

**The 6th Asia-Pacific Conference on Vision**  
(July 23-26, 2010, Taipei, Taiwan)

**Abstracts**

VISION : the Journal of the Vision Society of Japan  
Volume 22, supplement for APCV2010  
2010

Cited abstracts will be referred as follows, e.g., “Authors, Title. Vision, Volume 22  
(supplement for APCV2010), page, 2010.”

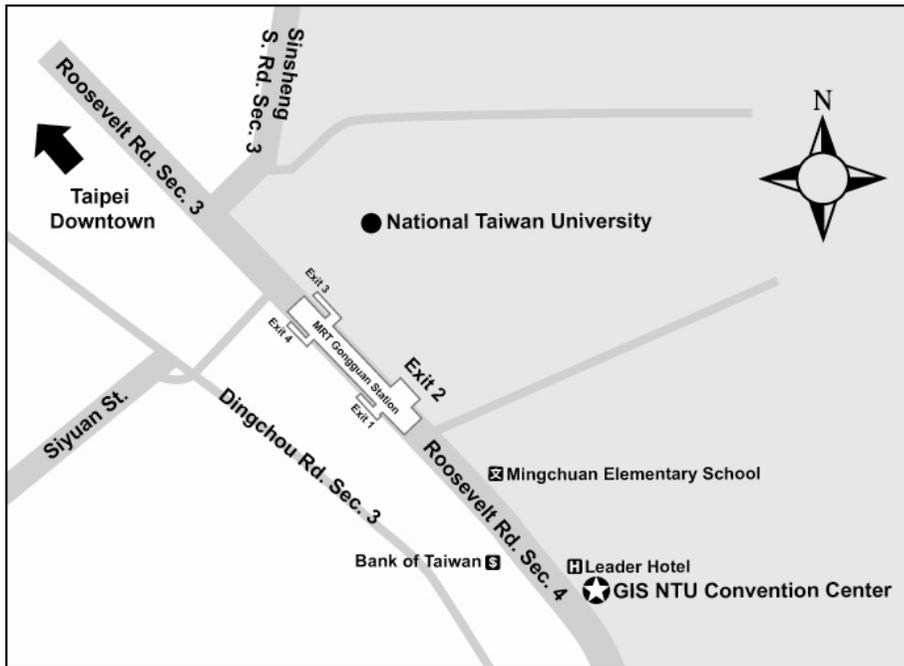


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Volume 22, supplement for APCV 2010, 2010

**APCV 2010 Conference Site** GIS NTU Convention Center, Taipei



## APCV 2010 Time Table

Time/Date	Friday, July 23	Saturday, July 24	Sunday, July 25	Monday, July 26
08:30-09:00				
09:00-09:30			<b>Symposium</b> <i>The Perception of Colored Patterns, Materials, and Scenes</i> (The Forum)	<b>Talk Session</b> <i>Color Vision II</i> (Socrates)
09:30-10:00	<b>Opening (The Forum)</b> <i>Dr. Si-Chen Lee</i>	<b>Keynote Speech</b> <i>Dr. Izumi Ohzawa</i> (The Forum)		<b>Talk Session</b> <i>Motion II</i> (Socrates)
10:00-10:30	<b>Keynote Speech</b> <i>Dr. Chung-Yu Wu</i> (The Forum)		<b>Break</b>	
10:30-11:00		<b>Break</b>	<b>Poster Session</b> <i>odd numbers present</i> (Plato)	<b>Break</b>
11:00-11:30	<b>Poster Session</b> <i>odd numbers present</i> (Plato)	<b>Break</b>		
11:30-12:00			<b>Lunch</b>	<b>Lunch</b>
12:00-13:30	<b>Lunch</b>	<b>Lunch</b>		
13:30-14:00			<b>Symposium</b> <i>Bionic Vision: A Vision for the Blind</i> (The Forum)	<b>Talk Session</b> <i>Face &amp; Objects</i> (Socrates)
14:00-14:30	<b>Symposium</b> <i>Spatial and Temporal Aspects of Perception and Attention</i> (The Forum)	<b>Talk Session</b> <i>Form &amp; Surface</i> (Socrates)		
14:30-15:00			<b>Break</b>	<b>Break</b>
15:00-15:30	<b>Break</b>	<b>Break</b>		
15:30-16:00			<b>Break</b>	<b>Break</b>
16:00-16:30	<b>Poster Session</b> <i>even numbers present</i> (Plato)	<b>Poster Session</b> <i>even numbers present</i> (Plato)		
16:30-17:00			<b>Banquet &amp; Tour</b> <i>National Palace Museum</i> <i>Silks Palace Restaurant</i>	<b>Keynote Speech</b> <i>Dr. Christopher W. Tyler</i> (The Forum)
17:00-17:30	<b>Business Meeting</b> (The Forum)	<b>Business Meeting</b> (The Forum)		
17:30-18:00			<b>Business Meeting</b> (The Forum)	<b>Business Meeting</b> (The Forum)
18:00-20:00	<b>Business Meeting</b> (The Forum)	<b>Business Meeting</b> (The Forum)		

## Attendee Resources

### **Abstract Book**

A conference book will be provided to each attendee. Additionally, you can download an electronic copy in PDF format from the APCV website.

### **ATM**

An ATM is located in the first floor of the venue.

### **Secretariat**

Secretariat is located in the Alexander Hall of the GIS Convention Center.

### **Copying and Printing**

Copying and printing are not provided at Secretariat. A copy machine for hire will be available in the FamilyMart Convenient Store, located in the first floor at the venue. There are several printing services around the campus, please inquire the APCV registration desk for detail.

### **Internet Access**

Wireless Internet access is provided in the Alexander Hall.

### **Lost and Found**

Lost and found is located at APCV registration desk in the GIS Convention Center.

### **Parking**

There is a charged parking lot next to the venue on the right side of the building.

### **Shipping**

If you would like to ship your poster or other items home from the meeting, the nearest post office is inside the MRT Gongguan station (Monday to Friday : 8:00-18:00 / Saturday : 8:30-12:00).

### **How to Contact Us**

If you have any other questions or are unable to make your presentation, you could reach APCV2010 staff at registration desk and each conference room.

## Keynote Speaker Introduction



### **Dr. Peter Chung-Yu Wu**

President / Chair Professor, National Chiao Tung University, Taiwan  
Director General, National System-on-Chip Program

Dr. Peter Chung-Yu Wu (1998 IEEE Fellow) is President/Chair Professor of National Chiao Tung University. He served as Vice President for Conferences in 2004 -2005, and was a Board of Governor (BoG) member in 2003 in IEEE Circuit and System (CAS) Society. He was General Chair of 1994 IEEE APCCAS Conference. Dr. Wu served as Guest Editors of November 2003 Nanoelectronics Special Issue for the Proceedings of the IEEE and Aug. 1997 Multimedia Special Issue for IEEE Trans on CSVT, as Associate Editor for Trans. on CAS-Part II, Trans. on VLSI Systems, and Trans. on Multimedia. He served as CAS Editor for IEEE Circuits and Devices Magazine in 2006. Dr. Wu is the founding Chair of Technical Committee on Nanoelectronics and Giga-scale Systems. He served as Chair of Neural Technical Committee and as Chair of Multimedia Technical Committee. In regional activities area, Dr. Wu served as CAS Taipei Chapter Chair, and IEEE Taipei Section Chair. In 2000-2001, Dr. Wu served as a Distinguished Lecturer in IEEE CAS Society. Currently, Dr. Wu serves as the President of Taiwan Engineering Medicine & Biology Association (TWEMBA) promoting biomedical device and biomedical electronics research and development. He is the Director General of National Program on System-on-Chip and the President of Global Talentrepreneur Innovation & Collaboration (Global TIC) Association.

The major research interest of Dr. Wu is in the area of nanoelectronic circuits and systems for implantable medical devices such as artificial retina, deep brain stimulator for epilepsy, etc.

Dr. Wu is a recipient of IEEE Third Millennium Medal, a Fellow of IEEE, and also a U.S. Fulbright Scholar. He is a member of Eta Kappa Nu and Phi Tau Phi Honorary Scholastic Societies. He served as a Semester-Full Professor in fall 2003 and as Adjunct International Professor since spring 2004 for the ECE Department at University of Illinois at Urbana-Champaign.



**Dr. Izumi Ohzawa**

Visual Neuroscience Laboratory(Ohzawa Lab)

Graduate School of Frontier Biosciences Osaka University, Japan

Website: <http://ohzawa-lab.bpe.es.osaka-u.ac.jp/>

Dr. Izumi Ohzawa is a well-known researcher in the field of early visual cortical functions. In the 90s, he used a marvelous tool -- the reverse correlation techniques (also known as spike-triggered averaging) -- to measure the electrophysiological responses of cell sand applied these techniques to measure the spatial and temporal attributes of receptive fields of early visual cortical cells. It was probably one of the greatest breakthroughs in the field of electrophysiological study since Nobel Laureates Hubel and Wiesel found the orientation-tuned cells in 1962. Dr. Izumi Ohzawa further extended these techniques to study dynamic vision and depth perception; his research helped us gain deeper understanding regarding the attributes of receptive fields in various aspects. Recently, he has used the same techniques to study the interactions among cortical cells and properties of high-order neurons in areas beyond early visual areas. This approach expanded the horizon of electrophysiological recordings from studying a single neuron's responses to explore the response properties of a larger neural network. Dr. Izumi Ohzawa is one of the most important contemporary figures in the field of single cell recording in vision sciences.



## **Dr. Christopher W. Tyler**

Smith-Kettlewell Brain Imaging Center,  
Smith-Kettlewell Eye Research Institute  
Website: [http://www.ski.org/cwtyler\\_lab](http://www.ski.org/cwtyler_lab)

Dr. Tyler is one of the most important contemporary vision scientists. In the past 40 years, Dr. Tyler has published hundreds of scientific papers, including several journal papers in *Nature* and *Science*. Dr. Tyler has made great contribution in spatial vision, depth perception, and neuroimaging. Dr. Tyler's research has influenced not only the academic field, but also the mass media. Many high-profile popular magazines and newspaper such as the *New York Times* have reported his work. Dr. Tyler is the inventor of the autostereogram which allows observers to see 3D patterns in one picture without any aids. The application of this technology has become an industry of million dollars per year, as the concept of free-viewing stereograms has spread into modern single-screen stereo display. In addition, Dr. Tyler applied the methods and theories of visual analysis to the domain of visual art. This approach has evoked extensive discussions, and impacted the development of modern vision science and the history of art. Recently, Dr. Tyler's research on the visual analysis of facial expressions has not only been a pioneer in this domain, but also attracted the public's eyes that it was reported many times by the mass media. Dr. Tyler extended the reverse correlation techniques to the global analysis of facial expressions (happy and sad) to show which parts of the face convey the relevant information.. At least 600 broadcasts reported this study in the United States during the first week after the publication of this paper.

# Symposia Summary

## **Symposium 1 : Bionic Vision: A Vision for the Blind**

Blindness afflicts millions of people worldwide. Although a number of approaches are currently being pursued in the hope of preventing blindness, once vision is totally lost, retinal transplantation and bioelectronic visual prosthesis are only two of the existing strategies for restoring vision. Several groups in past decade have developed electrical implants that can be attached directly to the retinas of patients suffering from retinal degeneration, and have shown promise of retinal prostheses that can be used clinically. In this symposium, leaders of retinal prosthesis around the world will present recent advances in artificial vision, and discuss major obstacles in improving these prosthetic devices.

## **Symposium 2 : Visual Cortex in Primates, Retinotopic Organisation and Plasticity**

Retinotopic maps are not simply an accidental property of early visual cortex, but a fundamental organisational principle of information processing. This symposium will present recent insights into contemporary concepts of retinotopic organisation. It will further present results on plasticity at three levels, at a micro level within V1, at an intermediate level across a complex of visual areas and finally on a system level across hemispheres.

## **Symposium 3 : The Perception of Colored Patterns, Materials, and Scenes**

There has been a shift recently from measuring color constancy for flat uniformly colored stimuli towards the perception of material qualities of real surfaces. This shift has been driven by the realization that whereas shape is important in object recognition, material perception can be just as important in identifying objects and their qualities, e.g. natural versus artificial fruits, or soft versus hard seats. Chemical and physical properties of objects provide them with specific surface patterns of colors and textures. Endogenous and exogenous forces alter these colors and patterns over time. Using material appearance to estimate physical and chemical properties of objects has great utility for organisms and is critical to survival in certain conditions. Whether color information facilitates object and scene recognition is supported only by a few studies, but color may take center stage as its role in these processes through material identification becomes clearer. Unfortunately, studies of pattern, texture, material, object, and scene perception have generally used achromatic images, thus leaving out potentially critical information. The papers in this symposium will use psychophysics, fMRI, image statistics and computational modeling to examine how color information is used in these tasks.

## **Symposium 4 : Spatial and Temporal Aspects of Perception and Attention**

Our visual experience is affected by both the spatial and the temporal aspects of the scene we are viewing. Understanding how our system processes both aspects is crucial for a comprehensive view of the visual system, yet we know considerably more about the spatial than the temporal domain. This is especially true of our knowledge of visual attention. The various talks in this symposium have taken different routes to explore the interplay between the temporal and spatial domains. These include an investigation of the temporal limits on extracting spatial relationships, tradeoffs between temporal and spatial processes and the role played by attention, spatial and eye specificity of top-down attentional modulation, and the effects of perceptual organization on temporal process.

### **Symposium 5 :**

#### **Fading, Perceptual Filling-in, and Motion-induced Blindness: Phenomenology, Psychophysics, and Neurophysiology**

Why do we see what is not there? This symposium strives to give the answer. Fading of a target on a uniform background and perceptual filling-in from the edge are examples of the failure of the visual system to provide sustained vision under conditions of prolonged fixation. Motion-induced blindness is another phenomenon that falls into this category. The relationship between these three phenomena is not entirely clear, but the preference for small, peripheral, and low contrast targets suggests that the mechanism underlying these effects may be similar. It has lately been shown that in addition to the above stimulus attributes, salience of the stimulus and perceptual grouping may also affect fading and filling-in. Furthermore, stereo-depth and monocular depth cues have been proposed as relevant factors. These findings imply that top-down (salience) as well as bottom-up mechanisms are responsible for the perceptual disappearance of a fixated target by fading and filling-in. Speakers will summarize the phenomenological and psychophysical findings for fading and filling-in of brightness, color, and texture and correlate these observations with the presumed neurophysiological mechanisms.

### **Symposium 6 : The Other-race Effect in Face Perception**

We are all experts at recognizing faces, and are much better at recognizing faces than most equally-complex non-face objects. But faces from races other than our own show a signature cost in recognition, relative to faces from our own race. What causes this other-race effect? Is it due to less efficient coding of faces with which we lack expertise, and if so, how? Or is it due to social categorization differences in the way we treat in-group and out-group members? In this symposium speakers will present recent studies that use a variety of methodologies to shed light on the causes of the other-race effect.

## Travel Awards

1) Garga Chatterjee

Harvard University

Advisor : Ken Nakayama

2) Ming Liang

Tsinghua University

Advisor : Zhaoping Li

3) Joris Vangeneugden

University of Leuven

Advisor : Rufin Vogels

4) Hsueh-Cheng Wang

University of Massachusetts Boston

Advisor : Marc Pomplun

5) Sze-Man Lam

The University of Hong Kong

Advisor : Janet H.W. Hsiao

# The 6<sup>th</sup> Asia-Pacific Conference on Vision

July 23-26, 2010

Taipei, Taiwan

## Program

### July 23

#### Opening

July 23, 9:40-9:50, The Forum

Si-Chen Lee (President and Professor, National Taiwan University, Taiwan)

#### Keynote Speech 1

July 23, 9:50-10:50, The Forum

K1 Peter Chung-Yu Wu (National Chiao Tung University, Taiwan) : The Design of Implantable Retinal Chips for Visual Prostheses

#### Symposium 1 : Bionic Vision: A Vision for the Blind

July 23, 13:30-15:30, The Forum

Organizer : Chuan-Chin Chiao (National Tsing Hua University, Taiwan)

S1-1 Joseph Rizzo (Massachusetts Eye and Ear Infirmary, USA) : The Development of the Boston Retinal Prosthesis: What is the Potential for Devices of This Type to Restore Vision to the Blind?

S1-2 Gregg Suaning (University of New South Wales, Australia) : Supra-Choroidal Electrical Stimulation of the Retina

S1-3 Long-Sheng Fan (Inst. of NEMS / Electronic Research Lab., Taiwan) [C. C. Hsieh, C. C. Chiao, Y. Dan, K. T. Tang, M. Feller, M. C. Wu (Taiwan, USA) ] : A Flexible Sensing CMOS Technology for Sensor-Integrated, Intelligent Retinal Prosthesis

#### Talk Session : Face & Objects

July 23, 13:30-15:30, Socrates

Moderators : Sarina Hui-Lin Chien (China Medical University, Taiwan)  
Takao Sato (University of Tokyo, Japan)

11.01 Kate Crookes, Elinor McKone (Hong Kong, Australia) : Individual-level Discrimination – An Innate Capacity? 4-month-old Infants Individuate Upright But Not Inverted Horses

- 11.02 Aki Tsuruhara, Hiroko Ichikawa, So Kanazawa, Masami K. Yamaguchi (Japan) : Infants' Preference of Moving Face-like Figure to Top-heavy Figure
- 11.03 Sarina Hui-Lin Chien, Hsin-Yueh Hsu (Taiwan) : The “Top-heavy” Bias is Gone: An Eye-tracking Study in Infants and Adults Revealed Common Preferences Specifically to Real Faces
- 11.04 Garga Chatterjee, Ken Nakayama (USA) : Perceptual and Cognitive Processes in a Widely Prevalent Face Recognition Deficit: the Case of Developmental Prosopagnosia
- 11.05 Withdrawn
- 11.06 Derek Arnold (Australia) : Binocular Rivalry: Facial Dominance and Monocular Channels
- 11.07 Yu-Chin Wu, Gary C.-W. Shyi (Taiwan) : Modulation of Familiarity on Dynamic Advantage Effect in Matching Faces
- 11.08 Takao Sato, Kenchi Hosokawa (Japan) : Dominance Shift with Hybrid Images is Dependent on Relative Spatial Frequency

Poster Presentations :

Morning Session: July 23, 11:00-12:00, Plato (Odd Numbers Present)

Afternoon Session: July 23, 15:40-16:30, Plato (Even Numbers Present)

- 12.01 Mikako Kuroki, Eiji Kimura (Japan) : How Is the Induced Color Determined in the Watercolor Configuration?
- 12.02 Han Nim Cha, Jung Woo Hyun (Korea) : The Effect of Binocular Disparity and Phase Transformation of Dotted Lines on Water Color Illusion
- 12.03 Shin Na Ri, Jung Woo Hyun (Korea) : The Effect of Color and Interval and Binocular Disparity Information on Water Color Illusion
- 12.04 Hiroto Kimura, Takehiro Nagai, Shigeki Nakauchi (Japan) : Detectability of Color Modulation on Isoluminant Apparent Motion Stimuli
- 12.05 Masataka Sawayama, Eiji Kimura (Japan) : Common-fate Grouping Affects Brightness Perception on the Articulated Surround.
- 12.06 Kazuya Inamoto and Keizo Shinomori (Japan) : The Effect of Background Color on Color Matching to Skin Color under Sinusoidal Luminance Modulation
- 12.07 Sze-Wing Lee, Chia-Huei Tseng (Hong Kong) : Impact of Red Color on Mood and Task Performance on Chinese in Hong Kong
- 12.08 Chia-Ching Wu, Chien-Chung Chen (Taiwan) : The Effect of the Chromaticity of Image Elements on Symmetry Detection
- 12.09 Ya-Ting Yang, C. Wan, W.-C. Yang, L.-J. Lin, P.-K. Lin, C.-Y. Wu, C.-C. Chiao (Taiwan) : Retinal Network Responses upon Subretinal Electrical Stimulation
- 12.10 Yukio Shimoda, Lee Chia Jung, Toru Yazawa (Japan) : Dopaminergic Retinal Nurons in Various Kinds of Animals Revealed by Glyoxylic Fluorescent Technique
- 12.11 Makoto Kaneda, Yasuhide Shigematsu, Yukio Shimoda (Japan) : Two Choline Transport Pathways in Cholinergic Amacrine Cells in the Mouse Retina

- 12.12 Wen-Hsuan Huang, C. Wan, W.-C. Yang, L.-J. Lin, P.-K. Lin, C.-Y. Wu, C.-C. Chiao (Taiwan) : Responses of the Ganglion Cells upon Light and Electrical Stimulations in the Rat Retina
- 12.13 Hung-Ya Tu, Pin-Chien Huang, Chuan-Chin Chiao (Taiwan) : Expression of Connexin 36 during Postnatal Development of the Rabbit Retina
- 12.14 Hsing-Yen Huang (Taiwan) : Arl6ip1 Functions in Differentiation, Mitosis, and ER-stress Mediated Apoptosis during Retinogenesis of Zebrafish Embryos
- 12.15 Kuan-Hui Li, Yi-Chin Lin, Yu-Hui Lo, Daisy L Hung, Chi-Hung Juan (Taiwan) : The Development and the Characteristics of Oculomotor Inhibition In the Preschool Children
- 12.16 Chang-Mao Chao (Taiwan) : Predictability of Saccadic Behaviors is Modified by Transcranial Magnetic Stimulation over Human Posterior Parietal Cortex
- 12.17 Chia-Lun Liu, Philip Tseng, Daisy Hung, Ovid Tzeng, Neil Muggleton, Chi-Hung Juan (Taiwan) : Frontal Eye Fields and the Location Probability Effects: A Repetitive Transcranial Magnetic Stimulation Study.
- 12.18 Hui-Yan Chiau, Chi-Hung Juan (Taiwan) : The Roles of Frontal Eye Field and Supplementary Eye Field in Trial Type Probability – A Transcranial Direct Current Stimulation Study
- 12.19 Yasumasa Ogata, Keiji Uchikawa (Japan) : Influence of a Visual Target Presented at Detection Sub-threshold on Saccadic Induction
- 12.20 Da-Lun Tang (Taiwan) : How Balanced Configuration Influence the Visual Scanpath and Processing
- 12.21 Meng-Hsun Wang, Da-Lun Tang (Taiwan) : Plausibility of a Lie Detection Procedure Based on Eye Tracking Patterns
- 12.22 Hsueh-Cheng Wang, Yi-Min Tien, Li-Chuan Hsu, Marc Pomplun (USA) : The Role of Semantic Transparency in the Processing of Two-character Chinese Words
- 12.23 Masae Yokota, Yasunari Yokota (Japan) : The Relation between Perceptual Filling-in Facilitation and Eye Movement
- 12.24 Jingling Li, Wan-Yu Shih, Tzu-Hui Pao (Taiwan) : Expectation Overcomes the Impairments Induced by a Large Task-irrelevant Salient Line in Visual Search
- 12.25 Kuan-Ming Chen, Su-Ling Yeh (Taiwan) : Asymmetric Cross-modal Effect on Time Perception Depends on Stimulus Duration
- 12.26 Shih-Yu Lo, Su-Ling Yeh (Australia, Taiwan) : Effect of Sound on Visual Persistence
- 12.27 Ming-Chou Ho (Taiwan) : Object-based Attention: Spread, Scanning and Shift
- 12.28 Fuminori Ono, Katsumi Watanabe (Japan) : Attention Can Distort Visual Space Backwards
- 12.29 Sung-En Chien, Katsumi Watanabe, Lee-Xing Yang (Taiwan, Japan) : Feature-location Binding When Tracking Moving Objects Do Not Affect Distribution of Attention within Objects
- 12.30 Wei-Lun Chou, Su-Ling Yeh (Taiwan) : Subliminal Spatial Cues Capture Attention and Cause Reversed Object Effects
- 12.31 Satoko Ohtsuka, Yuuya Shiozaki (Japan) : Interacting Properties of Spatial and Non-spatial Attention Revealed by Cueing Paradigm
- 12.32 Hsin-Yueh Hsu, Ming-Kuan Lin, Sarina Hui-Lin Chien (Taiwan) : Exploring the Other-Race-Effect in 6-, and 9-month-old Taiwanese Infants and Adults

- 12.33 Jie-Ju Lin, Chun-Chia Kung (Taiwan) : The Effect of Spatial Frequency on the Own Race Advantage in Face Recognition
- 12.34 Tsung-Ting Wang, Chun-Chia Kung (Taiwan) : Influence of Life Experience on Other Race Effect
- 12.35 Withdrawn
- 12.36 Myung Chan Lim, Lee Hyeon Soo, Woo Hyun Jung (Korea) : Ethnic Diversity\_Gender Perception
- 12.37 Cheuk-Fai Chung, William G. Hayward (Hong Kong) : Identification Accuracy and Confidence Reliability in Cross-racial Lineup Identification
- 12.38 Qian Qian, Keizo Shinomori, Miao Song (Japan) : Intertrial Inhibition Effect of Gaze Cueing

## July 24

### Keynote Speech 2

July 24, 9:30-10:30, The Forum

K2 Izumi Ohzawa (Osaka University, Japan) : Recent Advances in the Functional Analysis of High-order Visual Neurons

### Symposium 2 : Visual Cortex in Primates, Retinotopic Organisation and Plasticity

July 24, 13:15-15:15, Socrates

Organizer : Mark M. Schira (University of New South Wales, Sydney, Australia)

S2-1 Mark M. Schira (University of New South Wales, Sydney, Australia) : A Hyper Complex of Visual Areas, the Fovea Confluence and Its Consequences for Anisotropy and Magnification

S2-2 Stelios M. Smirnakis (Baylor College of Medicine, Houston, TX, USA) : Visual Cortex Reorganization After Injury: Lessons from Primate fMRI

S2-3 James A. Bourne (Monash University, Melbourne, Australia) : Maturation of the Visual Brain: Lessons from Lesions

S2-4 Lars Muckli (University of Glasgow, Glasgow, UK) : Bilateral Visual Field Maps in a Patient with Only One Hemisphere

### Talk Session : Attention II

July 24, 13:15-15:15, John Locke

Moderators : Ryota Kanai (University College London, UK)

Su-Ling Yeh (National Taiwan University, Taiwan)

21.01 Tsung-Ren Huang, Stephen Grossberg (USA) : Context-guided Visual Search via Global-to-Local Evidence Accumulation

21.02 Arni Kristjansson, Elmar Pels, Jan Brascamp (Iceland, USA) : Varied Timecourses for Priming for Different Feature Values in Pop-out Visual Search

21.03 Louis K. H. Chan, William Hayward (Hong Kong) : No Attentional Capture for Target detection – It Occurs Exclusively in Compound Search

21.04 Ryota Kanai, Vincent Walsh, Chia-Huei Tseng (UK, Taiwan, Hong Kong) : Awareness of Absence and Absence of Awareness: Failures of Sensation and Attention

21.05 Chun Hung Alexander Ng, William G. Hayward (Hong Kong) : The Role of Working Memory in Visual Attention

21.06 Xun He, Natalie Sebanz, Glyn W. Humphreys (UK, The Netherlands) : Joint Memory Effects on Visual Attention: Effect of Closedness

21.07 San-Yuan Lin, Su-Ling Yeh (Taiwan) : Hierarchical Object Representation: How the Object is Changed Affects Object-based Attention

Poster Presentations :

Morning Session: July 24, 10:40-11:40, Plato (Odd Numbers Present)

Afternoon Session: July 24, 15:25-16:15, Plato (Even Numbers Present)

- 22.01 Chu-Heng Lee, Chi-Shoung Tseng (Taiwan) : Taiwan's Traditional Koji Colors of the Visual Cognition Research
- 22.02 Kahiro Matsudaira, Hiroyuki Shinoda, Kitiroj Rattanakasemsuk, Hideki Yamaguchi (Japan) : Derivation of Color Confusion Lines and Copunctal Point for Dichromat Observers from Color Discrimination Thresholds
- 22.03 Kaori Ogawa, Hirohisa Yaguchi, Yoko Mizokami (Japan) : Color Discrimination on Various Test of Color Deficiency
- 22.04 Hirotooshi Nishita, Keiji Uchikawa (Japan) : Characteristics of Color Categories of Dichromats
- 22.05 Katsuaki Sakata, Hitomi Shimakura (Japan) : Effects of Chromatic Adaptation on Visual Search for Orientation
- 22.06 Jinhui Yuan, Minjie Xu, Bo Zhang, Zhaoping Li (China) : Understanding Cone Spectral Selectivities from Information Maximization and Color Constancy
- 22.07 Ayae Tajima, Yoko Mizokami, Hirohisa Yaguchi (Japan) : Color Constancy in Photographs and in Cartoon Image
- 22.08 Ryoichi Ishibashi, Hiroyuki Shinoda, Hideki Yamaguchi, Kitirochna Rattanakasamsuk (Japan) : Colorimetry-free Color Management System for Display Based on Color Constancy
- 22.09 Manabu Akimoto, Shinoda Hiroyuki, Yamaguchi Hideki (Japan) : Measurement of Luminance and Chromaticity Distribution by a Digital Camera
- 22.10 Yu-Chieh Chang, Shwu-Lih Huang (Taiwan) : May Threatening Faces Catch Your Eyes?
- 22.11 Yi-Chin Chou, Chien-Chung Chen (Taiwan) : The Discrimination Experiment Reveals the Nonlinear Properties of the Facial Expression Analyzer
- 22.12 Suzane Vassallo, Jacinta Douglas, Emma White (Australia) : Visual Scanning of Emotional Facial Expressions in Traumatic Brain Injury: A Case Report
- 22.13 Chia-Wei Liu, Ting-Tzu Chang, Yu-Shu Liang, Chia-Yao Lin, Yi-Min Tien, Li-Chuan Hsu, Hsian-Fu Chang (Taiwan) : On-line Recognition Revealed the In-group Advantage in Negative Facial Expressions
- 22.14 Yung-Hao Yang, Su-Ling Yeh (Taiwan) : Auditory-visual Integration Facilitates Unconscious Processing of Facial Expression
- 22.15 Chia-Chen Wu, Wan-Ru Huang, Jingling Li (Taiwan) : Neutral Features Induce Emotion in Schematic Faces
- 22.16 Ya-Huei Hsu, Chun-Chia Kung (Taiwan) : How Does Inferotemporal Cortex Respond to Average Faces?
- 22.17 Yu-Jen Tsai, Chun-Chia Kung (Taiwan) : The Effect of Attention in Face Selective Areas of Bird Experts: Reevaluating the Expertise Hypothesis
- 22.18 Miao Song, Keizo Shinomori (Japan) : High Level Facial Aftereffects Induced by the Non-face Meaningful Objects
- 22.19 Yu-Ting Ting, Chun-Chia Kung (Taiwan) : The Interaction between Face- and Object-selective Areas by Face-like Objects: An fMRI Study

- 22.20 Yi-Wen Chen, Chun-Chia Kung (Taiwan) : Integrating Auditory and Visual Information in Bird Experts: An fMRI Study
- 22.21 Yuki Yamada, Takahiro Kawabe, Keiko Ihaya (Japan) : The Uncanny Valley Phenomenon Is Explained by Deterioration of Object Evaluation due to Categorization Difficulty
- 22.22 Chia-Pei Lin, Yueh-Peng Chen, Chou-Po Hung (Taiwan) : Key Dimensions of Visual Object Representation in Macaque AIT
- 22.23 Daniel Yu-Chun Hsu, Yueh-Peng Chen, Chou-Po Hung (Taiwan) : Rapid Development of Pose and Illumination Invariance in Anaesthetized Macaque AIT via Dynamic Stimulus Correlation
- 22.24 Withdrawn
- 22.25 Chih-Ying Lin, Man-Ying Wang (Taiwan) : It Is Mine vs. It Looks Familiar – ERP N250 Responses
- 22.26 Kun Qian, Takahiro Kawabe, Kayo Miura, Yuki Yamada (Japan) : Scintillating Bar Illusion
- 22.27 Li-Feng Yeh, Kuan-Hung Cho, Chin-Po Lin, Chou-Po Hung (Taiwan) : Functional Organization of Key Dimensions in Human Lateral Occipital Complex
- 22.28 Hsin-I Liao, Neil Halelamien, Daw-An Wu, Shinsuke Shimojo (Taiwan, USA) : Retrieval of Visual Percept by Paired Association of a Visual Stimulus and Transcranial Magnetic Stimulation (TMS): Objective Evidence from a Masking Paradigm
- 22.29 Rumi Yamada, Hideki Yamaguchi, Hiroyuki Shinoda, Hirokuni Higashi (Japan) : Influence on Eye Strain from the Size of Visual Stimulus Examined by Accommodation Response Time
- 22.30 Yi-Woo Lee, Jung Woo Hyun (Korea) : The Effects of Stimulus Duration and Preceding Images on Aesthetic Experience
- 22.31 Jyh-Jong Hsieh, Erik Chang (Taiwan) : Tool-use and the Extension of Peripersonal Space: Is Temporal Synchronization Sufficient?
- 22.32 Gregory Kroliczak, Scott H. Frey (USA) : Neural Bases of Transitive and Intransitive Gestures during Perception and Imitation
- 22.33 Mitsuhiro Yoshida, Ken Wakata, Naoyuki Matsuzaki, Michiteru Kitazaki (Japan) : Driver's Gaze Control to Modulate Steering Performance in Accuracy and Workload
- 22.34 Jing Chen, Li Li (Hong Kong) : Separating the Contributions of Radial Flow, Splay and Bearing Angle Information to Lane-keeping Control
- 22.35 Joris Vangeneugden, Kathleen Vancleef, Tobias Jaeggli, Luc Van Gool, Rufin Vogels (Belgium, Switzerland) : Discrimination of Locomotion Direction in Impoverished Displays of Walkers by Macaque Monkeys
- 22.36 Yuki Kawashima, Hirohiko Kaneko, Kouji Yamamoto, Kenji Kiya, Keiji Uchikawa (Japan) : Influence of Vection Stimuli Arranged along a Road on the Car Driver
- 22.37 Joseph Cheng, Li Li (Hong Kong) : Looking Where You are Going Does Not Help Path Perception

## July 25

### Symposium 3 : The Perception of Colored Patterns, Materials, and Scenes

July 25, 9:00-11:00, The Forum

Organizer : Qasim Zaidi (State University of New York, College of Optometry, USA)

