Science to Design</strong></td>
<td>Yasuki Yamauchi</td>
</tr>
<tr>
<td>Features of New Light Sources and Their Evaluation</td>
<td>Yoko Mizokami</td>
</tr>
<tr>
<td>Color Appearance under White LED Light Sources</td>
<td>Keizo Shinomori</td>
</tr>
<tr>
<td><strong>Lighting Technology in the Age of New Light Source and Energy Saving.</strong></td>
<td>Wataru Iwai</td>
</tr>
<tr>
<td><strong>Power of Design ~ Recommendation of the Comfortable Darkness~</strong></td>
<td>Satoshi Uchihara</td>
</tr>
<tr>
<td><strong>Abstract for the 43rd Annual Meeting</strong></td>
<td></td>
</tr>
<tr>
<td>Historical Expansion of Coloring Materials and Names in Japanese Modern Age</td>
<td>Norifumi Kunimoto</td>
</tr>
<tr>
<td>Dunhuang Caisson —Colors and Patterns from the Building and Regional Culture</td>
<td>Zheng Xiaohong</td>
</tr>
<tr>
<td>Present Condition of Streetscape Color in Kyoto</td>
<td>Masako Miyamoto, Ryuichi Nakamura, Yasuto Watanabe, Kazaburo Murakami</td>
</tr>
<tr>
<td>7 Colors Sapporo's Landscape for Large-Scale Architecture, Feature and Comparative Study</td>
<td>Yuka Tonozaki</td>
</tr>
<tr>
<td>The Tale of Genji by Color Harmony of Beginner</td>
<td>Reiko Morimoto</td>
</tr>
<tr>
<td>Examination of Preferred Appearance Evaluation Method of Japanese Facial Skin Color</td>
<td>Wataru Iwai, Sayaka Yamaguchi</td>
</tr>
<tr>
<td>for Development of LED Lighting</td>
<td></td>
</tr>
<tr>
<td>Examination of Preferred Appearance Spectral Characteristics of Japanese Facial Skin Color</td>
<td>Sayaka Yamaguchi, Takashi Saito</td>
</tr>
<tr>
<td>for Development of LED Lighting</td>
<td>Taislchiro Ishida, Buntoku Mori</td>
</tr>
<tr>
<td>Visual Impression of a Set of Colors Characterized by a Colored Light and Its Applicability</td>
<td>Takashi Maruyama, Hideki Yamaguchi, Hiroyuki Shinoda, Kengo Nimura, Yuki Syouji</td>
</tr>
<tr>
<td>to Color Design in Architectural Space</td>
<td></td>
</tr>
<tr>
<td>Evaluation of the Effect of Window Size and Daylight Color on Space Brightness</td>
<td>Takashi Maruyama, Hideki Yamaguchi, Hiroyuki Shinoda, Kengo Nimura, Yuki Syouji</td>
</tr>
<tr>
<td>The Effect of Interior Chromatonicness on Space Brightness</td>
<td>Hidenari Takada, Hideki Yamaguchi, Hiroyuki Shinoda</td>
</tr>
<tr>
<td>Features of Portrait Affect the Acceptability Range of Image Color Difference</td>
<td>Noriko Shigeta, Hirohisa Yaguchi, Yoko Mizokami</td>
</tr>
<tr>
<td>Measurement of Accommodation Response Time for the Stimulus Illuminated by Various Monochromatic Lights and Polychromatic Lights</td>
<td>Massahto Nakaura, Hideki Yamaguchi, Hiroyuki Shinoda</td>
</tr>
<tr>
<td>The Perception of Gloss Caused by Color Appearance</td>
<td>Moe minoura, Katsuaki Sakata</td>
</tr>
<tr>
<td>Luminance Measurement of the Long Afterglow Phosphorescent Sheets Excited by Various Lamps</td>
<td>Hideki Sakai, Tadashi Doi</td>
</tr>
<tr>
<td>Multiple-Regression Analysis of Affective Effects of Two-Color-Combinations (2)</td>
<td>Tadasu Oyama, Hisao Miyano, Kumiko Miyata (to)</td>
</tr>
<tr>
<td>A Study of a Matched and Mismatched-Color for Psychological Classification of the Fragrance, About Using Tone and Same Hue Scale in PCCS-</td>
<td>Tadayuki Wakata, Miho Saito</td>
</tr>
<tr>
<td>Color Impression of Onomatopoeia A Study of Association Colors on Three-Color Combinations</td>
<td>Akiko Makino, Shin'ya Takahashi</td>
</tr>
<tr>
<td>Supporting System for Color Coordination of Bridal Space Using Genetic Algorithm</td>
