



15<sup>th</sup> BIENNIAL SCIENTIFIC MEETING OF  
THE INTERNATIONAL SOCIETY FOR  
COMPARATIVE PSYCHOLOGY

May 19 to 21, 2010

Awaji Yumebutai International Conference Center

Awaji Island, Hyogo, JAPAN

**PROGRAM and ABSTRACTS**

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Japan)

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We, Organizing & Program Committee of the 2010 ISCP meeting, express our deepest gratitude to Hyogo International Association and Department of Psychology, Osaka University of Education, for their financial assistance to this convention.

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PROGRAM OF THE 15TH BIENNIAL SCIENTIFIC MEETING OF THE  
INTERNATIONAL SOCIETY FOR COMPARATIVE PSYCHOLOGY

May 19 to 21, 2010

Awaji Yumebutai International Conference Center

Awaji Island, Hyogo, Japan

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Wednesday, May 19

Reception Desk :from 7:45

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WELCOME AND OPENING

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8:30-           **MASATO ISHIDA** (*Osaka University of Education, Japan*),  
Program Chair  
**MASATAKA WATANABE** (*President of the Japanese Society for Animal  
Psychology, Japan*)

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INVITED CONFERENCE #1

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9:00- 10:00    “Hippocampal-striatal Interactions in the Temporal Control of  
Behavior”  
**WARREN H. MECK** (*Duke University, USA*)  
Chair: SHOGO SAKATA (*Hiroshima University, Japan*)

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10:00-10:10    Break

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SYMPOSIUM#1

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10:10-11:30    “What is animal intelligence? The ability to generate novel adaptive  
behavior in human being and nonhuman animals”  
Chair: TOHRU MORIYAMA (*Shinshu University, Japan*)

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10:10-10:30    “Novel sensory organs’ in pill bugs (*Armadillidium vulgare*, Crustacea):  
artificial tubes attached to their antennae”  
**TOHRU MORIYAMA** (*Shinshu University, Japan*)

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10:30-10:50    “Mechanism for novel behaviors as observed in righting behavior of  
starfish”  
**MASAO MIGITA** (*Shiga University, Japan*)

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10:50-11:10    “Exploratory patterns and attuning of human touching behavior in  
discriminating surface roughness”  
**SHIN MARUYAMA**<sup>1</sup>, **NOBUHIRO FURUYAMA**<sup>1</sup>, **HIROYUKI  
MISHIMA**<sup>2</sup>, & **MASASHI TAKIYAMA**<sup>3</sup> (*<sup>1</sup>National Institute of  
Informatics, Japan, <sup>2</sup>Waseda University, Japan, <sup>3</sup>The University of  
Tokyo, Japan*)

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11:10-11:30 “The idea of perceptual systems as a framework to understand functionally comparable behaviors by structurally different animals”  
**NOBUHIRO FURUYAMA** (*National Institute of Informatics, Japan*)

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#### ORAL PRESENTATION #1

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11:40-12:40 “Cognition and Behavior in Primates”

Chair: **SERGIO M. PELLIS** (*University of Lethbridge, Canada*)

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11:40-11:55 “Rapid detection of snakes by Japanese monkeys (*Macaca fuscata*): An evolutionarily predisposed visual system”

**MASAHIRO SHIBASAKI**<sup>1</sup> & **NOBUYUKI KAWAI**<sup>2</sup> (<sup>1</sup>*Kyoto University, Japan*, <sup>2</sup>*Nagoya University, Japan*)

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11:55-12:10 “Combinatorial, syntactical and prosodic features in vocal exchanges of northern muriquis (*Brachyteles hypoxanthus*)”

**CÉSAR ADES**<sup>1</sup>, **FRANCISCO DYONÍSIO CARDOSO MENDES**<sup>2</sup>, & **DIDIER DEMOLIN**<sup>1</sup> (<sup>1</sup>*University of São Paulo, Brazil*, <sup>2</sup>*PUC Goiás, Brazil*)

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12:10-12:25 “Finding a ‘detour’ to study of animal play behavior”

**MASAKI SHIMADA** (*Teikyo University of Science & Technology, Japan*)

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12:25-12:40 “From the foot to the hand: The evolution of head scratching in primates”

**SERGIO M. PELLIS** & **VIVIEN C. PELLIS** (*University of Lethbridge, Canada*)

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12:40-13:30 Lunch

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#### SYMPOSIUM #2

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13:30-15:10 “Self Reflective Cognition”

Chair: **KAZUO FUJITA** (*Kyoto University, Japan*)

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13:30-13:50 “Experimental approaches to self-control in new world monkeys”

**JAMES R. ANDERSON**<sup>1</sup> & **KAZUO FUJITA**<sup>2</sup> (<sup>1</sup>*University of Stirling, Scotland UK*, <sup>2</sup>*Kyoto University, Japan*)

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13:50-14:10 “Memory-related activity of prefrontal neurons and metacognitive behavior in the rhesus monkey”

**AKIO TANAKA** & **SHINTARO FUNAHASHI** (*Kyoto University, Japan*)

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14:10-14:30 “Metamemory in jungle crows (*Corvus macrorhynchos*)”

**KAZUHIRO GOTO** (*Kyoto University, Japan*)

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14:30-14:50	<p>“Spontaneous retrieval and use of memory for a single unique experience by dogs: Implications for episodic memory”</p> <p><b>KAZUO FUJITA</b>, AYAKO MORISAKI, &amp; AKIKO TAKAOKA (<i>Kyoto University, Japan</i>)</p>
14:50-15:10	<p>“Recognition of live and delayed self-images in chimpanzees”</p> <p><b>SATOSHI HIRATA</b> (<i>Hayashibara Biomedical Laboratories, Inc., Japan</i>)</p>

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**POSTER SESSION #1**

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12:40-16:10	<p>Posters #1-#14</p> <p>Authors must be at the poster from 15:10 to 16:10</p>
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**SYMPOSIUM #3**