- S3-1 Qasim Zaidi (State University of New York, College of Optometry, USA) : Visual Perception of Material Changes
- S3-2 Karl R. Gegenfurtner (Giessen University, Germany) : Color Vision for Objects Made of Different Materials
- S3-3 Shin'ya Nishida (NTT Communication Science Laboratories, Japan) : Perception of the Colorful Natural Scene
- S3-4 Colin Clifford (The University of Sydney, Australia) : Interactions in the Processing of Color and Orientation

### Talk Session : Motion II

July 25, 9:00-11:00, Socrates

Moderators : Alan Johnston (University College London, UK)  
Li Li (The University of Hong Kong, Hong Kong)

- 31.01 Lizhuang Yang, Zhifang Shao (Hong Kong, China) : Dynamic Feature Change Affects the Object Persistence
- 31.02 Li Li, Diederick Niehorster, Joseph Cheng (Hong Kong) : Humans Use both Form and Motion Information for Heading Perception
- 31.03 Hirohiko Kaneko, Takuya Asano, Takuo Inui (Japan) : Perceived Trajectory of Moving Object under Normal- and Hyper-gravity Conditions
- 31.04 Hong-Jin Sun, Jingjiang Yan, Hong Li, Bailey Lorv (Canada, China) : Visual Processing of Impending Collision of a Looming Object
- 31.05 Brian Timney, Akos Solti, Sherene Fernando (Canada) : The Perception of Visual Acceleration
- 31.06 Alan Johnston, Andrew Rider, Shin'ya Nishida (UK, Japan) : Position-dependent Perceptual Organisation of an Ambiguous Global Motion Pattern
- 31.07 Koichi Shimono , Atsuki Higashiyama (Japan) : The Dual Egocenter Hypothesis Can Explain Directional Discrimination between a Visual Target and a Kinesthetic Target

Symposium 4 : Spatial and Temporal Aspects of Perception and Attention

July 25, 13:30-15:30, The Forum

Organizer : Yaffa Yeshurun (University of Haifa, Israel)

- S4-1 Alex O. Holcombe (University of Sydney, Australia) : Successes and Failures of Perception on the Fly
- S4-2 David I. Shore (McMaster University, Canada) : Objects, Space and Time: How Perceptual Grouping Affects Temporal Perception
- S4-3 Sheng He (University of Minnesota, USA) : Hemispheric Constraint and Eye Specificity of Spatial Attention
- S4-4 Yaffa Yeshurun (University of Haifa, Israel) : Transient Attention and Perceptual Tradeoffs

Talk Session : Form & Surface

July 25, 13:30-15:30, Socrates

Moderators : Branka Spehar (The University of New South Wales, Australia)  
Mel Goodale (The University of Western Ontario, Canada)

- 32.01 Isamu Motoyoshi (Japan) : Adaptation-induced Blindness and Spatiotemporal Filling-in
- 32.02 Branka Spehar, Yumiko Otsuka, Mark Schira (Australia) : An EEG Analysis of Visually Evoked Responses to Modally and Amodally Completed Contours
- 32.03 Hsin-Hung Li, Chien-Chung Chen (Taiwan) : Spatial Configuration Specific Surround Modulation of Global Form Perception
- 32.04 Shinya Takahashi (Japan) : Unnoticed Explanation of the ‘Transparency on Contrast’ Pattern
- 32.05 Naokazu Goda, Chihiro Hiramatsu, Hidehiko Komatsu (Japan) : Representation of Surface Materials in Human Visual Cortex
- 32.06 Mel Goodale, Melvyn A. Goodale, Jonathan S. Cant (Canada, USA) : Extracting Shape and Material Properties from the Same Surface Cues: an fMRI Study

Poster Presentations :

Morning Session: July 25, 11:10-12:00, Plato (Odd Numbers Present)

Afternoon Session: July 25, 15:40-16:30, Plato (Even Numbers Present)

- 33.01 Shinji Nakamura (Japan) : Effects of Retinal Eccentricity on Jitter Advantage in Visually Induced Self-motion Perception
- 33.02 Masato Kawano, Kazuhiko Ukai, Katsuaki Sakata, Shigehito Tanahashi (Japan) : Effects of Abrupt Color and Luminance Change on Reappearance in Motion-induced Blindness
- 33.03 Hiromasa Takemura, Ikuya Murakami (Japan) : Effects of Surrounding Motion on Motion Segregation
- 33.04 Toshio Kubodera, Philip Grove, Shuichi Sakamoto, Yo-iti Suzuki, Kenzo Sakurai (Japan, Australia) : Multimodal Integration in Perceiving Direction of Self-motion from Real Somatic Motion and Orthogonally Directed Optic Flow Pattern
- 33.05 Jy-Chyi Yuan (Taiwan) : The Transparency Effect on Plaids Illusion
- 33.06 Hiroshi Ashida, Akiyoshi Kitaoka (Japan) : Asymmetric Temporal Filtering Underlying the 'Rotating Snakes' Illusion
- 33.07 Makoto Ichikawa, Yuko Masakura (Japan) : Reduction of the Flash-lag Effect in Terms of Active Control of Visual Stimulus and Hand Movement Size
- 33.08 Satoshi Shioiri, Tomoki Harada, Ichiro Kuriki, Kazumichi Matsumiya (Japan) : Spatiotemporal Characteristics of Fast and Slow Motion Detectors
- 33.09 Han-Chang Lai, Shao-Kuang Tai, Sarina Hui-Lin Chien (Taiwan) : Visual Short-term Memory for Abstract Patterns: Comparing a Local Recognition Task and a Change-detection Task
- 33.10 Jing-Fong Wang, Shao-Kuang Tai, Han-Chang Lai, Sarina Hui-Lin Chien, Kuan-Pin Su (Taiwan) : Testing Visual Short-term Memory for Abstract Patterns in Hepatitis C Patients, Depressed Patients, Healthy Controls, and College Students
- 33.11 Withdrawn
- 33.12 Toshihiro Takahashi, Kazuho Fukuda, Hirohiko Kaneko (Japan) : The Effect of Luminance Distribution on the Perception of Gravitational Vertical in Pictures
- 33.13 James Ping-Fan Chien, Cheng-Chi Chu , Chou-Po Hung (Taiwan) : Coding of Relative Luminance Change in Macaque Primary Visual Cortex
- 33.14 Yusuke Matsuda, Kazuho Fukuda, Hirohiko Kaneko (Japan) : Stimulus Factors to Decide the Perception of Order and Disorder
- 33.15 David Rose, Paola Bressan (UK, Italy) : Poggendorff Illusion with Subjective Contours
- 33.16 Jong-Tsun Huang, Da-Lun Tang (Taiwan) : Operating Characteristics of Blind-Spot Completion
- 33.17 Naoki Nakamura, Shigehito Tanahashi, Kazuhiko Ukai (Japan) : Dynamic Measurement While Viewing Stereoscopic Images of Parallel Method

- 33.18 Kazuho Fukuda, Hirohiko Kaneko (Japan) : Effect of Vertical-size Disparity on Binocular Corresponding Points
- 33.19 Masayuki Sato, Shoji Sunaga (Japan) : Depth Reversal as a Function of Disparity-modulation Spatial Frequency, Number of Cycles, and Modulation Amplitude
- 33.20 Saori Aida, Koichi Shimono (Japan) : Magnitude of Perceived Depth in Two Stereo-overlapping Surfaces Is Larger than That in Three Stereo-overlapping Surfaces
- 33.21 Wen-Jing Lin, Erik Chihhung Chang (Taiwan) : Influence of Regularity of Geometric Structures and Types of Object Landmarks on Wayfinding Behavior
- 33.22 Nobuyuki Tanaka, Hiroyuki Shinoda, Hideki Yamaguchi (Japan) : Comparison of Simulator Sickness between Active and Passive Observations
- 33.23 Yoshimura Tatsuya, Hiroyuki Shinoda, Hideki Yamaguchi (Japan) : Enhancement and Inhibition of Vection by Peripheral Optic-flow Pattern
- 33.24 Kazuya Matsubara, Kazumichi Matsumiya, Satoshi Shioiri, Shuichi Takahashi, Takanori Ishikawa, Isao Ohashi (Japan) : The Effect of Luminance Contrast and Stimulus Distance on the Subjective Depth
- 33.25 Hiu-Mei Chow, Chia-Huei Tseng (Hong Kong) : Effects of Emotion on Attentional Blink
- 33.26 Shuo-Heng Li, Ming-Chou Ho, Su-Ling Yeh (Taiwan) : Competition of Emotional Words for Attentional Resource
- 33.27 Ya-Ling Shih, Ming-Chou Ho (Taiwan) : Can Attentional Inhibition to Emotional Stimuli Affect Emotion Vulnerability?
- 33.28 Winnie W. L. Chan, William G. Hayward (Hong Kong) : Using Target-distractor Discriminability to Examine Specific Task Strategies in Repetition Blindness
- 33.29 Apollo M. H. Chu, William G. Hayward (Hong Kong) : Repetition Blindness with Objects Having Parts Deleted and Added
- 33.30 Melanie Murphy, Melanie J. Murphy, Sheila G. Crewther, Suzane Vassallo, Linda Malesic (Australia) : Nature vs Nurture – The Relationship between Acute Stress and Vision
- 33.31 Yuki Miyahara, Shigehito Tanahashi, Kazuhiko Ukai (Japan) : Synchronism of Perceptual Reversals Involving Two Horizontally Presented Ambiguous Figures
- 33.32 Jih-Yun Hsiao, Su-Ling Yeh, Yi-Chuan Chen, Charles Spence (Taiwan, UK) : Auditory Semantic Context Modulates the Conscious Perception of Bistable Figures
- 33.33 Wei-Ming Huang, Jingling Li, Kuan-Pin Su (Taiwan) : Test of the Automaticity in Depression: An Example of the Stroop Effect
- 33.34 Lok-Teng Sio, Chien-Chung Chen (Taiwan) : Attention Modulated Binocular Suppression in Non-amblyopic Population
- 33.35 Ming Liang, Zhaoping Li (China) : Dual Code Principle for Integration of Bottom-up and Top-down Attentional Control

33.36 Osamu Watanabe (Japan) : Analytical Method for Investigating the Nonlinearities of Observer's Judgments with Psychophysical Reverse Correlation

33.37 Zong-En Yu, Chien-Chung Chen, Shyh-Kang Jeng, Michael Arbib (Taiwan) :  
A Neural Model for Counting and Subitizing

Keynote Speech 3

July 25, 16:45-17:45, The Forum

K3 Christopher W. Tyler (Smith-Kettlewell Eye Research Institute, USA) : The Human Representation of Visual Space through the Millennia

## July 26

### Talk Session : Color Vision II

July 26, 8:30-10:00, Socrates

Moderators : Hidehiko Komatsu (National Institute for Physiological Sciences, Japan)  
Keiji Uchikawa (Tokyo Institute of Technology, Japan)

- 41.01 Keizo Shinomori, John S Werner (Japan, USA) : Selective Age-related Changes in Temporal S-cone ON- and OFF-pathways.
- 41.02 Misha Vorobyev (New Zealand) : Chromatic and Achromatic Vision in Primates, Birds and Bees
- 41.03 Yoko Mizokami, Nobuki Ito, Hirohisa Yaguchi (Japan) : Colorfulness-adaptation Influenced by Low-level and High-level Factors in Natural Images
- 41.04 Hidehiko Komatsu, Masaharu Yasuda, Taku Banno, Naokazu Goda (Japan) : Neural Selectivity for the Luminance Gradients in the Posterior Inferior Temporal Cortex of the Monkey
- 41.05 Keiji Uchikawa, Yusuke Kitazawa, Donald I.A. MacLeod (Japan, USA) : Effects of Luminance Balance of Surfaces on Estimating the Illuminant Color
- 41.06 Manana Khomeriki (Georgia) : Color Naming and Color Visual Searching in the Georgian-speaking

### Talk Session : Reading and Learning

July 26, 8:30-10:00, Plato

Moderators : Chia-Huei Tseng (The University of Hong Kong, Hong Kong)  
Cong Yu (Beijing Normal University, China)

- 42.01 Sze-Man Lam, Janet H.W. Hsiao (Hong Kong) : Bilinguals Have Different Hemispheric Lateralization in Visual Processing from Monolinguals
- 42.02 Sheila Crewther, Robin Laycock, Paul B Fitzgerald, David P Crewther (Australia) : TMS Stimulation of V5 Interferes with Single Word Reading
- 42.03 Hsuan-Chih Chen, Suiping Wang, Xiuhong Tong (Hong Kong, China) : Effects of Different RSVP Displays on Semantic Integration in Reading Chinese: An ERP Study
- 42.04 Chien-Hui Kao, Chien-Chung Chen (Taiwan) : Inversion Effect in Visual Word Forms: the Role of Spatial Configurations and Character Components
- 42.05 Chia-Huei Tseng, Hin-Tai Lam (Hong Kong) : The Suppression Component of Attentional Selection in Long-term Visual Search Learning
- 42.06 Jun-Yun Zhang, Gong-Liang Zhang, Stanley A. Klein, Dennis M. Levi, Cong Yu, (China, USA) : Reweighting Rule Learning Explains Visual Perceptual Learning and Its Specificity and Generalization

Symposium 5 : Fading, Perceptual Filling-in, and Motion-induced Blindness: Phenomenology,  
Psychophysics, and Neurophysiology

July 26, 10:15-12:15, Socrates

Organizer : Li-Chuan Hsu (China Medical University, Taichung, Taiwan)

Su-Ling Yeh (National Taiwan University, Taiwan)

- S5-1 Lothar Spillmann, Neurocenter (University Hospital, Freiburg, Germany) : Fading and Filling-in and the Perception of Extended Surfaces
- S5-2 Hidehiko Komatsu (National Institute for Physiological Sciences, Okazaki, Japan) : Bridging Gaps at V1: Neural Responses for Filling-in and Completion at the Blind Spot
- S5-3 Li-Chuan Hsu (China Medical University, Taiwan) [Li-Chuan Hsu, Su-Ling Yeh (Taiwan)] : Perceptual Fading as Revealed by Perceptual Filling-in and Motion-Induced Blindness
- S5-4 Peter de Weerd (Universiteit Maastricht, The Netherlands) : fMRI Evidence for a Correlate of Surface Brightness in Early Visual Areas

Talk Session : Eye Movement & Gaze II

July 26, 10:15-12:15, Plato

Moderators : Choongkil Lee (Seoul National University, Korea)

David Crewther (Swinburne University of Technology, Australia)

- 43.01 Reschedule to the poster session "Eye movement & Gaze I"
- 43.02 Choongkil Lee, Jungah Lee (Korea, USA) : Temporal Impulse Response of V1 for Saccadic Decision
- 43.03 Yu-Li Liu, Gary C.-W. Shyi (Taiwan) : Gaze Cueing with Multiple Faces: The Time Course of Facilitation and Inhibition
- 43.04 Doris Braun, Doris I. Braun, Alexander C. Schütz, Karl R. Gegenfurtner (Germany) : Localization of Speed Perturbations of Context Stimuli during Fixation and Smooth Pursuit Eye Movements
- 43.05 Masahiko Terao, Ikuya Murakami, Shin'ya Nishida (Japan) : Contrast-dependent Change of the Effect of Pursuit Eye Movements on the Perceived Direction of Retinally Ambiguous Motion
- 43.06 David Crewther, Laila Hugrass (Australia) : Adaptation Affects Binocular Rivalry Dynamics at the Endpoint of Ventral Processing

Symposium 6 : The Other-race Effect in Face Perception

July 26, 13:30-15:30, Socrates

Organizer : William Hayward (University of Hong Kong, Hong Kong)

- S6-1 William Hayward (University of Hong Kong, Hong Kong) : Perceptual and Social Processes Interact to Cause the Other-race Effect
- S6-2 Jim Tanaka (University of Victoria, Canada) : Reversing the Other-race Effect: The Cognitive, Neural and Social Plasticity of Face Recognition
- S6-3 Siegfried Ludwig Sporer (University of Giessen, Germany) : Becoming a Face Expert: Inversion and the Own-ethnicity Effect
- S6-4 Roberto Caldara (University of Glasgow, UK) : Tracking Early Sensitivity to Race on the Human Visual Cortex

Talk Session : Neural Mechanisms

July 26, 13:30-15:30, Plato

Moderators : Chun-I Yeh (New York University, USA)

Chou-Po Hung (Yang-Ming University, Taiwan)

- 44.01 Dave Saint-Amour, Gina Muckle, Audrey-Anne Ethier, Celyne H. Batien, Eric Dewailly, Pierre Ayotte, Sandra W. Jacobson, Joseph L. Jacobson (Canada, USA) : Developmental Follow-up of the Effects of PCB Exposure on Visual Processing in Inuit Children from Arctic Quebec
- 44.02 Yuki Kamatani, Michiteru Kitazaki (Japan) : Spatio-temporal Resolution of Steady-state Visual Evoked Potentials for a Brain-computer Interface
- 44.03 Chun-I Yeh, Dajun Xing, Robert M. Shapley (USA) : The Structure of Cortical Receptive Fields Varies with Different Stimulus Ensembles
- 44.04 Yueh-Peng Chen, Chia-Pei Lin, Chou-Po Hung (Taiwan) : Functional Circuitry of Key Dimensions in Local Macaque AIT Ensemble Activity
- 44.05 Takayuki Sato, Go Uchida, Mark Lescroart, Manabu Tanifuji (Japan, USA) : Hierarchically Organized 'Functional Structures' in Monkey Inferior Temporal Cortex
- 44.06 Manabu Tanifuji, Go Uchida, Takayuki Sato (Japan) : Cortical Columnar Organization Is Reconsidered in Inferotemporal Cortex
- 44.07 Go Uchida, Takayuki Sato, Jun Kitazono, Masato Okada, Manabu Tanifuji (Japan) : Visual Information Represented in Different Levels of Functional Hierarchy in Monkey IT Cortex Revealed by Machine Learning



## **Abstracts**



Keynote Lecture 1

(Friday, July 23, 9:50-10:50, The Forum)

K1 : Peter Chung-Yu Wu (National Chiao Tung University, Taiwan) :  
The Design of Implantable Retinal Chips for Visual Prostheses

Keynote Lecture 2

(Saturday, July 24, 9:30-10:30, The Forum)

K2 : Izumi Ohzawa (Osaka University, Japan) :  
Recent Advances in the Functional Analysis of High-order Visual Neurons

Keynote Lecture 3

(Sunday, July 25, 16:45-17:45, The Forum)

K3 : Christopher W. Tyler (Smith-Kettlewell Eye Research Institute, USA) :  
The Human Representation of Visual Space through the Millennia

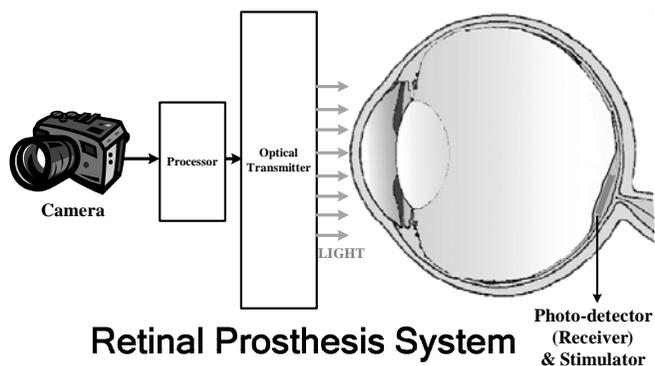
## The Design of Implantable Retinal Chips for Visual Prostheses

Peter Chung-Yu Wu, IEEE Fellow

President/Chair Professor, National Chiao Tung University, Taiwan

Director General, National System-on-Chip Program

In this talk, implantable retinal chips for visual prostheses. Vision loss is a serious medical issue, where retinal diseases play major roles. Both age-related macular degeneration (ARMD) and retinitis pigmentosa (RP) are the most important retinal diseases without effective cure. In the statistics of eye diseases, it is estimated that one out of 4000 peoples is suffering from retinitis pigmentosa (RP) and one tenth of the population with age over 65 years is affected by age-related macular degeneration (AMD). In order to provide a more effective therapeutic plan for recovering the vision loss, a sub-retinal implantation system is proposed. The system includes intraocular and extraocular units. The former contains photo-sensors and electrodes for optical receiver and stimulation, where as latter one is equipped with processor and optical transmitter. Successful ERG signal recorded after the implantation on animals indicated that the method is promising. A divisional power supply technique and a special electrode design enabling three times larger the output stimulating current are proposed to solve the problems of limited power supply and stimulation currents. Future research work to ensure the efficacy and biocompatibility for clinical trial will be presented.



## **Recent Advances in the Functional Analysis of High-order Visual Neurons**

Izumi Ohzawa

Osaka University, Japan

A standard definition of the receptive field of a visual neuron is the area of visual space in which stimuli can influence responses of the neuron. Applying this definition to neurons in high-order areas along the visual pathway is uninteresting, because receptive fields just become increasingly larger in high-order visual areas, providing minimally useful information about the properties of the neuron.

Methodologically, reverse correlation techniques have been instrumental in elucidating detailed characteristics of neurons in the early visual areas. However, it has generally been thought that the methods are not suitable for studying neurons in high-order visual areas because of their massive nonlinearities. I will outline recent advances in the functional analysis methods that are well suited for simultaneous recordings from a large number of neurons spanning even multiple visual areas. I will also describe our recent efforts in extending the notion of receptive fields to more useful space that is not necessarily limited to spatial dimensions. Examples of actual experimental measurements of such extended receptive fields are presented.

## The Human Representation of Visual Space through the Millennia

Christopher W. Tyler

Smith-Kettlewell Eye Research Institute, USA

The history of space representation through perspective has been one of great conceptual effort, with full mastery taking six centuries to evolve. Even in classical times, there was a substantial debate about how to express space, including perspective construction, from Agatharchus in the 5th century BC to early Roman painting. These early painters exhibited a mastery of shading, shadows, highlights and aerial perspective. They also generated good approximations of both one-point and two-point perspective constructions.

The earliest accurate perspective, however, is found in the 'zero-point' construction initiated by artists such as the Lorenzetti brothers in the 1300s. This metric construction allowed accurate convergence of single planes such as floor tiling without committing to the concept of a vanishing point at infinity. Depth representation through accurate convergence to a single vanishing point for the whole scene dominated the 1400s, being first used by Masolino da Panicale (1424). It was taken to great heights of sophistication by his pupil Masaccio and later artists such as Uccello, Mantegna, Leonardo and Raphael. Nonetheless, they all showed weaknesses of construction, implying that they lacked a full commitment to the intricacies of the one-point perspective scheme.

A further issue in the representation of visual space is Leonardo's distinction between the 'natural perspective' of the person in the world and the 'artificial perspective' of viewing a flat painting. Artificial (or geometric) perspective is well defined, particularly for a world consisting of straight lines projecting to flat picture planes. Natural perspective, on the other hand, is an ill-defined concatenation of the net visual experiences of a mobile two-eyed observer in a 3D world that has often been interpreted as implying a curvilinear concept of perspective. This is a deeper issue that cannot be addressed by images on a flat plane. In this concatenated view, parallel straight lines have two vanishing points viewable by moving the eyes, whereas on a flat plane they have only one. Paintings of curved perspective attempting to capture these properties date back to Fouquet and Mantegna in the 1400s, but they should be viewed as attempts to capture the true experience of natural perspective rather than as an improved geometry of perspective projection as such. Many varieties of perspective construction have been introduced since that time in the attempt to overcome the limitations of artificial perspective, but none can be regarded as entirely successful. Thus, capturing the structure of visual space through the geometry of perspective has remained a challenging problem throughout the history of painting and of visual representation in general.

## Keynote Lecture

(Friday, July 23, 9:50-10:50, The Forum)

K1 : Peter Chung-Yu Wu (National Chiao Tung University, Taiwan) :  
The Design of Implantable Retinal Chips for Visual Prostheses

## Symposia : Bionic Vision: A Vision for the Blind

(Friday, July 23, 13:30-15:30, The Forum)

S1-1

### **The Development of the Boston Retinal Prosthesis: What is the Potential for Devices of This Type to Restore Vision to the Blind?**

Joseph Rizzo

Massachusetts Eye and Ear Infirmary, USA

In the late 1980s, the Boston Retinal Implant Project was formed as one of the first two projects of this type. Our group has developed a wireless, hermetic, implantable device with “back telemetry” that is designed for implantation into the sub-retinal space. Our development strategy has been to fully develop all of the technologies that would be needed to produce a device with hundreds of electrodes, each of which can be individually controlled, prior to performing human implants. This approach has been taken to improve the likelihood that our device would yield higher quality vision. The results from other groups that have implanted retinal prosthetics have revealed very promising results from early human trials. The question of what ultimate level of vision might be attainable with devices of this type will be discussed.

S1-2

### **Supra-Choroidal Electrical Stimulation of the Retina**

Gregg Suaning

University of New South Wales, Australia

The key to an efficacious neural prosthesis is its electrode-tissue interface, and the ease at which this interface can be established. This is particularly true when applying neuroprosthesis as a treatment to some forms of profound blindness. Assessment of the efficacy and surgical difficulty in reaching various sites of intervention within the visual system: the visual cortex; the lateral geniculate nucleus; the optic nerve, and three sites on the retina: the epi-retinal surface; the sub-retinal space; and the supra-choroidal space have led us to believe that for so-called “first-generation” devices comprising electrical stimulation delivered via several tens- to hundreds-order electrodes, the supra-choroidal space may provide the most readily accessible, consistent, and efficacious electrode-tissue interface. This paper will show recent results that illustrate the benefits and identify the limitations of the supra-choroidal approach in terms of surgical intervention, electrode separation, and discrete phosphene thresholds. Further, a device for chronic implantation into the supra-choroidal space will be presented.

## **A Flexible Sensing CMOS Technology for Sensor-Integrated, Intelligent Retinal Prosthesis**

L.-S. Fan<sup>1,2</sup>, C. C. Hsieh<sup>3</sup>, C.C. Chiao<sup>4</sup>, Y. Dan<sup>5</sup>, K.T. Tang<sup>3</sup>, M. Feller<sup>5</sup>, M. C. Wu<sup>2</sup>

<sup>1</sup>Inst. Of NEMS, <sup>3</sup>Inst. Of Electronics, <sup>4</sup>Life Science, Natl. Tsing-Hua University, <sup>2</sup>Electronic Research Lab., <sup>5</sup>Helen Wills Neuroscience Inst., UC, Berkeley

Previous technologies available for artificial retinal prosthesis implant devices include micro electrodes array on flexible polymers or the integration of photodiodes and micro electrode arrays driven directly by the outputs from the photodiodes. It is now feasible to monolithically integrate mm-sized flexible microsystems with 180 nm CMOS transistors, image sensors and the cell-size-pitched micro electrode array with the total microsystem thickness comparable to that of the thinnest soft contact lens for potential sub-retinal or epi-retinal prosthesis applications. The flexible format allows better proximity between stimulating electrodes and retina neurons for local stimulation, the integrated photo sensors sense local light intensity, and the integrated pixel electronics allows calculating and supplying individual electrode the adequate and appropriate stimulation waveforms right at each individual electrode. Since each element can include its photo sensor, transistor electronics and microelectrode, the multiple-module sensors/electronics/electrodes interconnections problem in implementing large arrays is greatly simplified. We implemented 1,024-element arrays and are implementing 4,096-element arrays using this technology. We use in vitro loose patch and whole-cell patch clamp techniques to characterize the retina ganglion cell responses on these arrays.

Talk Session : Face & Objects  
(Friday, July 23, 13:30-15:30, Socrates)

11.01

**Individual-level Discrimination – An Innate Capacity? 4-month-old  
Infants Individuate Upright But Not Inverted Horses**

Kate Crookes<sup>1,2</sup>, Elinor McKone<sup>2</sup>

<sup>1</sup>University of Hong Kong, Hong Kong

<sup>2</sup>Australian National University, Australia

Are there innate representations of structural form that support individual-level discrimination of some object classes? Previous studies demonstrate this for primate faces: babies and monkeys with no or little visual experience of the class discriminate primate faces upright but not inverted. Here, we show this finding extends beyond primate faces. Four-month-old babies without prior experience of horses individuate side views of whole horse bodies upright but not inverted. This is despite adults showing the classic pattern of good discrimination only for upright faces, with a large inversion effect for faces and none for horses. We discuss these findings in terms of a possible broad representation of animal body shape that undergoes perceptual narrowing across infancy to eventually support discrimination only of faces of conspecifics.

**Acknowledgement** : Supported by Australian Research Council DP0770923 and DP0984558

11.02

**Infants' Preference of Moving Face-like Figure to Top-heavy Figure**

Aki Tsuruhara<sup>1</sup>, Hiroko Ichikawa<sup>1</sup>, So Kanazawa<sup>2</sup>, Masami K. Yamaguchi<sup>1,3</sup>

<sup>1</sup>Chuo University, Japan

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Infants, even at birth, show looking preference of face-like figures to non-face-like figures. However, newborns younger than 1-month-old look longer at top-heavy configurations (i.e., more elements in the upper part than in the lower part) than bottom-heavy configurations (i.e., more elements in the lower part than in the upper part), even if both of the configurations did not look like faces for adults (Simion et al., 2002). This suggests that young infants did not discriminate 'faces' from top-heavy figures. In this study, we examined infants' preference of face-like figure to top-heavy figure. A face-like moving with which 'eyes' and 'mouth' seems open and close was added to the figures, and the infants' looking preferences with this moving condition was compared those with the static condition. Our results showed that if a face-like moving was added, 2- and 3-month-old infants looked longer at the face-like-figure than the non-face-like top-heavy figure. By contrast, in the static condition, the infants did not show a preference to the face-like figure. Facial movements were shown to enhance face recognition in infants (Otsuka et al. 2009). Our results suggest that facial movements also enhance discrimination of 'faces' from non-face-like figures.

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11.03

## **The “Top-heavy” Bias is Gone: An Eye-tracking Study in Infants and Adults Revealed Common Preferences Specifically to Real Faces**

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Newborns show preferences for “top-heavy” configuration and which has been proposed to explain neonatal face preference (Simion et al, 2002). However, the later development of such a preference has not been fully studied. Thus, using an eye-tracker apparatus (Tobii T60), we intended to investigate the face preference mechanism for 2-5 month-old infants and for adults as a comparison group. Each infant and adult viewed three classes of stimuli: “top-heavy” and “bottom-heavy” geometric patterns, face-like figures, and photographed faces. Using area of interest (AOI) analyses on fixation duration and count, we computed a top-heavy bias index (between -1 ~ +1) for each pair of stimuli and for each participant. Our results showed that the top-heavy bias indices for geometric and face-like patterns were close to zero in both infants and adults, indicating a disappearance of the top-heavy bias. Moreover, we found significant looking preferences for photographed natural faces over inverted or unnatural ones in both infants and adults, indicating a specific sensitivity to up-right real faces, and not top-heavy configuration. Lastly, the patterns of looking preferences across stimulus types were strikingly similar in infants and adults. Taken together, these findings suggest a very early cognitive specialization process toward face representation.

**Acknowledgement** : NSC 98-2410-H-039-002 and NSC 97-2410-H-039-006

11.04

## **Perceptual and Cognitive Processes in a Widely Prevalent Face Recognition Deficit: the Case of Developmental Prosopagnosia**

Garga Chatterjee, Ken Nakayama

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Developmental prosopagnosia (DP) is an important test case regarding modularity and structure of the visual system. In this widely prevalent face recognition deficit, subjects are severely impaired in the face memory test confirming their face recognition deficits. They were also impaired on two novel tests of non-face visual memory, the abstract art and the within category object memory test. However, they did not show deficits in verbal memory. Hence most cases did show general visual memory deficits. The implications of this result is discussed. Certain models of face processing (Bruce and Young, 1986) postulate that certain types of non-identity based facial information (like age, gender, attractiveness) can be processed independently of face identity recognition. Taking advantage of the severe deficit in face-identity in prosopagnosia, we show that normal performances in age and gender processing can exist concomitantly with identity recognition deficits. The kinds of facial information that are compromised along with face-based identity recognition speak to the organization of these information processing streams by understanding what deficits go together and what do not. Phenotype differences also exist in developmental prosopagnosia in the nature of the associations and dissociations – information from individual differences in this regard is presented.

**Acknowledgement** : NIH-NEI

11.05 Withdrawn

11.06

## **Binocular Rivalry: Facial Dominance and Monocular Channels**

Derek Arnold

The University of Queensland, Australia

When different images are presented to the two eyes, each can intermittently disappear, leaving the other to dominate perception. This is called binocular rivalry (BR). The causes of BR are debated. One view is that BR is driven by a low-level visual process, characterized by competition between monocular channels. Another is that BR is driven by higher-level processes involved in interpreting ambiguous input. We assessed these proposals via two manipulations involving facial images. We found that when a dominance change is triggered in one section of a facial image, dominance changes propagate through the rest of the image via monocular channels. We also assessed the timing of BR changes in proximate pairs of rival images. We found that the timing of BR changes, for pairs of both simple (orthogonal gratings) and complex (houses / faces) stimuli were related, but only when similar images were encoded in the same monocular channels. These observations show that monocular channel interactions are integral to determining the dominance of facial images. This is consistent with BR being driven by an inherently visual process, intended to suppress monocular obstructions from awareness, and thereby enhance the visibility of fixated objects.

**Acknowledgement** : Supported by ARC Discovery Grant and Research Fellowship

11.07

## **Modulation of Familiarity on Dynamic Advantage Effect in Matching Faces**

Yu-Chin Wu, Gary C.-W. Shyi

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This study examines how familiarity modulates the advantage of dynamic information on face recognition. A sequential face matching task was used to measure the ability of face recognition, allowing for an unbiased comparison between famous and unfamiliar faces. Moreover, a new display method was developed to present moving and multi-frame static face stimuli, controlling for extraneous confounding factors. In Experiment 1, where intact face stimuli were used, the results revealed the dynamic advantage effect when participants judged whether two sequentially presented images of famous faces were the same person, but not when matching images of unfamiliar faces. Face stimuli with different degrees of blurredness were created by adjusting blur radius for subsequent experiments. In Experiment 2, where less blurred faces were used, no dynamic advantage was found with either famous or unfamiliar faces. In Experiment 3, where face stimuli were more degraded, however, a reversed pattern emerged in that the dynamic advantage effect was found only with unfamiliar faces. Taken together, our findings indicate that the dynamic advantage effect only exists in intact famous faces and highly degraded unfamiliar faces, suggesting that the mechanisms underlying dynamic advantage effect may be qualitatively different between famous and unfamiliar faces.