<td>Tatsunori Matsui, Yoko Tanemura, Keiichi Muramatsu, Kazuki Kojima, Miho Saito</td>
</tr>
<tr>
<td>A Study on the Impression of Trademark Design</td>
<td></td>
</tr>
<tr>
<td>Impression of Wallpaper Color and the Influence to the Impression of the Composition by Wallpaper Color</td>
<td>Miho Saito, Chihori Kunito, Seitaro Inamura, Takashi Matano, Chikako Ohara</td>
</tr>
<tr>
<td>A Direction for Design and Color of Local Specialty Package</td>
<td>Yasuyo Hagiwara</td>
</tr>
<tr>
<td>Color Planning of the Nursery with a Rooftop Garden (Uji City)</td>
<td></td>
</tr>
<tr>
<td>Long-Term Effects for the Total Color Coordination</td>
<td>Hiroki Matsuda, Yasuo Sakai</td>
</tr>
<tr>
<td>Measurement of the Effect of Contrast and Assimilation in “Dōsōkyō sai-e” by Itō Zakyūryū</td>
<td>Takuzi Suzuki, Mitou Kobayasi</td>
</tr>
<tr>
<td>The Association Words of Color Name for Children</td>
<td>Yukiko Shimada, Yuko Ohgami</td>
</tr>
<tr>
<td>The Method on Color Education and Using a Color Scheme Card</td>
<td>Satoru Kubota</td>
</tr>
<tr>
<td>A Study of Estimation of Spectral Reflectance Using Smartphone Camera</td>
<td>Kyohsei Watanabe, Shigeyuki Toya, Norihiro Tanaka, Jie-Yong Woo</td>
</tr>
<tr>
<td>Color Management Using Color Constancy on Multiple Mobile Phone Displays</td>
<td></td>
</tr>
<tr>
<td>Representation of Shading and Texture in Mixed Reality</td>
<td>Masahide Kobayashi, Yoshiitsu Manabe, Noriko Yata, Yuki Uranishi</td>
</tr>
<tr>
<td>A Method for CG Reproduction of Human Skin in Natural Scene Illumination</td>
<td>Chikako Nesaka, Norihiro Tanaka, Hajime Arai, Jie-yong Wook</td>
</tr>
<tr>
<td>Learning Skewed Training Data for a Construction of a Categorical Color Perception Model</td>
<td>Yutarō Kamata, Noriko Yata, Keiji Uchikawa: Yoshiitsu Manabe</td>
</tr>
<tr>
<td>Kansei Evaluation by Using Multidimensional Neural Networks Based on Affective Dimensional Model</td>
<td>Koji Ogawa, Keiichi Muramatsu, Tatsunori Matsui</td>
</tr>
<tr>
<td>Investigation of Acceptable Color-difference of Printed Document</td>
<td>Mitsukos Nishiura, Hirohisa Yaguchi, Yoko Mizokami, Hiroko Hano, Kazunori Tanaka</td>
</tr>
<tr>
<td>A Simple Representation of Munsell Value Function</td>
<td>Mituo Kobayasi</td>
</tr>
</tbody>
</table>
Whiteness Appearance under Light Emitting Diodes II .......................... Hiroki Uchida, Masayuki Osumi, Gorow Baba .......................... 84
Visual Characteristics of Colored LED Lights in Dense Fog .................. Yukio Kusubara, Mamoru Takamatsu, Yoshio Nakashima, Hiroshi Terakawa, Kenji Tada, Hirokazu Iwane .......................... 86
The Evaluation Method of Effect Material Applied Gonio-Photometric Spectral Imaging .......................... Masayuki Osumi .......................... 88
The Measurement of the Preocular Illumination of Disability Ambient Light for the Color Discrimination Task by Simulation Cataract .......................... Akira Oka, Hiroyuki Shinoda .......................... 90
Color Universal Design - Is the Confusion Lines Linear? .......................... Tomohiro Ikeda, Natsuki Kojima, Yasuyo Ichihara .......................... 92
Categorical Color Perception in Color Defective Observers - Effect of Viewing Condition and Degree of Defect- .......................... Yukari Kagawa, Hirohisa Yaguchi, Yoko Mizokami .......................... 94
Image Dataization for Dichromats Viewing the Best Colors Based on Spectral Response Model .......................... Hiroaki Kotera .......................... 96