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16:10-17:50	<p>“Comparative Studies of Animal Communication”</p> <p>Chair: STAN KUCZAJ (<i>University of Southern Mississippi, USA</i>) &amp; KATHLEEN M. DUDZINSKI (<i>Dolphin Communication Project, USA / University of Southern Mississippi, USA</i>)</p>
16:10-16:30	<p>“Tactile contact exchanges between dolphins: self-rubbing versus inter-individual contact in three species from three geographies”</p> <p><b>KATHLEEN M. DUDZINSKI</b><sup>1,2</sup>, J. D. GREGG<sup>1</sup>, K. E. MELILLO<sup>1</sup>, &amp; STAN A. KUCZAJ<sup>1,2</sup> (<i><sup>1</sup>Dolphin Communication Project, USA, <sup>2</sup>University of Southern Mississippi, USA</i>)</p>
16:30-16:50	<p>“The ecological design of the affiliative vocal communication style in wild Japanese macaques - behavioral adjustments to social contexts and environments”</p> <p><b>HIROKI KODA &amp; HIDEKI SUGIURA</b> (<i>Kyoto University, Japan</i>)</p>
16:50-17:10	<p>“Touch and communication in Asian Elephants (<i>Elephas maximus</i>)”</p> <p><b>RADHIKA MAKECHA</b><sup>1</sup>, STAN KUCZAJ<sup>1</sup>, &amp; OTTO FAD<sup>2</sup> (<i><sup>1</sup>University of Southern Mississippi, USA, <sup>2</sup>Busch Gardens, USA</i>)</p>
17:10-17:30	<p>“Acoustic communication by dolphins: An evolutionary perspective”</p> <p><b>TADAMICHI MORISAKA</b> (<i>Kyoto University, Japan</i>)</p>
17:30-17:50	<p>“Behavioral factors governing song complexity in Bengalese finches”</p> <p><b>KAZUO OKANOYA</b> (<i>RIKEN Brain Science Institute, Japan</i>)</p>

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18:00-(18:45)	NINGYO-JORURI PERFORMANCE
(18:45)-20:30	RECEPTION PARTY
20:30	End of Wednesday Program

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Thursday, May 20th

(Reception Desk: from 8:00)

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**PRESIDENTIAL ADDRESS**

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8:30-9:30 “Nothing makes sense in neuroscience, except in the light of behavior: A personal testimony”

**MAURICIO R. PAPINI** (*Texas Christian University, USA*)

Chair: MASATO ISHIDA (*Osaka University of Education, Japan*)

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9:30-9:40 Break

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**ORAL PRESENTATION #2**

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9:40-10:55 “Evolutionary Aspects of Cognition”

Chair: PAT COUVILLON (*University of Hawaii at Manoa, USA*)

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9:40-9:55 “Working memory in the honeybee (*Apis mellifera*)”

**GENTARO SHISHIMI & PAT A. COUVILLON** (*University of Hawaii at Manoa, USA*)

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9:55-10:10 “The unobservability hypothesis in physical causal cognition from developmental perspective.”

**YOSHIHIRO NAGAMORI** (*Waseda University, Japan*)

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10:10-10:25 “Development of probabilistic judgment in humans”

**TOMOKO ITOH** (*Waseda University / Japan Society for the Promotion of Science, Japan*)

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10:25-10:40 “Behavior of dogs facing a difficult situation”

**YUSUKE HORI & KAZUO FUJITA** (*Kyoto University, Japan*)

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10:40-10:55 “How do dogs (*Canis familiaris*) recognize what is reachable? A comparison between Japanese and German dogs”

**TOMOMI MAEDA & KAZUO FUJITA** (*Kyoto University, Japan*)

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10:55-11:05 Break

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**SYMPOSIUM #4**

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11:05-12:25 “Conditioned Taste Aversion in Rats”

Chair: KOSUKE SAWA (*Senshu University, Japan*)

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11:05-11:25 “Activity-based taste aversion learning in rats: Some tests of the energy-expenditure hypothesis”

**SADAHIKO NAKAJIMA** (*Kwansei Gakuin University, Japan*)

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11:25-11:45 “Representation-mediated flavour aversion as a window into the contents of Pavlovian conditioning and instrumental learning”

**YOSHIO IGUCHI** (*Kanazawa University, Japan*)

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11:45-12:05 “Learned aversions to flavors signaling reduction in a nutrient: The missing calorie effect”

**ROBERT A. BOAKES** (*University of Sydney, Australia*)

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12:05-12:25 “Context-switch effects upon performance on rats’ conditioned taste aversion”

**JUAN M. ROSAS, SAMUEL P. LEÓN, & JOSÉ E. CALLEJAS-AGUILERA** (*University of Jaén, Jaén, Spain*)

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12:25-13:20 Lunch

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#### SYMPOSIUM #5

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13:20-14:40 “Neural Mechanisms of Behavior: Recent Approaches in Behavioral Neuroscience”

Chair: **YUKIO ICHITANI** (*University of Tsukuba, Japan*)

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13:20-13:40 “Prefrontal neuronal activity in the monkey during competitive and noncompetitive video shooting games”

**MASATAKA WATANABE & TAKAYUKI HOSOKAWA** (Tokyo Metropolitan Institute for Neuroscience, Japan)

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13:40-14:00 “Modulation of brain reward system by cholinergic neurons in the mesopontine tegmentum: intracranial self-stimulation studies in the rat”

**DAIICHIRO NAKAHARA** (*Hamamatsu University School of Medicine, Japan*)

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14:00-14:20 “Effects of the application of radiofrequency lesions to the nucleus basalis magnocellularis or the medial septum on short-term memory for visual and auditory stimuli in rats”

**YUJI TSUTSUI** (*Fukushima University, Japan*)

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14:20-14:40 “Spontaneous object recognition and object-in-place recognition for testing memory function of the hippocampus and related structures in rats”

**YUKIO ICHITANI** (*University of Tsukuba, Japan*)

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14:40-14:50 Break

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#### INVITED CONFERENCE #2

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14:50-15:50 “Superstition in the Laboratory and Stereotypies in Zoos: A Behavior System Analysis”

**WILLIAM TIMBERLAKE** (*Indiana University, USA*)

Chair: **MASATO ISHIDA** (*Osaka University of Education, Japan*)

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**POSTER SESSION #2**

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12:25-16:50 Posters #15-#28

Authors must be at the poster from 15:50 to 16:50

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**INVITED CONFERENCE #3**

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16:50-17:50 “Animal Aesthetics”

**SHIGERU WATANABE** (*Keio University, Japan*)

Chair: **KAZUO FUJITA** (*Kyoto University, Japan*)

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17:50-18:00 Break

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**SYMPOSIUM #6**

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18:00-19:00 “Understanding Animal Thinking”

Chair: **ROBIN A. MURPHY** (*Oxford University, UK*)

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18:00-18:20 “Rational rats: Causal inference and representation”

**AARON P. BLAISDELL** (*University of California-Los Angeles, USA*)

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18:20-18:40 “A comparative approach to causal cognition”

**ANDREW G. BAKER**<sup>1</sup>, **IRINA BÄETU**<sup>1</sup>, & **ITSASO BARBERÍA**<sup>2</sup>

(<sup>1</sup>*McGill University, Canada*, <sup>2</sup>*University of Barcelona, Spain*)

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18:40-19:00 “Rules: Associations or computations”