## **Dominance Shift with Hybrid Images is Dependent on Relative Spatial Frequency**

Takao Sato, Kenchi Hosokawa

University of Tokyo, Japan

In prototypical hybrid images such as that of Einstein vs. Monroe pictures, low-spatial frequency face becomes perceptually dominant with smaller image-sizes or longer viewing-distances (Schyns & Oliva, 1999). This apparently indicates an importance of absolute (retinal) spatial frequency in facial recognition. However, this hypothesis is not very definite, since the cut-off frequency also shifts as or and distance are manipulated. To examine the roles of absolute and relative (as defined against face-width) spatial frequencies, we measured the dominance shift with hybrid facial images generated by combining a low-pass and a high-pass face with a common absolute cut-off frequency. In experiments, such hybrid images with 13 different cut-off frequencies were presented with either a fixed size, or a fixed viewing-distance while varying the other parameter, i.e. distance or size. It was found that the cut-off frequencies where the dominance shifts occur are almost identical if they are expressed in relative spatial frequency regardless of the viewing-distance or image-size. These results indicate the importance of relative spatial frequency in face recognition. The dominance shift with regular hybrid images occurs because the cut-off frequency shifts higher and high SF components becomes invisible with smaller sizes or longer distances.

**Acknowledgement** : Supported by Ministry of Education, Science, Sports and Culture, Grant-in-Aid 21330167

## Poster Presentations

Morning Session: Friday, July 23, 11:00-12:00, Plato (Odd Numbers Present)

Afternoon Session: Friday, July 23, 15:40-16:30, Plato (Even Numbers Present)

12.01

### **How Is the Induced Color Determined in the Watercolor Configuration?**

Mikako Kuroki, Eiji Kimura

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When a dark contour is flanked on the inside by a lighter chromatic contour, the lighter color will spread over the entire enclosed area. This spreading of the inner color is known as the watercolor effect. However, it has been also demonstrated that a color different from the inner color could spread with the same stimulus configuration; e.g., when the outer color is magenta and the inner color is red, yellowish color could spread under certain conditions. In this study, we aimed to clarify how the color induced in the watercolor configuration is determined. We examined the effects of relative luminance between the inner and outer contours in Experiment 1 and the influences of the outer color on the induced color in Experiment 2. Results showed that, when the luminance of the outer contour was higher, the induced color became different from the inner color and was affected by complementary color of the outer color. These results can be accounted for by assuming that the induced color in the watercolor configuration is determined by a mixture of the inner color and complementary color of the outer color and the strength of each color depends on relative luminance of two contours.

12.02

### **The Effect of Binocular Disparity and Phase Transformation of Dotted Lines on Water Color Illusion**

Han Nim Cha, Jung Woo Hyun

Chungbuk National University, Korea

Two experiments were conducted to investigate the impact of collinearity of inside-dotted-line and outside-dotted-line and binocular disparity on Water Color Illusion(WCI). The stimuli was the modification of figure used by Pinna, Brelstaff and Spillmann(2001); the figure was four- diamond shape and was constructed of dotted line, the outside-dotted-line color was purple and the inside-dotted-line was yellow. In the experiment 1, the effect of collinearity was tested in the outside-dotted-line and inside-dotted-line. In the experiment 2, the impact of dotted lines that were put in different depth were tested. The result showed that illusion was persisted when collinearity of outside-dotted-line and inside-dotted line was changed. Despite change of collinearity, results was convinced WCI and color assimilation like Neon Color Spreading appeared through by different mechanism. And illusion was persisted when components of stimuli were placed on the different plane. This result was supported the study of Pinna, Brelstaff and Spillmann(2001). With this, could confirmed that the WCI was affected by high-levels information processing stages were after combination of binocular information.

12.03

## **The Effect of Color and Interval and Binocular Disparity Information on Water Color Illusion**

Shin Na Ri\*, Jung Woo Hyun

Chungbuk National University, Korea

Three experiments were performed to investigate the impact of colors, interval of zigzag lines and binocular disparity on Water Color Illusion(WCI). The stimuli was transformation of figure used by Pinna and Tanca(2008); figure was constructed of the bars. That was formed double-zigzag lines shape. Black bars were located outside in the large zigzag line and red bar was located inside in the small zigzag line then that color was reversed. In experiment 1, the impact of changed colors at the outside of small zigzag line was tested. Color was changed four conditions; red, green, yellow, gray. In experiment 2, the effect of interval between large zigzag line and small zigzag line was tested. In experiment 3, the effect of binocular disparity was tested. In this case inside bar of large zigzag line was red and outside bar of small zigzag line was green. The results showed that illusion was reduced when induced bar was different color. The illusion was cleared when the interval of lines was narrow. The illusion was weakened when condition of binocular disparity regardless of depth of stimuli. That was suggested that color was filled from the outside to the inside by the Feature Contour System.

12.04

## **Detectability of Color Modulation on Isoluminant Apparent Motion Stimuli**

Hiroto Kimura, Takehiro Nagai, Shigeki Nakauchi

Toyohashi University of Technology, Japan

A previous study has reported that detectability of luminance modulation on multiple targets was considerably decreased when they were perceived as a single moving object. In this study we measured discrimination sensitivity to color modulation on apparent motion stimuli to investigate the influence of apparent motion on color perception. The observer was instructed to discriminate alternating two colors of different discs presented sequentially at concyclic eight locations on a black background. Strength of apparent motion perception varied with SOA (Stimulus Onset Asynchrony) between disc presentations. In the results, the color discrimination sensitivity was lower in the SOA corresponding to the strongest motion perception than in the other SOAs. These results may be consequence of integration of disc colors along apparent motion trajectory. In addition, to investigate the effect of motion perception on color modulation detectability more clearly we conducted similar experiments using a colored background isoluminant with the discs, where motion perception was weaker than on the black background. We compare the results between black and isoluminant backgrounds, and discuss the relationship between motion perception and color modulation detectability.

12.05

## **Common-fate Grouping Affects Brightness Perception on the Articulated Surround.**

Masataka Sawayama<sup>1</sup>, Eiji Kimura<sup>2</sup>

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<sup>2</sup>Department of Psychology, Faculty of Letters, Chiba University, Japan

Brightness of a target depends upon the luminance of a surrounding field. Moreover, the effect of the surrounding luminance can be enhanced by articulating the surround (i.e., adding small patches of different luminances to the uniform field), even if the spatially-averaged luminance is kept constant. This study further investigated this articulation effect by asking whether spatial interaction found between the target and surrounding field is governed only by retinal proximity or also affected by spatial organization such as common-fate grouping. The target in the experiment was a moving patch located at the center of an articulated surround. Either small patches or uniform background in the surround was moved in the same speed, direction, and timing with the target. The target was easily grouped with the patches in the former case, whereas with the background in the latter case, although retinal proximity was kept nearly constant. Results showed clear influences of common-fate grouping on the articulation effect; the effect was strong when the target was grouped with the patches, but reduced when grouped with the background. These findings suggest that brightness on the articulated field could be computed even after retinal elements were spatially organized according to some grouping principles.

12.06

## **The Effect of Background Color on Color Matching to Skin Color under Sinusoidal Luminance Modulation**

Kazuya Inamoto and Keizo Shinomori

Kochi University of Technology, Japan

In this paper, we investigated the influence of background color on color appearance when a central stimulus was skin color under sinusoidal luminance modulation. The color appearance was measured by color matching method. The skin color and the amount of luminance were obtained as the average of human face images presented on a CRT monitor. We used four kinds of central stimuli. They were the skin color square under sinusoidal luminance modulation and the same skin color under constant luminance for control (the highest-, lowest- and averaged-luminance of the sinusoidal luminance modulation stimulus). One of the central stimuli was surrounded by one background color (gray, red, yellow, green, blue, or purple). In one session, all combinations of the central stimuli and background colors were presented and matched to a color patch with gray background. Four color-normal subjects participated in. The results indicated following three points. First, when the background color is gray, subjects can match the luminance to the averaged-luminance. Second, when the background color is red, yellow, green, blue or purple, the influence of the background colors on the matching under sinusoidal luminance modulation is less than that on the matching under the constant luminance. Third, when the background is not gray, the skin colors under sinusoidal luminance modulation are perceived in higher luminance than the averaged-luminance.

**Acknowledgement** : KAKEN B20300081

12.07

## **Impact of Red Color on Mood and Task Performance on Chinese in Hong Kong**

Sze-Wing Lee, Chia-Huei Tseng

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Red color means differently in diverse cultural contexts, and our mood is moderated by the object or physical space that attaches to color. This study studies the impact of red color on Chinese people in Hong Kong in an object-based context.

32 Chinese participants listed first ten objects that came to their mind with color red, and their associated moods. Culture-specific items (e.g. red packets) never mentioned in previously studies were noted. We selected the most frequently mentioned positive and negative objects to conduct a word categorization task. In each trial, an object-word pair, either congruent or incongruent in mood, was printed in either red or black shown for 2sec. Participants judged whether the word contained positive or negative mood. We predicted observers would benefit from the task-irrelevant but red-associated object if it was presented in red and with congruent associated mood. No significant difference in response time was found in either printed color or mood condition. However, error rate analysis showed an advantage in mood congruent condition. Our results suggested that mood effect associated with color requires more sensitive measurement (e.g. error rate), and response time may not be a good choice for future similar studies.

12.08

## **The Effect of the Chromaticity of Image Elements on Symmetry Detection**

Chia-Ching Wu, Chien-Chung Chen

Department of Psychology, National Taiwan University, Taiwan

We investigated the effect of chromatic content of image elements on symmetry detection threshold with a noise masking paradigm. In a temporal 2AFC trial, the random dot noise mask was presented in both intervals. The target was randomly presented in one interval while a random dot control was presented in the other. The task of an observer was to determine which interval contained the vertical symmetric target. The image elements varied both in chromaticity and luminance. In Experiment 1, the target density threshold was measured at various target-mask chromaticity and luminance combinations. In Experiment 2, the chromaticity varied among image elements in both the target and the mask. The number of color types (red, green, blue and yellow) ranged from 1 to 4 in a pattern. The symmetry detection threshold was highest when the target and the mask were of the same hue and luminance. The threshold decreased as the difference in chromaticity and luminance between the target and the mask increased. This suggests that the symmetry detector is color turned. The symmetry detection threshold decreased with the number of colors. This suggests a probability summation among independent symmetry detectors in each color channel.

**Acknowledgement** : NSC96-2413-H-002-006-MY3

12.09

## **Retinal Network Responses upon Subretinal Electrical Stimulation**

Ya-Ting Yang<sup>1</sup>, C. Wan<sup>2</sup>, W.-C. Yang<sup>2</sup>, L.-J. Lin<sup>2</sup>, P.-K. Lin<sup>3</sup>, C.-Y. Wu<sup>2</sup>, C.-C. Chiao<sup>1</sup>

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The development of the efficient subretinal implants requires deeper understandings of how the retinal network responds to the electrical stimulation. In the present study, we characterized the responses of retinal ganglion cells (RGCs) upon subretinal electrical stimulation with a silicon-based microphotodiode array in the normal adult New Zealand White rabbits. Various pharmacological reagents were also used in conjunction with the electrical stimulation to dissect the upstream components of these RGC responses. In contrast to previous studies, we found that the RGC responses were initially increased as the stimulation strength increased, but then decreased when the stimulation exceeded an optimal range. During the repeated electrical stimulation, the RGC responses were significantly suppressed when the temporal frequency was above 10-20 Hz. Importantly, we noticed that the ON- and OFF-alpha RGCs showed different response thresholds and latencies, and sometimes recurring bursts of spikes after the initial responses, a suggestion of synaptic inhibition and excitation oscillation. All RGC responses upon electrical stimulation were abolished by CNQX, and picrotoxin can significantly decrease the spike latency and increase the firing rate. Furthermore, the responses of ON-alpha RGCs were inhibited by APB, an indication of direct photoreceptor activation. These results provide insights into the artificial retina design.

**Acknowledgement** : NSC 98-2627-B-009-002

12.10

## **Dopaminergic Retinal Neurons in Various Kinds of Animals Revealed by Glyoxylic Fluorescent Technique**

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<sup>3</sup>Dept. Biology, Tokyo Metropolitan University, Japan

The glyoxylic acid fluorescence method was developed by Lindvall and Björklund (1974) to find monoamine neuron systems in the brain. We have applied this method on the retinas of various kinds of animals to investigate the morphology of dopaminergic cells. We could distinguish the dopaminergic cells from other monoaminergic cell, such as serotonin and glutamate cells by fluorescent color. We have also performed immunohistochemical studied using anti-tyrosine hydroxylase antibody and Alexa Fluor 546 to confirm the results of the glyoxylic acid fluorescence method. The results obtained by both methods are almost identical in every animal, fish, frog, chicken and mouse. The cell bodies of dopaminergic cell were seen in the inner nuclear layer and they extended many dendrites both in the outer- and inner plexiform layers. They have very wide dendritic field approximately 0.4mm in diameter. Distances between the neighboring cells are around 160µm. Therefore, density of the dopaminergic cells is roughly estimated as 40 cells/mm<sup>2</sup>. This value is very few as compared to other retinal neurons, for instance photoreceptors are about 10000 and the horizontal cells are 4000 cells/mm<sup>2</sup> each. Intriguingly, these cell counts are almost identical among the animals which have been used in these experiments.

**Acknowledgement** : Tokyo Women's Medical University (TWMU)

12.11

## **Two Choline Transport Pathways in Cholinergic Amacrine Cells in the Mouse Retina**

Makoto Kaneda<sup>1</sup>, Yasuhide Shigematsu<sup>2</sup>, Yukio Shimoda<sup>2</sup>

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Ion channels of P2X2-purinoceptors have a permeability to large cations. In the present study, we examined whether choline can permeate the ion channels of P2X2-purinoceptors in the cholinergic amacrine cells of the mouse retina by the patch clamp technique. An application of ATP activated choline current in the OFF-cholinergic amacrine cells. Concentration response curve of ATP-induced choline current was fitted with a Hill coefficient of 1.93 and EC50 of 46 microM. Reversal potential of ATP-induced choline current shifted 25 mV per 10 times change of extracellular choline concentration. Choline current was activated by an application of ATP-gamma-S but not by alpha,beta-methylene ATP or benzoyl, benzoyl ATP. In the presence of pyridoxalphosphate-6-azophenyl-2',4'-sulfonic acid, ATP did not induce any choline current. These characteristics of ATP-induced choline current well corresponded to the characteristics of the current mediated by P2X2-purinoceptors. The immunoreactivity for choline transporter (high affinity) was stronger in the ON-cholinergic amacrine cells than in the OFF-cholinergic amacrine cells. Our data raise a possibility that choline transport mechanism in cholinergic amacrine cells is different between ON-and OFF-pathway. Ion channels coupled with P2X2-purinoceptors work as an additional pathway of choline transport especially in the OFF-cholinergic amacrine cells of the mouse retina.

12.12

## **Responses of the Ganglion Cells upon Light and Electrical Stimulations in the Rat Retina**

W.-H. Huang<sup>1</sup>, C. Wan<sup>2</sup>, W.-C. Yang<sup>2</sup>, L.-J. Lin<sup>2</sup>, P.-K. Lin<sup>3</sup>, C.-Y. Wu<sup>2</sup>, C.-C. Chiao<sup>1</sup>

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To achieve an efficient retinal prosthesis, it is important for the retinal ganglion cells (RGCs) to generate meaningful spike patterns upon electrical stimulation that are comparable to the normal light stimulation. While many studies have investigated the responses of RGCs upon electrical stimulation, fewer studies have compared the spiking activities upon light and electrical stimulations in the same cells. In the present study, we used normal Sprague-Dawley rats to characterize RGC responses upon both light and electrical stimulations with a silicon-based microphotodiode array. The rat retina was placed onto the chip with its photoreceptor side down, and the stimulating current was elicited by activating the solar cell with a 532 nm laser light source. The charge density dependent response and the frequency dependent pair-pulse suppression were examined. We found that the light intensity dependent responses of ON, OFF, and ON-OFF types of RGCs were similar to their charge density dependent responses. However, the frequency dependent pair-pulse suppression was more severe upon electrical stimulation than upon light stimulation. This suggests that RGCs may not achieve the same temporal precision in subretinal electrical stimulation as in its normal light stimulation. This study thus points out some limitations in developing subretinal prosthesis. **Acknowledgement** : NSC 96-2627-B-009-007

12.13

## **Expression of Connexin 36 during Postnatal Development of the Rabbit Retina**

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Connexin 36 (Cx36) gap junction channels play an important role in the rod pathway by directly connecting AII amacrine cells to ON cone bipolar cells and other AII amacrine cells in the mammalian retina. The expression of Cx36 in cone photoreceptors and some ganglion cells also plays significant roles in retinal circuitry. Given the importance of Cx36 in the adult retinas, it is of great interest to characterize the temporal and spatial patterns of Cx36 expression in the developing retina, and to examine its functional significance regarding various developmental events.

The retinas from New Zealand White rabbits of different developmental stages were used for immunohistochemistry and Western blots. The antibody against Cx35/36 was used to examine the postnatal expression patterns of Cx36. We found that the Cx36 puncta were faintly labeled both in the IPL and the OPL after birth. The increase of Cx36 expression remained slowly during the early postnatal stage, and then became faster around P10, reaching the adult level after P22. A similar trend was observed from the quantification of Cx36 protein levels in Western blots. These results suggest that the formation of Cx36 gap junction is correlated with synaptogenesis around the second postnatal week.

**Acknowledgement** : NSC 98-2311-B-007-004-MY3

12.14

## **Arl6ip1 Functions in Differentiation, Mitosis, and ER-stress Mediated Apoptosis during Retinogenesis of Zebrafish Embryos**

Hsing-Yen Huang

Molecular and Cellular Biology, Taiwan

We found that arl6ip1 was a maternal expression gene which distributes around the whole embryo before 24-hpf, but after 48-hpf, arl6ip1 was exclusively expressed in brain, retina, heart and kidney. When Arl6ip1 translation was blocked by injecting arl6ip1-morphino, many organs and tissues developed abnormally, and defective embryos could not survive beyond 5-dpf. Next, we focused on the retinal development to discuss the functional role(s) of Arl6ip1 that because small eyes were easily observed in all phenotypic defects. We observed the failure of cell differentiation, the reduction in cell number, bigger cells, and the imperfect progression of cell cycle in the defective retina. Moreover, mosaic analysis demonstrated Arl6ip1 is required for retinal differentiation in a non-cell autonomous manner by cell transplantation. In addition, we observed the swelling of ER, the swelling of Golgi apparatus, pale and engorged mitochondria, and bigger nucleus in the defective retina. ER-stress responded marker, chop, was highly expressed in the defective retina that indicating cells undergoing ER stress, which led, in turn, the cell death were observed at later development stage. These evidences suggested that Arl6ip1 secures cell-cycle progress and maintains the structural integrity of ER and mitochondria in the retinae.

**Acknowledgement** : NSC:98-2313-B002-020-MY3

12.15

## **The Development and the Characteristics of Oculomotor Inhibition In the Preschool Children**

Kuan-Hui Li, Yi-Chin Lin, Yu-Hui Lo, Daisy L Hung, Chi-Hung Juan

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The development of executive function is very rapid in preschool children. One of vital ability in executive function is to prevent execution of a behavior in circumstances where to do so may be inappropriate. Only several studies have investigated the performance of oculomotor inhibition in preschool children (e.g. 4 to 6 yrs). However, the characteristics of the developmental curves in the preschoolers are still unclear. In this study, we used a well-established Pro-/Anti-saccade paradigm (Juan et al., 2004; 2008; Liu et al., 2009) to gauge the function of the oculomotor inhibition and the developmental curves in the preschoolers. The results indicated the performance of inhibitory had gradually but significantly improved across the stages of the preschool ages. The children mainly had difficulties when they were required to antisaccade into a position where there was no object. When an extra object was placed in that position, their performance of antisaccades improved. This pattern of results indicates that the competition between target and distractor may benefit the antisaccade latencies and accuracy. This also suggests preschoolers may develop more slowly in the spatial-based attention than in the object-based attention.

**Acknowledgement :** 97-2511-S-008-005-MY3, 96-2413-H-008-001-MY3, 98-2410-H-008-010-MY3

12.16

## **Predictability of Saccadic Behaviors is Modified by Transcranial Magnetic Stimulation over Human Posterior Parietal Cortex**

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Predictability in the visual environment provides a powerful cue for efficient processing of scenes and objects. Recently, studies have suggested that the directionality and magnitude of saccade curvature can be informative as to how the visual system processes predictive information. The present study aimed to investigate the role of the right posterior parietal cortex (rPPC) in shaping saccade curvatures in the context of predictive and non-predictive cues. We employed an orienting paradigm with the target predictability and delivered transcranial magnetic stimulation (TMS) over rPPC. Participants were presented with either an informative or un-informative cue to upcoming target locations. Our results showed that rPPC TMS generally increased saccade latency and error rates. Intriguingly, rPPC TMS increased curvature away from the distractor only when the target location was unpredictable and decreased saccadic errors attracted by the distractor but no effects in predictable target location. These results dissociate the strong contingency between saccade latency, curvature and also indicate that rPPC plays an important role in allocating and suppressing attention to distractors when the target demands visual disambiguation. Furthermore, the study suggests that rPPC is critically involved in determining saccade curvature and the generation of saccadic behaviors under conditions of differing target predictability.

**Acknowledgement :** 96-2413-H-008-001-MY3, 97-2511-S-008-005-MY3, 98-2

12.17

## **Frontal Eye Fields and the Location Probability Effects: A Repetitive Transcranial Magnetic Stimulation Study**

Chia-Lun Liu, Philip Tseng, Daisy Hung, Ovid Tzeng, Neil Muggleton, Chi-Hung Juan

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Utilization of the regularity that imbedded in the environment allows the organism to preserve more cognitive resources for monitor other peril. Our recent study demonstrates that the location probability of a saccade modulates the magnitude of antisaccade cost (Liu et al., 2009). This highlights that the probabilistic information can override the attentional effect like the antisaccade cost. The neural substrates of the probability effect were first associated with the neural activities in the superior colliculus (SC). It is plausible that the modulation can be descended from higher oculomotor regions like frontal eye field (FEF) and supplementary eye field (SEF), given their immense reciprocal connections. We investigate this issue with an antisaccade task combined with the manipulation of the location probability. rTMS was applied over FEF and SEF, respectively, to probe the functional roles of these area in the involvement of location probability. The results revealed that FEF TMS prolonged the overall saccade reaction times, moreover, the interference is more pronounced in high probability locations. In contrast, none of the effects was observed found in the SEF TMS condition. This pattern of results confirms the critical role of FEF in initiating a saccade and in modulation of the location probability effects.

**Acknowledgement** : 96-2413-H-008-001-MY3, 97-2511-S-008-005-MY3

12.18

## **The Roles of Frontal Eye Field and Supplementary Eye Field in Trial Type Probability – A Transcranial Direct Current Stimulation Study**

Hui-Yan Chiau<sup>1</sup>, Chi-Hung Juan<sup>2</sup>

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The effects of prior probabilistic information on our behaviors are influential. However, the characteristics of its dynamic interaction with our flexible control over behaviors are still unclear. The antisaccade task, where eye movements are made away from a target, has been used to investigate the flexibility of cognitive control of behavior. In this study, the trials for pro- and antisaccade were interleaved within one block and their relative probabilities were systematically manipulated across blocks. The saccade latencies were decreased with higher trial type probabilities. The transcranial direct current stimulation (tDCS) was applied to investigate functional roles of frontal eye field (FEF) and supplementary eye field (SEF). We found that anodal tDCS over SEF, the accuracy of saccadic responses declined when the likelihood of pro- and antisaccade was equal. Furthermore, the elongated saccade latencies were consistently observed for almost all conditions after anodal tDCS over FEF. The results suggested the supervisory role of SEF on saccades that may provide the signals to bias the preference for preparation of a saccade according to prior probabilistic information. These SEF signals may descend to area, which is directly responsible for saccade, such as FEF, and consequently speeded the response of trials with higher probability.

**Acknowledgement** : This work was sponsored by the National Science Council, Taiwan (96-2413-H-008-001-MY3, 97-2511-S-008-005-MY3, 98-2410-H-008-010-MY3)

12.19

## **Influence of a Visual Target Presented at Detection Sub-threshold on Saccadic Induction**

Yasumasa Ogata, Keiji Uchikawa

Tokyo Institute of Technology, Japan

Saccades are unconsciously induced by objects in the natural scene. It would be common that a saccade is triggered toward an object even if we are not aware of the object before the saccade occurs. In this study we examined whether a target could induce saccades when it was set at the sub-threshold level in detection. We used the metacontrast masking paradigm to make the stimulus being below detection threshold. The saccade latency was measured at various SOAs between the target and the mask onsets. A trial consisted of two sequences of the target-mask presentation. Either in the first or in the second sequences no target, but only the mask, was presented. The observer made a saccade toward any stimulus that first appeared. He also answered the sequence that contained the target in the 2AFC manner. The results showed that the saccade latency was shorter at a certain SOA than the total time (T) of the latency for the no-target (only-mask) presentation plus the SOA value. At this SOA the target detection was below threshold. This indicates that the saccade was not determined solely by the mask, but influenced by the target that was not detected.

12.20

## **How Balanced Configuration Influence the Visual Scanpath and Processing**

Da-Lun Tang

Tamkang University, Taiwan

Balance is considered as one of the most essential elements of aesthetics. However, few definite evidences were offered from objective or empirical aspects. In order to exclude the influence of confounding variables and to follow a strict statistical process, this study tried to develop two kinds of objective indicators with mathematical parameters called “uniform index” and “progressing index” to re-verify the influence of balance configuration during aesthetic evaluation. In this study, the manipulation of balance configuration was conducted by two experts in visual art. Twenty well-balanced pictures and twenty ill-balanced pictures were used as experimental stimuli. The participants were randomly assigned to perform the memory test or the balance judgment task after viewing each picture in one session. Eye movements were recorded using eye-tracking system when participants were performing the tasks. The following results were obtained: (1) The relationship between the balanced configuration and the uniform index achieved significant level totally, no matter what task was performed. (2) The relationship between the balance configuration and the progressing index achieved significant level only in the balance judgment task. (3) The balanced configuration did affect participants' memory performance significantly.

12.21

## **Plausibility of a Lie Detection Procedure Based on Eye Tracking Patterns**

Meng-Hsun Wang<sup>1</sup>, Da-Lun Tang<sup>2</sup>

<sup>1</sup>Department of Psychology, Soochow University, Taiwan

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

Previous studies of lie detection tests have been mostly based on liar's emotional responses. They assumed that tension or stress induced by lying affects responses of the sympathetic nervous system. Increasing numbers of recent studies took interests in the visual cognitive processes involved in lying that sheds light on the design of practical lie detection procedures. Current study tested a hypothesis derived from the relationship between working memory and an eye movement behavioral model. Participants were randomly assigned to lying or truth telling conditions. They drew a number between one and six and then answered number-relevant and control questions. The target number that they drew earlier was displayed along with three distracter numerals briefly after presenting the question. Eye tracking pattern showed that participants in the lying condition fixated less than in the truth telling condition if the question was number relevant. For control questions, lying participants fixated more on the target number than truth telling participants. These findings suggested that liars may deliberately avoid fixating the to-be-lied target. The implication of these eye tracking patterns for lie detection tests was also discussed.

12.22

## **The Role of Semantic Transparency in the Processing of Two-character Chinese Words**

Hsueh-Cheng Wang<sup>1</sup>, Yi-Min Tien<sup>2</sup>, Li-Chuan Hsu<sup>3</sup>, Marc Pomplun<sup>1</sup>

<sup>1</sup>Department of Computer Science, University of Massachusetts Boston, USA

<sup>2</sup>Department of Psychology, Chung Shan Medical University, Taiwan

<sup>3</sup>Graduate Institute of Neural and Cognitive Sciences, China Medical University, Taiwan

The study proposes a computational method to provide quantitative measures of semantic transparency of Chinese words and English compound words using Latent Semantic Analysis, and we found that LSA can distinguish transparent and opaque constituents. In an eye-movement experiment, two-character words with opaque-transparent (OT), transparent-opaque (TO), high-frequent opaque-opaque (OO1), and low-frequent opaque-opaque (OO2) combinations were paired with matched transparent-transparent (TT) words, and each target word was embedded in an individual sentence. Different eye movement measures (first fixation duration, gaze duration, and total time) were examined for both whole-word and individual-character level. The results support dual-route model that the meaning of two-character Chinese words is mainly from whole word, but character-level processing was involved during Chinese reading.

## **The Relation between Perceptual Filling-in Facilitation and Eye Movement**

Masae Yokota<sup>1</sup>, Yasunari Yokota<sup>2</sup>

<sup>1</sup>Nagoya Bunri University, Japan

<sup>2</sup>Gifu University, Japan

When a small area is presented in peripheral vision, it becomes invisible and invaded by surrounding texture within a few seconds. This visual illusion is called perceptual filling-in. In our preliminary study (Yokota, eMBEC 2005), we found that incomplete fixation distributes filling-in time. Furthermore, that we can see nothing by restraining eye movement artificially is well known. Therefore, we can consider that filling-in time is influenced by eye movement. Although it has been recently reported that eye movement influences the filling-in occurrence (Martinez-Conde, Neuron 2006), the relation between eye movement and the filling-in time has rarely been reported.

For this study, we measured the filling-in time for three subjects, for four surrounding textures, with simultaneous recording of eye movement. The results show that the filling-in time correlates the standard deviation of the power of the eye distance from the fixation point. Furthermore, we found relatively strong correlation between the filling-in time and the power of high frequency component 50-200 (Hz) in the eye movement, though the correlation of the power of low frequency component 10-50 (Hz) is not so high. Thus we suppose that filling-in is inhibited by small involuntary eye movement.

## **Expectation Overcomes the Impairments Induced by a Large Task-irrelevant Salient Line in Visual Search**

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<sup>3</sup>Department of Medicine, China Medical University, Taiwan

Our previous study found that a task-irrelevant large salient line impaired visual search (Jingling, 2010). In this study, we further investigated how expectation modulates this impairment. The search display was a lattice of regularly spaced short horizontal bars. The target, either left-tilted or right-tilted, was located on one of the bars in the middle of the display. The salient line was one of the vertical columns with all the bars rotating 90 degrees, forming a line of orthogonal bars to the texture. In Experiment 1, the location of the target and the salient line varied independently from trial to trial. Therefore, the salient line did not predict target location. We replicated our previous findings in that a target presented directly on the salient line was discriminated less quickly and less reliably. In Experiment 2, the target was on the salient line for 60 % of the trials, and the impairments vanished. In Experiment 3, 100 % of relevance was used and the salient line finally facilitated visual search. We argue that high expectation was required to overcome the low-level perceptual grouping effects in our display.

**Acknowledgement** : NSC96-2413-H-039-004-MY2; CMU97-338

12.25

## **Asymmetric Cross-modal Effect on Time Perception Depends on Stimulus Duration**

Kuan-Ming Chen, Su-Ling Yeh

Department of Psychology, National Taiwan University, Taiwan

Chen and Yeh (2009) observed asymmetric cross-modal effects in time perception: A concurrent sound expanded perceived visual duration but not the reverse. We examined the cross-modal effects across different stimulus durations to test whether modal variability is constant (Gibbon et al., 1984). A two-interval-forced-choice paradigm with the method of constant-stimuli was used. Participants indicated the longer duration after viewing two successive intervals with different durations. One of the intervals served as a standard while the other as a comparison. The comparison was either in the same modality as the standard (visual or auditory) or with the other modality added, and participants judged the duration based on one modality while ignoring the other. To exclude the possibility of biased preference on bi-modal comparison, in one experiment participants indicated the shorter duration. Results showed that sound expanded perceived visual duration and this cross-modal effect did not result from biased preference for bi-modal stimuli. However, this auditory bias on visual duration judgment declined with longer duration whereas no visual bias on auditory duration judgment was found across all durations. These results support the view that relative variability between audiovisual modalities changes with the mean stimulus duration (Wearden et al., 1998).  
*Acknowledgement* : Supported by NSC96-2413-H-002-009-MY3

12.26

## **Effect of Sound on Visual Persistence**

Shih-Yu Lo<sup>1</sup>, Su-Ling Yeh<sup>2</sup>

<sup>1</sup>The University of Sydney, Australia

<sup>2</sup>National Taiwan University, Taiwan

A briefly presented visual stimulus remains visible for 150 ms after offset, and this visual persistence should have led to blurry vision. Previous research has identified the factors reducing such visual persistence, for example, eye movements and object updating. Beyond the within-modal interaction between visual processes, we hypothesize that auditory stimuli may modulate visual persistence. Based on the previous finding that a change in visual size influences visual persistence, we additionally presented sounds to see whether the sound change in pitch can modulate visual persistence. Participants were required to report whether they saw one or two discs in the final frame, after viewing a disc moving continuously in a semicircle trajectory. If visual persistence remains, participants should perceive two discs even when there was only one disc because visual persistence of the last second frame should make it visible and co-exist with the last disc. Two experiments showed that visual persistence was reduced when the sound change in pitch occurred 186 ms prior to the change in visual size. However, this did not occur if pitch change occurred concurrently with the size change. These results have potential applications on display industry to solve motion-blur problems in LCD displays.

*Acknowledgement* : NSC96-2413-H-002-009-MY3

12.27

## **Object-based Attention: Spread, Scanning and Shift**

Ming-Chou Ho

Chung-Shan Medical University, Taiwan

Sensory enhancement, scanning prioritization, and attentional shift are often used to account for object-based attention (OBA). The present study reports on two series of four experiments using a modified flanker paradigm and on both reaction time and data-limited procedures to examine the possibility of (1) sensory enhancement within objects in the experimental conditions used to support the strong scanning prioritization; and (2) the weak versions accounting for OBA. In the target positional certainty condition, a target is always in the center of the central rectangle with the flankers in the same or in the different rectangles. In the uninformative and informative cue conditions, a central cue is either uninformative about the target location (50%) or it indicates the rectangle where the target is most likely (80%) or less likely (20%) to appear. The flankers and target in the cue condition never appear in the same rectangle. Findings based on the data-limited procedure suggest the sensory enhancement within the attended object in target positional certainty. Further, the current study provides evidence for the weak versions, because sensory enhancement and scanning prioritization are observed together in 80% of the cue validity condition and neither of these two accounts is absent.