Differences in Brain Activity between Color Harmony and Disharmony .......................... Takashi Ikeda, Daisuke Matsuoyoshi, Nobukatsu Sawamoto, Hidenao Fukuyama, Naoyuki Osaka .......................... 98
Colors of Restroom Signs and Urban Landscape on the Chromatic Vision Simulator .......................... Haruyu Ohno, Shigezaru Tamura, Takashi Hiraige .......................... 102

Study on Construct of Store Illumination for Energy-Saving System .......................... Hiroki Fujita, Masaki Oota, Yohei Saito, Mamoru Takamatsu, Yoshio Nakashima .......................... 104

Psychological Effects of the Tray Color with Meal .......................... Keiko Tomita, Fuki Mizutani, Chikage Kikuta, Motoko Matsui, Kimiko Ohtani .......................... 106
Color Space Suted for Drapes to Diagnose Personal Color .......................... Takenori Ichiba, Emi Kondo, Naomi Yoshida .......................... 108
Associated Colors with Symbolic Terms - by Male and Female Students and Elderly Persons .......................... Kumiko Miyata(to), Tadazu Oyama .......................... 110

Representation in Color of Coloring Pictures - A Case Study of Coloring of People with Intellectual Disabilities- .......................... Ikuko Narita .......................... 112

Psychological Evaluation on the Green-Occupancy Rate: The Indoor/Outdoor Comparison and the Age-Related Change .......................... Aki Iishi, Ken Saga .......................... 114
A Study of the Area Effect on the Dental Treatment Field .......................... Takahiro Kajiura, Azusa Yokoi, Mio Saito .......................... 116
A Comparative Study of Color Preference Classified by Life Field in Seven Countries .......................... Takashi Inaba .......................... 118
Color Converter Considered both Normal and Defective Color Vision .......................... Takashi Sakamoto, Toshiki Karasuj Shiro Hotta .......................... 120
Effect of Illuminance on Color Categorization to Dichromat .......................... Ken-ichiro Kawamoto, Tenji Wake, Tetsushi Yasuma, Akio Tabuchi .......................... 122
Primary Experiment of Color-Barrer-Free Illumination by Using W-LED, R-LED .......................... Shigezaru Tamura .......................... 124
Production of Lighting System with B Primaries of Colored LEDs and Automatic Setting of Lighting Properties .......................... Wataru Nakashima, Shoji Sunaga, Takeharu Seno, Naoyuki Oi .......................... 126
A Simplified LED Lighting Device for Metameric Experiments .......................... Takahiro Nakashiga .......................... 128
Stereo Matching Based on Multiband Imaging by Using Programmable Light Source .......................... Hiroki Uchida, Motonori Doi .......................... 130
Wavelet Analysis Based on Multiband Skin Image .......................... Masahiro Konishi, Motonori Doi .......................... 132
Evaluation of Color Features and Formal Features for Pictures of Infants .......................... Yuko Uchida, Kyoko Kajura, Toshio Mori .......................... 134
Effect of the Lightness Framework of the Achromatic Surround on Color Appearance of the Object .......................... Haruka Maruyama, Yoko Mizokami, Hirohisa Yaguchi .......................... 136

Psychological Influence of Chromatic Light in Residential Area .......................... Ryuichi Yoda, Tadayuki Waka, Mio Saito .......................... 138
Research on the Psychological Effect of Colored Lights .......................... Atsushi Koshinaka, Shingo Sakuta, Hiroki Fujita, Mamoru Takamatsu, Yoshio Nakashima .......................... 140
Perceived Color of Surfaces in a Space Illuminated by Colored Light .......................... Akiko Fukui, Tatsuo Oishi .......................... 142
Examination of Lighting in the Office Lobby for a Nap .......................... Genki Yamasaki, Shoji Sunaga, Takeharu Seno, Tadashi Kanazaki .......................... 144

A Study of Painting Color Used for Road Scenes and Road Surfaces-Report of the Survey Result- .......................... Nonko Takamatsu, 5copp/Committee landscape road problem (chair:Motoko Hihara) .......................... 146