**ROBIN A. MURPHY**<sup>1</sup> & **IRINA BÄETU**<sup>2</sup> (<sup>1</sup>*Oxford University, UK*,

<sup>2</sup>*McGill University, Canada*)

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19:10- **BANQUET**

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End of Thursday Program

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Friday, May 21st

(Reception Desk: from 8:00)

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ORAL PRESENTATIONS #3

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- 8:30-9:45 “Memory and Perception in Birds ”  
Chair: FRANCISCO J. DONIS (*Central Connecticut State University, USA*)
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- 8:30-8:45 “Do bantams (*Gallus gallus domesticus*) amodally complete? An analysis of line classification performance”  
**NORIYUKI NAKAMURA**<sup>1,2</sup>, SOTA WATANABE<sup>2,3</sup>, TORU BETSUYAKU<sup>3</sup>, & KAZUO FUJITA<sup>3</sup> (<sup>1</sup>*Chiba University, Japan*, <sup>2</sup>*Japan Society for the Promotion of Science, Japan*, <sup>3</sup>*Kyoto University, Japan*)
- 
- 8:45-9:00 “Bantams' (*Gallus gallus domesticus*) perception of Zöllner illusion: the tendency is opposite to that of humans”  
**SOTA WATANABE**<sup>1,2</sup>, NORIYUKI NAKAMURA<sup>2,3</sup>, & KAZUO FUJITA<sup>1</sup> (<sup>1</sup>*Kyoto University, Japan*, <sup>2</sup>*Japan Society for the Promotion of Science, Japan*, <sup>3</sup>*Chiba University, Japan*)
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- 9:00-9:15 “The oblique effect in pigeons may depend on a perceptual Gestalt”  
**FRANCISCO J. DONIS**, YACIHUILCA MONI, & EMILY HALE (*Central Connecticut State University, USA*)
- 
- 9:15-9:30 “Perceptual grouping according to the *Gestalt* factor of similarity in pigeons (*Columba livia*)”  
**TOMOKAZU USHITANI & MASAKO JITSUMORI** (*Chiba University, Japan*)
- 
- 9:30-9:45 “Pigeons exhibit higher accuracy for chosen memory tests than for forced memory tests in duration matching-to-sample”  
**ANGELO SANTI & ALLISON ADAMS** (*Wilfrid Laurier University, Canada*)
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9:45-9:55 Break

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KEYNOTE ADDRESS

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- 9:55-10:55 “Cognitive Development in Chimpanzees”  
**TETSURO MATSUZAWA** (*Kyoto University, Japan*)  
Chair: MASATO ISHIDA (*Osaka University of Education, Japan*)
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10:55-11:05 Break

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## SYMPOSIUM #7

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- 11:05-12:45 “Comparative Hippocampus Functions”  
Chair: SHOGO SAKATA (*Hiroshima University, Japan*)
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- 11:05-11:25 “Immunohistochemical identification of telencephalic neurons expressing c-Fos protein during learning and memory in the mudskipper”  
**TAKAO MUKUDA** (*Hiroshima University, Japan*)
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- 11:25-11:45 “Molecular asymmetry in mouse hippocampal circuitry”  
**ISAO ITO** (*Kyushu University, Japan*)
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- 11:45-12:05 “Expression of the immediate-early genes *c-fos* and *Arc* reveal distinct mechanisms for place and response navigation in the hippocampus and striatum of female rats”  
**CHRISTINA L. WILLIAMS & KRISTEN E. PLEIL** (*Duke University, USA*)
- 
- 12:05-12:25 “Dissociative contributions of medial temporal and frontal regions to prospective remembering”  
**SATOSHI UMEDA** (*Keio University, Japan*)
- 
- 12:25-12:45 “PUFA, GPR40 and adult-born hippocampal neurons for memory”  
**TETSUMORI YAMASHIMA** (*Kanazawa University, Japan*)

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12:45-13:30 Lunch

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## ORAL PRESENTATIONS #4

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- 13:30-14:45 “Spatial Learning in Rodents”  
Chair: IAN JOHNSTON (*University of Sydney, Australia*)
- 
- 13:30-13:45 “Novel object exploration in mice and rats: The role of habituation.”  
**C. J. HEYSER, D. VISHNEVETSKY, R. E. BLASER, & A. CHEMERO**  
(*Franklin & Marshall College, USA*)
- 
- 13:45-14:00 “Transitive responding and the symbolic distance effect in rats’ transitive inference task”  
**SUMIE IWASAKI<sup>1</sup> & TOHRU TANIUCHI<sup>2</sup>** (<sup>1</sup>*Kyoto University, Japan*,  
<sup>2</sup>*Kanazawa University, Japan*)
- 
- 14:00-14:15 “Free operant procedure for studying spatial learning in the laboratory rat”  
**IAN JOHNSTON** (*University of Sydney, Australia*)
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14:15-14:30	<p>“How Syrian hamsters (<i>Mesocricetus auratus</i>) use various cue-objects in finding targets?”</p> <p><b>TOMOYUKI TAMAI</b><sup>1</sup>, TORU BETUYAKU<sup>1</sup>, NORIYUKI NAKAMURA<sup>2,3</sup>, &amp; KAZUO FUJITA<sup>1</sup> (<i><sup>1</sup>Kyoto University, Japan, <sup>2</sup>Chiba University, Japan, <sup>3</sup>Japan Society for the Promotion of Science, Japan</i>)</p>
14:30-14:45	<p>“Spatial navigation in Syrian hamsters: Flexible use of beacon and geometric cues?”</p> <p><b>TORU BETSUYAKU</b><sup>1</sup>, NORIYUKI NAKAMURA<sup>2,3</sup>, &amp; KAZUO FUJITA<sup>1</sup> (<i><sup>1</sup>Kyoto University, Japan, <sup>2</sup>Chiba University, Japan, <sup>3</sup>Japan Society for the Promotion of Science, Japan</i>)</p>
14:45-15:00	<p>“City rats: Utilizing rat's cognitive mapping to study principles of urban design and city planning”</p> <p><b>DAVID EILAM</b>, OSNAT YASKI, &amp; JUVAL PORTUGALI (<i>Tel-Aviv University, Israel</i>)</p>
15:00-15:10	Break
<hr/> <b>SYMPOSIUM #8</b> <hr/>	
15:10-16:50	<p>“Social Cognition in Nonhumans“</p> <p>Chair: IKUMA ADACHI &amp; MASAKI TOMONAGA (<i>Kyoto University, Japan</i>)</p>
15:10-15:30	<p>“Social cognition in dolphins?”</p> <p><b>STAN KUCZAJ</b> (<i>University of Southern Mississippi, USA</i>)</p>
15:30-15:50	<p>“Development, environment, and experience are important contributors to canine social cognition”</p> <p><b>MONIQUE UDELL</b> (<i>University of Florida, USA</i>)</p>
15:50-16:10	<p>“Raven social cognition: generally Machiavellian or context specific?”</p> <p><b>THOMAS BUGNYAR</b>, (<i>University of Vienna, Austria</i>)</p>
16:10-16:30	<p>“Auditory-visual individual recognition in rhesus macaques (<i>Macaca mulatta</i>)”</p> <p><b>IKUMA ADACHI</b><sup>1</sup> &amp; ROBERT R. HAMPTON<sup>2</sup> (<i><sup>1</sup>Kyoto University, Japan, <sup>2</sup>Emory University, USA</i>)</p>
16:30-16:50	<p>“Perception of social stimuli in chimpanzees: From body, face, to gaze”</p> <p><b>MASAKI TOMONAGA</b> (<i>Kyoto University, Japan</i>)</p>
<hr/> <b>POSTER SESSION #3</b> <hr/>	
12:45-17:50	<p>Posters #29-#44</p> <p>Authors must be at the poster from 16:50 to 17:50</p>