12.28

## **Attention Can Distort Visual Space Backwards**

Fuminori Ono<sup>1</sup>, Katsumi Watanabe<sup>2</sup>

<sup>1</sup>The University of Tokyo, Japan

<sup>2</sup>The University of Tokyo, JST, AIST, Japan

A brief visual cue that attracts attention repels the perceived position of a subsequent target from the focus of attention (attentional repulsion effect). In the present study, we presented the visual cue “after” the presentation of a visual target and found that the perceived location of the preceding target was shifted toward the location of the following cue (attentional attraction effect). The attraction effect decreased when a masking pattern was presented between the target and the cue but the repulsion effect did not. The last experiment showed that the attraction effect due to following cue was countered by the repulsion effect due to preceding cue. The present findings suggest that both preceding and following contexts modulate the perceived location of a briefly presented stimulus.

**Acknowledgement** : Supported by Hokuriku Innovation Cluster for Health Science, Japan Society for the Promotion of Science, Japan Science and Technology Agency, MEXT

12.29

## **Feature-location Binding When Tracking Moving Objects Do Not Affect Distribution of Attention within Objects**

Sung-En Chien<sup>1</sup>, Katsumi Watanabe<sup>2</sup>, Lee-Xing Yang<sup>1</sup>

<sup>1</sup>National ChengChi University, Taiwan

<sup>2</sup>University of Tokyo, Japan

Tracking multiple objects in a dynamic environment is one of important abilities of our vision. It has been proposed that ‘object files’ keep track of items of current interest and accumulate information about them as they move and change (Cavanagh & Alvarez, 2005). In the literature of visual attention, it is known that the distribution of attention within objects affected by objects’ features (shape and color). The purpose of this study was to examine whether memory for binding objects’ feature (colors and spatiotemporal information) affects how visual attention spreads within objects. The experiment combines an irregularity detection task and a probe detection task in order to test if participants fail to bind objects’ feature and spatiotemporal information in memory (i.e., fail to detect irregularity), whether visual attention spreads within objects would be affected? The results showed that distribution of visual attention within objects was not affected by unsuccessful feature-location binding, indicating that feature encoding is also retained when tracking objects, but separated from location information.

*Acknowledgement* : National Chengchi University

12.30

## **Subliminal Spatial Cues Capture Attention and Cause Reversed Object Effects**

Wei-Lun Chou, Su-Ling Yeh

National Taiwan University, Taiwan

Mulckhuyse, Talsma, and Theeuwes (2007) showed that a subliminal spatial cue can capture attention to its location. According to the spreading hypothesis of object-based attention (e.g., Richard, Lee, & Vecera, 2008), a subliminal cue that can successfully capture attention to a location within an object should also cause attention to spread throughout the whole cued object and led to the same-object advantage (i.e., faster response to a target within an cued object than within a non-cued object). By adopting the two-rectangle method (Egly, Driver, & Rafal, 1994) and using an effective subliminal cue, we tested whether the same-object advantage can be obtained as with the classic suprathreshold cue. Opposite result patterns were found for subliminal and suprathreshold cues. A subliminal cue presented 100 ms before the target facilitated the cued location and led to different-object advantage, whereas when it was presented 1000 ms before the target it inhibited the cued location and led to same-object advantage. The use of a suprathreshold cue replicated the conventional location and object effects. This finding was inconsistent with the spreading hypothesis. A subliminal cue strengthens between-object links, which are coded primarily within the magnocellular to dorsal pathway that governs the visual guidance of action.

*Acknowledgement* : NSC96-2413-H-002-009-MY3

12.31

## **Interacting Properties of Spatial and Non-spatial Attention Revealed by Cueing Paradigm**

Satoko Ohtsuka, Yuuya Shiozaki

Saitama Institute of Technology, Japan

The literature has shown the property of spatial attention. For instance, its facilitatory effect is followed by inhibitory effect as is a typical result of cueing paradigm. The property of non-spatial attention and its relationship with spatial attention, on the other hand, is to be studied. The present study aimed to study the interrelationship of two aspects of attention. In Posner type cueing paradigm, the cue and target was determined by a combination of position (left/right) and color (blue/red), so the trials were divided into position-valid and -invalid conditions, and into color-valid and -invalid conditions. The SOAs were 300 and 1,200 ms. Observers were required to respond to the target position or color in separated experiments. RT data in position discrimination experiment showed the facilitatory and inhibitory effects on position-validity analysis whereas did no effect on color-validity analysis. The pattern of data was definitely different in color discrimination experiment: No facilitatory effect was shown on position-validity analysis whereas facilitatory and inhibitory effects were on color-validity analysis. These suggest a mutual relationship between spatial and non-spatial deployment of attention. On these evidences a property of attention resource would be discussed.

**Acknowledgement** : 862004

12.32

## **Exploring the Other-Race-Effect in 6-, and 9-month-old Taiwanese Infants and Adults**

Hsin-Yueh Hsu, Ming-Kuan Lin, Sarina Hui-Lin Chien\*

Graduate Institute of Neural and Cognitive Sciences, China Medical University, Taiwan

The present study investigated whether the other-race effect (ORE) exist in Taiwanese infants aged between 6 and 9 months when the visual system is still maturing. The faces of three ethnic groups (Asian, Caucasian, African) and of three levels of difficulty: Easy (change identity), Median (change one feature and one spacing), Hard (change one spacing) were included. Experiment 1 adopted the visual-paired-comparison (VPC) task to assess 6-month-old infant's discriminability for the familiar/novel faces. Each infant completed a total of 18 trials (3 ethnic groups\*3 levels of difficulty \*2 reversed locations) of three ethnic blocks in randomized order. Looking preference (fixation time) was recorded by two observers. Experiment 2 further tested 9-month-old infants' discriminability with the same condition. Experiment 3 was an adult control experiment that offers a performance reference point. Our results showed that 6-month olds can discriminate "easy" faces of all three ethnic groups and "median" Asian faces. 9-month olds can further discriminate "hard" Asian faces and "median" Caucasian faces. Taken together, these findings suggest a mixture of general improvement in face discrimination task as well as the other-race effect. The role of visual experience seems to be facilitation rather than merely maintenance.

**Acknowledgement** :

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12.33

## **The Effect of Spatial Frequency on the Own Race Advantage in Face Recognition**

Jie-Ju Lin, Chun-Chia Kung

National Cheng Kung University, Taiwan

People are better in recognition of own-race than other-race faces, which is known as ORA (Own Race Advantage). Past studies have identified components and configurations of the faces to be factors influencing facial recognitions. In previous study, Goffauz et al., (2005) indicated changes in components lead to better recognitions in high spatial frequency (SF) faces while changes in configurations lead to better performances in low SF faces. To date, the issue of how SF modulates ORA is still unclear. In experiment 1, memory recognition task, we manipulated five levels of SF (from lowest to highest), own- and other-race effects. The results showed that ORA was present in middle-ranged SF. Experiment 2 was the training-with-feedback discrimination task. We did two groups of low and high spatial frequencies and examined the effect of familiarity on ORA. Results indicated that under low SF, same-race performance is better than that of other-race faces, but the ORA appear in certain (optimal) SF. Under high SF, component clues are important in identifying other-race facial characteristics. Under slightly high SF, we find other-race advantage. Taken together, our findings suggest a dynamic recognition mechanism in human facial recognition system.

**Acknowledgement** : NSC98-2410-H-006-002-MY2

12.34

## **Influence of Life Experience on Other Race Effect**

Tsung-Ting Wang, Chun-Chia Kung

Institute of Cognitive Science, National Cheng Kung University, Taiwan

It is well known that we usually do not recognize faces of other-race as well as those of own-race. Such other-race effect, or ORE, has received extensive support. One fMRI study suggested that people's Fusiform face area (FFA) respond more activated to same- than other-race faces. We expect that life experience will affect this result: Caucasian participants who have stayed in Asian countries, their sensitivity for Asian faces will be modulated by their years of stay in that country. For example, the longer the Caucasian subjects live in Taiwan, the more activity of their middle Fusiform gyrus (mFG) will be toward Asian faces. Subjects are all Caucasians, with varying years of stay in Taiwan. They underwent fMRI while viewing pictures of Caucasian faces, Asian faces, and objects. Across these 14 subjects, we found their mFG activation of "Asian\_faces minus Objects" are significantly correlated with to their duration of residency in Taiwan, supporting the experience modulation hypothesis. Besides, there is another mFG region whose "Asian\_faces minus Caucasian\_faces" seems marginally correlated with years of stay. With further evidence bridging the neural substrates and the behavior with fMRI, we again exemplify the adult brain plasticity.

**Acknowledgement** : NSC98-2410-H006-002-MY2

12.35 Withdrawn

12.36

## **Ethnic Diversity\_Gender Perception**

Myung Chan Lim, Lee Hyeon Soo, Woo Hyun Jung

Department of Psychology, Chungbuk National University, Korea

Two experiments were conducted to examine the Impact of facial features(e.g., eyes, nose and mouth) and expressions(e.g., neutral, happy, angry, sad and surprised) across different ethnic groups(d.g., caucasian, asian, & black) on perception of gender and facial expression. A series of pictures with 3 different facial features and 5 different expressions across 3 ethnic groups were presented to the participants and their perception of gender(Experiment 1) and facial expression(Experiment 2) was examined. The results showed that perception of gender and facial expression was depending on in order of eye, mouth, and nose. The interaction effect between ethnicity facial expressions was found; gender perception was most accurate for happy in Asian, angry in Black, and sad in Caucasian. In perception of facial expressions, differences across ethnic groups were found only for perception of male faces; Black and Asian males were perceived more accurately than Caucasian males. These results suggested the generality of gender perception even when only parts of facial features were available, and facial features specific to an ethnic groups could be helpful for gender perception.

12.37

## **Identification Accuracy and Confidence Reliability in Cross-racial Lineup Identification**

Cheuk -Fai Chung, William G. Hayward

University of Hong Kong, Hong Kong

Much previous research suggests that when testing eyewitness memory in legal settings, sequential lineups, where suspects are displayed one-by-one, are more effective at promoting correct identifications and reducing false identifications than simultaneous lineups, where suspects are all displayed together. However, most previous studies used only own-race photographs. The present research systematically tests and compares the identification accuracy and confidence reliability of these two types of lineups across own-race and cross-race lineups. Both Chinese and Caucasian participants were presented with target photographs and were later asked to identify them from target-present and target-absent lineups. The results found a consistent own-race advantage only in sequential lineups, but not in simultaneous lineups. In addition, there was a mild positive correlation between accuracy and confidence. A subsequent experiment showed that the own-race advantage for sequential lineups disappeared when faces were inverted, consistent with evidence that inversion disrupts holistic processing. These results have clear implications for the use of lineups to test eyewitness memory in legal settings, and suggest that lineup design should be based upon the similarity in race between the witness and the suspect.

## **Intertrial Inhibition Effect of Gaze Cueing**

Qian Qian<sup>1</sup>, Keizo Shinomori<sup>2</sup>, Miao Song<sup>2</sup>

<sup>1</sup>Graduate School of Engineering, Kochi University of Technology, Japan

<sup>2</sup>Kochi University of Technology, Japan

An uninformative cue by a centrally-presented face gazing to one-location can trigger attention shifts in observers toward the location gazed at, facilitating the detection of simple targets. In the literature, it has been widely accepted that perception of another people's gaze can shift observer's attention automatically and reflexively. In present study, the magnitude of gaze-cueing effects, which preceded by a cooperative or deceptive gaze, was compared. The results showed that gaze-cueing effect induced by current gaze was inhibited when the observer was deceived by a previous gaze on target detection. This intertrial inhibition effect was found for both schematic faces and real faces as central cues. The arrow cues also can elicit the intertrial inhibition effect, but there has a subtle difference between gaze cues and arrow cues. The results presented here suggest that gaze cueing is not purely automatic or reflexive but is influenced by the cueing states in the immediate past. This intertrial effect is probably based on a general processing for any directional cues and afforded by implicit visual memory mechanisms of previous views in human brain.

**Acknowledgement** : KAKEN B20300081

## Keynote Lecture

(Saturday, July 24, 9:30-10:30, The Forum)

K2 : Izumi Ohzawa (Osaka University, Japan) :

Recent Advances in the Functional Analysis of High-order Visual Neurons

## Symposia : Visual Cortex in Primates, Retinotopic Organisation and Plasticity

(Saturday, July 24, 13:15-15:15, Socrates)

S2-1

### **A Hyper Complex of Visual Areas, the Fovea Confluence and Its Consequences for Anisotropy and Magnification**

Mark M. Schira

University of New South Wales, Australia

After remaining terra incognita for 40 years, the detailed organization of the foveal confluence has just recently been described in humans. I will present recent high resolution mapping results in human subjects and introduce current concepts of its organization in human and other primates (Schira et al. 2009, J. Nsci). I will then introduce a new algebraic retino-cortical projection function that accurately models the V1-V3 complex to the level of our knowledge about the actual organization (Schira et al. PLoS Comp. Biol. 2010). Informed by this model I will discuss important properties of foveal cortex in primates. These considerations demonstrate that the observed organization though surprising at first hand is in fact ideal with respect to cortical surface and local isotropy, proving a potential explanation for this organization. Finally, I will introduce simple techniques that allow fairly accurate estimates of the foveal organization in research subjects within a reasonable timeframe of approximately 20 minutes, providing a powerful tool for research of foveal vision.

S2-2

### **Visual Cortex Reorganization After Injury: Lessons from Primate fMRI**

Stelios M. Smirnakis

Baylor College of Medicine, USA

The ability of networks of neurons to undergo plastic rearrangement represents a general organizing principle of the nervous system and has been demonstrated to persist in adulthood in several areas, including motor, visual, auditory and somatosensory cortex. To date animal models appropriate for studying recovery after cerebrovascular injury remain scarce. Paradigms developed in the rodent, though valuable, are far removed from human physiology and have restricted behavioral repertoires, which limits the type of questions they can be used to address. By contrast, a macaque model of cortical reorganization based on fMRI is closer to human physiology, has a rich behavioral repertoire and can be compared directly to fMRI results from human patients. This makes it highly versatile for testing experimental hypotheses on the nature of plasticity, and for gauging the global effect of pharmacologic or rehabilitative manipulations on neuronal recovery after cortical injury. In my talk, I shall describe the emergence of macaque fMRI as an animal paradigm/tool for studying cortical plasticity, and will discuss its application to the study of cortical reorganization following primary visual cortical lesions (Schmid et al., PLoS ONE, 4(5):e5527, 2009).

S2-3

## **Maturation of the Visual Brain: Lessons from Lesions**

James A. Bourne

Australian Regenerative Medicine Institute, Monash University, Australia

In the nonhuman primate (marmoset monkey), which comprises a lissencephalic cortex, we have demonstrated that there may be not one, but two areas (V1 and the middle temporal (MT) area), which develop earlier than the “extrastriate” visual areas of the cortex. To this end we created a model that suggests the primary areas serve as genetically pre-determined organisational “anchors” which prompt the development of the rest of the visual cortex in a sequential manner. In order to further characterize the importance of the specific areas and connections in visual cortical maturation, we unilaterally lesioned V1 in adult and neonate monkeys. Surprisingly, the consequences of focal injury to the cerebral cortex in the immature brain differ from those induced by similar damage to the mature cerebrum. The ability of the immature brain to reorganize and reroute connections to result in considerable sparing of visual function is a phenomenon which has been largely unstudied. I will discuss the relevance of the nonhuman primate in such studies and the affect of a V1 lesion during development. Also, I will discuss whether better knowledge of the mechanisms operative in the immature brain will enable us to one day repair lesioned pathways/cortical nuclei in the adult brain?

S2-4

## **Bilateral Visual Field Maps in a Patient with Only One Hemisphere**

Lars Muckli

Centre of Cognitive Neuroimaging, Department of Psychology, University of Glasgow, United Kingdom

The prenatal development of retinotopic maps is regulated by two basic principles: gradients of molecular markers determine map orientations and waves of spontaneous activity determine neighbourhood relations.

We were able to observe the developed retinotopic maps of a 10 year old girl who was born with only one cerebral hemisphere. The retinal ganglion cells from her normal developed left eye project entirely to the left thalamus and the left cerebral hemisphere, where full-field visual maps emerged. The precise retinotopic folding patterns in V1, V2 and LGN provide evidence for the underlying developmental mechanisms based on molecular markers and on activity-dependent cues.

## Talk Session : Attention II

(Saturday, July 24, 13:15-15:15, John Locke)

21.01

### **Context-guided Visual Search via Global-to-Local Evidence Accumulation**

Tsung-Ren Huang<sup>1</sup>, Stephen Grossberg<sup>2</sup>

<sup>1</sup>Department of Psychology, Boston University, USA

<sup>2</sup>Department of Cognitive and Neural Systems, Boston University, USA

How do humans use target-predictive contextual information to facilitate visual search? How are consistently paired scenic objects and positions learned and used to more efficiently guide search in familiar scenes? The ARTSCENE Search model is developed to illustrate the neural mechanisms of such memory-based context learning and guidance, and to explain challenging behavioral data on positive/negative, spatial/object, and local/distant cueing effects during visual search, as well as related neuroanatomical, neurophysiological, and neuroimaging data. The model proposes how global scene layout at a first glance rapidly forms a hypothesis about the target location. This hypothesis is then incrementally refined as a scene is scanned with saccadic eye movements. The model simulates the interactive dynamics of object and spatial contextual cueing and attention in the cortical What and Where streams starting from early visual areas through medial temporal lobe to prefrontal cortex. After learning, model dorsolateral prefrontal cortex (area 46) primes possible target locations in posterior parietal cortex based on goal-modulated percepts of spatial scene gist that are represented in parahippocampal cortex. Model ventral prefrontal cortex (area 47/12) primes possible target identities in inferior temporal cortex based on the history of viewed objects represented in perirhinal cortex.

**Acknowledgement** : This work was supported in part by CELEST, a National Science Foundation Science of Learning Center (NSF SBE-0354378) and HRL Laboratories LLC (subcontract #801881-BS under DARPA prime contract HR0011-09-C-0001).

21.02

### **Varied Timecourses for Priming for Different Feature Values in Pop-out Visual Search**

Arni Kristjansson<sup>1</sup>, Elmar Pels<sup>1</sup>, Jan Brascamp<sup>2</sup>

<sup>1</sup>School of Health Sciences, University of Iceland, Iceland

<sup>2</sup>Vanderbilt Vision Research Center, Department of Psychology, Vanderbilt University, USA

Brascamp and colleagues (PlosONE, 3, e1497) have shown how fluctuations in the perception of ambiguous stimuli reflect memory traces operating at multiple different timescales. The percept at any given moment is affected by perception during a very long period, as well as influences from the immediately preceding percepts. Here we investigate whether similar multiplicity in timescales is seen for priming effects in pop-out visual search tasks. We contrasted long-term trial-by-trial build up of priming of pop-out of a particular color against shorter term build-up for a different color. We found that the priming effects from the two colors do indeed reflect memory traces at different timescales, and that the priming decay function for the long term priming is well described with a long time constant while the short-term time priming decay reflects memory traces with a shorter time constant. The results suggest that priming effects in visual search reflect neural modulations from repeated presentation of a feature value which operate at multiple different time scales. These similarities between attentional priming and perception of ambiguous stimuli are striking and suggest compelling avenues of further research into the relation between the two effects. **Acknowledgement** : University of Iceland Research Fund

21.03

## **No Attentional Capture for Target detection – It Occurs Exclusively in Compound Search**

Louis K. H. Chan, William Hayward

University of Hong Kong, Hong Kong

It has been believed that simple visual features are detected preattentively. If this description is strictly true, one should not expect attentional capture, in which attention is driven away from the target by a salient distractor, to impair performance. Consistent with this, attentional capture is generally reported only in compound search, which requires attention to be focused on the target in order to judge the response. It has been recently reported, however, that attentional capture can be produced in detection by mixing distractor trials with no-distractor trials. In this study, in a similar setting, we measured attentional capture in terms of accuracy. If detection requires attention, attentional capture should render search less accurate; however, accuracy should not be influenced by other factors, such as a slowing down in response production. We presented brief search displays in which duration was set so that accuracy was near 0.8. Results show attentional capture in compound search, but not in detection. Therefore, attention does not enhance the registering of a simple feature in the same way that it enhances compound search performance. The present results are consistent with a proposal (Chan & Hayward, 2009, JEP:HPP) that feature detection and localization involve distinct search processes.

**Acknowledgement** : This research was supported by a grant from the Hong Kong Research Grants Council (HKU744209H) to William G. Hayward.

21.04

## **Awareness of Absence and Absence of Awareness: Failures of Sensation and Attention**

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Failure of conscious visual perception occurs under a range of circumstances. The causes and processes leading to incidences of stimulus-blindness are poorly understood. Failure of conscious report could be, for example, a consequence of reduction of the sensory signal or lack of attentional access to sensory signals. When examining these phenomena one has the intuition that in some types of invisibility, a target is phenomenally invisible (awareness of absence), whereas in other types of manipulations, we do have a sense that we missed a target (absence of awareness). To distinguish different causes leading to a failure of visual awareness, we employed a new measure, termed subjective discriminability of invisibility (SDI) that measures whether confidences of reporting the absence of a target are different for trials in which visual awareness was impaired (miss trials) from those where no target was present (correct rejections). Targets misses were subjectively indistinguishable from physical absence when contrast reduction, backward masking and flash suppression were used. Confidence could be appropriately adjusted when dual task, attentional blink and spatial uncertainty methods were employed. These results show that failure of visual perception can be either a result of perceptual or attentional blindness depending on the circumstances under which visual awareness was impaired.

21.05

## The Role of Working Memory in Visual Attention

Chun Hung Alexander Ng, William G. Hayward

University of Hong Kong, Hong Kong

Working memory (WM) plays a crucial role in the guidance of visual attention. However, findings from past studies of the WM effect on visual attention are quite controversial. Some studies claimed that the presence of such an effect is automatic, i.e. attention is driven to stimuli related to the working memory representation, independent of the relevance to any explicit task goal. In contrast, some other studies provided evidence that such WM effects are not so automatic or rigid. The present study aims to investigate the controversy over memory-driven effects in visual selective attention. We found that an automatic WM effect may not be present in some visual search tasks using consistent mapping (search target remains unchanged between trials) and high energy stimuli. Furthermore, with modifications of the experimental setup that has previously been used to support positive findings of the automatic WM effect, we report some strategic uses of the WM item to speed up visual search. Therefore, our experiments support an alternative view that an automatic WM effect may be an outcome of incongruence of concurrent processing between a WM item and a non-target stimulus in the search set.

21.06

## Joint Memory Effects on Visual Attention: Effect of Closedness

Xun He<sup>1</sup>, Natalie Sebanz<sup>2</sup>, Glyn W. Humphreys<sup>1</sup>

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It has been established that when engaged in joint action, people will represent and be affected by others' actions. Our previous research went further in demonstrating that people could share information in working memory according to the overlap in concurrently performed tasks and guide the subsequent attentional deployment accordingly. In the present study, we tested one group of close friends and a second group of strangers with a setup in which two participants had to hold particular stimuli in working memory and carried out a visual search task. Participants were drawn to stimuli in search that matched their own memory. Priming images which requested no memory performance yielded similar results. For the testing partner's stimuli, however, the attentional guidance effect only occurred among strangers, and not between close friends. These data suggest that, participants who engage in joint action represent in memory information relevant to their co-actor; and its subsequent effects on attention allocation may well depend on the relationship between the participating persons. In the present setup, joint memory effects were inhibited as a result of closedness.

**Acknowledgement** : Supported by Economic and Social Research Council, UK; European Science Foundation grant (EURYI)

## **Hierarchical Object Representation: How the Object is Changed Affects Object-based Attention**

San-Yuan Lin, Su-Ling Yeh

Department of Psychology, National Taiwan University, Taiwan

Lin and Yeh (submitted) have shown that when an attended object was later changed via amodal completion induced by an occluder, the changed object display (but not the initially attended one) determines object-based attention, supporting the changed-object hypothesis. This study followed the previous one but added changes at the element level to see whether the changed-object hypothesis still holds. We used a variation of Egly, Driver, Rafal (1994)'s double rectangle paradigm, but created discrepancies between the elements in the initial display (four separate hashes) and those in the final display (four separate squares). The two displays were linked either by an abrupt change, a smooth transition, or a shuffled one, occurring after attention was cued to the initial object display. After the element-level change, the four squares are grouped into two larger objects via amodal completion induced by an occluder in the final display. The object effect resulting from the final changed object display was found only when the element-level transition was in a smooth sequence. This suggests that attention selects on a hierarchical representation of objects that is sensitive to element change while it can tolerate global configural reorganization such as those induced by amodal completion.

**Acknowledgement** : NSC96-2413-H-002-009-MY3

## Poster Presentations

Morning Session: Saturday, July 24, 10:40-11:40, Plato (Odd Numbers Present)

Afternoon Session: Saturday, July 24, 15:25-16:15, Plato (Even Numbers Present)

22.01

### **Taiwan's Traditional Koji Colors of the Visual Cognition Research**

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“Taiwan Koji Pottery” has the multi-color characteristic, these cultural relic could concrete show the colors utilization and presentation in the early Taiwan. It is an indispensable subject to study Taiwan color culture. The study finished the program “Index and Filter of Colors and Shades” by using the linear function, and then it can investigate the cognition of the color appearance expression from the populace by this tool. The final result developed the accordant color expression to conform the Taiwan color name. This research ran through the study of tradition color culture, the color investigation with statistics and the sign of color standardization system. On this way, it shows the culture of tradition color. On the other hand, it also establishes feasible expression foundation, simultaneously returns to the history of color to discuss the development of colors by the literature. All of studies anticipated that the findings may promote the application value for Taiwan color culture.

22.02

### **Derivation of Color Confusion Lines and Copunctal Point for Dichromat Observers from Color Discrimination Thresholds**

Kahiro Matsudaira, Hiroyuki Shinoda, Kitiroj Rattanakasemsuk, Hideki Yamaguchi

Ritsumeikan University, Japan

Our final objective is to develop a method of finding a copunctal point in the display RGB color space so that any sets of confusion colors can be identified in the device dependent color space. In the current experiment we tried to find a copunctal point from the discrimination thresholds around reference colors. A reference and a test square patches were presented side by side on a liquid crystal display. The subject's task is to set the color of the test where the color difference between the test and the reference is just noticeable to him/her. In a single trial, the color of the test was only adjustable along one of 18 directions around the reference color which was held constant meanwhile. Thus eighteen threshold colors were obtained around each reference. The copunctal point was determined where the squared sum of the distance of the threshold colors to the confusion line drawn from it to each reference colors is at the minimum. Copunctal points were obtained by pseudo-dichromats (color normal observers with a dichromat simulator) and compared in different color spaces such as CIE xy, CIE u'v', and the device dependent rg chromaticity diagram.

## Color Discrimination on Various Test of Color Deficiency

Kaori Ogawa, Hirohisa Yaguchi, Yoko Mizokami

Chiba University, Graduate School of Advanced Integration Science, Japan

Many studies have shown the red-green discrimination threshold of people with color deficiency was high. It has not, however, been investigated the influence of a test color on the threshold. In this study, we measured color contrast threshold on five test colors (grey, red, green, blue and yellow) in a LMS color space. Stimulus was presented in a square array of four 1° squares with a temporal Gaussian modulation. One protanomalus, three deuteranomalos and four color normal subjects were tested. The thresholds of eight directions were obtained on L+M (luminance), L-2M and S-(L+M) plane, respectively. We also measured individual LM ratio at equiluminant setting by a flicker photometry. Results showed both protanomalous and deuteranomalous had large color contrast thresholds in the L-2M direction for all test colors. Only on the red background, the color contrast thresholds in the L+M direction of deuteranomalous were larger than other subjects. In flicker photometry, each group of protanomalous, deuteranomalous and normal subjects showed the different trend of equiluminant LM ratio, respectively. The LM ratio setting of protanomalous was the largest, implying the contribution of luminance component to the result of color contrast thresholds. (discuss relations between the color discrimination threshold and the equiluminant LM ratio.)

**Acknowledgement** : Grant-in-Aid for Scientific Research (C) 20560031

## Characteristics of Color Categories of Dichromats

Hirotohi Nishita, Keiji Uchikawa

Tokyo Institute of Technology, Japan

Dichromats cannot discriminate some colors because they lack a type of cones. However it was reported that they could categorize colors by using color-names as trichromats did. We reported the color memory-matching experiments designed to explore the higher color-vision mechanism of dichromats (Uchikawa and Nishita, ICVS, Braga, 2009). In the experiments a test color sample was presented for 5sec, and then after 30sec the observer started selecting a color sample from a set of 1406 simulated OSA UCS that matched the test color sample in his memory. 100 test colors were used in the experiments. The results showed that color samples selected by color memory were restricted in the categorical color-naming regions for trichromats, but this tendency was not clearly shown for dichromats. In the present study we further analyzed the data in order to clarify color categories of dichromats. It was found that dichromats' matching points tended to concentrate on a single point in the OSA-g direction whereas trichromat's matching points spread on the j-g plane. These results suggest that dichromats' color categories are less than those of trichromat and exist not along the r-g direction but just along the y-b direction.

22.05

## **Effects of Chromatic Adaptation on Visual Search for Orientation**

Katsuaki Sakata, Hitomi Shimakura

Joshi University of Art and Design, Japan

The present study demonstrates the effects of chromatic adaptation on visual search tasks for right and left oriented Gabor patch stimuli defined in colour or luminance. Observers, who were confirmed their colour vision by Ishihara pseudo-isochromatic plates, searched for the different colour and orientation patch with an eye after chromatic adaptation by the other eye. The detection performance of chromatic adaptation condition always resulted in lower than non-adaptation condition. We conclude that the visibility of stimuli colour in a search task failed to draw on chromatic information from the target. The effect could be explained by the cortical mechanism of chromatic adaptation.

22.06

## **Understanding Cone Spectral Selectivities from Information Maximization and Color Constancy**

Jinhui Yuan<sup>1</sup>, Minjie Xu<sup>1</sup>, Bo Zhang<sup>1</sup>, Li Zhaoping<sup>2</sup>

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<sup>2</sup>Department of Computer Science, University College London, UK

Lewis and Zhaoping (2006) proposed to understand cone spectral selectivities by the need to maximize the amount of information extracted about the object surface spectra from natural scenes under a fixed illumination. The predictions from this proposal are consistent with the spectral selectivities of the S and M cones, but require the L cone to prefer much longer wavelength than observed, if one ignores the consequent penalties such as increased chromatic aberration and increased noise level caused by this preference shift toward longer wavelength. In this work, we propose that color constancy under variable illumination is an additional constraint on the cone spectral selectivities. In particular, to discount the variable illumination, the spectral selectivities should make von Kries coefficient law hold as much as possible for the ensemble of surface reflectance and the ensemble of illuminations in natural scenes. Using information theoretical terms, we formulate the combination of two constraints, information maximization and color constancy, as an optimization problem. Our proposal can better predict the cone spectral selectivities than the previous one, it particularly constrains the preferred wavelength of the L cones away from the long wavelength end of the visible light spectrum.

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22.07

## **Color Constancy in Photographs and in Cartoon Images**

Ayae Tajima, Yoko Mizokami, Hirohisa Yaguchi

Chiba University, Graduate School of Advanced Integration Science, Japan

Color constancy is a mechanism required to the stable recognition of object color. It has been suggested that recognizing a room as a three dimensional space is important for color constancy, and that in a two dimensional photograph is lower (Mizokami et al, 2004). We predicted that color constancy in a cartoon image might be even lower than that in a photograph because of less spatial information (such as shade and depth) and weak 3D recognition in it.

We examined color constancy in three conditions: A real room, photographs of it and cartoon images made from these photographs. We built a booth arranged like a natural room containing color patches, and took photographs in the room under two illuminants: fluorescent lamps with correlated color temperature 5000K and 2700K, respectively. A subject observed an image on a CRT display in a room illuminated by 5000K illumination, then answered the colors of stimuli in the image using the elementary color naming method.

The result showed that color constancy in the real room condition was the highest among all conditions and that in the cartoon condition was the lowest. However, the difference between photograph and cartoon images would depend on the hue of stimulus.

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22.08

## **Colorimetry-free Color Management System for Display Based on Color Constancy**

Ryoichi Ishibashi, Hiroyuki Shinoda, Hideki Yamaguchi, Kitirochana Rattanakasamsuk

Ritsumeikan University, Japan

Many of color management systems (CMS) are to achieve colorimetrically equal color. However, in metameric color match, equal colorimetric values assure equal color appearance only to the standard observer but not to every observer in practical situations. Another and more serious problem is the effect of color adaptation to the illuminant. Even though spectral composition from the display is held constant, color adaptation to the illuminant may change the color appearance. In order to cope with observer and illuminant variabilities, we developed a new CMS based on color constancy for reflecting surfaces. The idea is to derive a conversion matrix for RGB values from one to another environments through a visual or subjective color match with reflecting color chips under the illuminant. Another advantage of the new CMS is a procedure where no colorimetric measurement is required. A conversion matrix between two environments is calculated by applying a pseudo-inverse matrix to an equation consisting of pairs of RGB values from visual color match. In the experiment, the conversion matrices were derived using various sets of color chips and their performances were compared. As a result, 5 or more color chips of uniformly distributed hues give better and stable performance.

22.09

## Measurement of Luminance and Chromaticity Distribution by a Digital Camera

Manabu Akimoto, Shinoda Hiroyuki, Yamaguchi Hideki

Ritsumeikan University, Japan

A digital camera may be a useful instrument when you want to obtain chromaticity and luminance distribution from the natural scene. One of the problems is its small dynamic range. The objective of the study is to develop formulae to calculate CIEXYZ from RGB pixel values of several images taken with different exposures. In calibration, the Macbeth color chart under different illuminant levels were taken by a digital camera and measured by a color meter CS-100A. The luminance of color charts ranged from 0.59cd/m<sup>2</sup> to 6140cd/m<sup>2</sup>. At each illuminance level, several images were taken with different exposure times from 0.00625sec to 10sec. From the collection of RGB and XYZ, the multiple regressions for the logarithms of each tristimulus value were obtained like  $\log_{10}X = X_R + X_G + X_B + X(t)$ . The coefficients  $X_R, X_G, X_B$  are constant while the intersect was a function of exposure  $t$ . The range, within which the multiple regressions are predictive, was also determined as functions of exposure  $t$ . The error between the actual measurement values and the predicted values were 8% in X, 6% in Y, and 5% in Z. Therefore further refinement is needed for a digital camera as color meter.