Basic Study on the Features of Scene Viewed from CENTRAM-Train Window .......................... Jia Chen, Hiroshi Sawo, Lin Ma, Mamoru Takamatsu, Yoshio Nakashima .......................... 148
Effect of Color of Window Treatment on Evaluation for Machiya Façade .......................... Akari Kagimoto, Shino Okuda .......................... 150
Development of an Ontology for Image Retrieval Based on Color Emotions .......................... Keiichi Muramatsu, Tatsuo Togawa, Tatsunori Suzuki .......................... 152

The Quantification of Whiteness Change by the Watercolor Illusion .......................... Shoko Isawa, Tsuneo Suzuki .......................... 154
Estimation Method of Synesthesia Color in a Broad Sense Befitting to the Fatigue Arising from Driving a Wheelchair .......................... Hiroyoshi Tsuiji, Rie Suetsugu .......................... 156

Study on the Optimum Speed of the Scrolling Text on the LED Indication .......................... Kazuhiro Yakushi, Mamoru Takamatsu, Hiroki Fujita, Yoshio Nakashima, Yasuyuki Matsumoto .......................... 158
Color Preference Style for Multi-Colors (4) .......................... Takeaki Hanari, Shin'ya Takahashi .......................... 162
Impression of New Color Combinations on Wood .......................... Mikuko Sasaki, Kumiko Matsumoto, Koji Kawato, Yasuhiro Kawabata .......................... 164
The Investigations of the Attitudes to Black as Fashion Color in Japan, China and U.S. .......................... Xia Fan, Mio Saito .......................... 166
Color Affects Face Perception in Schematic Faces ............................................ Fumio Takahashi, Yasuhiro Kawabata .......................... 168
Effects of Color Variation on Consumers' Decision-Making in Clothes Selection ......................................................... Noriko Sato, Hiroko Tokunaga, Atsushi Kimura .............. 170
Difference of Evaluation on Draping between Colorist and Non-Colorist ................................................................. Chie Hijita, Takanori Ichiba, Emi Kondo, Hiromi Kondo, Ikuko Suga, Manami Tada, Ichiko Tomimoto, Hisako Naganawa, Naomi Yoshida, Asako Adachi, Kazuyoshi Takekawa ...................................................... 172
Analysis on the Use of Hair Texture Differences as One of the Determinants for Choosing the Best Hair Colors, and the Importance of Hair Texture Consideration for the Color Reproduction in Hair Coloring ................................................................. Katsumi Nakane, Yossuke Yoshizawa ...................................... 174
Comparison of Idioms about Color between Korea and Japan ................................................................. Halsong Xu, Weige Lu ................................................. 176
Reproduction of Color Based on Analysis of Mameitaijin Used in Edo Period................................................................. Satoko Taguchi, Fumiyoshi Kirino ....................................... 178
Color Representing Imagined from Aroma ......................................................................................................................... Manami Tada, Ikuko Suga, Emi Kondo .......................... 180
A Study of Design Education and Color Vision Deficiency ................................................................. Akemi Yamashita, Yurie Yaura ........................................... 182
The Design of Exchangeable-Cover Desktop PC ........................................................................................................ Ji-ihwan Park, Jae-yong Woo, Norihito Tanaka .................. 184
The Color Design System by the Color-Cubes .................................................................................................................... Tomoko Mitsutake, Katsuyuki Aihara, Yossuke Yoshizawa......................... 186
Designs Using the "Red" Fraser- Wilcoxon Illusion ........................................................................................................... Akiyoshi Kitaoka .................................................................. 188

Abstract for the International Symposium

Towards Perceptual Contrast of Display
- Halsong Xu, Weige Lu .............................................................................. 192
Color as a Nocent of Crossmodal Perceptions for Our Better Life - Miho Saito ................................................................................. 194
Modern Approaches to Utilize Traditional Chinese Color Theory - Tien-Rein LEE ................................................................. 196
Color Perception and Preference of Elderly People in Korea - Young-in Kim ........................................................................... 198
Size Limit of the Color Patches for Perceiving Object Color Mode by the Elderly - Pontaewee Punggrassamee .................. 200
Similarity of Colors and Conspicuousness of Color Combination for Younger and Older People - Ken Sagawa ................................................................................. 202