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**SYMPOSIUM #9**

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- 17:50-19:10 “Reasoning and Learning in Nonhuman Animals”  
Chair: AARON BLAISDELL (*University of California-Los Angeles, USA*)
- 
- 17:50-18:10 “Difficulties in obtaining some cue-competition phenomena in human  
associative learning”  
**KOUJI URUSHIHARA** (*Health Sciences University of Hokkaido,  
Japan*)
- 
- 18:10-18:30 “When I cannot be rational; the conditional and unconditional effect of  
nicotine on intracranial self-stimulation behavior”  
**KOSUKE SAWA** (*Senshu University, Japan*)
- 
- 18:30-18:50 “Fly decision-making: spontaneous actions or habitual responses?”  
**BJÖRN BREMBS** (*Freie Universität Berlin, Germany*)
- 
- 18:50-19:10 “Reward inference by primate prefrontal neurons”  
**MASAMICHI SAKAGAMI**<sup>1</sup>, XIAOCHUAN PAN<sup>1</sup>, & KOSUKE SAWA<sup>2</sup>  
(<sup>1</sup>*Tamagawa University, Japan* <sup>2</sup>*Senshu University, Japan*)
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- 19:10-20:00 ISCP GENERAL MEETING
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- 20:00 End of Friday Program
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## Poster Session #1

(Wednesday, May 19th, 12:40-16:10; Authors must be at the poster from 15:10 to 16:10)

#1. “Obsessive-compulsive disorder (OCD): From animal model to behavior of human patients”

**DAVID EILAM**, RAMA ZOR, JOEL MORT, HENRY SZECHTMAN, & HAGGAI HERMESH (*Tel-Aviv University, Israel*)

#2. “The role of within compound associations in backward blocking revisited”

**DAVID LUQUE**, JOAQUÍN MORÍS, PEDRO L. COBOS, & FRANCISCO J. LÓPEZ (*University of Málaga, Spain*)

#3. “Transfer of non-extinguished CSs to new contexts after extinction: Comparative results in humans and rats”

**JUAN M. ROSAS**<sup>1</sup>, SAMUEL P. LEÓN<sup>1</sup>, JOSÉ E. CALLEJAS-AGUILERA<sup>1</sup>, & J. BYRON NELSON<sup>2</sup> (<sup>1</sup>*University of Jaén, Spain*, <sup>2</sup>*University of the Basque Country, Spain*)

#4. “Visual priming in pigeons and humans: A facilitating effect in humans and an inhibiting effect in pigeons”

**KATSUO SEKIGUCHI**, TOMOKAZU USHITANI, & MASAKO JITSUMORI (*Chiba University, Japan*)

#5. “Double alternation learning in pigeons: A preliminary experiment”

**KYOICHI HIRAOKA** (*Hirosaki University, Japan*)

#6. “Directed forgetting in two different memory tasks in rats: delay-interposed radial arm maze and delayed nonmatching-to-position tasks”

**MASAMI KAKU**, KAZUO YAMADA, & YUKIO ICHITANI (*University of Tsukuba, Japan*)

#7. “Hippocampal theta activity during Negative, Positive, and Elemental task in the rat”

**YUYA SAKIMOTO**, MINORU HATTORI, and SHOGO SAKATA (*Hiroshima University, Japan*)

#8. “Interference effects by spatial proximity and age-related declines in spatial memory by Japanese monkeys (*Macaca fuscata*): Deficits in integration of multiple spatial cues”

**NAMIKO KUBO-KAWAI**<sup>1</sup> & NOBUYUKI KAWAI<sup>2</sup> (<sup>1</sup>*Aichi Shukutoku University, Japan*, <sup>2</sup>*Nagoya University, Japan*)

#9. “Effects of dog-assisted therapy on the mood of inmates in a specialized unit of a prison and dog handlers”

**NAOKO KODA**<sup>1</sup>, YOSHIO MIYAZI<sup>2</sup>, MIYAKO KUNIYOSHI<sup>3</sup>, HISASHI UEHARA<sup>3</sup>, GEN WATANABE<sup>1</sup>, & CHIEMI MIYAZI<sup>2</sup> (<sup>1</sup>*Tokyo University of Agriculture and Technology, Japan*, <sup>2</sup>*Japan Animal-Assisted Therapy Council, Japan*, <sup>3</sup>*Harima Rehabilitation Program Center Japan*)

#10. “The effect of nicotine on rats’ impulsive and timing behavior in intracranial self-stimulation”

**NAOYA MUROTA**<sup>1</sup>, HISATUGU MIYATA<sup>2</sup>, & KOSUKE SAWA<sup>1</sup> (<sup>1</sup>*Senshu University, Japan*, <sup>2</sup>*Jikei University, Japan*)

#11. “Effects of amniotic fluid, mother's milk, and saliva on preference of mother and father in newborn mice”

**NORIKO KODAMA**, SONOKO KIYAMA, & AKIHIRO HIGASHIYAMA (*Shiga University, Japan*)

#12. “Facilitation of the performance of honeybees (*Apis mellifera*) in long-delay matching- and nonmatching-to-sample problems”

AKIRA SHISHIMI<sup>1</sup>, GENTARO SHISHIMI<sup>2</sup>, & **PAT A. COUVILLON**<sup>2</sup> (<sup>1</sup>*Hiroshima Shudo University, Japan*, <sup>2</sup>*University of Hawaii at Manoa, USA*)

#13. “Working memory of numerals in humans: a comparison with chimpanzees”

**SANA INOUE** (*Hayashibara Biochemical Laboratories, Inc., Japan*)

#14. “The formation of a context-US association in rats’ running-based taste aversion learning”