**Acknowledgement** : 3461013

22.10

## May Threatening Faces Catch Your Eyes?

Yu-Chieh Chang, Shwu-Lih Huang

Department of Psychology, National Chengchi University, Taiwan

Based on the evolutionary view, people can quickly detect dangerous signals and respond unconsciously. Further, according to the lateralization hypothesis, right brain hemisphere is specialized for processing emotional information. In order to explore current issue, the influence of threatening faces on goal-driven saccadic eye movement was investigated.

For the purpose of generating goal-driven saccadic eye movement, participants were directed by a left or right arrow and then saccade toward the arrow-directed rectangle as soon as possible. At the same time, a face picture was presented at the same or opposite rectangle relative to arrow's direction. In some trials, no picture was presented, which was called as no-picture condition.

The result showed that if faces were presented at left visual hemifield, fearful and angry faces presented for only 17ms could delay onset of anti-saccade. But happy faces needed 167ms presentation time to cause longer anti-saccadic latency than no-picture condition. The above-mentioned effects were absent if pictures were presented at right hemifield.

In conclusion, the threatening faces presented at left hemifield can delay onset of anti-saccadic eye movement but cannot overtly catch eyes toward. Both evolutionary view and lateralization hypothesis were preliminarily supported.

22.11

## **The Discrimination Experiment Reveals the Nonlinear Properties of the Facial Expression Analyzer**

Yi-Chin Chou, Chien-Chung Chen

Department of Psychology, National Taiwan University, Taiwan

To understand the response properties of facial expression analyzer in the visual system, we measured the facial expression discrimination threshold at various expression valences.

We constructed a series of facial images with different happy/sad valences by morphing happy and sad faces from the POFA database (Ekman & Friesen, 1976) and divided each face image into upper and lower parts. In each 2AFC trial, either one part of the image was the same in both intervals while the other part differed in morphing level. The observer was to judge which of the two composite faces appeared happier. We used the PSI adaptive threshold seeking algorithm to measure the morphing threshold at 75% correct response level.

When the morphing level of the lower face was fixed, the discrimination threshold for the upper face was similar regardless the base morphing level. On the other hand, when the morphing level of the upper face was fixed, the discrimination threshold first decreased and then increased as the base morphing level of the lower faces increased. Our result suggests that the upper face contributes little to happy/sad discrimination. In addition, the dipper shape of the discrimination function suggests a nonlinear response property in the happy analyzer.

**Acknowledgement** : NSC97-2410-H-002-158-MY2

22.12

## **Visual Scanning of Emotional Facial Expressions in Traumatic Brain Injury: A Case Report**

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**Introduction:** Neurological damage may cause the interpretation of facial expression to breakdown at various stages of processing. Visual scanning of emotional facial expressions has been examined extensively in some patient groups (e.g., schizophrenia), though this is not the case in those individuals with a traumatic brain injury (TBI). We present an interesting case report which demonstrates how the visual scan path in TBI can deviate from neurologically normal controls.

**Method:** Participants were one adult male (LY) with impaired ability to interpret facial expression as a result of severe TBI and 3 neurologically normal male controls. Stimuli were 18 static pictures of facial expressions depicting the six basic universal emotions (sadness, happiness, anger, surprise, fear and disgust). Eye movements were recorded using a binocular infrared eye tracker.

**Results:** LY's pattern of scanning differed significantly from that of the neurologically normal controls. For the controls, the majority of fixations were within the internal facial region (that area including the eyes, nose and mouth). In contrast, LY's scanning was more dispersed (i.e., hyperscanning), with frequent foveal fixations to external peripheral regions (hair, ears, forehead, stimulus background). **Discussion:** Impaired visual scanning can contribute to impaired interpretation of facial expression after a TBI.

**Acknowledgement** : Faculty of Health Sciences, La Trobe University

## **On-line Recognition Revealed the In-group Advantage in Negative Facial Expressions.**

Chia-Wei Liu<sup>1</sup>, Ting-Tzu Chang<sup>1</sup>, Yu-Shu Liang<sup>1</sup>, Chia-Yao Lin<sup>2</sup>, Yi-Min Tien<sup>1</sup>,  
Li-Chuan Hsu<sup>2</sup>, Hsian-Fu Chang<sup>1</sup>

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Facial expressions are suggested to be universal. However, studies show the in-group advantage of the recognition of facial expression (Matsumoto, 1989; 1992). People understand emotion more accurately when they are expressed by members of their own culture group. We investigated whether this in-group advantage was showed in Taiwanese by adopting an on-line emotional discrimination task in which participants were asked to discriminate positive (happy) versus negative (sad, fear, and anger) faces among Eastern and Western faces. The materials included Eastern faces from Taiwanese Facial Expression Image Database (Chen, 2007) and Western faces from Ekman and Friesen's database (Ekman & Friesen, 1979). Both reaction times and accuracies of performance were measured. Results showed that even participants can discriminate positive and negative faces accurately; they responded significantly faster to negative Eastern faces than to negative Western faces. However, no such culture difference was found to positive faces. The results revealed the in-group advantage of the perception of facial expressions was specific to negative emotions and question the universality of facial expressions of emotion.

**Acknowledgement :**

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## **Auditory-visual Integration Facilitates Unconscious Processing of Facial Expression**

Yung-Hao Yang, Su-Ling Yeh

National Taiwan University, Taiwan

Emotional expression of faces plays an important role for social interaction. Previous studies have shown that unconscious processing of facial expression activates the same brain areas as the visual-auditory integration of facial expression (i.e., the amygdale and posterior superior temporal sulcus). Here we examine whether auditory-visual integration could occur for audible voice but invisible facial expression. We adopt the continuous flash suppression paradigm (Jiang, Fang, Huang, & He, 2005; Tsuchiya & Koch, 2005) in which a face in one eye was suppressed by dynamic flash masks in the other eye, and the manipulated sound was presented at the same time. Experiment 1 examines whether voice is special for multisensory integration to occur for invisible face. We found that either a beep sound or a voice can facilitate the detection of an inverted face; however, only the voice can facilitate the detection of an upright face. In Experiment 2, we manipulated the semantic congruency between the voice and the face, and found a semantic congruency effect: faster detection for matched emotional prosody and facial expression than for unmatched pair. Audio-visual integration can occur even when participants are unaware of the face, and semantic congruency facilitates the formation of a unity percept.

**Acknowledgement :** NSC96-2413-H-002-009-MY3

## Neutral Features Induce Emotion in Schematic Faces

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Schematic faces usually express emotion with strong emotional features, such as a downward curve represents a smile and faces with this curve induce positive emotions. In this study, we explored whether neutral schematic faces could induce emotion. Five factors: gaze directions, shape of eyes, noses, mouths, and outline of faces, were manipulated. The eyes were directly gazed or avertedly gazed, with vertical oval, circle, or horizontal oval shapes. The faces were with a round nose, a vertical line-shaped nose, or without nose. The mouth was either a horizontal line or none. The outline of the faces was either round or oval. All these features were emotionally neutral. The faces with noses must have mouths to avoid mistaken of noses as mouths; otherwise all the factors were orthogonally assigned into 72 faces. A questionnaire with these neutral faces and 20 emotional faces were submitted to data collection. Five-point Likert scale was used. Seventy-one valid questionnaires were obtained. We found that (1) averted gazes, (2) faces with mouths, and (3) faces without noses, tend to be perceived as in negative emotions. We argue that these neutral features may induce social cues in communications that relate to emotional perception.

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## How Does Inferotemporal Cortex Respond to Average Faces?

Ya-Huei Hsu, Chun-Chia Kung

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Face perception is an important ability, which including face identification and recognition. Neuroimaging studies have found several related brain regions, among FFA, OFA, STS and aIT (Kriegeskorte, 2007). Loffler (2005) used synthetic faces in fMRI study, and found FFA activations for the individual faces were stronger than the average faces. However, the synthetic face changes were primarily achieved by manipulating external face contours. Jiang (2009) pursued this issue and demonstrated the contour change invoked the largest response in the rFFA. This raises a concern of whether the lower FFA responds to average faces by Loffler is either caused by the face averaging process, or confounded by the change of face counter. This study morphs real individual faces to create sets of 3-, 6-, and 10-averaged faces, while controlling face contours to the same egg-shapes, and asks subjects judge the two face presentations are same or different sex. The ROI analyses show that compared to average faces, individual faces elicit the highest activations in FFA. In addition, group analyses identify and find similar activations in fusiform gyrus and aIT. We conclude that the average faces do indeed lessen FFA and aIT activations, suggesting their joint importance in face processing.

**Acknowledgement** : NSC98-2410-H-006-002-MY2

22.17

## **The Effect of Attention in Face Selective Areas of Bird Experts: Reevaluating the Expertise Hypothesis**

Yu-Jen Tsai, Chun-Chia Kung

Institute of Cognitive Science, National Cheng Kung University, Taiwan

Fusiform Face Area (or FFA) has been associated with at least two possible accounts: face specificity and perceptual expertise. These two views have exchanged over ten some years, with no firm conclusion reached. One recent claim made by supporters of the face specificity was that when experts see the objects of their expertise domain, the increased FFA response is an “overall increased attentional engagement for these stimuli” (McKone et al., 2007). If this hypothesis is correct, we shall predict that when experts view the stimuli of expertise inattentively, their FFA response should be no different than that of a control object class.

In this study, we explicitly test this claim by asking bird experts and novices to engage (and disengage) their attention from faces, bird, and car images. The task consists of a central fixation, occasionally dimming (central task, or unattended condition), and six flanking and consecutive pictures pairs (periphery task, or attended condition). The results show that for experts, the FFA activation for bird-unattended condition is always larger than that of car-unattended, inconsistent with the face specificity hypothesis. This situation is not seen in bird novices.

*Acknowledgement* : NSC98-2410-H-006-002-MY2

22.18

## **High Level Facial Aftereffects Induced by the Non-face Meaningful Objects**

Miao Song, Keizo Shinomori

Kochi University of Technology, Japan

Our previous study shows that the facial aftereffect can occur not only in real face but also in the simple visual stimuli, when this simple stimuli share the same low level visual properties with the face. In terms of this observation , we introduced a novel facial identity adaptation paradigm to investigated the relationship of neural systems processing the face and the non-face meaningful objects, this issue is a long-term debate in the face study. We measured the facial identity aftereffect within the morphing test faces, using the face, the color chip, and the three kinds of non-face objects (i.e., bird, house, apple) as adapting stimuli. All the adapting stimuli share the same color, brightness, and contrast with that of the test face to minimize the influence of adaptation effect from low level. The results show that all five adapting stimuli generated the significant adaptation effect, and the adaptation effect by the real face is significantly stronger than that by the other four adapting stimuli. In terms of these observations, we discussed the theoretical implication for understanding the functional organization for faces and meaningful objects in human sensory system.

*Acknowledgement* : KAKEN B20300081

22.19

## **The Interaction between Face- and Object-selective Areas by Face-like Objects: An fMRI Study**

Yu-Ting Ting, Chun-Chia Kung

Institute of Cognitive Science, National Cheng Kung University, Taiwan

In daily lives, many objects with their “two-eyes-on-top, one-mouth-below” configurations, look like human faces. In one MEG study, Hadjikhani (2009) found that subjects' FFA (Kanwisher et al., 1997), responded similarly to those “face-like objects” as to faces (both peaking around 165ms), providing the first neuroscientific support of those “face-likeness” impressions. However, face-like objects are by default objects, so they should activate object-selective region--LOC (Malach et al., 1995) as well. To investigate the temporal dynamics between FFA and LOC in viewing face-like objects, we use behavioral and fMRI methods to disentangle their relations. Subjects did speeded face-or-object judgments on faces, objects, and face-like objects. First, the behavioral results (N=17) show, that the reaction time of face-like objects are significantly longer than that of faces or objects, suggesting the effect of interaction between face- and object-selective areas. Second, the fMRI results (so far N=10) show that FFA activity for face-like objects is in general lower than that for faces, but higher than that for objects. In LOC, the activity for face-like objects is higher than that for faces, and similar to that for objects. We are currently working on the Granger Causality Mapping to see their inter-relations between FFA and LOC, and other face-and-object processing networks.

**Acknowledgement** : NSC98-2410-H-006-002-MY2

22.20

## **Integrating Auditory and Visual Information in Bird Experts: An fMRI Study**

Yi-Wen Chen, Chun-Chia Kung

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Our brain integrates the multisensory information from various senses: you can recognize the objects either by vision(seeing your mother's face), by audition(hearing your mother's voice), or by both. Where and how the brain integrates different multisensory information? Beauchamp(2004) referred to the Superior Temporal Sulcus(STS) as one of the important sites: they showed that not only did the visuo-auditory combinations(Sheep image + “Meeeh sound”) activated the highest, compared to either audition or vision alone, in STS, but also its activity for the congruent information was higher than the incongruent(e.g., mom's face + papa's voice). How does this integration ability arise? Of course our everyday experience is very important. But in order to show this point, we can't rely on the common scenarios where all of us are expert. Instead, in the current study we recruit bird-watchers, acquiring their behavioral expertise indices by both sequential matching(visual expertise) and visuo-auditory congruency judgments(auditory expertise). The fMRI exp is the event-related version of the same visuo-auditory congruency judgment task. The fMRI results, as we calculate the response difference in STS between two conditions(congruent – incongruent) are highly correlated( $r = .84$ ;  $n=8$ ) with birder's expertise, supporting the importance of experience in the multisensory integration.

**Acknowledgement** : NSC98-2410-H-006-002-MY2

22.21

## **The Uncanny Valley Phenomenon Is Explained by Deterioration of Object Evaluation due to Categorization Difficulty**

Yuki Yamada, Takahiro Kawabe, Keiko Ihaya

Kyushu University, Japan

When the human likeness of non-human objects increases, evaluation of the objects drastically decreases at a certain point (the uncanny valley phenomenon). The present study examined whether this deterioration of object evaluation is related to the cognitive difficulty in categorizing objects into given two categories. In Experiment 1, we employed 11 morphing images generated from images of a real person and a cartoonish person with morphing rates varying from 0 to 100% in steps of 10%. Observers were asked to categorize each image (real or cartoon), and we measured the response latency from the onset of the image as an index of categorization difficulty. Moreover, the observers were asked to evaluate likability of each image on a 7-point scale from -3 (dislikable) to 3 (likable). As a result, the longest latency and the lowest evaluation score were observed at the same morphing rate. In Experiment 2, we obtained the results similar to Experiment 1 by using dog images (real, stuffed, and cartoonish dog). These results suggest that low processing fluency in the images that were difficultly categorized induced negative evaluation of the image, explaining the uncanny valley phenomenon.

*Acknowledgement* : A Grant-in-Aid for JSPS Fellows

22.22

## **Key Dimensions of Visual Object Representation in Macaque AIT**

Chia-Pei Lin, Yueh-Peng Chen, Chou-Po Hung

National Yang-Ming University, Taiwan

One of the main bottlenecks to understanding information processing in higher cortical areas is that we don't know the key dimensions which underlie coding in these areas. At the end of the macaque ventral visual pathway, the anterior inferotemporal cortex (AIT) has been hypothesized to encode anywhere from 36 to a nearly infinite number of shape dimensions via multiple scales of functional organization. Here, we recorded from 64-site multielectrode arrays spanning 1.4x1.4 mm (distance x depth) in AIT of anaesthetized *Macaca cyclopis* monkeys.

We presented two stimulus sets, one consisting of color, grayscale, and silhouette versions of 112 objects, and the other consisting of grayscale images of 240 rendered 3D objects. We applied principal components analysis to the responses at each (~2 mm<sup>2</sup>) location. Remarkably, the ensemble activity patterns were consistent across the independent stimulus sets for each location and differed across locations. Each pattern was differentially driven by subsets of stimuli with opposite features, essentially defining a key dimension in stimulus space for each location. We propose that a collection of such key dimensions, mapped via piecewise reconstruction using imaging methods, would serve as a useful map for exploring object recognition computations and for cortical prosthetics.

*Acknowledgement* : NSC-97-2811-B-010-501, and NSC-98-2321-B-010-003

22.23

## **Rapid Development of Pose and Illumination Invariance in Anaesthetized Macaque AIT via Dynamic Stimulus Correlation**

Daniel Yu-Chun Hsu, Yueh-Peng Chen, Chou-Po Hung

Institute of Neuroscience, National Yang-Ming University, Taiwan

Recent studies have demonstrated rapid (~1 hr) adult plasticity for receptive fields in macaque anterior inferior temporal (AIT) cortex. Such rapid adult plasticity is hypothesized to enable the development of invariant object recognition across changes in pose and illumination, binding the representations of multiple views of the same object. Here, we sought to test whether such rapid plasticity is dependent on mechanisms (e.g. motivation) in awake animals, and to explicitly and quantitatively characterize the role of temporal contiguity in the development of pose and illumination invariance. We presented repeated and contiguous sequences of images of objects at different poses and illuminations at 85 Hz while recording from AIT via 64-site multi-electrode arrays (MEAs). The rapid frame rate and the use of MEAs are designed to increase the likelihood of observing experience dependent plasticity via spike-timing-dependent-plasticity (STDP) mechanisms. We find examples of neurons with increased invariance and others with decreased invariance following training. The changes in invariance were specific to the modality trained (pose or illumination). These results highlight the role of local cortical plasticity excluding reward mechanisms in the rapid development of pose and illumination invariance.

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22.24 Withdrawn

22.25

## **It Is Mine vs. It Looks Familiar – ERP N250 Responses**

Chih-Ying Lin, Man-Ying Wang

Department of Psychology, Soochow University, Taiwan

Is perceptual identification susceptible to self-relevant processing? Miyakoshi et al. (2009) failed to find electrophysiological differences between daily objects that were familiar and those owned by the participant. Current study showed a difference in cognitive neural processing between familiar and one's own objects by adopting a repetition priming paradigm. The ERP N250 responses to consistent and inconsistent probes (i.e., the priming effect) were recorded and compared when participants made same-different judgments to the prime and the probe. Inconsistent probes resulted in stronger N250 than consistent probes (Chauncey & Holcomb, 2008) for unfamiliar and one's own objects, but not for familiar objects. Strongest difference between consistent and inconsistent probes was observed at left prefrontal electrode sites for one's own objects, signaling possible activation of self-memory system (Conway & Pleydell-Pearce, 2000) in the perceptual identification of one's own objects.

**Acknowledgement** : NSC98-2815-C-031-005-H

## Scintillating Bar Illusion

Kun Qian<sup>1</sup>, Takahiro Kawabe<sup>1</sup>, Kayo Miura<sup>1</sup>, Yuki Yamada<sup>2</sup>

<sup>1</sup>Kyushu University, Japan

<sup>2</sup>Japan Society for the Promotion of Science, Japan

Illusory black spots are perceived within luminance patches placed at the intersection of orthogonal gray bars on a black background (scintillating grid illusion; Schrauf, Lingelbach, & Wist, 1997). The present study reported an interesting phenomenon wherein a similar kind of illusory spots were also observed within patches placed either on a horizontal or vertical bar. We named this phenomenon scintillating bar illusion, and examined its relationship to scintillating grid illusion. Both size and shape of patches are critical visual factors for scintillating grid illusion (Qian, Yamada, Kawabe & Miura, 2009). Thus, we tested the effect of these factors on scintillating bar illusion. There were three stimulus factors: patch size (0.33, 0.46, and 0.59 degrees), patch shape (circle, diamond, and square), and bars (horizontal bars only, vertical bars only, and both-bars). Consequently, illusory spots were observed in the horizontal or vertical bar condition though they were significantly weaker than those in the both-bars condition. The strengths of both scintillating grid illusion and scintillating bar illusion peaked at the similar patch size and shape. These results indicate that the two illusions share a common underlying mechanism.

## Functional Organization of Key Dimensions in Human Lateral Occipital Complex

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Institute of Neuroscience, National Yang-Ming University, Taipei, Taiwan

An accurate understanding of the neural representation is required to decode perceptual state from activity in visual cortex. Although the key dimensions in early visual areas can be guessed with high decoding accuracy, such guesswork along semantic or category labels results in poor decoding performance for higher areas and lacks the capability to extrapolate beyond learned categories. To overcome this ‘curse of dimensionality’, we recently developed methods to extract key object shape dimensions from the spike patterns of local neuronal ensembles in macaque inferior temporal (IT) cortex. Here we show that such monkey-derived key shape dimensions activate specific BOLD patterns in the lateral occipital complex (LOC), the human homolog of IT. Four participants viewed images from two independently generated stimulus sets. Images were blocked according to the polarity of the key dimension and by stimulus set. As in monkeys, the human key dimension map appears as discrete patterns of activation tuned to opposing features. Three out of four participants showed significantly higher BOLD activation in anterior LOC for the key dimension stimuli than their low-level feature control. We surmise that key dimensions are likely shared across primate species, supporting a common code for visual object recognition.

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## **Retrieval of Visual Percept by Paired Association of a Visual Stimulus and Transcranial Magnetic Stimulation (TMS): Objective Evidence from a Masking Paradigm**

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<sup>2</sup>Computation and Neural Systems, California Institute of Technology, USA

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TMS to visual cortex interacts with retinal input, altering perceptual experience. When double-pulse TMS is applied following a visual stimulus, an "instant replay" of the percept could be perceived. Furthermore, after repeating several pairs of the visual stimulus and TMS, the replay percept could be retrieved by TMS alone without accompanying with visual stimulus (Liao et al., ASSC '08; Liao & Shimojo, APCV '08). Here, we adopted a masking paradigm developed by Vasudevan et al. (VSS '09) to examine whether the retrieved percept causes similar masking effect as well as the replay. A pattern mask was paired with TMS to produce a spatially and temporally specific replay masking effect on a letter identification task. After ten or five trials, TMS followed by the target letter with identical delay is delivered without the pattern mask. In results, the replay of pattern mask was retrieved by TMS alone to degrade the identification performance. When the pattern mask appeared at a different location from the letter, no masking was observed for replay or retrieved percept. That both the replay and the retrieved percept caused location-specific masking provides objective evidence for a common perceptual mechanism underlying the replay and the retrieval.

*Acknowledgement* : JST, ERATO Shimojo Implicit Brain Function Project

## **Influence on Eye Strain from the Size of Visual Stimulus Examined by Accommodation Response Time**

Rumi Yamada<sup>1</sup>, Hideki Yamaguchi<sup>1</sup>, Hiroyuki Shinoda<sup>1</sup>, Hirokuni Higashi<sup>2</sup>

<sup>1</sup>Ritsumeikan University, Japan, <sup>2</sup>Toshiba Lighting & Technology Corporation

Elapsed time for changing focus from far to near point, accommodation response time (ART), has been studied as an objective measure for eye strain. In our previous studies ART was measured as a function of fixation duration to far point. As the duration becomes longer ART rapidly increases and gradually saturate. The influence on eye strain from the condition and task was estimated by the time constant. In this study the influence from the stimulus size was examined. Stimulus size was 0.37, 0.72, 1.45 and 2.88deg. Its luminance was 26 and 2.6cd/m<sup>2</sup>. Fixation duration to far point was 0, 10, and 20sec. Far point/near point was achieved by insertion of the convex/concave lens in front of eye. When the stimulus image through the convex lens comes into focus the observer presses the keyboard. Then the lens is automatically replaced by the concave lens after a certain delay corresponding to one of the fixation durations. The rate of increase in ART with a fixation duration was higher with the smaller stimulus. When the stimulus size is large enough there's almost no difference in the increase rate. There might be a critical stimulus size and it seems smaller with lower stimulus luminance. *Acknowledgement* : Supported by 4517

22.30

## **The Effects of Stimulus Duration and Preceding Images on Aesthetic Experience**

YI-Woo Lee, Jung Woo Hyun

Department of Psychology, Chungbuk National University, Korea

Two experiments were conducted to investigate the effect of stimuli duration and exposure of preceding image on aesthetic experience. The stimuli were 270 fractal images and 81 pictures of natural scene and these images were estimated on the aesthetic dimension in preparatory survey. In the experiment 1, fractal images were presented for 20, 400, 1000ms and estimated aesthetically. After the fractal image or pictures of natural scene was presented, aesthetic estimation on fractal image was measured in every trial of the experiment 2. The results showed that the shorter stimuli duration, the smaller variance of aesthetic response. After seeing the pictures of natural scenes, fractal images were evaluated as an unattractive. On the other hand, fractal images were appreciated more attractively when the preceding stimuli were unbeautiful fractal images than beautiful fractal images. These results suggest that aesthetic experience is related to the later visual information processing and aesthetic contrast is stronger than assimilation in aesthetic experience.

22.31

## **Tool-use and the Extension of Peripersonal Space: Is Temporal Synchronization Sufficient?**

Jyh-Jong Hsieh<sup>1</sup>, Erik Chang<sup>2</sup>

<sup>1</sup>Institute of Neuroscience, Yang-Ming University, Taiwan

<sup>2</sup>Institute of Cognitive Neuroscience, National Central University, Taiwan

Previous studies reported that tool-use induced extension of peripersonal space (EPS), as evidenced by a dynamic, effector-centered congruency effect between visual and tactile perception whose pattern alternated depending on the way the tools were held. We suspect that the effector-centered EPS induced by tool-use may be a special case of temporal synchronization between one's actions and consequential environmental events. EPS may still occur without physical contact between the effector and its acting site. To examine the sufficiency of temporal synchronization in EPS, we adopted a visual-tactile congruency task which required location discrimination of brief tactile vibrations accompanied by visual flashes on a virtual object which participant could move synchronously and remotely. In Experiment 1 the participant could move a single virtual object at the center of the display and we found the typical congruency effect between the visual and tactile stimuli. Experiment 2 included two virtual objects to create a "crossed" condition in which each hand could move an object at its opposite side, respectively, yet the congruency effect did not alter with the mapping between the hand and its effective site. Taken together, we suggest that temporal synchronization itself is not sufficient to induce plasticity in the peripersonal space.

**Acknowledgement** : NSC 96-2413-H-008-003-MY3

22.32

## **Neural Bases of Transitive and Intransitive Gestures during Perception and Imitation**

Gregory Kroliczak, Scott H. Frey

University of Oregon, USA

Recent fMRI results indicate comparable responses within left parieto-frontal areas during planning both familiar object use (transitive) and nonobject-related (intransitive) gestures for subsequent production with either limb (Kroliczak & Frey, 2009). Yet, neuropsychological evidence suggests a double dissociation between these gesture subtypes. Using fMRI we tested whether distinct neural representations support perception and imitation of transitive vs. intransitive gestures. Twelve right-handed, English speaking adults watched and then imitated gestures performed by an actor in 2.75-s videos. Neural responses to movies depicting transitive and intransitive gestures were used to determine if different areas might be involved in their perception. We also directly contrasted activity associated with imitation of transitive and intransitive gestures. Watching transitive gestures invoked stronger activation within several areas, including right lateral occipital cortex. The inverse contrast did not yield any activation. Whereas imitation of transitive gestures resulted in greater activity in left dorsal premotor cortex, imitation of intransitive gestures invoked stronger bilateral activation in parietal operculum and medial prefrontal cortex, and right anterior intraparietal cortex and precuneus. These findings suggest that transitive gestures are more demanding to process visually. Consistently with prominent models of praxis they also indicate that the two gesture categories can be dissociated during imitation. *Acknowledgement* : LCNI SPS to GK

22.33

## **Driver's Gaze Control to Modulate Steering Performance in Accuracy and Workload**

Mitsuhiro Yoshida<sup>1</sup>, Ken Wakata<sup>2</sup>, Naoyuki Matsuzaki<sup>2</sup>, Michiteru Kitazaki<sup>2</sup>

<sup>1</sup>Toyohashi University of Technology, Japan

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Drivers utilize near visual information to control their car position accurately, and far visual information to make a plan of steering (Land and Horwood, Nature 1995). Drivers' steering accuracy was deteriorated by occluding near visual fields, and their workload was increased by occluding far visual fields (Kishida et al, SAE 2009). We aimed to investigate if driver's gaze control to a near or far region modulates their steering performance. Experiments were conducted using a driving simulator, where we manipulated drivers' gaze using a fixation point with varying car's speed. The car's lateral displacement from the road center and the steering angle speed were measured as a driving accuracy index and a workload index, respectively. We found that drivers' steering was more accurate with looking at a nearer region, and their workload decreased with looking at a far region. The slower car simulation increased the driving accuracy, particularly with a near gaze. The faster car increased workloads more with the near gaze than the far gaze. Thus, the gaze control to a near region is effective for the accurate steering without increasing workloads when a car is slow, while the far gaze is effective for decreasing workloads with a faster car. *Acknowledgement* : Supported by Nissan Science Foundation

22.34

## **Separating the Contributions of Radial Flow, Splay and Bearing Angle Information to Lane-keeping Control**

Jing Chen, Li Li

Department of Psychology, The University of Hong Kong, Pokfulam, Hong Kong SAR

While bearing, radial flow, and splay angle information can all contribute to accurate lane-keeping control, previous studies have reported that people rely mainly on splay angles provided by lane edges for lane keeping. In this study, we aimed to separate the contributions of these three types of visual cues to lane keeping. The displays simulated observers steering down a straight path defined by either a pair of posts (providing only bearings) or a part of lane markers (providing bearings and splay angles), and the ground plane contained no flow, sparse flow, or dense flow information. Observers used a joystick to control their movement to stay in the center of the lane while facing random perturbations to both their simulated gaze direction and their lateral position in the lane. The lateral position perturbations affected the use of radial flow, bearing, as well as splay angle cues for lane keeping, but the gaze perturbations affected the use of only bearings. We found that performance improved as more flow information was added to the scene regardless of the presence of bearings or splay angles. In the presence of splay angles, observers would ignore bearings and rely mainly on splay angles for lane keeping.

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22.35

## **Discrimination of Locomotion Direction in Impoverished Displays of Walkers by Macaque Monkeys**

Joris Vangeneugden<sup>1</sup>, Kathleen Vancleef<sup>1</sup>, Tobias Jaeggli<sup>2</sup>, Luc Van Gool<sup>2,3</sup>, Rufin Vogels<sup>1</sup>

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A vast literature exists on human biological motion perception in impoverished displays, e.g. point-light walkers. Less is known about the perception of impoverished biological motion displays in macaques. We trained 3 macaques in the discrimination of facing-direction (left versus right) and forward versus backward walking using motion-capture-based locomotion displays (treadmill walking) in which the body features were represented by cylinder-like primitives. The displays did not contain translatory motion. Discriminating forward versus backward locomotion requires motion information while the facing-direction/view task can be solved using motion and/or form. All monkeys required lengthy training to learn the forward-backward task, while the view task was learned more quickly. Once acquired, the discriminations were specific to walking and stimulus format but generalized across actors. Although the view task could be solved using form cues, there was a small impact of motion. Performance in the forward-backward task was highly susceptible to degradations of spatio-temporal stimulus coherence and motion information. These results indicate that rhesus monkeys require extensive training in order to use the intrinsic motion cues related to forward versus backward locomotion and imply that extrapolation of observations concerning human perception of impoverished biological motion displays onto monkey perception needs to be made cautiously.

## Influence of Vection Stimuli Arranged along a Road on the Car Driver

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It is common for the car drivers to judge the speed of their cars by the objects moving outside. The purpose of this study is to know whether the moving visual stimuli placed in a line along the road can yield vection to a driver so that the drivers can have the sensation of higher or lower speed than that the drivers would have in the natural scene. The computer simulated 3D highway-driving scene was presented on the hemisphere-screen of 8.5m diameter that produced a wide visual field of 120 deg. The vection stimuli consisted of gray boards placed along both side of the road. They were moving to make a forward vection with different speeds from other surrounding objects. The observers estimated their sensations of speed with the method of paired comparison. Twenty observers participated in this experiment. It was shown that the speed sensation perceived by the observer was modified by the vection stimuli, even when the surrounding objects moved at the same speed, in such a way that the speed sensation increased with the moving speed of the vection stimuli. Our results suggest the moving stimuli along a road could influence the driver's sensation of speed.

## Looking Where You are Going Does Not Help Path Perception

Joseph Cheng, Li Li

The University of Hong Kong, Hong Kong

It has been mathematically shown that when travelling on a circular path and fixating a target on the future path, flow lines for environmental points on the path would be vertical. Here we test whether fixating a target on the future path helps path perception. Observers viewed displays (110°Hx94°V) simulating their traveling on a circular path over a textured ground ( $T=3$  m/s,  $R=\pm 3^\circ/s$  or  $\pm 6^\circ/s$ ) for 1 s. Three display conditions were tested. In the path-fixation condition, the simulated gaze direction in the display pointed to a target along the path at 20° away from the starting position; in the non-path-fixation condition, the simulated gaze direction was on a target 10° inside or outside the path at the same distance; and in the heading-fixation condition, the simulated gaze pointed to the instantaneous heading (i.e., the tangent to the path). At the end of the trial, observers used a mouse to place the probe (10 m) on their perceived future path. We found that path perception largely depends on solving the translation and rotation problem in retinal flow, fixating a target on the future path does not help the perception of the path trajectory.

**Acknowledgement** : Hong Kong Research Grant Council, HKU 7471//06H

## Keynote Lecture

(Sunday, July 25, 16:45-17:45, The Forum)

K3 : Christopher W. Tyler (Smith-Kettlewell Eye Research Institute, USA) :  
The Human Representation of Visual Space through the Millennia

## Symposia : The Perception of Colored Patterns, Materials, and Scenes

(Sunday, July 25, 9:00-11:00, The Forum)

S3-1

### **Visual Perception of Material Changes**

Qasim Zaidi

SUNY College of Optometry, USA

In snapshots, scenes consist of things. In reality, the world consists of processes. Some are repetitive like foliage through seasons or terrain becoming wet then dry, others are unidirectional like fruit ripening and decaying, water damage, or dust accumulating. Chemical and physical properties of objects are manifested as patterns of colors and textures, which are altered by endogenous and exogenous factors. To examine how observers identify these changes, we used calibrated images acquired from 15 viewpoints of 26 materials, including fruits, foods, woods, minerals, metals, fabrics and papers, undergoing changes like drying, burning, decaying, rusting, oxidizing and heating. The images revealed that material changes exhibit complex spatial and chromatic patterns, e.g. specular and diffuse components are affected differently by dust, and the spatial pattern of drying is different on stone than on fabric. Observers identified type of material and change for colored and achromatic images. Color cues improved performance in all conditions but most dramatically for organic materials. Interestingly, material changes create natural “metamers”, e.g. wetting and polishing are confused for hard materials, while bleaching and drying are confused for porous materials. We hope to elucidate the role of color in object recognition through its role in material perception. *Acknowledgments:* Grants EY07556 & EY13312 to QZ.