Abstract for the International Conference

Colors and Color Arrangement Characteristics of Korean Tracking Jackets for Men and Women - In-Kyung Seo, Moon-Jung Seo, Young-Whoa Lee, Young-In Kim ......................................................... 204
Fashion Image Types and Color Images of Middle-Aged Women in Korea ................................. Suin Chung, Rira Kim, Sieun Lim, Youngin Kim ................................................. 206
Fashion Color Preference of Senior Generation Based on Fashion Style and Self-Image - Yun Jung Hong, Hee Yeon Kim, So-Won Hahn, Young-In Kim ......................................................... 208
The Comparative Study of Psychological Background of Black as Fashion Color in Japan, China & U.S. - Xia Fan, Saito Miho ................................................................. 210
The Effects of a Person's Personal Background on Bedroom Color Preference - Mahshid Baniani, Sari Yamamoto ......................................................... 212
Semantic Priming with Mandarin Characters and Color Patches - Vincent C. Sun, Tien-Rein Lee ................................................................. 214
Visual Acuity of Thai Letters with and without Cataract Experiencing Goggles - Boonchail Waeleterncheepsawat, Pontaewee Punggrassamee, Tomoko Okama, Mitsuo Ikeda ................................................................................. 216
The Effect of Garnut Expansion Ratio on Delicious-Looking Food under Multi-Primary Circumstance - Chunkai Chang, Hirohisa Yaguchi, Yoko Mizokami ................................................................................. 218
Preference of Images with Color Enhancement Assessed by Color Anomalous and Normal Observers - Yi-Chun Chen, Yung Guan, Tomoharu Ishikawa, Hiroaki Eto, Takahiro Nakata, Jinho Choi, Miyosi Ayama ................................................................................. 220

The Color Constancy in a 3D Space Perceived Stereoscopically
- Chanprapha Phuangwan, Hiroyuki Shinoada, Kitirochana Rattanakasamsuk, Mitsuo Ikeda, Pichayada Katsamke ................................................................................. 222
A Study of Color Impression about "tone" in PCCS Color System - Tadayuki Watan, Miho Saito ................................................................................. 224
Physiological and Psychological Responses to Color Lights under Cold Environmental Condition - Yang Guo, Miho Saito, Mayumi Nakamura, Kei Nagashima ................................................................................. 226
Color Emotion and Color Preference Responses of Chinese Youngsters - Rui Gong, Haisong Xu, Ming R. Luo, Aimin Chou, Taichiro Ishida ................................................................................. 228
Psychological Evaluation of Street Lighting Environment at Night - Aimin Chou, Taichiro Ishida ................................................................................. 230
The Effect of Illumination on Visual Acuity of Thai Characters for Billboard Advertising Design
- TANGKIJWUT Urai, TONGSAWANG Akadet ................................................................................. 232

Study in Human Color Perception on Outdoor Advertising Cutout
- TONGSAWANG Akadet, TANGKIJWUT Urai, Intelligent Support Tool with Dynamic Image Processing for Color Universal Design - Katsunori Ojima, Shino Okuda, Naboru Tsukamoto, Kenji Iwamoto, Masahiro Suzuki ................................................................................. 236
Color Image Rendering of Human Skin Based on Multi-Spectral Reflection Model - Norihito Tanaka, Haimei Arai, Jae-Yong Woo, Hideaki Morikawa, Mihiko Miura ................................................................................. 240
Preferred Skin Color Reproduction under Conditions of Different Correlated Color Temperatures and Luminance Levels on Display - SiH-Han Chen, Hung-Shine Chen, Naboru Ohta, Ronny Luo ................................................................................. 242
Effect of Digital Printing on Image Qualities Obtained by Digital Compact Camera - KHANKAEW Surachai, TANWILASI Anan ................................................................................. 246
An Improved Adaptive Algorithm Based on Local-Searching for Color Object Tracking and Segmentation - Chao Wang, Wei Ye, Fucal Yan ................................................................................. 248

Venue and Program ......................................................................................... 250
The Effect of Illumination on Visual Acuity of Thai Characters for Billboard Advertising Design

TANGKIUVIWAT Uravis
TONGSAWANG Akradet
Rajamangala University of Technology Thanyaburi, Thailand

Keywords: Visual Acuity, Thai Characters, Billboard Advertising Design

1. Introduction
The usage of billboards is one of effective strategies in advertisements. According to a new market research report published by MarketsandMarkets, the global market of billboard advertising is expected to reach 12.5 billion dollar in 2016 at estimated CAGR of 5.7% from 2011 to 2016. Considering the fact that advertisements on billboards are largely visible, they are very effective in promoting goods or services. Several factors are said to be responsible for visual acuity: character types and size, achromatic and chromatic contrast, visual duration, visual distance and so on. So far various studies have been carried out to investigate the factors that influence visual acuity of Thai characters on billboards when they are observed under a difference of illumination levels. This study, hence, aims to explore the effects of illumination on visual acuity of Thai text stimuli for billboard advertising design.