**TAKAHISA MASAKI** (*Japan Society for the Promotion of Science, Japan*, / *Nagoya University, Japan*)

## Poster Session #2

(Thursday, May 20th, 12:25-16:50; Authors must be at the poster from 15:50 to 16:50)

#15. “The influence of occupation-related gender stereotypes on self-reported service satisfaction toward medical professional”

**MEIN-WOEI SUEN**<sup>1</sup>, **YI-CHUN CHEN**<sup>1</sup>, **SHIN-RU CHEN**<sup>2</sup>, **WEI-YA WU**<sup>3</sup>, & **JUI-HSING WANG**<sup>4</sup> (<sup>1</sup>*Chung Shan Medical University, Taiwan*, <sup>2</sup>*National Changhua University of Education, Taiwan*, <sup>3</sup>*Chung Shan University Hospital, Taiwan*, <sup>4</sup>*China Medical University Hospital, Taiwan*)

#16. “Muridae fear conditioning: A comparative study of inbred mice, rats and mongolian gerbils”

**CRISTINA VARGAS-IRWIN**<sup>1</sup> & **J. R. ROBLES**<sup>2</sup> (<sup>1</sup>*Fundacion Universitaria Konrad Lorenz, Columbia*, <sup>2</sup>*Virginia Commonwealth University, USA*)

#17. “Musical performance of African Gray Parrot (*Psittacus erithacus*)”

**LUCIANA BOTTONI**<sup>1</sup>, **DANIELA LENTI BOERO**<sup>2</sup>, **LAURA HABEGGER**<sup>1</sup> (<sup>1</sup>*Università degli Studi Milano Bicocca, Italy*, <sup>2</sup>*Università della Valle d'Aosta, Italy*)

#18. “Backward blocking associative representation measured with a recognition priming task”

**JOAQUÍN MORÍS**, **DAVID LUQUE**, **PEDRO L. COBOS**, & **FRANCISCO J. LÓPEZ** (*University of Málaga, Spain*)

#19. “Olive oil concentration and induced response biases independently affected sensory and decision indexes in olive oil tasting”

**M. MANUELA MORENO-FERNÁNDEZ**, **CONCEPCIÓN PAREDES-OLAY**, **JUAN M. ROSAS**, & **MANUEL M. RAMOS-ÁLVAREZ** (*University of Jaén, Jaén, Spain*)

#20. “Do monkey’s scream calls directly change receiver’s emotional states?”

**YO MORIMOTO**<sup>1,2</sup>, **NOELÉ RENÓ**<sup>3</sup>, **KAZUO FUJITA**<sup>1</sup>, & **CARLOS C ALBERTS**<sup>3</sup> (<sup>1</sup>*Kyoto University, Japan*, <sup>2</sup>*Japan Society for the Promotion of Science, Japan* <sup>3</sup>*São Paulo State University, Brazil*)

#21. “Effects of mating preference on maternal behavior of female mice”

**KAZUYA TOMIHARA** (*Kagoshima University, Japan*)

#22. “Impaired long-term but intact short-term contextual fear memory in *Arc/Arg3.1*- deficient mice”

**KAZUYUKI YAMADA**<sup>1</sup>, **CHIIHIRO HOMMA**<sup>1</sup>, **TOSHIO IKEDA**<sup>1</sup>, **KENTARO TANEMURA**<sup>2</sup>, **SHIGEYOSHI ITOHARA**<sup>1</sup>, & **YOSHIKO NAGAOKA**<sup>1</sup> (<sup>1</sup>*Brain Science Institute, RIKEN, Japan,* <sup>2</sup>*Biological Safety Center, NIHS, Japan*)

#23. “Predictive judgment modulates cue competition in human contingency learning: Evidence from overshadowing”

**KEITARO NUMATA** & **TSUNEO SHIMAZAKI** (*Kwansei Gakuin University, Japan*)

#24. “History of comparative psychology in Japan in terms of generation”

**MIKI TAKASUNA** (*Tokyo International University, Japan*)

#25. “Assessment for adaptation process to outdoor semi-natural environment of laboratory rats”

**MIYUKI YASUE** & **TAKAMASA KOYAMA** (*Japan Women’s University, Japan*)

#26. “Time flies when you are busy: An experimental study with a Japanese macaque”

**NOBUAKI OHSHIBA**<sup>1</sup> & **MASAYUKI NAKAMICHI**<sup>2</sup> (<sup>1</sup>*Baika Women’s University, Japan,* <sup>2</sup>*Osaka University, Japan*)

#27. “Choice between two shared feeding stations that differed in the number of other pigeons”

**TETSUO YAMAGUCHI**, **MASATO ITO**, & **DAISUKE SAEKI** (*Osaka City University, Japan*)

#28. “Counting of objects by rats”

**TOHRU TANIUCHI** & **MAKIKO KAMIJO** (*Kanazawa University, Japan*)

## Poster Session #3

(Friday, May 21st, 12:45-17:35; Authors must be at the poster from 16:35 to 17:35)

#29. “Abnormality in the left-right asymmetry of the brain affects spatial learning: behavioral studies in iv mice”

**KAZUHIRO GOTO**<sup>1</sup>, RYO KURASHIMA<sup>2</sup>, HAYATO GOKAN<sup>2</sup>, NAOMI INOUE<sup>2</sup>, ISAO ITO<sup>3</sup>, & SHIGERU WATANABE<sup>2</sup> (<sup>1</sup>*Kyoto University, Japan*, <sup>2</sup>*Keio University, Japan*, <sup>3</sup>*Kyushu University, Japan*)

#30. “Golden ratio and aesthetic based preferences in humans and rats”

FÉLIX VICO-PRIETO, ANGEL CAGIGAS, JOSÉ E. CALLEJAS-AGUILERA, SAMUEL P. LEÓN, & **JUAN M. ROSAS** (*University of Jaén, Spain*)

#31. “Capuchin monkeys do not behave prosocially to group members at the expense of their own reward’s value in an experimental reward sharing situation”

**AYAKA TAKIMOTO**<sup>1,2</sup>, KAZUO FUJITA<sup>1</sup> (<sup>1</sup>*Kyoto University, Japan*, <sup>2</sup>*Japan Society for the Promotion of Science, Japan*)

#32. “Relationship between cooperative choices in the prisoner’s dilemma game and social discounting rates in pigeons”

**DAISUKE SAEKI**, MASATO ITO, TETSUO YAMAGUCHI, KUMIKO HARA, & SHOKO KITANO (*Osaka City University, Japan*)

#33. “Object Displacement in the Ring-tailed Lemur”

**ROBERT L. BOUGHNER** & JESSICA A. MARCHEWKA (*Rogers State University, USA*)

#34. “Tracking of food quantity by coyotes (*Canis Latrans*)”