S3-2

### **Color Vision for Objects Made of Different Materials**

Karl R. Gegenfurtner

Justus-Liebig-Universität Giessen, Germany

The objects in our environment are made from a wide range of materials. The color appearance of the objects is influenced by many factors, including the geometry of the illumination, the three-dimensional structure of the objects, and the surface reflectance properties of their materials. Only few studies have investigated the effect of material properties on color perception. In most of these studies the stimuli were three-dimensional objects rendered on a computer screen. Here we set out to investigate color perception for real objects made from different materials. The surface properties of the materials ranged from smooth and glossy (porcelain) to matte and corrugated (crumpled paper). We tested objects with similar colors made from different materials and objects made from the same material that differed only in color. Observers matched the color and lightness

of the objects by adjusting the chromaticity and the luminance of a homogeneous, uniformly colored disk presented on a CRT screen. In general observers' matches were close to the true chromatic and luminance distributions due to the objects. However, observers systematically tended to discount the variations in reflected light induced by the geometry of the objects and rather matched the light reflected from the materials themselves.

S3-3

## **Perception of Colorful Natural Scenes**

Shin'ya Nishida

NTT Communication Science Laboratories, Japan

(i) Color provides useful information about whether bright spots on a surface body are highlights, or splashed ink. For instance, white spots on a red body are seen as highlights, but red spots on a white body are not, even when the luminance profiles are identical in the two cases. This suggests that the human visual system utilizes a physical rule of optics that the color spectrum of highlight normally includes the spectrum of the surface body (Nishida et al, 2008, VSS). (ii) When chromatic contrasts are increased (decreased) while luminance contrasts remain the same, or when luminance contrasts are decreased (increased) while chromatic contrasts remain the same, natural photos look unnaturally oversaturated (undersaturated). A clear perceptual sign of oversaturation is unnatural self-glowing of normal objects, such as apples and oranges (Nakano et al, 2009, VSS). For both (i) and (ii), the human brain should compute natural luminance-color relationships. I will discuss that a redundant color representation consisting of multiple intensity images for different color bands, like a set of RGB images, may be more suited for processing luminance-color interactions in natural scene, than the orthogonal color representation consisting of an achromatic channel and two chromatic opponent channels.

S3-4

## **Interactions in the Processing of Color and Orientation**

Colin Clifford

University of Sydney, Australia

According to the modular view of visual processing, different aspects of a scene, such as its colour, form and motion, are analyzed by dedicated and anatomically distinct sub-systems. Modularity creates a binding problem: representations of the various features of an object are distributed across brain areas but must be associated with, or bound to, the same object. These issues are controversial – just how modular is the visual system, and is there really a binding problem? Here, I describe evidence from psychophysics and fMRI indicating that the processing of colour and orientation is closely coupled early in visual cortex, challenging the strongly modular view of vision. This coupling appears to alleviate the binding problem for colour and orientation. However, for more complex forms, the functional architecture appears to be essentially modular and a marked binding problem demonstrably exists.

Symposia : Spatial and Temporal Aspects of Perception and Attention

(Sunday, July 25, 13:30-15:30, The Forum)

S4-1

**Successes and Failures of Perception on the Fly**

Alex O. Holcombe

University of Sydney, Australia

Hurrying past other passengers on a subway platform, running down the basketball court towards the net, driving on a lonely country highway— this is perception on the fly, when one must perceive the arrangement of objects as they move rapidly across one's retina. Some perceptual qualities, such as motion direction and edges, are computed with high temporal resolution and are perceived even at high speeds. However, some aspects of the visual world cannot be apprehended. To investigate the speeds above which various information is lost, two concentric circular arrays of objects orbit fixation at variable speed. At high rates, the color of each patch is easily perceived. However, judging which patches are aligned cannot be done accurately above a low speed of 1.3 revolutions per second. Furthermore, judging the order of the sequence of colors around a single ring could only be done at similarly low rates. Finally, keeping track of a single object as it revolves round and round was also very limited, to about 1.4 rps. These failures of perception on the fly may reflect a limit on the ability of attention to keep up with moving objects and feed selected objects into visual cognition.

S4-2

**Objects, Space and Time: How Perceptual Grouping Affects Temporal Perception**

David I. Shore

McMaster University, Canada

Perceptual grouping provides a fundamental organizing factor in understanding the environment. Simple features are bound together into objects, which form the basis for both perception and action. Within this context, the perceived relative onset of stimuli can be very different if they come from the same object or from two different objects. Using Temporal Order Judgments (TOJs), these relations were explored across different modalities and within the visual modality alone. Poorer perception was usually observed when stimuli were presented from the same location in space and the same object. The one interesting exception occurs with the pairing of audition and touch. Discussion will focus on the potentially special role of vision in organizing perception in space.

S4-3

## **Hemispheric Constraint and Eye Specificity of Spatial Attention**

Sheng He

University of Minnesota, USA

Stimuli presented on opposite sides of the vertical meridian initially project to different hemispheres. For a target (grating or letter) presented near the vertical meridian, we observed a stronger spatial crowding effect when a distractor was on the same side of the meridian compared with an equidistant distractor on the opposite side. No such ipsi vs contra modulation was observed across the horizontal meridian. These results constrain the cortical locus of the crowding effect to a stage where left and right visual spaces are represented discontinuously, but the upper and lower visual fields are represented continuously, likely beyond the early retinotopic areas.

In addition to the hemispheric constraint, we also showed that attending to a monocular cue while remaining oblivious to its eye of origin significantly enhanced the signal strength of a stimulus presented to the cued eye. Furthermore, this eye-specific attentional effect is insensitive to low-level properties of the cue, but depends on the attentional load on the cue. Thus voluntary attention could be eye-specific, modulating visual processing associated with a specific monocular channel, despite the fact that observers normally do not have explicit access to the eye-of-origin information.

S4-4

## **Transient Attention and Perceptual Tradeoffs**

Yaffa Yeshurun

University of Haifa, Israel

In this talk I will present a mechanism of transient attention that takes into account the tradeoffs between segregation and integration processes and between the spatial and temporal domains. Specifically, I will suggest that attention facilitates spatial segregation and temporal integration but impairs their counterparts –spatial integration and temporal segregation. Support for this mechanism is derived from various studies that explored the effects of transient attention on various temporal and spatial processes such as enhancement of spatial resolution, degradation of temporal resolution, prolongation of perceived duration, prolongation of temporal integration, and degradation of spatial integration. I will further suggest a possible physiological instantiation of this mechanism: an attentional preference for parvocellular over magnocellular neuronal activity. Finally I will present evidence in support of this physiological instantiation. This will include evidence from different stimuli and paradigms including attentional effects on selective adaptation, isoluminant stimuli, reversed apparent motion, and the steady-pedestal and pulsed-pedestal paradigms.

Talk Session : Motion II  
(Sunday, July 25, 9:00-11:00, Socrates)

31.01

**Dynamic Feature Change Affects the Object Persistence**

Lizhuang Yang<sup>1</sup>, Zhifang Shao<sup>2</sup>

<sup>1</sup>Department of Psychology, Chinese University of Hong Kong, Hong Kong

<sup>2</sup>Department of Psychology and Cognitive Science, East China Normal University, China

According to the object file theory (Kahneman et al., 1992), object persistence is guided by position consistency (or spatial-temporal continuity) instead of object's visual features. This study aimed to test whether changing dynamics (gradually or abruptly) of feature had influence on object persistence. Object reviewing paradigm was used and object persistence was indicated by the Object Specific Preview Benefits (OSPBs). From experiment 1 to 3, OSPBs in 3 kinds of changing dynamics (no change, gradual change and abrupt change of object's size) were measured separately. The result showed that object persistence was preserved in no change condition and abrupt change condition while not in the gradual change condition. The abrupt change have no effect on object persistence may because the change happens at the final frame of motion while object persistence had been preserved during previous frames. In the following 3 experiments, object persistence were measured when the object's shape unchanged, changed abruptly at the first frame of motion and change gradually during the motion. The results showed that no significant OSPBs were found when object shape changed, no matter gradually or abruptly.

**Acknowledgement** : B08012

31.02

**Humans Use both Form and Motion Information for Heading Perception**

Li Li, Diederick Niehorster, Joseph Cheng

The University of Hong Kong, Hong Kong

It has long been known that humans use the focus of expansion (FOE) in a radial optic flow pattern to perceive their instantaneous direction of self-motion (heading). Here we report that motion-streak-like form information is also used for heading perception. We presented observers with an integrated form and motion display in which the dot pairs of a radial Glass patterns were oriented toward one direction on the screen (the form FOE) while moving in a different direction in depth (the motion FOE). Heading judgments were strongly biased towards the form FOE. We then manipulated the global form strength in the integrated display by randomly orienting certain dot pairs in the radial Glass pattern. As the global form strength in the radial Glass pattern decreased, so did the heading bias towards the form FOE. Lastly, we examined how the local effect of each dot-pair orientation on its perceived motion direction shifted heading estimation. We found that the visual system functioned like a maximum-likelihood integrator in combining the global and local interactions between form and motion signals for heading perception. The findings support the claim that humans make optimal use of both form and motion information for heading perception.

**Acknowledgement** : Hong Kong Research Grant Council, HKU 7471//06H

## **Perceived Trajectory of Moving Object under Normal- and Hyper-gravity Conditions**

Hirohiko Kaneko<sup>1</sup>, Takuya Asano<sup>1</sup>, Takuo Inui<sup>2</sup>

<sup>1</sup>Tokyo Institute of Technology, Japan

<sup>2</sup>Japan Air Self-Defense Force, Japan

An object moving vertically with downward acceleration appears to move with uniform velocity. This bias in motion perception could be related to the motion bias in the natural environment produced by the gravitational acceleration. In this study, we investigated whether this motion bias differs depending on the magnitude of environmental acceleration. Visual stimulus was a moving object on the frontal plane with various magnitude of vertical acceleration. In the first experiment, the object was moving vertically and the subject responded whether the stimulus was accelerated or decelerated. In the second experiment, the object was moving horizontally and the subject responded whether the stimulus was moving upward or downward. We manipulated environmental acceleration along the vertical axis of the body from 1 G up to 2 G using a flight simulator and determined the acceleration magnitudes contained in the perceived motions with uniform velocity and with straight trajectory. The results showed that the acceleration bias in the perceived motion was greater in the hyper-gravity conditions than in the normal-gravity condition. This result suggests that the perceptual baseline for motion perception does not depend on the experience of visual motion but on the vestibular signal or on the eye movement signal.

## **Visual Processing of Impending Collision of a Looming Object**

Hong-Jin Sun<sup>1</sup>, Jingjiang Yan<sup>2,3</sup>, Hong Li<sup>2,3</sup>, Bailey Lorr<sup>1</sup>

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When an object moves toward an observer, the expansion of the retinal image of the object can be used to process information about impending collision. It has been proposed that an optical variable called tau can inform the observer about the "time-to-collision" which refers to the time that will elapse before the observer collides with the object. In the present study we examine whether human visual system can encode tau by directly manipulating the visual information of the retinal image independently from other cues (e.g., distance information). Observers were presented with a visual display of an object moving on a collision course toward the observer. In a relative time-to-collision judgment task, the physical size of object was sometimes made to either expand or contract while approaching the observer. These increases or decreases in object size altered the relative rate of retinal image expansion that occurred during the approaching movement. It was found that expanding the size of the object (decreasing the tau value) caused an underestimation of time-to-collision while contracting the object (increasing the tau value) led to overestimation of time-to-collision. The results indicate that observers are able to use the tau strategy to process impending collision.

## The Perception of Visual Acceleration

Brian Timney, Akos Solti, Sherene Fernando

University of Western Ontario, Canada

We measured thresholds for the detection of acceleration. Subjects were required which of two temporal intervals contained dots that were accelerating. The measurements were made for a range of starting velocities and presentation durations. We also measured speed discrimination under identical conditions. Acceleration thresholds increased systematically as a function of start velocity. Thresholds also varied with the duration of stimulus presentation, requiring greater acceleration rates for a shorter presentation. A subsequent analysis was directed towards the question of whether the perception of visual acceleration is direct; i.e. mediated by "acceleration detectors" in the visual cortex, or whether it is a second-order process in which acceleration is "inferred" by the visual system when it detects that the speed of a target is detectably different from its starting velocity. When the data were replotted as a function of final velocity achieved, rather than acceleration rate, the differences due to presentation duration were eliminated. These results suggest that the perception of acceleration is indirect and contingent on the recognition of speed differences. A direct comparison of the acceleration and speed discrimination data showed that thresholds for velocity differences in both speed and acceleration conditions were very similar.

*Acknowledgement* : University of Western Ontario

## Position-dependent Perceptual Organisation of an Ambiguous Global Motion Pattern

Alan Johnston<sup>1</sup>, Andrew Rider<sup>1</sup>, Shin'ya Nishida<sup>2</sup>

<sup>1</sup>University College London, United Kingdom

<sup>2</sup>NTT Communication Science Laboratories, Japan

Local motions are often ambiguous due to the aperture problem. Multiple ambiguous motions combine to give unambiguous perceptions of rigid translation (Amano et al., 2009; doi:10.1167/9.3.4) or rotation (Rider and Johnston, 2008, ECVF). For translation, the velocity can be found by a least squares fit to the intersection of the constraints. This solution is unique if the 1D motions are not all parallel. We can use a similar least squares method to find the centre and speed of rotation for a rotating stimulus. Again the 1D motions must be non-parallel but one further criterion is needed to provide a unique solution. We constructed an array of drifting Gabors that fails to meet this criterion and is therefore consistent with an infinite number of rotations. Perception varies with position in the visual field (Rider et al., 2010, VSS). Combining two such arrays gives a stimulus that is consistent with a single global rotation. This array appears coherent when the global rotation centre is close to fixation and separates into two transparent rotations when the global centre is in the periphery. The visual system can compute several solutions to ambiguous motion stimuli but we perceive only one solution at a time.

*Acknowledgement* : BBSRC BBF01354X1

## **The Dual Egocenter Hypothesis Can Explain Directional Discrimination between a Visual Target and a Kinesthetic Target**

Koichi Shimono<sup>1</sup>, Atsuki Higashiyama<sup>2</sup>

<sup>1</sup>Tokyo University of Marine Science & Technology, Japan

<sup>2</sup>Ritsumeikan University, Japan

We examined the hypothesis (Shimono & Higashiyama, 2009) that angular errors in visually directed pointing can be due to the difference of locations of visual and kinesthetic egocenters. This hypothesis assumes that direction of the target judged from the visual egocenter between the two eyes is transferred to the kinesthetic space where its direction is judged from the kinesthetic egocenter between the neck and the hand-shoulder assembly used to point. Seven observers judged whether kinesthetic direction of a target, touched with the left or right hand after it was seen in advance, was the right or left of the visual target, or whether visual direction of a target, seen after it was touched with one hand, was to the right or left of the kinesthetic target. Consistent with the hypothesis, the results showed that the kinesthetic direction judged with the right hand shifted to the right of that judged with the left hand, and the visual direction after the right hand was used shifted to the left of that after the left hand was used.

**Acknowledgement** : 20530661 (JSPS)

Talk Session : Form & Surface  
(Sunday, July 25, 13:30-15:30, Socrates)

32.01

**Adaptation-induced Blindness and Spatiotemporal Filling-in**

Isamu Motoyoshi

NTT Communication Science Laboratories, Japan

We recently showed that adaptation to dynamic stimuli strongly suppresses the conscious detection of a sluggish target (Motoyoshi & Hayakawa, 2008, 2010). Here, we used this adaptation-induced blindness (AIB) to distinguish visual functions achieved via unconscious and conscious neural processes. The adapting stimulus was an annular contour of 3.4 deg diameter flickering at 8 Hz in the peripheral, and the test was a filled bright disc of the same diameter gradually presented at the same location. We found that following adaptation to the flickering annulus, the whole disc became invisible even though the central region of the disc was not subject to adaptation. We also found that when a small square patch of constant luminance was embedded in the center of the test disc, the patch appeared to be darkened even though the test disc was invisible. These results indicate that AIB disrupts filling-in, but not spatial contrast, of brightness, leading to a notion that integrative visual processes are more correlated with the conscious awareness than the analytical processes.

32.02

**An EEG Analysis of Visually Evoked Responses to Modally and Amodally Completed Contours**

Branka Spehar, Yumiko Otsuka, Mark Schira

The University of New South Wales, Sydney, Australia

A number of visual phenomena share the property that boundaries and shapes are perceived in locations where no local information is present. Central to many models of these phenomena is the assumption that they are mediated by the common underlying mechanism. Here we investigated visual evoked potentials (VEP) in response to Kanizsa type inducers that support modal completion, amodal completion or no completion in inward-oriented configurations that were closely matched in terms of local geometry and luminance. The equivalent, but outward-oriented configurations served as a control. We found significantly greater negativity for the inward- compared to the outward-oriented inducers in both 150-210ms and 240-270ms period. However, significant difference between modal and amodal configurations emerged only in 240-270 ms period. The time/frequency decomposition analysis revealed significantly higher mean Alpha amplitude (8-12 Hz) during 150-210 period for modally completed stimuli compared to their outwardly oriented control configurations. However, there was no difference in the mean Alpha amplitude between amodally completed and control configurations.

**Acknowledgement** : Australian Research Council DP0666441

32.03

## **Spatial Configuration Specific Surround Modulation of Global Form Perception**

Hsin-Hung Li, Chien-Chung Chen

Department of Psychology, National Taiwan University, Taiwan

We studied how the detection of a Glass pattern (target) can be modulated by the presence of a surround Glass pattern (mask). The stimuli were Glass patterns consisted of random dot pairs (dipoles). The orientation of dipoles conformed a designated geometric transform to create a percept of concentric, radial, spiral or translational global forms.

In Experiment 1, the target was presented in a central disc surrounded by an annulus mask. In Experiment 2, the target was presented in an annulus while the masks were placed either inside or outside the target annulus. We measured the target coherence threshold with and without the presence of masks. For concentric targets, the concentric and the spiral masks increased the thresholds in both experiments while the radial mask had little effect, and the outer mask produced greater effect than the inner mask. For radial targets, the threshold was elevated only by spiral mask in Experiment 1, and in Experiment 2, the form tuning of this masking effect is broader. The threshold elevation of radial target was similar regardless the target-mask configuration. No surround modulations were found for translational or spiral targets.

Our results suggest a configuration specific lateral interaction among global form detectors.

*Acknowledgement* : NSC 96-2413-H-002-006-MY3

32.04

## **Unnoticed Explanation of the ‘Transparency on Contrast’ Pattern**

Shinya Takahashi

Nagoya University, Japan

The ‘transparency on contrast’ pattern, originally presented by Albert (2006) and examined by Takahashi (2006), was reconsidered. This pattern comprises two middle-gray test fields of equal lightness, the lighter/darker inner inducing fields and the even-lighter/even-darker outer inducing fields. The test fields change their apparent lightness in keeping with traditional lightness contrast phenomenon. What is intriguing is that this lightness illusion is more prominent in this pattern than in a pattern omitting the inner inducing fields where the test fields are directly surrounded by the even-lighter/even-darker fields. Observation of the stereo versions and the moving versions of this pattern shows that the illusion becomes stronger when the test fields look like transparent patches put together with the other transparent surface (inner inducing fields) than when they look like opaque patches seen through the transparent surface. It was argued that the lightness illusion seen here is different in nature from other lightness illusions usually explained by the ‘discounting’ theory, and should be understood as the result of a perceptual reorganization of the entire pattern caused by the transparency perception. In addition, chromatic illusions in a similar configuration were introduced.

32.05

## Representation of Surface Materials in Human Visual Cortex

Naokazu Goda, Chihiro Hiramatsu, Hidehiko Komatsu

National Institute for Physiological Sciences, Japan

We can easily discriminate and identify material of a surface (wood, metal, fabric etc) at a glance. Little is known, however, about the neural bases of this ability. Here we used functional MRI (fMRI) to uncover how information of the surface material is represented in human visual cortex. We measured the physical, perceptual, and neural similarities between pairs of nine material categories, each of which consisted of eight different realistic, synthesized images with controlled 3D shape. Physical similarities for each pair of categories were obtained from statistics of image features (spatial frequency and color histogram); perceptual similarities were obtained based on perceptual material space measured with a semantic differential method; and neural similarities in various cortical regions were obtained from a multivoxel pattern analysis of the fMRI data. We found that the neural similarities in various cortical regions correlated with the physical and perceptual similarities differently; the early visual areas mainly reflected physical similarities, whereas neural similarity in the ventral-occipital region including fusiform gyrus reflected perceptual similarity. This finding indicates that representation of surface materials is transformed along the ventral pathway: from image-based representation in early visual areas into perceptual category representation in the ventral-occipital region.

**Acknowledgement** : 17022040

32.06

## Extracting Shape and Material Properties from the Same Surface Cues: an fMRI Study

Mel Goodale<sup>1</sup>, Melvyn A. Goodale<sup>2</sup>, Jonathan S. Cant<sup>3</sup>

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<sup>2</sup>Centre for Brain and Mind, University of Western Ontario, London, Ontario, Canada

<sup>3</sup>Vision Science Laboratory, Psychology Department, Harvard University, Cambridge, Massachusetts, USA

We used fMRI to investigate the brain areas that extract different kinds of information (shape vs. material) from an object's surface cues. Participants attended to differences in the shape (flat/convex), texture (wood/rock), or material properties (soft/hard) of a set of circular visual surfaces. Attending to surface curvature activated the lateral occipital area (LO) whereas attending to texture activated a region of the collateral sulcus (CoS) within the parahippocampal place area (PPA). Attending to material properties activated the same texture-sensitive region in the CoS as well as a dorsal sub-division of the left LO. Our results suggest that the processing of surface texture, which takes place within the scene-sensitive PPA, is a route to accessing stored knowledge about the material properties of objects. In addition, the results suggest that area LO has a complex organization, with neurons tuned not only to the outline shape of objects, but also to their surface curvature, independent of contour, and to aspects of their material properties. We argue that the organization of category-selective areas in the ventral stream may arise in part from specialization within different areas for the processing of the stimulus attributes that best define those categories.

## Poster Presentations

Morning Session: Sunday, July 25, 11:10-12:00, Plato (Odd Numbers Present)

Afternoon Session: Sunday, July 25, 15:40-16:30, Plato (Even Numbers Present)

33.01

### **Effects of Retinal Eccentricity on Jitter Advantage in Visually Induced Self-motion Perception**

Shinji Nakamura

Nihon Fukushi University, Japan

It is well-known that uniform visual motion can induce illusory self-motion perception in the direction opposite to the inducer's motion (vection). Recently, it has been revealed that visual expansion which contains additional jitter components (visual motion alike as external scene shot by camera which was moved forward with "camera-shake") can induce much stronger forward self-motion perception than pure radial expansion (jitter advantage). In this investigation, the effect of retinal eccentricity on which the visual jitter was adopted was analyzed; the expanding visual pattern was presented on observer's entire visual field, while the dots in the pattern contained jitter components only in the central or peripheral portion of it. Radius on the central area or inner radius of the peripheral area where the jitter motion was adopted was also manipulated. The result of psychophysical experiment indicated that 1) the jitter advantage was greater in the condition where the stimulus area with jitter motion was larger, and 2) the jitter advantage was slightly robust in the central visual field than in the peripheral visual field. These results would be useful in considering perceptual mechanism underlying the jitter advantage in self-motion perception.

33.02

### **Effects of Abrupt Color and Luminance Change on Reappearance in Motion-induced Blindness**

Masato Kawano<sup>1</sup>, Kazuhiko Ukai<sup>2</sup>, Katsuaki Sakata<sup>3</sup>, Shigehito Tanahashi<sup>2</sup>

<sup>1</sup>Graduate School of Advanced Science and Engineering, Waseda University, Japan

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<sup>3</sup>College Art and Design, Joshibi University of Art and Design, Japan

Motion-induced blindness (MIB) is a remarkable phenomenon by which salient static stimuli disappear when surrounded by moving stimuli. Regarding causes of MIB, Bonneh et al. (2001) reported that visual attention was engaged by a superimposed moving pattern. Additionally, Theeuwes et al. (1995) described that visual attention was engaged by a change in luminance or chromaticity. This study investigated the detection disappearance duration, as affected by abrupt luminance or chromaticity change of a target, after a stimulus' disappearance (Experiment 1). We presented two red dots (targets) together with 49 blue cross patterns arranged in a grid (mask) rotating around its center fixation point. Observers were instructed to hold the ENTER key of a computer keyboard while gazing at a fixed point when the left target became invisible. Observers released the ENTER key when the left target became visible. Results show that the disappearance duration was reduced by the changing luminance or chromaticity. The next experiment varied the luminance change magnitude (Experiment 2). However, no significant difference was found in the disappearance duration. Therefore, we infer that abrupt change of the target factor (luminance, chromaticity) is more important in relation to MIB than the luminance change magnitude.

## Effects of Surrounding Motion on Motion Segregation

Hiromasa Takemura<sup>1</sup>, Ikuya Murakami<sup>2</sup>

<sup>1</sup>The University of Tokyo, Japan, <sup>2</sup>Department of Life Sciences, The University of Tokyo, Japan

Motion segregation and center-surround interaction are important processes in identifying specific motion components of objects from background stimuli. However, functional relationship between motion segregation and center-surround interaction is unclear. Here we examined how surrounding motion affects motion segregation in a central field. A vertically moving random-dot pattern was presented in the surround, and in the center two random-dot patterns moving leftward and rightward were superimposed. The surrounding motion perceptually induced a vertical illusory motion in the central field (induced motion). In this stimulus, subjects perceived the central stimulus as moving in a purely vertical direction at shorter stimulus durations. However, at longer stimulus durations (around 300 ms or longer), subjects reported that the central stimulus appeared as transparent patterns moving in two oblique directions. Thus, a summation occurred between a vertical illusory motion and a horizontal physical motion in each central pattern. Durations required for segregating two oblique motion components were much longer than those required for perceiving two horizontal motions without illusory motion. Our results suggest that processes for motion segregation and center-surround interaction can interact under the constraint that computational cost for integration between induced and physical motions is higher than that for motion segregation per se. *Acknowledgement* : Grant-in-Aid for JSPS Fellows

## Multimodal Integration in Perceiving Direction of Self-motion from Real Somatic Motion and Orthogonally Directed Optic Flow Pattern

Toshio Kubodera<sup>1</sup>, Philip Grove<sup>2</sup>, Shuichi Sakamoto<sup>3</sup>, Yo-iti Suzuki<sup>3</sup>, Kenzo Sakurai<sup>1</sup>

<sup>1</sup>Department of Psychology, Tohoku Gakuin University, Japan <sup>2</sup>School of Psychology, The University of Queensland, Australia <sup>3</sup>Research Institute of Electrical Communication, Tohoku University, Japan

We measured observers' perceived direction of self-motion resulting from the simultaneous presentation of visual and vestibular information, each simulating a different direction of motion. Sakurai et al. (2003) reported that when observers experienced real leftward/rightward somatic motion while viewing a visual expanding/contracting optic flow pattern consistent with forward/backward self-motion, their perceived motion direction was intermediate to those specified by visual and vestibular information. Here, we extend that study to other combinations of real somatic motion and orthogonally directed optic flow patterns, ascertaining observers' perceived directions as a function of visual amplitude at different vestibular amplitudes. Observers were seated on an oscillating motor-driven swing providing real motion (leftward/rightward, forward/backward), while they viewed a orthogonally directed visual oscillatory optic flow pattern (upward/downward, leftward/rightward, forward/backward) phase-locked to the swing motion. Observers performed a rod-pointing task and reported their perceived direction of self-motion for each combination of visual and vestibular information. Observers' direction judgments progressively favored the direction specified by vision with larger amplitudes of optic flow. This effect was mediated by swing amplitude such that the effect of vision increased with optic flow amplitude more rapidly for small swing amplitudes than at large swing amplitudes. *Acknowledgement* : Supported by Grant-in-Aid of MEXT for Specially Promoted Research (no. 19001004) to YS, and ARCIF LX0989320 to PG.

## The Transparency Effect on Plaids Illusion

Jy-Chyi Yuan

Department of Psychology, Fu-Jen University, Taiwan

Plaids motion illusion is relative to motion perception, transparency effect, depth perception (figure-ground separation), and aperture problem. First experiment finds random dot can cancel the aperture problem of the single grating. Second experiment manipulate the gray level of the interposition area of the two gratings composed the plaids. The results show that when the transparency cue of the interposition area is clear, the coherence motion perception of the plaids will be replaced by the component motion perception which means the plaids illusion has been diminished. Third experiment is adding some random dot on the two gratings. The results show that plaids illusion is still being there. Fourth experiment generates random dots plaid pattern stimulus. But when the stimulus is static, subject can not detect where the boundary of the two grating is. This experiment also manipulates the dot density in the interposition area of the unseen two grating. It seems the density is not the influential variable of coherent motion illusion. The whole study tells us, random dot can cancel the aperture problem, but not the plaid illusion. The transparency cue of the interposition area is very important in gray level composed grating, but not in random dots composed plaids.

## Asymmetric Temporal Filtering Underlying the ‘Rotating Snakes’ Illusion

Hiroshi Ashida<sup>1</sup>, Akiyoshi Kitaoka<sup>2</sup>

<sup>1</sup>Kyoto University, Japan

<sup>2</sup>Ritsumeikan University, Japan

Illusory motion can be seen in repeated patterns of asymmetric luminance profiles, such as in the ‘Rotating Snakes’ by Kitaoka. While the illusion might occur partly due to latency differences for high and low contrast regions at the onset of the pattern (Backus & Oruç 2005 JoV; Conway et al. 2005 JNS), smooth percept of motion may be better explained by biased responses to retinal motion caused by small eye movements, or by the combination of these effects.

As spatial processing in our visual system is assumed nearly isotropic, asymmetry in temporal processing should be crucial for biased motion responses. We have proposed a schematic model on the basis of gradient computation with distorted temporal derivative filters (Murakami et al. 2006 Vision Res). Recently, Fermüller et al. (2010 Vision Res) proposed a comprehensive model on the basis of conventional motion energy computation (Adelson & Bergen 1985 JOSA). The basic ideas are similar, but there are differences in details. In essence, our model rely on strong second-phase inhibition while Fermüller et al. argue for the reliance on the first positive inputs. Here we review both models and discuss differences in computations for possible reconciliation and extensions.

**Acknowledgement** : JSPS #B20330149

33.07

## **Reduction of the Flash-lag Effect in Terms of Active Control of Visual Stimulus and Hand Movement Size**

Makoto Ichikawa<sup>1</sup>, Yuko Masakura<sup>2</sup>

<sup>1</sup>Chiba University, Japan

<sup>2</sup>Tokyo Polytechnic University, Japan

Observer's active control of the stimulus movement would reduce the flash-lag effect (Ichikawa & Masakura, 2006 Vision Research, in press AP&P). In order to examine the effects of proprioceptive signal on the flash-lag effect, we measured the flash-lag effects for different size conditions for the hand movement. In the active condition, the position of the visual stimulus was controlled by the use of computer-mouse. There were three conditions for the hand movement size on the desk to control the vertical movement of the visual stimulus on the display (30.0, 10, or 2 cm). In the automatic condition, the stimulus moved automatically with a constant velocity that was determined by the mean velocity in the active condition. We found that the flash-lag effect in the active condition might be reduced in any of the hand movement size conditions although the reduction would depend upon the initial condition for the hand movement size for each observer. These results suggest that the proprioceptive signal to control the visual stimulus would be effective in reducing the flash-lag effect regardless of the hand movement size while that cooperation could be violated by novel relationship between the visual information and proprioceptive signal.

**Acknowledgement** : Japan Society for Promotion of Science Grant (21530760)

33.08

## **Spatiotemporal Characteristics of Fast and Slow Motion Detectors**

Satoshi Shioiri, Tomoki Harada, Ichiro Kuriki, Kazumichi Matsumiya

Research Institute of Electrical Communication, Tohoku University, Japan

Motion signals are analyzed by several motion detectors with different spatial frequency tunings. Recent studies revealed that there are also multiple motion detectors that have different temporal frequency tunings. For example, it has been reported that velocity-selective aftereffect was observed by adapting simultaneously to high spatial- and low spatial-frequency gratings drifting at the same temporal frequency, when tested with a static or a flicker grating [Shioiri and Matsumiya, J Vis, Vol. 9, pp. 1-15., 2009]. Their study suggests that the visual system has at least two different mechanisms for motion processing with different spatiotemporal frequency characteristics. In this study, we estimated the spatiotemporal-frequency tuning of each motion detectors by using a masking technique. The results showed that there are multiple spatial frequency-selective channels for higher temporal frequencies ( $> 8$  Hz), whereas only one channel was found for lower temporal frequencies (one peaking at 1 c/deg and 4Hz). The masking effects for the lower temporal frequency tests ( $< 2$  Hz) were always strongest at around 4cpd test at 0.5 Hz, independent of test spatial frequency. The visual system is likely to use different types of motion detectors to analyze fast and slow motion signals.

33.09

## **Visual Short-term Memory for Abstract Patterns: Comparing a Local Recognition Task and a Change-detection Task**

Han-Chang Lai<sup>1</sup>, Shao-Kuang Tai<sup>2</sup>, Sarina Hui-Lin Chien<sup>2</sup>

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<sup>2</sup>Graduate Institute of Neural and Cognitive Sciences, China Medical University, Taichung, Taiwan

Previously, we used a local recognition task to assess visual short-term memory for abstract patterns across encoding durations. We found that memory for abstract pattern was more accurate when the pattern was symmetrical, had a higher connectedness, and when the probes located in the upper-left quadrant. However, the local recognition task may bias subjects to adopt a strategy that recalls local parts only. Therefore, the present study adopted a change-detection task that encourages subjects not only memorize local parts but also the whole pattern. We used E-Prime 2.0 to run the experiments on an Acer computer. Each trial began with a fixation cross, then a red sample abstract pattern (within the 5\*5 grids) appeared for 300 ms, followed by a 1200 ms blank, and a test pattern that may be identical or different (a red and a white squares were switched) to the sample, appeared until response. Subject's task was to judge whether the two patterns were the same or not. Our results (N= 19) showed that, as compared to the previous local recognition task, the symmetry advantage in the current change-detection task was augmented while the connectedness effect was decreased. Further experimentation with longer stimulus duration is in progress.