2. Experiments
Three female of 22 years old took part in this experiment. All the subjects had normal or corrected to normal visual acuity. Each subject was screened for color deficiency using the Ishihara plate test.

Task I was to measure the minimal character size for visual acuity when observing under different illumination levels. A set of adjustable daylight type fluorescent lamp with relative color temperature at 6500K was used for setting up a room illumination. The illumination level set to 20, 80, 200, 800, and 1500 lx to cover the range of whole day illumination. Achromatic Thai characters used as test stimuli varied in different sizes of character height (4.2, 4.0, 3.8, 3.5, 3.0, 2.8, 2.6, 2.5, 2.3, 2.1, 1.9, 1.8, and 1.6 mm). Within each stimulus, 10 random characters of same size in the same line were presented in 5 illumination levels for subjects to read out and report. Each subject repeated 5 times of all experiment sessions.

Task II was devoted for investigating the effect of illumination on visual acuity in colored text. The colored texts included nine hues and one achromatic varied in three different lightness levels as shown in figure 1. Within each stimulus, 10 random characters of 4 mm in size were also presented in 5 illumination levels, as same as the illumination used in task I, for subjects to read out and report. Each subject repeated 5 times of all experiment sessions.

All stimuli in both tasks were printed on white vinyl substrate by screen printing process and subjects were asked for observation at 155 cm. of a viewing distance at subject's eye level.

3. Results and Discussions
The number of characters correctly read by subjects is accumulated as percentage of readable characters. Figure 2(a) shows the mean results with increasing character height. The results show that a higher font size results in a higher percentage of readable character. Our results agree with previous studies for PDA and visual display terminal.

To investigate a possible variation of correct response score among different illumination levels, the 75% seeing curves of each subject were acquired and the threshold character size curve was analyzed. Figure 2(b) shows a result of the three.

Figure 1. xy chromaticity coordinate of test stimuli (solid dot) and a substrate (opened dot) used in Task II.

Figure 2. (a) the relationship between character height and illumination in different tasks.

Next, different character height results show that the threshold character size against the illumination level. The results reveal different character size performance. This tendency may be due to the size and material. This implies that the character size is effective for which the character size and its performance.

Figure 2(b) the result of character size. This result shows different character size for visual acuity.

4. Conclusion
This study investigated the effects of illumination on visual acuity in Thai billboard. It was found that illumination level on billboard decreased the character seeing distance. The results also showed that illumination condition affects the relationship between character size and performance.

To investigate this interaction further, more subjects and different conditions would be necessary.
threshold character size in different illumination levels expressed on a logarithmic scale. As shown by the results, visual acuity was improved with increased illumination level. The lower size of character required a high illumination level for perfect visual acuity.

![Graph showing readable character size vs. illumination level](image1)

**Figure 2.** (a) Mean of readable character in different sizes, (b) The 75% threshold character size curve of illumination in different sizes of character.

Next, an effect of illumination on visual acuity in different colored character was explored. Figure 3 shows the mean of readable character plotted against the hue angles of colored character. The results revealed that the percentage of readable character was dropped on hue angle nearly 90°. This tendency occurred in all illumination levels. This implied that yellow character might be ineffective for white background.

![Graph showing readable character size vs. hue angle](image2)

**Figure 3.** The results of visual acuity of colored character.

![Graph showing readable character size vs. contrast ratio](image3)

**Figure 4.** Mean of readable character plotted against the log of the contrast of the stimulus.

4. Conclusion

This study was undertaken to obtain the visual acuity in the different illumination levels in simulated billboard. It was found that visual acuity is improved with illumination. The effective character size for billboard design that is observed with 9 m. of viewing distance should be higher than 45 mm for dim illumination condition and 17 mm for bright illumination condition. In addition, the low lightness contrast between character and background might be kept away from design. The future study will include more subjects and more illumination conditions to investigate the effect of actual lighting up using in billboard advertising on visual acuity.

References