**KERRY E. JORDAN**, JOSEPH M. BAKER, KATI RODZON, & JOHN SHIVIK (*Utah State University, USA*)

#35. “The effects of early weaning and neonatal handling on nose-poke operant learning of rats”

**KATSUYOSHI KAWASAKI** (*Hoshi University, Japan*)

#36. “Individual differences in wild (WWCPS) rat – manifested in the exploration box”

**WOJCIECH PISULA** (*Polish Academy of Sciences, Poland*)

#37. “Analysis of spatial organisation of behavior, physical contact, verbal and nonverbal activity in children with autism and their fathers”

**EWA PISULA** (*University of Warsaw, Poland*)

#38. “Preferred exploration behavior affects results of allothetic and idiothetic navigation of three rodent species in the Morris water maze”

**MICHALA ZELENKOVA**<sup>1</sup> & **FRANTISEK SEDLACEK**<sup>1,2</sup> (<sup>1</sup>*University of South Bohemia, Czech Republic*, <sup>2</sup>*Institute of Systems Biology and Ecology AS CR, Czech Republic*)

#39. “Evaluation of reliability of rat P3-like potential in the anterior cingulate cortex”

**MINORU HATTORI**<sup>1</sup>, **KEIICHI ONODA**<sup>2</sup>, & **SHOGO SAKATA**<sup>1</sup> (<sup>1</sup>*Hiroshima University, Japan*, <sup>2</sup>*Shimane University, Japan*)

#40. “Covariation vs. temporal order in human causal structure learning”

**MOTOYUKI SAITO** & **TSUNEO SHIMAZAKI** (*Kwansei Gakuin University, Japan*)

#41. “Summation of latent inhibition and overshadowing in human predictive learning”

**TAKATOSHI NAGAISHI** & **SADAHIKO NAKAJIMA** (*Kwansei Gakuin University, Japan*)

#42. “Is full physical interaction necessary for the buffering effects of pair-housing on social stress in rats?”

**TOMOHIRO NAKAYASU**<sup>1,2</sup> & **KATSUNORI KATO**<sup>1</sup> (<sup>1</sup>*University of Tsukuba, Japan*, <sup>2</sup>*Japan Society for the Promotion of Science, Japan*)

#43. “Recovery from conditioned inhibition in rat’s operant conditioning: using deflation and inflation”

**AKIRA KURIHARA**<sup>1</sup>, **NAOYUKI HIRONAKA**<sup>2</sup>, & **KOSUKE SAWA**<sup>1</sup> (<sup>1</sup>*Senshu University, Japan*, <sup>2</sup>*Japan Science and Technology Agency, Japan*)

#44. “Did maternal plasma PCBs contaminations in cynomolgus monkeys affect mother-infant behaviour?”

**AKIKO NAKAGAMI**<sup>1</sup>, **KASTUYOSHI KAWASAKI**<sup>2</sup>, **TAKAMASA KOYAMA**<sup>1</sup> (<sup>1</sup>*Japan Women’s University, Japan*, <sup>2</sup>*Hoshi University, Japan*)

# ABSTRACTS

## [KEYNOTE ADDRESS]

Cognitive development in chimpanzees.

**TETSURO MATSUZAWA**

*Kyoto University, Japan*

This is an effort to know the evolutionary basis of human mind. The mind does not remain in fossil records. To know the various aspects of the mind, we have to compare those of humans and other species, especially the closest species, chimpanzees. Fieldwork and laboratory work need to go hand in hand to provide us with a complete picture of the mind of the chimpanzee. I have studied the chimpanzees both in Japan and in Africa. A community of 14 chimpanzees of 3 generations inhabits an enriched, semi-natural environment at KUPRI. A community of 13 chimpanzees of 3 generations inhabits the forests at Bossou, Guinea, West Africa. The combination of laboratory and field studies has revealed a unique mode of social learning in chimpanzees, called “Education by master-apprenticeship”. Through education by master-apprenticeship, chimpanzees seem to be able to pass knowledge and skills from one generation to the next, thereby maintaining their community’s cultural repertoire. Although there are a lot of common features in humans and chimpanzees, there are some differences between the two. A recent study revealed that young chimpanzees outperform human adults in a memory task: They are good at memorizing numerals at a glance. However, we found that chimpanzees were less proficient at a variety of other cognitive tasks including imitation, cross-modal matching, symmetry of symbols and referents, and one-to-one correspondence. In sum, chimpanzees do not possess humanlike capabilities for representation at an abstract level. The present paper will discuss the constraints of chimpanzee mind, and illuminate some unique features of human mind.

## [PRESIDENTIAL ADDRESS]

Nothing makes sense in neuroscience, except in the light of behavior:

A personal testimony.

**MAURICIO R. PAPINI**

*Texas Christian University, USA*

Paraphrasing Dobzhansky's famous dictum on biology and evolution, I will review my own research on the comparative analysis of learning mechanisms as it developed over the past 30 years. My interest centered on the study of brain mechanisms of learning and my approach involved using wide variety of species, including armadillos, marsupials, pigeons, bony fish, octopuses, toads, turtles, mice, dogs, and rats. The goals of these experiments were, first, to broaden the comparative database for learning phenomena involving surprising incentive omissions or reductions (e.g., incentive contrast), and, second, to identify brain mechanisms underlying these behavioral effects that are likely targets for comparative analysis (e.g., opioid receptors). I will argue that in my own research, as in most research involving neuroscience techniques, the types of behavioral theories developed by comparative psychologists offer a guide to interpret the results.

## **[INVITED CONFERENCE #1]**

Hippocampal-striatal interactions in the temporal control of behavior.

**WARREN H. MECK**

*Duke University, USA*

The hippocampus and the striatum are thought to play fundamental and distinct roles in learning and memory, supporting two dissociable systems. In addition, numerous studies have shown that post-training hippocampal lesions of various types typically produce a horizontal leftward shift (underestimation) and/or an increase in the precision of psychophysical timing functions for durations in the seconds-to-minutes range. The explanation for these effects in terms of a change in pacemaker or oscillation frequencies (clock process), a multiplicative translation constant (memory process), or response thresholds (decision process) remains unclear. In contrast, post-training lesions of the dorsal striatum typically impair timing performance by reducing or eliminating the temporal control of behavior consistent with “knocking out” the accumulator or coincidence-detection mechanism (clock process). Given the reported “compensatory” interactions between the hippocampus and striatum in which inhibition of one structure leads to increased activation of the other or vice versa, the question naturally arises as to whether such interactions might contribute to the timing effects observed following hippocampal lesions, i.e., can these relatively selective effects be understood in terms of modified striatal activity? Moreover, recent data suggest that the medial and lateral sub-regions of the striatum interact differentially with the hippocampal system, thereby mediating the behavioral expression of certain striatal- and hippocampal-dependent behaviors (e.g., stimulus-response vs. place learning). A new model of spatial/temporal processing will be presented in order to show how these different factors may be taken into account in order to explain the temporal control of behavior in a variety of duration discriminations.