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33.10

## **Testing Visual Short-term Memory for Abstract Patterns in Hepatitis C Patients, Depressed Patients, Healthy Controls, and College Students**

Jing-Fong Wang<sup>1</sup>, Shao-Kuang Tai<sup>1</sup>, Han-Chang Lai<sup>1</sup>, Sarina Hui-Lin Chien<sup>1</sup>, Kuan-Pin Su<sup>1,2</sup>

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The present study adopted a computerized test to explore visual short-term memory performance for Hepatitis C patients, depressed patients, healthy controls, and college students. The patient groups were tested at the clinic while the normal groups were tested in the laboratory. Each trial began with a fixation cross, then a red abstract pattern appeared for 300ms followed by a blank, and a recognition probe appeared until response. Subject's task was to judge whether the probe overlaps with the red abstract pattern. Our results showed that Hepatitis C patients had the highest mean errors (36.0%), followed by the depressed patients (30.9%), the healthy controls (29.1%), and the college students (19.0%). We also found significant effects for pattern connectedness and symmetry. More recognition errors occurred for the low-connected than those for the high-connected patterns and the magnitudes of differences were similar among groups. Moreover, more errors occurred for the asymmetrical patterns and the differences were dissimilar among groups (college students 9.4% > healthy controls 8.3% > depression 6.1% > Hepatitis C 2.8%). Thus, it suggested that the patients groups (Hepatitis C and depressed patients) seemed to be less able to use symmetry information in a memory task. Further data collection is in progress.

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33.11 Withdrawn

33.12

## **The Effect of Luminance Distribution on the Perception of Gravitational Vertical in Pictures**

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We can perceive the direction of gravitational vertical (up-down) when observing natural pictures. It is obvious that our visual system uses the knowledge and inference regarding the objects for perceiving vertical direction. In addition, our visual system directly would use the factors processed in the early stage, such as color, luminance and edges. In this study, we investigated how such elemental factors, especially the distribution of luminance, affect the perception of gravitational vertical in pictures. Subjects observed stimulus of natural picture with one of four conditions of the presentation time, and responded the direction of gravitational vertical of the stimulus. Results showed that subjects perceived gravitational vertical depending on the luminance distribution when presentation time was short. This tendency increased as the presentation time decreased. The results also showed that the strength of the effect was dependent on the profile of luminance distribution. These results suggest that if the information produced in the late stage of visual system is not available, the effect of luminance distribution increases. We discuss the relationship between the visual information processed in different level of the system and the perception of gravitational vertical.

33.13

## **Coding of Relative Luminance Change in Macaque Primary Visual Cortex**

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Saccade targets in the visual scene can vary widely ( $10^9$ ) in luminance but our perception largely discounts these differences. While some of the lightness constancy can be explained by changes in pupil size, many of the mechanisms underlying brightness perception are thought to occur in cortex, as early as area V1. Many experiments and computational models are based on V1 encoding of absolute luminance, and the coding of relative luminance change remains unexplored. To characterize absolute versus relative luminance change encoding in macaque primary visual cortex (V1), we mapped the receptive fields of V1 neurons under rapidly changing luminance. We presented m-sequence randomized 32x32 binary patterns at 42Hz and switched them rapidly at 10.5 Hz among 4 average luminance levels. We analyzed the spiking responses via peristimulus time histogram, reverse correlation, and principal component analysis. We find neurons that encode absolute luminance (7/72), relative luminance change (20/72), both (43/72), or neither (2/72). Neurons encoding relative luminance change were primarily located in layer 4. Most of these neurons encoded relative increases in luminance. We surmise that the encoding of relative luminance change by V1 neurons is linked to the mechanism of lightness constancy.

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33.14

## **Stimulus Factors to Decide the Perception of Order and Disorder**

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When we look at a table with some object on it, we have a feeling of order or disorder depending on the distribution of the objects. However, it is not clearly known what factors in the stimulus affect the perception of disorder. In this study, we investigated the effects of “uniformity” and “entropy” in the stimulus on the perception of disorder of visual pattern.

In the experiments, we used the stimuli consisted of dots. We defined the uniformity of the pattern as the deviation of the dot densities in local regions and the entropy of the pattern as the number of different patterns perceived to be the same. Two patterns having different values of uniformity or entropy were presented at the same time and the subject judged which pattern was more disorderly. Using the data, we represented the relation among the two factors and the magnitude of perceived disorder quantitatively.

The result showed that the perception of disorder increased as the uniformity of dot distribution increased. This result was consistent among subjects. The perception of disorder seems to depend on relatively simple factors in the pattern, such as the uniformity and entropy.

33.15

## **Poggendorff Illusion with Subjective Contours**

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The Poggendorff illusion is a puzzle. Numerous mechanisms have been proposed to account for it, including lateral inhibition in the visual cortex, spatial blurring, assimilation to cardinal axes, apparent depth induction, distance mis-estimation, and extrapolation errors. Several such factors may be operational at once. Replacing luminance edges by subjective contours enables us to exclude some of the proposed accounts. When the Poggendorff's rectangle is demarcated by subjective contours, the illusion remains. Here, we investigate a startling reversal of the normal direction of the illusion that occurs when instead it is the diagonals that are subjective. This occurs whether the rectangle's contours are real or subjective, but only for acute angles of intersection. Eliminating the rectangle altogether reveals a persisting misalignment too, supporting extrapolation error and assimilation to cardinal axes as explanatory factors.

## Operating Characteristics of Blind-Spot Completion

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Blind-spot completion is a unique process to construct a continuous spatial representation by integrating information over the vicinity area around the blind-spot. Three hypotheses were suggested to explain how this completion could be made possible. The first Ignorance Hypothesis held that the visual system does not process any information in the blind-spot and, henceforth, the completion is achieved by extending the surrounding processing over the squeezed and ignored blind-spot. The second Cognitive Inference Hypothesis stated that the completion is adjusted by higher cognitive and non-visual factors. The third Complementary Hypothesis proposed that one eye's blind-spot in space is covered by the corresponding area in the fellow eye, therefore, the completion can be accomplished by the non-blind-spot corresponding visual system. Three experiments were conducted to differentiate the relative explanatory power of the three hypotheses. Accidentally, these results implied that the blind-spot completion might be accomplished through luminance processing under quick excitatory operation. The area-symmetric operation around the blind-spot seems to be luminance-based.

## Dynamic Measurement While Viewing Stereoscopic Images of Parallel Method

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Stereoscopic images of parallel method (conflict between accommodative and convergence stimulus, and convergence stimulus further than accommodation stimulus) reduced visual fatigue and caused accommodation relaxation. However, Ukai et al. (2007) described that an imbalance between stimulus to the accommodation and the convergence induces visual fatigue. Kim et al. (2009, Japan Ergonomics Society) reported that the latter was straight when they measured visual fatigue by subjective response.

For this study, we measured accommodative and convergence dynamic responses using a video refraction unit while viewing normal images (non-conflict between accommodative and convergence stimuli) and stereoscopic images of parallel methods.

Results showed accommodative transient overshoot in some subjects. Additionally, we compared the relation between the CA/C ratio and the accommodation response: high-CA/C-ratio subjects have the appearance of overshoot. This result resembles findings obtained using stereoscopic images and the cross method (conflict between accommodative and convergence stimulus, and accommodative stimulus further than convergence stimulus) (Fukushima et al., 2009)

Based on results of the present study, we infer that stress on accommodation and convergence systems caused by viewing stereoscopic images exists whether using the cross method or parallel method.

## Effect of Vertical-size Disparity on Binocular Corresponding Points

Kazuho Fukuda, Hirohiko Kaneko

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Vertical-size disparity produces slant perception (Ogle, 1938). In recent studies, it was revealed that internal eye position signal created by vertical-size disparity recalibrates the relationship between horizontal disparity and perceived slant and that the Ogle's effect was due to miss-application of the recalibration mechanism. There are two possible mechanisms for the recalibration. One is that vertical-size disparity recalibrates the relationship between the output signal of horizontal disparity detectors and the slant perception. The other is that vertical-size disparity recalibrates binocular corresponding points for horizontal disparity detection. Here, we examined whether vertical-size disparity recalibrates binocular corresponding points. The stimuli were composed of horizontal lines to introduce vertical-size disparity and a probe to measure binocular corresponding points. Within a short adaptation to a vertical-size disparity pattern, subject observed an apparent motion created by the probe presented dichoptically. The first stimulus of the probe appeared in one eye and the second appeared in the other eye with variable horizontal positional differences. Subjects judged the direction of the apparent motion. Results showed that there is little effect of vertical-size disparity on the binocular corresponding points, which suggests that the assumption that vertical-size disparity recalibrates corresponding points would not be appropriate for the slant perception.

## Depth Reversal as a Function of Disparity-modulation Spatial Frequency, Number of Cycles, and Modulation Amplitude

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It is known that perceived depth from binocular disparity is sometimes in the opposite direction to the geometrical prediction (depth reversal). In the present study we measured the apparent depth direction as a function of some spatial factors such as (i) spatial frequency, (ii) number of cycles (i.e. overall stimulus size), and (iii) amplitude of disparity modulation. Binocular disparity introduced into a random-dot stereogram was modulated sinusoidally along a horizontal axis to produce a vertical corrugation in depth. The peak or trough was at the center of the pattern. The observer's task was to indicate the direction of apparent depth. The spatial frequency of disparity modulation was either 0.1, 0.2, or 0.4 cycles/deg. The number of cycles ranged from 1 to 8. The amplitude of disparity modulation was up to 0.5 deg. The duration of the test stimulus was 0.5 s. All five observers reported reversed depth in the condition with the highest spatial frequency and larger stimulus size. Two observers also reported reversed depth in the condition with the lower spatial frequency and smaller stimulus size. It appears that multiple factors cause depth reversal.

33.20

## **Magnitude of Perceived Depth in Two Stereo-overlapping Surfaces Is Larger than That in Three Stereo-overlapping Surfaces**

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The geometric relational expression of horizontal disparity, viewing distance, and depth magnitude between objects in stereopsis suggests that magnitude of perceived depth would be the same as long as disparity size and viewing distance are constant. However, we found that this is not necessarily the case, using two and three stereo-overlapping surfaces, in two experiments. In Experiment 1, 10 observers performed a depth reproduction task and showed that the magnitude of reproduced depth between the two stereo-surfaces was larger than that between outer two surfaces of the three stereo-surfaces for each of the disparities used (6.28', 9.43', and 18.86'). In Experiment 2, 7 observers performed a depth discrimination task and showed that the perceived depth between two stereo-surfaces was larger than that between outer two surfaces of the three stereo-surfaces for the smallest and largest disparities used (6.28' and 18.86') but not for the middle disparity used (9.43'). We discussed these results in terms of "incomplete" disparity averaging.

33.21

## **Influence of Regularity of Geometric Structures and Types of Object Landmarks on Wayfinding Behavior**

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People often rely on landmarks to find their ways, but relatively few studies have examined how different types of landmarks influence wayfinding. A previous study from our lab showed that participants had better wayfinding performance in environments with local object landmarks than with global ones when the geometric structure inside the environment was irregular. We speculated that the superior performance with local landmarks could be explained by the fact that global landmarks only provided rough directional guidance and were thus less informative references during wayfinding. In the current study, we adopted a factorial experimental design to further examine how regularity of geometric structures and types of object landmarks conjointly influence wayfinding. The results showed that participants learned to find their ways quickly in both regular and irregular environments with local landmarks, and they kept performing well even when the target was removed from sight. In contrast, for environments with global landmarks, their performance became much worse in the regular than in the irregular environment when the target was invisible. These results suggested that participants referred to both landmarks and geometric structures in the irregular maze, and confirmed that global landmarks offered little help when one attempted to achieve precise wayfinding.

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33.22

## **Comparison of Simulator Sickness between Active and Passive Observations**

Nobuyuki Tanaka, Hiroyuki Shinoda, Hideki Yamaguchi

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The simulator sickness is thought to be caused by the discrepancy between self-motion perceptions induced by the visual and the vestibular systems. In motion sickness, we know empirically a driver hardly gets carsick while a passenger suffers. Both inputs from visual and vestibular systems a passenger receives are supposedly identical to those a driver does. An active observation, such as drivers do, may also reduce the simulator sickness. In this study simulator sickness in active and passive observation conditions are compared by means of subjective evaluations. After the observation of optic-flow for 10 minutes subjects filled out questionnaires consisting of items of the simulator sickness questionnaire and evaluated strength of vection itself and that of the sense of acceleration/deceleration (change in vection). The expanding/contracting optic-flow simulates the motion of dots filling a space when you move forward/backward. In the active condition, a subject presses the keyboard to accelerate or decelerate his/her own motion in response to the color change of the central fixation. In the passive condition, a subject just views the exact same sequence of optic-flow as in the active condition without any active involvement. The results of questionnaire did not show an obvious difference.

*Acknowledgement* : 3460722

33.23

## **Enhancement and Inhibition of Vection by Peripheral Optic-flow Pattern**

Yoshimura Tatsuya, Hiroyuki Shinoda, Hideki Yamaguchi

Ritsumeikan University, Japan

When stationary observers view an optic-flow pattern, they feel as if they move themselves in the opposite direction to the pattern. This perception is called visually induced self-motion perception, or vection. In our previous studies the strength and the duration of vection was examined as a function of field size of optic-flow. As expected, the larger field size of expanding or contracting optic-flow induces the stronger and the longer perception of forward or backward vection. The interaction between two optic-flow patterns presented in central and peripheral fields is examined in the current study. The circular field of 90deg was divided into the central circle and the annular ring. Optic-flow of both fields simulate flying dots of 0.9cm in diameter filling up the space of 20m in depth with a density of 0.125 /m<sup>3</sup>. The dots in the central field were flying -40km/h (backward) or 40km/h(forward). The velocity and direction of surround dots were -80, -40, -20, 0, 20, 40, or 80km/h. The observer was to keep responding either forward-, backward-, or null-vection while watching the optic-flow. The duration of vection was shorter with the surrounding optic-flow of opposing direction to the center and vice versa.

*Acknowledgement* : 2791

## **The Effect of Luminance Contrast and Stimulus Distance on the Subjective Depth**

Kazuya Matsubara<sup>1</sup>, Kazumichi Matsumiya<sup>1</sup>, Satoshi Shioiri<sup>1</sup>,  
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<sup>2</sup>Sony Corporation

Stimuli with higher luminance contrasts tend to be perceived closer in depth. In order to quantify this effect, we measured perceived depth of the test stimulus as a function of luminance contrast, using a depth matching technique. The depth of a reference stimulus was matched to that of the test stimulus by changing the binocular disparity. We also varied the test spatial frequency (from 0.5 to 8 cpd) and the disparity (crossed, uncrossed, or zero). The results showed that for all disparity conditions the test stimulus was perceived much closer with a higher luminance contrast. This suggests that the effect of luminance contrast on depth perception is independent of the binocular disparity. Luminance contrast contributes to a monocular depth process that does not interact with the mechanism of stereopsis. The difference between different spatial frequency conditions suggests that more than one spatial frequency channels contribute to the monocular depth process. Although the effect of luminance contrast was similar for all spatial frequencies, the slopes of the contrast-depth function are steeper with lower spatial frequencies. This is not easily explained by a single mechanism.

## **Effects of Emotion on Attentional Blink**

Hiu-Mei Chow, Chia-Huei Tseng

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Attentional blink (AB), a failure to identify the second target (T2) when it is presented closely after the first target in a rapid sequential visual presentation, was employed as a paradigm to probe on how emotion is in relation to attention. Previous studies found emotional words as T2, as well as an induced sad mood in participants compared to happy mood, would reduce AB in both conditions. Current study investigates whether there is an interaction between the emotion of the participant and the emotion in the stimuli.

Participants were induced with positive or negative mood with music before they completed an AB task with emotional T2 (positive, neutral and negative words). It was found that emotional T2, especially negative words, had an effect of resisting attentional blink, replicating the previous research. The performance in AB between positively and negatively induced mood groups did not differ significantly, nor the congruency effect of the two variables. Yet, the study revealed potential weakness of previous studies of attentional blink task using words. Suggestions were made to improve the experimental design to demonstrate congruency effect in future research.

33.26

## Competition of Emotional Words for Attentional Resource

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Zeelenberg, Wagenmakers, and Rotteveel (2006) have shown that emotional words (negative and positive) are better identified than neutral words. However, there was no difference in performance between positive and negative words. We hypothesize that this may be due to their using only a single word as target, unlike previous studies showing different performance often presenting multiple words in the display (e.g., visual search or dot-probe task). To test whether words with positive and negative valence have different effects only when they are presented with competitive items, we presented two words (a target word and a competitive word) briefly and the participants had to respond to the target in a two-alternative forced-choice (2AFC) paradigm. Results showed a competitive advantage for positive words, compared to neutral words. Biased competition affects processing of emotional stimuli, causing the difference in performance between conditions when emotional stimuli are presented alone versus under competition.

33.27

## Can Attentional Inhibition to Emotional Stimuli Affect Emotion Vulnerability?

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Attentional orienting toward negative information has been shown to increase, but not reduce, emotion vulnerability (EV). With impaired inhibition ability among highly anxious people, we suggested that improving attention control (through attentional inhibition) may be critical to reduce EV. The current study contained two phases: inhibition training (IT) and EV assessment. In the IT there were two groups of participants trained to inhibit negative stimulus or neutral stimulus. There were a series of Go/No-Go task in this phase. Participants were presented with a pair of Chinese words (consisting of a negative word and a neutral one), and then one of them changed color to serve as a Go/No-Go cue. Participants responded to the cue location (top or bottom) in the Go cue condition; otherwise, they held their responses. In the EV assessment, participants needed to complete stress task, and their emotion reactivity was recorded before and after stress task. We assess EV both before and after the IT to examine whether attentional inhibition would affect EV. Results are expected that attentional inhibition toward negative stimulus leads to a decrease in emotion vulnerability. Studies focusing on the inhibition to negative stimulus have critical implications regarding clinical therapies based on cognitive change.

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## **Using Target-distractor Discriminability to Examine Specific Task Strategies in Repetition Blindness**

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Repetition Blindness (RB) refers to a reduced performance in reporting repeated items in a rapid serial visual presentation (RSVP) stream. Whether the size of RB is influenced by using targets and distractors of different categories (e.g., digits versus letters) has been a controversial issue in recent years. In this study, we investigated the effect of categorical discriminability on RB, by asking participants to either report the targets or to detect repetition. In Experiment 1, targets were letters and distractors were digits. Significant RB was found in the detection task, but priming was found in the report task. In Experiment 2, distractors were collections of letter segments, which rendered targets less discriminable from the distractors. RB was still found in the detection task, but unlike Experiment 1 no priming was found in the report task. Comparing the two experiments, categorical discriminability had an effect on performance in the report task, but not in the detection task. This result suggests that different strategies may be involved across tasks, so that target-distractor discriminability influences RB differently in the two tasks.

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## **Repetition Blindness with Objects Having Parts Deleted and Added**

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University of Hong Kong, Hong Kong

Repetition blindness (RB) refers to the finding that participants often fail to report a repeated target in rapid serial visual presentation (RSVP) streams. An earlier study from our lab (Hayward, Zhou, Man, & Harris, 2010) reported that RB for familiar objects is based upon processing of isolated features. The current study investigates whether RB for objects is affected by addition or deletion of object features. In two experiments RB for familiar objects was studied with the first target being a complete object and the second target having some parts removed or extra parts added (that is, if the first target was a dog, the second target might be half the dog or might be a dog with six legs). While the magnitude of RB was found to decrease as a part of the object was removed, it remained invariant as extra parts were added. These results support the contention that processing of independent object components provides the basis for RB.

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33.30

### **Nature vs Nurture – The Relationship between Acute Stress and Vision**

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Purpose: Although genetic factors are recognised, environmental influences play a notable role in the development of the most prevalent refractive error, myopia. Recent investigations highlight the impact of nearwork and stressful lifestyle as important determinants in the incidence of this condition. The present investigation examined whether acute psychological stress (assessed verbal university presentation) contributes to the myopic shift previously observed to occur over the course of a 3 year degree. Method: First, the relationship between refractive state and demographic characteristics of first and senior year Australian University students was investigated. Then sympathetic nervous system activation (indicated by heart rate, salivary cortisol, systolic and diastolic blood pressure), pachymetry, intraocular pressure (IOP) and refractive state in first year students at baseline and following acute stress was measured. Results: Myopia was significantly greater in the senior cohort and was associated with greater amounts of near work. Levels of myopia significantly increased following acute stress, in conjunction with elevated cortisol levels and an increase in IOP. Conclusion; Acute stressful events at University contribute to a myopic shift in refraction over the course of tertiary study, though whether these shifts are transient or permanent remains to be tested.

33.31

### **Synchronism of Perceptual Reversals Involving Two Horizontally Presented Ambiguous Figures**

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Previous studies demonstrate that eye movement and visual attention with ambiguous figures are related to perceptual reversals. Our study examines processing of perceptual reversals by presenting two ambiguous figures simultaneously. For our experiments, we chose two figures from ambiguous figures of two types (depth reversals and figure-ground reversals), then situated them horizontally. In Experiment 1, the dispositions and combinations of figures were varied. In Experiment 2, distances between two figures were varied in six steps. Participants evaluated the synchronism of perceptual reversals on a scale of 0–9 in each experiment. Experiment 1 results show that synchronism evaluations of stimuli including reversal figures of two types were less than those of stimuli including figures of the same type. This result suggests that global visual processing cannot be conducted in parallel because processing of reversals has two mutually differing types. Experiment 2 results show that evaluations decreased with increased distance on each combination of figures. This result suggests that participants pay less visual attention to shape perception as stimuli occupy a larger area.

## **Auditory Semantic Context Modulates the Conscious Perception of Bistable Figures**

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We perceive integrated percepts in our daily life by combining the information available in multiple sensory modalities. Here we tested whether the soundtrack that a person hears can influence the perception of bistable figures and whether any such crossmodal influence interacts with attentional control. In Experiment 1, participants viewed the figure “my wife or my mother-in-law” which typically induced percept that alternates between the old woman and young lady, while listening to soundtrack with either the voice of old woman, young lady, or else without sound. The results showed that participants report a particular percept as being dominant for significantly more of the time when listening to a semantically-congruent auditory soundtrack. However, this effect was eliminated when the participants tried to actively maintain a particular percept. That is, the sound of the young lady could not bias percept toward young lady when participants actively maintained the percept of the old woman. These results imply that sounds may induce an involuntary shift of attention to the percept that is congruent with the sound, or, through voluntarily attentional control, to help maintain the percept once established, and this effect was mitigated when voluntary attention was directed simultaneously with the sound.

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## **Test of the Automaticity in Depression: An Example of the Stroop Effect**

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Patients with depression have been found to have specific impairments in the Stroop tasks. Our previous study suggested that the patients with depression were intact in controlled processes in Stroop tasks (Huang, Jingling, & Su, 2010). The goal of this study was to further investigate whether they have deficits in automatic processes. We used the diluted Stroop paradigm, in which ink color and words were separately presented at different locations. The separation should shorten response times for subjects could focus on the ink color more easily and ignore the automatic activations of the words. Thus, the Stroop effect should be smaller. In the experiment, the subjects were instructed to name the ink color, either on a bar (diluted condition) or on a color word (classical condition). Preliminary results with twelve patients and nine healthy controls showed that the reduction of the Stroop effect was observed only in controls but not in depression. In other words, patients still experienced large Stroop effect even when color and words were separated. Our findings thus suggest that the worse Stroop performance in patients with depression might be attributed to their abnormal automatic activations.

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33.34

## **Attention Modulated Binocular Suppression in Non-amblyopic Population**

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We demonstrated that observers with no known history of amblyopia can suppress the input to one of the eyes with attention. The stimuli in each trial contained a Gabor target presented in one of the four possible locations (up, down left and right) in one of the eye and a Gabor distractor at another location either in the same or the different eye of the target. Other possible locations for stimulus presentation in both the left and the right eye images were filled with white noise. A cue at the center of the display indicated the location of the target. The cue was presented to only one eye to control the ocular attention of the observers. The task of the observer was to detect the target. Thus, to perform the task, the observer had to attend to the cued eye. When the target and the cue were presented to the same eye, the target threshold reduced nearly 2-fold (5.2dB) in the dominant eye and more than 3-fold (10.6dB) in the non-dominant eye compared with the condition when the cue and the target were presented to the different eye. Thus binocular suppression can be voluntarily controlled in normal population as well.

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33.35

## **Dual Code Principle for Integration of Bottom-up and Top-down Attentional Control**

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Visual attentional selection includes both bottom-up saliency and top-down guidance, involving multiple visual cortical areas. It is still unresolved how the two types of attentional control are integrated. We propose to extend the dual code principle from the theory of a bottom-up saliency map in V1 to post-V1 processes and top-down control, accordingly input information and attentional control signals are represented in the same neural population at each visual stage. In a prototype model implementing the proposal, the saliency signal is the modulation of neural population responses to input, and is thus transmitted from V1 to V4 along the visual hierarchy. Consequently, the responses to low level image features in V1 and to object shape features in V4 not only code input by the identities of the responding neurons, but also the saliency strength by the response levels. Top-down guidance further modulates the V4 responses, and is thus naturally integrated with bottom-up control. In detecting target objects in cluttered scenes, the model performs better than alternative models having artificial separation and integration of the input representation and attentional control. Information theory measures indicate that the dual code representation significantly improves the discriminability between objects and background clutters by V4 responses.

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33.36

## **Analytical Method for Investigating the Nonlinearities of Observer's Judgments with Psychophysical Reverse Correlation**

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Muroran Institute of Technology, Japan

Many physiological researches have utilized the reverse correlation technique to probe receptive field structures of neurons in early visual cortex. Recently, this technique is also employed in psychophysical researches. The psychophysical reverse correlation aims at exploring a whole brain mechanism for an observer's judgment, while physiological researches, in general, investigate a filter property of a single neuron. Brain mechanism for observer's judgments should be made up of many neurons interacted each other and would be a complex nonlinear system. Therefore, the psychophysical reverse correlation requires an analytical method considering the system's nonlinearity. Here, we formulate a general framework to probe the nonlinearities of brain mechanisms with the psychophysical reverse correlation. Similar to physiological researches, the difficulty of the psychophysical reverse correlation analysis is that observer's responses to a stimulus are stochastic and only have discrete values (such as in yes/no and n-AFC tasks). We show that the joint cumulants for stimuli and observer's responses have the information about nonlinear kernels of brain mechanisms and present a general method to extract the kernel information from the cumulants. We can obtain the joint cumulants for stimuli and responses experimentally. We also discuss the application of this analytical method to psychophysical experiments.

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33.37

## **A Neural Model for Counting and Subitizing**

Zong-En Yu<sup>1</sup>, Chien-Chung Chen<sup>1</sup>, Shyh-Kang Jeng<sup>1</sup>, Michael Arbib<sup>2</sup>

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Counting involves repeatedly identifying items during the search, and incrementing internal representation of number. Therefore the response time are observed to be proportional to the number of items. On the other hand, subitizing for small numbers yields much quicker response than counting. This implicates two distinct mechanisms might take place in turns dealing with different scale of items.

In this research, a neural model describing the possible neural mechanism of subitizing and counting is proposed. The model deals with the interplay between the intraparietal sulcus, area TE, and the prefrontal cortex. It consider subregion LIP in the intraparietal sulcus works as a visual buffer which tagging items been identified and incremented, subregion hIPS as a functional unit coding semantic representation of numbers, area TE as a pattern recognition unit tuned to the pattern of the input image, and the prefrontal cortex as an association area mediating other representations of numbers, such as visual and auditory representations.

The proposed model is expected to replicate the response of normal subject during a numerosity task. Furthermore, this model describes the counting and subitizing mechanisms of patients with simultagnosia, by blocking the IPS layer in the model.

**Acknowledgement** : NSC98--2917--I--002--103

Symposia : Fading, Perceptual Filling-in, and Motion-induced Blindness:

Phenomenology, Psychophysics, and Neurophysiology

(Monday, July 26, 10:15-12:15, Socrates)

S5-1

**Fading and Filling-in and the Perception of Extended Surfaces**

Lothar Spillmann

University of Freiburg, Germany

Since Troxler's original observation in 1804, fading and filling-in phenomena have aroused the interest of researchers. However, the question of why we see what is not there, i.e., induced properties from the surround, has been systematically studied only during the last 20 years. We now know that with prolonged fixation most figures fade into the background: targets can be static, moving, flickering, and textured. Furthermore, the background need not be uniform and steady, dynamic visual noise is as effective and even more so. While the mode of disappearance and the time course of fading for these different conditions may differ, the tendency of the visual system to make a background appear spatially uniform is common to all. We have recently found that filling-in requires a minimum of surround information. A thin red ring hugging the boundary of the physiological blind spot will fill in the enclosed area uniformly and completely. Similarly, a thin chromatic double-contour will induce watercolor over a large area. This spread of color suggests long-range horizontal interaction in the cortex for an explanation. On the other hand, fading time for stimuli consisting of oriented vs. randomly oriented bars depends on what is center and what surround. A uniformly oriented center is less salient and takes less time to fade than a randomly oriented center despite an identical texture contrast. This suggests an influence by figure-ground organization.

S5-2

**Bridging Gaps at V1: Neural Responses for Filling-in and Completion at the Blind Spot**

Hidehiko Komatsu

National Institute for Physiological Sciences, Japan

No retinal input exists at the blind spot (BS). However, we do not perceive a hole in the visual field. Instead, within the BS, we perceive the same color, contour or texture as the stimuli surrounding the BS. This is called perceptual filling-in or completion at the BS. Filling-in and completion occurs not only at the BS but also in the retinal scotoma and in various phenomena in the normal visual field. This suggests that there are some mechanisms in our visual system that could interpolate incomplete retinal signals to form contiguous surface and contour. To elucidate the role of V1 in filling-in and completion, we analyzed neural responses at the retinotopic representation of the BS in V1. We addressed two questions: (1) Do V1 neurons respond to stimuli inducing filling-in or completion even though there is no direct retinal input to this region? (2) Do the responses of V1 neurons to such stimuli correlate with perception? Our results suggest that V1 plays an important role in the occurrence of filling-in and completion at the BS.

References : Komatsu H et al. (2000) J Neurosci 20: 9310-9319. Matsumoto M and Komatsu H (2005) J Neurophysiol 93: 2374-2387. Komatsu H (2006) Nat Rev Neurosci 7:220-231.

S5-3

## **Perceptual Fading as Revealed by Perceptual Filling-in and Motion-Induced Blindness**

Li-Chuan Hsu, Su-Ling Yeh

China Medical University, Taiwan

Perceptual-Filling-in (PFI) and Motion-Induced-Blindness (MIB) are two phenomena of perceptual rivalry in which a perceptually salient target, among a field of non-targets, disappear and reappear alternatively after prolonged viewing. Despite the apparent differences between PFI and MIB, when we manipulate eccentricity, contrast, perceptual grouping, and depth ordering, the results indicate that both PFI and MIB are most likely caused by a common mechanism. We argue that this mechanism involves boundary adaptation but it is a sufficient but not a necessary condition. Given that more PFI/MIB is observed if the target has an uncrossed than crossed disparity, we test further whether monocular depth cues such as interposition and watercolor illusion can also affect them, and whether they can affect perceptual fading in static displays as well. We find positive answers to these questions, implying that perceived depth affects perceptual fading in almost any stimulus, dynamic or static.

S5-4

## **fMRI Evidence for a Correlate of Surface Brightness in Early Visual Areas**

Peter de Weerd

Maastricht University, The Netherlands

The neural mechanisms of surface perception are surprisingly poorly understood and ongoing research both in the domain of neurophysiology with animal models and fMRI with humans has led to conflicting outcomes. In the domain of surface brightness perception, it is debated whether surface perception would depend on an interpolation of brightness in early visual areas across regions in the visual field where that information is physically absent. We used fMRI in human subjects to test a possible contribution of early visual areas to the perception of surface brightness. A brightness induction paradigm was employed in which the perceptual appearance of a surface is modulated in absence of physical changes. In this paradigm, dynamic luminance changes in inducers produce counterphase (illusory) brightness changes in an enclosed grey surface of constant luminance. We found activity modulations in the retinotopic region of early visual areas corresponding to the visual field location of the constant, grey surface that corresponded to the brightness modulations in the constant surface. These data suggest a role in early visual cortex in the perception of surface brightness. The data will be presented in the context of related neurophysiological studies in cat and monkey, as well as human fMRI studies. Further experiments that need to be performed to fully demonstrate a correlate of brightness interpolation during surface perception will be suggested briefly.

Symposia : The Other-race Effect in Face Perception

(Monday, July 26, 13:30-15:30, Socrates)

S6-1

**Perceptual and Social Processes Interact to Cause the Other-race Effect**

William Hayward

University of Hong Kong, Hong Kong

Is the other-race effect is caused by perceptual expertise (greater experience with own race faces endows us with more efficient processing of the visual features that discriminate them from each other) or social categorization (people normally encode individuating features for own-race faces, but only category-defining features for faces from other races)? In this talk I will discuss a range of studies that demonstrate that both contribute to the effect. First, I will present data that show better recognition of own-race faces when they are presented as coming from one's own social group than another social group. Second, I will show that even if all faces need to be individuated, however, own-race faces are still learned more efficiently than other-race faces. Third, we will examine changes in holistic processing of faces caused by social categorization. These results suggest that a combination of perceptual and social processes combine to cause the other-race effect.

S6-2

**Reversing the Other-race Effect: The Cognitive, Neural and Social Plasticity of Face Recognition**

Jim Tanaka

University of Victoria, British Columbia, BC, Canada

Although it is well established that we are better at recognizing faces from our own race than faces from another race, the factors that contribute to the own-race face advantage are not well understood. Levin (2001) hypothesized that people initially classify faces from one's own race as individuals and faces from other races as members of their racial group. His hypothesis is compatible with an expertise view: As own-race "experts," we categorize own-race faces at the subordinate level of the individual and as other-race "novices," we categorize other-race faces at the basic level of race. According to the expertise view, the subordinate categorization tunes the recognition system to a finer grain of perceptual analysis that in turn, produces an own-race advantage. Is it possible to train up other-race face recognition similar to other forms of perceptual expertise? In my talk, I will discuss an expertise training protocol intended to improve other-race face recognition through other-race individuation. In our study, Caucasian participants were trained to differentiate African (or Hispanic) faces at the subordinate individual level or at the basic level of race. Our results showed that individuation training reduced the other-race effect by improving the recognition of novel faces from the individuated race. We found that other-race training also produced changes in event-related brain potentials characteristic of expert function and ameliorated the negative biases that are implicitly associated with other-race faces.