## **[INVITED CONFERENCE #2]**

Superstition in the laboratory and stereotypies in zoos: A behavior system analysis.

**WILLIAM TIMBERLAKE**

*Indiana University, USA*

Repetitive, stereotyped behaviors by animals in captive environments have been attributed to: (1) repeated, accidental reward-response contiguities; (2) stress produced by artificial, constrained environments, differing critically from typical habitats; and/or (3) temporal/spatial entrainment of components of a behavior system in the absence of sufficient environmental support for completed sequences of behavior. I will examine the contribution of these alternatives to several examples of superstitions and stereotypies in birds and mammals.

## [INVITED CONFERENCE #3]

### Animal Aesthetics.

**SHIGERU WATANABE**

*Keio University, Japan*

Why is fur of leopard attractive for us? Why are feathers of peacock beautiful for us? Such beauty does not contribute to survival of individuals. This was a puzzle for Darwin and he invented idea of sexual selection in addition to natural selection. G.Fechner started experimental aesthetics in 19<sup>th</sup> Century, and then Berlyne introduced behavioral method to the experimental aesthetics. Recently S.Zeki established a new field of aesthetics, "Neuro-aesthetic". Although some researchers explored "zoological aesthetics", comparative approach to the aesthetics is rather rare. From viewpoint of experimental psychology, the aesthetics has three aspects, discriminative property (we can discriminate "good" art from "bad" art), reinforcing property (we can enjoy art) and motor skills (we can produce art). These three aspects can be examined even in infrahuman animals experimentally. I have reported discriminative property of visual art and music in birds and recently found discriminability of "good" art in pigeons. Songbirds, but not non-songbirds, showed preference for particular music. Sense of beauty depends on individuals, culture, age etc, but there might be common beauty for humans might be common beauty in primates or might be common beauty in vertebrates. There could be evolutionary origin of our sense of beauty. Our central nervous system may share common mechanism of sense of beauty with other animals. I will propose s new field of research, comparative aesthetics.

## [SYMPOSIUM #1]

### “What is animal intelligence? The ability to generate novel adaptive behavior in human being and nonhuman animals”

Chair: TOHRU MORIYAMA (*Shinshu University, Japan*)

‘Novel sensory organs’ in pill bugs (*Armadillidium vulgare*, *Crustacea*):  
artificial tubes attached to their antennae.

**TOHRU MORIYAMA**

*Shinshu University, Japan*

In this symposium we reconsider the intelligence of animals focusing on their ability to generate novel adaptive behaviors in unfamiliar situations, and attempt to argue that intelligence in this sense is ubiquitous across different species of animals. To contribute to this goal, the present paper reports on an experiment investigating the intelligence of pill bugs. The antennae length of the subjects in the test group was extended by using either short Teflon tubes (aprox. as long as the flagella of their own antennae) or with longer ones (aprox. twice as long as the flagella) attached to the tips of the antennae (Fig. 1), while nothing was attached to the individuals in the control group. They were each placed on the top tier of 14 stairs, in which the depth between the first and the second stairs was 5 mm, and the inter-step depth was increased by 1 mm for the rest of the stairs. They were all highly motivated to move down the stairs to run away from the experimenter. The maximum reachable stair and the body length for each individual were recorded, and the correlation between the maximum reachable stair and the tube length (none, short, and long) was calculated for each body-length class (in the range of 9.8 to 11.2 mm). A significant positive correlation was confirmed for the 11.2-mm body length class alone (Fig. 2), suggesting that pill bugs that were 11.2 mm long might use the Teflon tubes as novel sensory organs to explore unfamiliar environments.

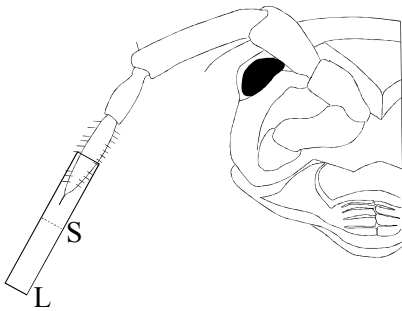


Fig. 1

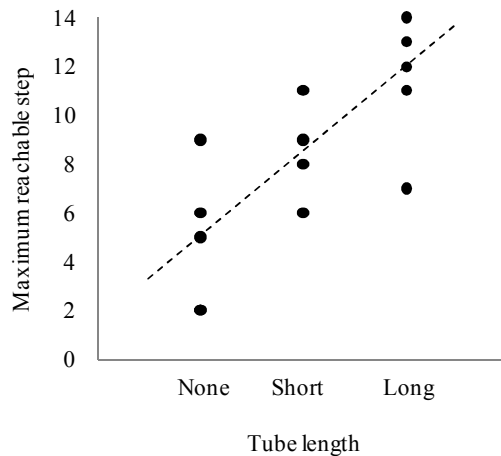


Fig. 2

## Mechanism for novel behaviors as observed in righting behavior of starfish.

**MASAO MIGITA**

*Shiga University, Japan*

The righting behavior of starfish is a well-known behavioral pattern in which starfish show their incredible dexterity. Without a central nervous system to simultaneously control all the arms, starfish perform righting maneuvers that require the ordered movements of their arms; these ordered movements are generated by performing certain processes of self-organization of a group behavior of the arms. This shows that the righting behavior of starfish is organized in an ad-hoc fashion. Past studies on this righting behavior probed whether starfish could learn to right themselves with a specialization of the roles of the arms, such as leaders and followers, but most of them reported negative results. However, recent studies concerning this righting behavior have dealt with it as an indication of stress, as physiologically or physically damaged individuals take longer time to right themselves. The present study investigates whether the righting behavior can be considered an indication of intelligence of starfish. The repeated righting behavior of the starfish *Asterina pectinifera* was observed, but learning indicated by decreasing the righting time or specializing the roles of arms did not occur. A detailed description of this righting was introduced by recording the transition of states of the arms. It revealed that the process of righting was so complex that a starfish could take several strategies to right itself. This suggested that the complexity of arm movement maybe the mechanism that generates the novel behaviors of starfish.