S6-3

## **Becoming a Face Expert: Inversion and the Own-ethnicity Effect**

Siegfried Ludwig Sporer

University of Giessen, Germany

This presentation focuses on the role of expertise in processing faces and other visual stimuli. The majority of our studies were conducted on the own-ethnicity ethnicity effect, the differentially better recognition of faces of one's own ethnic group in comparison to faces of another ethnic group. An in-group/out-group model is proposed that integrates existing explanatory models and suggests additional hypotheses regarding a general in-group advantage in processing in-group stimuli. Studies on recognition of faces and horses in normal and inverted view as well as classification and matching studies with real and forged bank notes from different countries are presented. Expertise was operationalized via group membership (own- vs. other ethnic group, adults vs. children), riding experience (horseback riders vs. non-riders), and pre- and post-experience with a new currency (the Euro).

S6-4

## **Tracking Early Sensitivity to Race on the Human Visual Cortex**

Roberto Caldara

Department of Psychology, University of Glasgow, United Kingdom

Race is a universal, socially constructed concept used to categorize humans originating from different geographical locations by salient physiognomic variations (i.e., skin tone, eye shape, etc.). Race is extracted quickly and effectively from faces and, interestingly, such visual categorization impacts upon face processing performance. Humans are noticeably better at recognizing faces from the same- compared to other-racial groups: the so-called other-race effect. This well-established phenomenon is also paired by the perception of individuals belonging to “other-races” as all looking alike. However, despite the impressive number of studies showing the robustness of the other-race effect at the behavioural level, whether electrophysiological sensitivity to race occurs at early or late (post-) perceptual stages of face processing remains to be clarified.

To this end, we recorded high-time resolution electrophysiological scalp signals in East Asian and Western Caucasian observers in a series of face processing experiments (i.e., face inversion effect, face adaptation and parametric manipulation of noise) with well-controlled East Asian and Western Caucasian faces. Our results consistently show that discrimination of same- and other-race faces begin early at the perceptual level in both groups of observers. Such very early detection of race could relate to biologically relevant mechanisms that shape human social interactions.

## Talk Session : Color Vision II

(Sunday, July 26, 8:30-10:00, Socrates)

41.01

### **Selective Age-related Changes in Temporal S-cone ON- and OFF-pathways.**

Keizo Shinomori<sup>1,2</sup>, John S Werner<sup>2</sup>

<sup>1</sup>School of Information, Kochi University of Technology, Japan

<sup>2</sup>Department of Ophthalmology & Vision Science, University of California, Davis, USA

S-cone sensitivity decreases with age and this influences the temporal response. In this study, age-related changes in an S-cone pathway were quantified for chromatic increments and decrements in terms of their impulse response functions (IRF). Thresholds for double pulses, separated by varying interstimulus intervals, were measured for chromatically modulated stimuli in 4AFC method. Isoluminance and the location of tritan lines were determined individually. The stimuli were presented as a Gaussian patch on an equiluminant white background. Subjects included ten younger (mean, 24 years) and nine older (74) observers, carefully screened to rule out anterior segment, retinal or optic nerve abnormalities. IRFs were calculated from thresholds as a function of ISI using a model that varied four parameters of an exponentially-damped sinewave. IRFs for S-cone increments in excitation were slower than for luminance modulation. We now find that S-IRF decrements are even slower. In terms of age-related changes, time for peak amplitude is significantly slower with age in S-cone OFF IRF, but not for the S-cone ON IRF. These results are consistent with detection by separate ON- and OFF- S-cone pathways and indicates that their neural substrates change differently with age.

**Acknowledgement** : KAKEN\_B20300081 (to KS) and NIA AG04058 (to JSW)

41.02

### **Chromatic and Achromatic Vision in Primates, Birds and Bees**

Misha Vorobyev

Optometry and Vision Science, University of Auckland, New Zealand

Perceptual separation of chromatic aspects of colour (hue and chroma) from achromatic ones (lightness) is a fundamental property of human colour vision. The separation of chromatic from achromatic aspects of colour can be a consequence of constraints imposed by neural wiring in retina of primates. Alternatively, this separation might be generally useful for detection and identification of objects in conditions of patchy illumination. In humans, stimuli subtending large visual angles are discriminated on the basis of their chromatic properties – large variations in the intensity of light stimuli are ignored. In contrast, high spatial resolution vision is mediated by a luminance channel that is sensitive to changes in stimulus intensity, but is not sensitive to variation in the chromatic aspects of colour. Here I show that bees and birds also have chromatic and luminance mechanisms that are functionally similar to ours. Because colour vision in primates, birds and bees evolved independently, I conclude that chromatic vision probably evolved independently in different animals to achieve colour constancy in conditions of patchy illumination.

41.03

## **Colorfulness-adaptation Influenced by Low-level and High-level Factors in Natural Images**

Yoko Mizokami, Nobuki Ito, Hirohisa Yaguchi

Chiba University, Japan

It has been shown that perceived colorfulness changes with adaptation to chromatic contrast modulation and to surrounding chromatic variance. It is not clear how colorfulness perception changes with adaptation to color variations in actual environments or natural images and what levels of visual mechanisms contribute to the perception.

We examined if the colorfulness perception of an image was influenced by adaptation to various natural images. To compare the effect of low- and high-level factors, three different types of image-sets were used for adaptation; natural images consisting of natural scene or objects, jumbled images consisting of the collage of color patches cut from original images, and phase-scrambled images maintaining low-level factors such as color distribution and spatial frequency spectrum similar to original images. Observers adapted to several images with different levels of saturation and judged the colorfulness impression of a test image after the adaptation.

The results show that colorfulness perception is changed by adaptation to the levels of image saturation. The effect is stronger with adaptation to natural images than with jumbled and phase-scrambled images, implying that the colorfulness-adaptation mechanism works better with natural scenes including high-level factors such as the presence of recognizable objects and naturalness.

41.04

## **Neural Selectivity for the Luminance Gradients in the Posterior Inferior Temporal Cortex of the Monkey**

Hidehiko Komatsu, Masaharu Yasuda, Taku Banno, Naokazu Goda

National Institute for Physiological Sciences, Japan

Shading generated by luminance gradient is an important visual stimulus for perception of the three-dimensional structure of objects or their surface qualities. However, little has been known about where and how shading is represented in the brain. We recorded single neuron activities from the posterior inferior temporal cortex (PIT) of the monkeys performing a visual fixation task and examined the responses to the linear luminance gradients. We found that neurons selective for the direction of luminance gradients were concentrated in a small region in PIT anterior and dorsal to the PIT color area (Yasuda et al. Cerebral Cortex 2009). They responded strongly to stimuli with luminance gradient in one direction and did not respond or responded little to the opposite direction. The sharpness of selectivity varied from cell to cell. Many of them showed position invariance in direction selectivity when the stimulus position was changed within the RF, indicating that the selectivity cannot be explained by the heterogeneity in the luminance preference within the RF. These results together with recent human fMRI study (Georgieva et al. Cerebral Cortex 2008) suggest that PIT cortex plays an important role in the coding of shading stimuli.

**Acknowledgement** : Japanese Grant-in-Aid for Scientific Research

41.05

## **Effects of Luminance Balance of Surfaces on Estimating the Illuminant Color**

Keiji Uchikawa<sup>1</sup>, Yusuke Kitazawa<sup>1</sup>, Donald I.A. MacLeod<sup>2</sup>

<sup>1</sup>Department of Information Processing, Tokyo Institute of Technology, Yokohama 226-8502, Japan

<sup>2</sup>Department of Psychology, University of California at San Diego, La Jolla, CA 92093-0109, USA

The human visual system can discount the illuminant color from a light reflected from surfaces. This ability of human color vision is known as color constancy. Mean chromaticity across all surfaces in an image can be a strong cue for estimating the illuminant color. However this cue is only effective for limited cases. The luminance balance as well as chromaticities of surfaces varies with the illuminant color. Here we investigated how effectively the luminance balance of surfaces works for color constancy. We used the stimulus that consisted of 61 hexagons, presented on a CRT. The center hexagon served as a test stimulus. The 60 surrounding hexagons were of bright and dim red, green and blue colors. We used simulated 3000, 6500 and 20000K black body radiations as test illuminants. The observer adjusted the chromaticity of the test stimulus so that it appeared as gray or white. In a condition where the chromaticities of surrounding colors were set invariant, and only the luminance balance of those colors varied according to the test illuminant the observer's achromatic point shifted consistently with the illuminant chromaticity. This result indicates that the luminance balance can be an effective cue for estimating the illuminant color.

41.06

## **Color Naming and Color Visual Searching in the Georgian-speaking**

Manana Khomeriki

I. Beritashvili Institute of Physiology, Georgia

When verbally sequencing colors, Georgian-speaking individuals name approximately forty colors, starting with the basic colors mainly primarily with red. When viewing a collage composed of familiar colors, four year old children initially name the basic colors, in most cases starting with red, without giving preference to any specific strategy. However, school-aged children and adults name colors in a sequence that coincides with the eye movement during the color viewing process; specifically, from left to right and top to bottom. The influence of color saliency is overridden by a behavioural strategy which is not specific to color.

It can be supposed that during an acquisition of color names by children they should be kept in mind in certain succession what, while verbal reproduction, is revealed first of all in enumeration of basic colors. This succession should not be changed significantly in age as the preference of basic colors is obvious by name them orally. School children and adults, while visual searching, give preference to the color according to its position. Acquiring the reading and writing skills has certain influence on the color hierarchy existing in mind and causes some shifts of earlier priority colors.

42.01

## **Bilinguals Have Different Hemispheric Lateralization in Visual Processing from Monolinguals**

Sze-Man Lam, Janet H.W. Hsiao

The University of Hong Kong, Hong Kong

Previous bilingual studies showed reduced hemispheric asymmetry in non-verbal tasks such as face perception in alphabetic bilinguals compared with alphabetic monolinguals. Here we examined whether this effect can also be observed in bilinguals of a logographic language and an alphabetic language, i.e., Chinese-English bilinguals. Since logographic and alphabetic languages are dramatically different in their orthography and how orthographic components are mapped to pronunciations and meanings, Chinese-English bilinguals may have different visual experience from bilinguals and monolinguals of alphabetic languages. We compared performance of English monolinguals, Chinese-English bilinguals, and alphabetic-English bilinguals in three tachistoscopic recognition tasks: Chinese character sequential matching, English word sequential matching, and intact-altered face judgment tasks. In discrimination sensitivity measures (D-prime), we found that both Chinese-English bilinguals and alphabetic-English bilinguals exhibited a stronger right visual field/left hemisphere advantage in English word matching than English monolinguals; in addition, a tendency of reduced right hemisphere lateralization in face judgment was observed in Chinese-English bilinguals, consistent with the findings in the previous studies. Our results suggest that increased experience in and exposure to more than one language may have influences on hemispheric lateralization in visual processing in general.

**Acknowledgement** : This research was supported by a grant from the Hong Kong Research Grants Council (HKU 744509H) to Janet H. W. Hsiao

42.02

## **TMS Stimulation of V5 Interferes with Single Word Reading**

Sheila Crewther<sup>1</sup>, Robin Laycock<sup>1</sup>, Paul B Fitzgerald<sup>2</sup>, David P Crewther<sup>3</sup>

<sup>1</sup>La Trobe University, Australia, <sup>2</sup>The Alfred Hospital and Monash University, Australia

<sup>3</sup>Swinburne University of Technology, Australia

Word reading is a skill commonly associated with parvocellular and ventral pathway processing rather than magnocellular or dorsal stream processing. However there is considerable evidence for a magnocellular/dorsal impairment in developmental dyslexia. We investigated the necessity of V1/V2 and dorsal area V5/MT+ in word recognition using transcranial magnetic stimulation (TMS). Twelve healthy young adults viewed brief presentations of single words followed by a mask of white noise. On each trial a paired-pulse of TMS was delivered to either V1 or V5 at randomly selected onset asynchronies between 0 and 225ms post word onset. TMS over V1/V2, 4-36 ms post word onset disrupted accurate word discrimination, with disruption also evident at approximately 99 ms. TMS over V5/MT+ also disrupted accuracy following stimulation at 4 ms and also at 130 ms post word onset. Thus, a role for V5/MT+ in accurate single word identification is apparent suggesting rapid parietal attention mechanisms may be required prior to word specific processing in primary and temporal cortical regions. **Acknowledgement** : DP0985837

## **Effects of Different RSVP Displays on Semantic Integration in Reading Chinese: An ERP Study**

Hsuan-Chih Chen<sup>1</sup>, Suiping Wang<sup>2</sup>, Xiuhong Tong<sup>2</sup>

<sup>1</sup>Department of Psychology, Chinese University of Hong Kong, Hong Kong

<sup>2</sup>Department of Psychology, South China Normal University, Guangzhou, China

Using rapid serial visual presentation (RSVP) procedure and event-related brain potential (ERP) recording, this study investigated the possible effects of display mode and presentation rate on semantic integration during Chinese sentence reading. In two experiments, participants read 160 individually presented sentences containing a single-character target word either congruent or incongruent with the sentential context for comprehension. Experiment 1 manipulated the display mode of sentence presentation (i.e., character-by-character or word-by-word with a constant display rate of 300ms per display and 200ms interval between two consecutive displays), while Experiment 2 manipulated the display rate (i.e., 250ms or 400ms per display with a 200ms interval) on the word-by-word presentation. Results of both experiments consistently demonstrated that the only significant difference across different display conditions lied in the amplitude of the N400 component. More importantly, regardless of the display conditions used, the N400 elicited by the incongruent target word was larger than that elicited by the congruent one. Taken together, these results indicate that whether or not providing explicit word marker in written Chinese would not affect high-level on-line semantic integration in reading Chinese.

**Acknowledgement** : CUHK441008

## **Inversion Effect in Visual Word Forms: the Role of Spatial Configurations and Character Components**

Chien-Hui Kao, Chien-Chung Chen

Department of Psychology, National Taiwan University, Taiwan

We investigated the configural processing of orthographic stimuli by measuring the inversion effect in five types of stimuli. The real-characters were composites with two components arranged in a left-right configuration. The non-characters had the two components swapped in position. The lexical components were components in a composite that are also independent characters while the non-lexical components are not. The oracle bone characters have the same structure as modern Chinese characters but contain no familiar components. The inverted stimuli were the upside-down versions of their upright counterparts. Two characters of the same type were presented to the left and right of the fixation. Observers' task was to determine whether the two characters presented in a trial were the same. The percentage correct of matching for the upright real-characters and lexical components was greater than that for their inverted versions. Such inversion effect was not observed in the non-characters, non-lexical components, or oracle characters. Thus, the configuration processing, as manifested in the inversion effect, only occurs in well practiced characters. This result is consistent with the template hypothesis of visual word form processing, in which a word was recognized through a holistic process rather than an analysis of its components.

**Acknowledgement** : NSC96-2413-H-002-006-MY3

42.05

## **The Suppression Component of Attentional Selection in Long-term Visual Search Learning**

Chia-Huei Tseng, Hin-Tai Lam

Department of Psychology, The University of Hong Kong, Hong Kong

Attention can alter human's long-term motion perception, mainly through enhancing the attended feature (Tseng et al, 2010). This finding conflicts with ample evidences supporting the co-existence of facilitatory and inhibitory components of attentional selection. We revisited this issue with an extreme visual search task to maximize the previously non-significant suppression component.

We trained each observer in two phases of visual search that requires to identify target letter on a target color background. In phase 1, there was one target color and three distracter colors, while in phase 2, there was one distracter but three target colors. The most economic strategy for phase 2 search would be to inhibit the single distracter color. Observers' sensitivities to target color in phase 1 increased after 7-10 hours of search, measured by the same isoluminant ambiguous motion display as in Tseng et al. (2004, 2010). No significant desensitization for distracter colors was found, consistent with previous results. In phase 2, strong inhibition on the relative salience of distracter color was discovered. This suggests that facilitation is not always the primary contributor in a visual search task, and people are flexible in the use of facilitation/suppression based on the task demand.

42.06

## **Reweighting Rule Learning Explains Visual Perceptual Learning and Its Specificity and Generalization**

Jun-Yun Zhang<sup>1</sup>, Gong-Liang Zhang<sup>1</sup>, Stanley A. Klein<sup>2</sup>, Dennis M. Levi<sup>2</sup>, Cong Yu<sup>1</sup>

<sup>1</sup> State Key Laboratory of Cognitive Neuroscience and Learning Beijing Normal University, China

<sup>2</sup> School of Optometry and Helen Wills Neuroscience Institute, University of California, Berkeley, USA

Visual perceptual learning models are constrained by orientation and location specificities, leading to the assumption that learning either reflects changes in V1 neuronal tuning, or reweighting of specific V1 inputs in either the visual cortex or higher areas. Here we used a "training plus exposure" procedure, in which the observers were attentively trained at one orientation and inattentively exposed to the transfer orientation, to demonstrate complete learning transfer across orientations in three tasks known to be orientation specific, indicating that perceptual learning involves more general learning. We also demonstrate that precise learning specificity, once regarded as the strongest evidence for V1 involvement, may result from "over-attention". Learning becomes more transferrable to nearby orientations with reduced attention during training. We thus propose a new reweighting rule learning model to explain perceptual learning and its specificity and generalization. In this model a decision unit in high-level brain areas learns the rules of reweighting V1 inputs. However, the learned reweighting rules can only be applied to a new orientation/location when functional connections between the decision unit and new V1 inputs are established through repeated orientation exposure or location training.

**Acknowledgement** : Natural Science Foundation of China grant 30725018(CY), US National Institute of Health grants RO1-04776 (SAK) and RO1-01728 (DML)

## Talk Session : Eye movement & Gaze II

(Sunday, July 26, 10:15-12:15, Plato)

43.01 Reschedule to the poster session "Eyemovement & Gaze I"

43.02

### **Temporal Impulse Response of V1 for Saccadic Decision**

Choongkil Lee<sup>1</sup>, Jungah Lee<sup>2</sup>

<sup>1</sup>Seoul National University, Korea, <sup>2</sup> Duke University, USA

From spike sequences of single V1 neurons recorded from the macaque monkeys trained to make saccadic eye movements to a visual target, we determined the time course of the signal related to saccadic decision. The firing rate during sequential epochs of 10ms following target onset was correlated with saccadic response time. The correlation between firing rate and response time dynamically changed until saccadic onset; significant correlation emerged at around 45 ms, peaked at 65 ms after target onset, and lasted but decayed until saccadic onset. The time of peak correlation was roughly the same as the mean time of the first spike of visual response. The time course of correlation is reminiscent of the impulse response of human vision to luminance change supporting the hypothesis that 'single-shot' output of early temporal filter providing signals for saccadic decision resides within V1 (Ludwig et al. 2005). The results are also consistent with the finding that spike activity of MT within tens of milliseconds can reliably convey information about behavioral choice for a rapid perceptual judgment (Ghose and Harrison 2009).

**Acknowledgement** : Cognitive Neuroscience Research Program of the Korea Ministry of Education, Science, and Technology

43.03

### **Gaze Cueing with Multiple Faces: The Time Course of Facilitation and Inhibition**

Yu-Li Liu, Gary C.-W. Shyi

Department of Psychology and Center for Research in Cognitive Science National Chung Cheng University, Chiayi, Taiwan

Recent studies have demonstrated that orienting of attention in response to nonpredictive gaze cues arises rapidly and automatically, and inhibition of return (IOR) for gaze cueing emerges only at long cue-target intervals. Here, we investigated whether time course of gaze cueing is influenced by the number of faces on display. In Experiment 1, we used a single face and replicated previous findings, namely facilitation at 200-ms SOA, null effect at 1200-ms SOA, and inhibition at 2400-ms SOA. In Experiment 2, we manipulated the number of face and found identical time courses for facilitation and inhibition between one- and two-face conditions. In Experiment 3, we compared three faces with one, and found IOR at 2400-ms SOA disappeared in the three-face condition. Finally, in Experiment 4, we compared all three face conditions and found IOR at 2400-ms SOA disappeared in both two- and three-face conditions. Furthermore, facilitative, rather than null, cueing effect was found with SOA of 1200 ms for all three face conditions. Taken together, we conclude that gaze cueing with multiple faces indeed evoked a time course of facilitation and inhibition different from that evoked with a single face. Implications for how multiple faces may affect gaze cueing are discussed.

43.04

## **Localization of Speed Perturbations of Context Stimuli during Fixation and Smooth Pursuit Eye Movements**

Doris Braun<sup>1</sup>, Doris I. Braun<sup>2</sup>, Alexander C. Schütz<sup>2</sup>, Karl R. Gegenfurtner<sup>2</sup>

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We investigated whether smooth pursuit eye movements improve the ability to localize a short (500 ms) speed perturbation affecting one of two moving peripheral context stimuli consisting of vertical sine wave gratings placed above and below a pursuit or central fixation target. Psychophysical thresholds were measured for localization, discrimination and detection during fixation and smooth pursuit at the same or different speeds in the same direction. We also tested the effect of stimulus size, feedback, depth and speed difference between both context stimuli. While detection and discrimination thresholds for speed perturbations were in the normal range (10%-15% Weber fraction), localization thresholds were dramatically increased (30%-50%). These high localization thresholds were particularly observed when retinal motion was only or mainly due to movements of the context stimuli as during fixation or slower pursuit movements. When the retinal motion was mainly due to pursuit, localization thresholds at equal retinal velocities were lower. We conclude that the localization of speed perturbations of peripheral objects is a difficult task for the visual system probably due to the dominance of relative motion signals. Smooth pursuit eye improve the localization of speed perturbations, also feedback and the reduction of relative motion cues have positive effects. *Acknowledgement* : DFG FOR 560

43.05

## **Contrast-dependent Change of the Effect of Pursuit Eye Movements on the Perceived Direction of Retinally Ambiguous Motion**

Masahiko Terao<sup>1</sup>, Ikuya Murakami<sup>1</sup>, Shin'ya Nishida<sup>2</sup>

<sup>1</sup>University of Tokyo, Japan

<sup>2</sup>NTT Communication Science Laboratories, Japan

When an apparent-motion stimulus, whose direction is ambiguous in the retinal image, is presented during smooth pursuit eye movements, the dominant perceived direction is opposite to the direction of pursuit (Terao et al, 2009, SfN). This finding suggests that the pursuit movement enhances motion signals in the anti-pursuit direction, relative to that in the pro-pursuit direction. In contrast, it is known that the contrast sensitivity of luminance grating is reduced for the anti-pursuit direction (Shütz et al, 2007, Journal of Vision). To resolve the apparent inconsistency between these findings, we investigated how stimulus contrast affected motion perception during pursuit. We presented a retinally counter-phase sinusoidal grating on a gray background, while the observer's eyes were tracking a marker smoothly moving below the grating. The counter-phase grating was a linear sum of two gratings that had the same spatiotemporal frequency but drifted in opposite directions. Our preliminary result suggests that dominant perceived direction is the anti-pursuit direction when the grating contrast is high, while it can be changed to the pursuit direction when the grating contrast is significantly reduced. These results indicate that the effect of pursuit on the perceived motion direction is dependent on the level of stimulus contrast. *Acknowledgement* : MEXT #20020006

43.06

## **Adaptation Affects Binocular Rivalry Dynamics at the Endpoint of Ventral Processing**

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<sup>1</sup>Swinburne University of Technology, Australia

<sup>2</sup>Brain Sciences Institute, Swinburne University of Technology, Australia

Blake and Sobel proposed that low-level neural adaptation is key to rival instability on the basis that orbital movement slows binocular rivalry between simple patterns by stimulating fresh receptive fields, reducing build up of neural adaptation. We extended this theory to rivalry of complex stimuli - faces and houses, for which ventral processing is terminated within the inferotemporal cortex (IT), where the receptive fields of object selective neurons are much larger in visual extent than in V1/V2. We predicted that stimulus movement would increase the perceptual stability of rivalry between grating stimuli, but not face and house stimuli because changing the stimulus position does not prevent adaptation in IT. A secondary experiment revealed that stimulus orbit also destabilizes rivalry by increasing the saccade rate for both simple and complex stimulus pairs. We argue that stimulus orbit can both stabilize rivalry by delaying neural adaptation and destabilize rivalry by evoking saccades. As orbit reduces adaptation within retinotopic but not complex object selective neural representations, we conclude that adaptation controls rivalry dynamics at the endpoint ventral processing for the inducer stimuli.

Talk Session : Neural Mechanisms

(Sunday, July 26, 13:30-15:30, Plato)

44.01

## **Developmental Follow-up of the Effects of PCB Exposure on Visual Processing in Inuit Children from Arctic Quebec**

Dave Saint-Amour<sup>1</sup>, Gina Muckle<sup>3</sup>, Audrey-Anne Ethier<sup>2</sup>, Celyne H. Batien<sup>3</sup>, Eric Dewailly<sup>3</sup>, Pierre Ayotte<sup>3</sup>, Sandra W. Jacobson<sup>4</sup>, Joseph L. Jacobson<sup>4</sup>

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Alterations of visual function in the developing human brain have been linked to heavy metals exposure but very little is known regarding persistent organic pollutants such as polychlorinated biphenyls (PCBs). In a cohort of preschool Inuit children from Arctic Quebec (Canada), we previously found alterations of visual evoked potentials (VEPs) in association with chronic PCB exposure. This follow-up study aimed at assessing the impact of PCBs on visual processing at school age. Blood concentrations of several toxins including PCBs were measured at birth from cord blood samples and at the time of testing. VEPs were obtained at different contrast levels. Spatial visual attention was also assessed using a Posner cue-target paradigm. The relationships between PCBs and outcomes were assessed by multivariate regression analyses. No effects were observed for VEPs. In the Posner task, high level of PCBs during postnatal development was significantly related to longer reaction times. In addition, prenatal PCB exposure was associated with a greater number of missing targets and false alarms. This prenatal effect remained significant after adjustment for postnatal exposure. This study suggests that chronic PCB exposure has transitory effects on early visual processing but impairs vigilance and impulsivity at school age. **Acknowledgement** : R01 ES07902

44.02

## **Spatio-temporal Resolution of Steady-state Visual Evoked Potentials for a Brain-computer Interface**

Yuki Kamatani<sup>1</sup>, Michiteru Kitazaki<sup>2</sup>

<sup>1</sup>Toyohashi University of Technology, Japan

<sup>2</sup>Graduate School of Engineering, Toyohashi University of Technology, Japan

We aimed to investigate spatio-temporal resolutions of steady-state visual evoked potentials (SSVEP) for applying to development of a brain-computer interface (BCI), particularly a BCI system for steering a car. We measured SSVEPs (O1 and O2 with Fz reference and Fpz ground) with presenting two flickering checker patterns, which were located apart right and left (30deg) and had different reversal frequencies (12, 15, 20, 30Hz, 15s duration). Three different time-windows were used for time-frequency analysis (250, 500, 1000ms, every 62.5ms shift). When observers looked at one of 7 positions between two checkers, observers' SSVEPs quantitatively changed depending on the distance between the fixation point and the left/right checkers. With a long time-window, SSVEP's fixation dependency was clear and a 15-20Hz pattern combination was best. With a short time-window, the fixation dependency generally decreased, but better with higher frequency combinations such as a 20-30Hz pattern. Then, we applied these findings to a BCI-driving simulator, in which a driver could steer a car by looking at a heading direction between two checkers flickering at 15 and 20Hz. Drivers' steering was stable with a longer time-window, but sometimes delayed. With a shorter time-window, the steering was unstable, but quick and sensitive. **Acknowledgement** : Supported by Nissan Science Foundation

44.03

## **The Structure of Cortical Receptive Fields Varies with Different Stimulus Ensembles**

Chun-I Yeh, Dajun Xing, Robert M. Shapley

Center for Neural Science, New York University, USA

We found that simple cells in layer 2/3 of macaque primary visual cortex (V1), which provide visual information to extrastriate cortical areas, have qualitatively different receptive-field maps when measured with sparse noise (Jones and Palmer, 1987) and Hartley subspace (Ringach et al, 1997) stimuli. Furthermore, the layer-2/3 population also shows a black-over-white preference in response to sparse noise (less evident with Hartley stimuli). Because sparse noise and Hartley differ in many ways (e.g. sparse vs. dense), what stimulus parameters contribute to the discrepancy between the two maps remains unclear. To address this question, we introduced a third stimulus ensemble, a spatio-temporal white noise (m-sequence, Reid et al, 1997) to measure receptive-field maps in sufentanil-anesthetized monkey V1. The receptive field similarity (RFS) for the two dense noises (white noise and Hartley) is somewhat greater than that between Hartley and sparse noise, but still RFS is significantly smaller in layer 2/3 than in layer 4. Moreover, the black-preference of layer-2/3 neurons is more evident from white noise maps than from both Hartley and sparse-noise maps. These results challenge the idea that the receptive field is a fixed property of V1 neurons.

**Acknowledgement** : NIH-EY001472, NSF-0745253, Patterson Trust Fund

## **Functional Circuitry of Key Dimensions in Local Macaque AIT Ensemble Activity**

Yueh-Peng Chen<sup>1</sup>, Chia-Pei Lin<sup>1</sup>, Chou P. Hung<sup>1,2</sup>

<sup>1</sup>Institute of Neuroscience and Brain Research Center National Yang Ming University, Taipei, Taiwan

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The anterior inferior temporal (AIT) cortex is the last purely visual processing stage at the end of the macaque ventral visual stream and is thought to underlie invariant object recognition via a high-dimensional code for complex shapes. The number and identity of these key dimensions is unknown and has been hypothesized to range from 36 'geons' to an infinite number of shape dimensions. We recorded from 64-site multielectrode arrays spanning 1.4x1.4 mm (distance x depth) in AIT of anaesthetized *Macaca cyclopis* monkeys and found ensemble activity patterns by applying principal component analysis. We previously showed that the patterns allow generalization/extrapolation across independently constructed stimulus sets and are differentially driven by stimuli with opposite features. Here, we applied cross-correlation analysis with covariation correction to map the functional circuitry underlying the ensemble patterns. The patterns of excitatory and suppressive functional connections suggest a precise functional network underlying the ensemble patterns. The consistency between ensemble activity and functional networks strengthens the case for a topographically stable map of key dimensions capable of supporting invariant object recognition and generalization to novel objects.

**Acknowledgement** : Support by the Taiwan Ministry of Education Five Year Aim for the Top University Plan, NSC-97-2811-B-010-501, and NSC-98-2321-B-010-003

## **Hierarchically Organized 'Functional Structures' in Monkey Inferior Temporal Cortex**

Takayuki Sato<sup>1</sup>, Go Uchida<sup>1</sup>, Mark Lescroart<sup>2</sup>, Manabu Tanifuji<sup>1</sup>

<sup>1</sup>RIKEN Brain Science Institute, Japan

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Previously, we showed that neurons in a columnar region have a common property in object selectivity, and the common property is different from the property in adjacent columnar region, supporting the columnar organizations in IT cortex (Sato et al., 2009). Here, in the present study, we address a question whether functional structures larger than columns do exist in IT cortex.

We recorded multi-unit activities (MUAs) densely from wide range of exposed IT. For each site, we recorded fifteen MUAs from surface down to the white matter. Object responses of these MUAs were averaged to extract the common response property of the site (avgMUA). As in the previous study, analysis of common response property showed that the property was different from site to site. Then, we categorized the object response property of avgMUAs according to hierarchical clustering based on the similarity in object selectivity of each avgMUA. We found that there were multiple functional domains each covering multiple sites. Each functional domain was specific to a particular stimulus category such as face, animal body etc. Taking into account the previous study, these findings suggest that there is hierarchical organization of functional structures from single cells, columns to functional domains.

## **Cortical Columnar Organization Is Reconsidered in Inferotemporal Cortex**

Manabu Tanifuji, Go Uchida, Takayuki Sato

RIKEN Brain Science Institute, Japan

The previous study suggested that inferotemporal (IT) cortex is organized with columnar structure (Fujita, et al., 1992). However, we frequently observed that nearby cells revealed seemingly different object selectivity. Thus, columnar organization in IT cortex is still controversial. One critical point in the previous study was that they used the simplest visual feature critical for cells, and then columnar organization was examined for the feature. In this study, we used object stimuli to reexamine the columnar organization.

We identified activity spots revealed by optical imaging, and recorded unit activities from these spots. To quantify the similarity among the cells, we calculated correlation coefficients of responses to 100 object stimuli. Pairs of nearby single units did not show significant correlation in object selectivity, but MUA pairs did so. This result indicates that averaging single cell activity in MUA reduced variability in object selectivity and disclosed common property among the cells. We also found that this common property is similar for the cells in the same columnar region, but is different for pairs of cells from nearby columnar regions. These results reconfirm the columnar organization in IT cortex. Furthermore, the detailed analysis suggests that the columns do not cover entire IT cortex.

## **Visual Information Represented in Different Levels of Functional Hierarchy in Monkey IT Cortex Revealed by Machine Learning**

Go Uchida<sup>1</sup>, Takayuki Sato<sup>1</sup>, Jun Kitazono<sup>2</sup>, Masato Okada<sup>2</sup>, Manabu Tanifuji<sup>1</sup>

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Inferotemporal (IT) cortex is essential for visual object recognition. In our previous study (Sato et al., *Cereb. Cortex*, 2009), we showed that neurons with similar object selectivity are locally clustered in IT cortex, and forming functional columns. Furthermore, we recently found a larger functional structure (functional domain) that covers multiple columns, suggesting hierarchy in functional structure in IT. What kind of visual information is represented by each level of the hierarchy? To address this problem, in the present study, we identified local clusters that are essential for categorization and identification of object images (faces) with a regularized linear classifier. We first trained the classifier so as to categorize faces among various objects. Although local clusters essential for the classification appeared across different functional domains, the one with positive weight parameters appeared only in a domain that sensitive to faces. On the other hand, there is no correlation with the domain structure for the local clusters essential for identification of a particular face among other faces. These results suggest that the functional domain represents information about object category such as faces, whereas local clusters represent generic visual features useful for identifying an object.

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