## Exploratory patterns and attuning of human touching behavior in discriminating surface roughness.

**SHIN MARUYAMA<sup>1</sup>, NOBUHIRO FURUYAMA<sup>1</sup>,**

**HIROYUKI MISHIMA<sup>2</sup>, & MASASHI TAKIYAMA<sup>3</sup>**

*<sup>1</sup>National Institute of Informatics, Japan, <sup>2</sup>Waseda University, Japan, <sup>3</sup>The University of Tokyo, Japan*

The present study examined the perceptual ability of human touch in discriminating surface roughness. In our experiment, we used several grid sizes of sandpaper and asked subjects to discriminate the given roughness by placing the tips of the index fingers of their right-hand on the surfaces of the sandpaper. They didn't simply use only their bare finger, as in some of trial blocks the subjects were asked to touch the surfaces with their finger covered with an intermediate material (Scotch tape or sandpapers). After each trial, the subjects reported their confidence in their judgement, scaled from 1 to 5, 1 being "no confidence" and 5 being "absolute confidence". We observed their touching behaviours, and compared the confidence scores and performance accuracy between the with- and without-obstacle manipulations. The results show that, while the averaged confidence scores in the blocks with the covered finger trials clearly decreased, the range in performance accuracy was almost identical throughout the experiment. The videotaped data revealed that when material was attached to the finger, the subjects showed alternative patterns of finger movements by adjusting the pressure put on their finger tips, and the velocity and direction of their movement. These findings suggest that, even when encountering some perceptual disturbance (such as the covered finger tip), our perceptual and behavioural mechanism is flexibly attuned to the disturbance and robustly seeks any critical information by alternating the exploratory patterns.

The idea of perceptual systems as a framework to understand functionally comparable behaviors by structurally different animals.

**NOBUHIRO FURUYAMA**

*National Institute of Informatics, Japan*

The papers presented in this symposium show that intelligence, when it is considered in terms of animals' ability to generate novel adaptive behaviors in an unfamiliar situation, can be found not only in humans, but also in animals whose behaviors are otherwise considered to be mechanical in want of the central nervous system, such as pill bugs and starfish. Pill bugs with a Teflon tube attached to their antennae exhibited a primitive form of tool use to explore the environment, which is in a sense comparable to human subjects with a cane exploring the environment, or as demonstrated in another paper, with a piece of Scotch tape on their index finger trying to discriminate different roughness of sand paper. The righting behavior of starfish seems comparable in many respects to that of human infants trying to roll over for the first time, yet starfish perform it not only without the central nervous system, but also without statocysts. These observations made us reconsider the mechanism underlying the performances. I will discuss this question in terms of the resources available to these animals in achieving the adaptive behavior, referring to the idea of perceptual systems proposed by James J. Gibson.

## [SYMPOSIUM #2]

### “Self Reflective Cognition”

Chair: **KAZUO FUJITA** (*Kyoto University, Japan*)

Experimental approaches to self-control in new world monkeys.

**JAMES R. ANDERSON<sup>1</sup> & KAZUO FUJITA<sup>2</sup>**

*<sup>1</sup>University of Stirling, Scotland UK, <sup>2</sup>Kyoto University, Japan*

We review some of our studies on capuchin and squirrel monkeys' abilities to solve problems that require self-control. First, we consider the reverse-reward procedure, in which one of two simultaneously presented stimuli is given as a reward, namely the one that is inherently less attractive to the monkey. Nonhuman primates find it hard to spontaneously inhibit their tendency to reach for the larger of two quantities of food, even if this results in them receiving the smaller quantity as the reward each time. However, after being trained to select the smaller quantity to gain the larger amount (reverse reward), squirrel monkeys proceeded to show transposition of the acquired rule (“Go for the smaller amount!”) to new pairs of quantities. One capuchin monkey mastered the reverse reward spontaneously and relatively fast, while others mastered a qualitative version of the task faster than monkeys tested on the conventional quantitative version. In another series of studies monkeys of both species observed while up to 6 pieces of food were transferred one by one to within reach. As soon as the monkey reached for any of the accumulated food items the trial ended. Some but not all capuchins and squirrel monkeys showed an ability to delay gratification and thus increase the amount of food gained on each trial. Interesting individual differences in delay maintenance behaviors emerged, which should be studied further. Finally, we describe the possible use of self-control by squirrel monkeys in a specific social context, namely deception in a competitive food-getting situation.

Memory-related activity of prefrontal neurons and metacognitive behavior  
in the rhesus monkey.

**AKIO TANAKA & SHINTARO FUNAHASHI**

*Kyoto University, Japan*

To investigate the neural basis of metamemory, the ability to monitor one's own memory processes, and its relation to the neural basis of working memory, we recorded single-neuron activity from the dorsolateral prefrontal cortex while a rhesus monkey performed a modified spatial working memory task. In this task, the monkey had to remember the location of a visual cue during a several-second delay period for a subsequent recognition test. At the end of the delay period, the monkey was sometimes given a chance to freely choose whether to take or escape from the memory test (FrC trials) and was sometimes forced to take the test (FoT trials). The proportion of correct responses was higher in the FrC trials than in the FoT trials, indicating that the monkey tended to choose the escape option when it was likely to make an error. This result suggests that the monkey used its metamnemonic ability when deciding whether or not to take the memory test. We observed neurons with directionally selective delay-period activity, which is considered to be the neural basis for the short-term maintenance of spatial information in working memory. The analysis of these neurons indicates that when the monkey chose to escape from the memory test, their delay-period activity tended to lose its original directional selectivity. Although preliminary, our results provide insight into the relationship between prefrontal memory-related activity and metacognitive behavior in monkeys.

## Metamemory in jungle crows (*Corvus macrorhynchos*).

**KAZUHIRO GOTO**

*Kyoto University, Japan*

Metamemory refers to ones' knowledge of what they do and do not remember. Converging evidence in animals revealed that nonhuman primates are able to use private experience of uncertainty as a discriminative cue, whereas such metamnemonic stimulus control was not yet demonstrated in birds. We examined whether metamnemonic stimulus control is effective in jungle crows using a modified delayed matching-to-sample tasks. In Experiment 1, the birds could choose whether to take or escape from a memory test prior to the choice of comparison stimuli in some trials (prospective judgment), whereas they were forced to take or escape from a memory test in other trials. In Experiment 2, birds could choose whether they accept normal reinforcement contingencies based on response accuracy or switch to the accuracy-independent partial reinforcement contingencies (retrospective judgment) after the choice of comparison stimuli. In Experiment 1, bird's choice of take or decline memory test did not differ between chosen or forced memory test trials. In contrast, in Experiment 2, birds' accepted normal reinforce contingencies were more often after the choice of correct than incorrect comparison stimuli. These results suggest that the retrospective confidence is an effective discriminative cue in jungle crows but prospective uncertainty may not be.

## Spontaneous retrieval and use of memory for a single unique experience by dogs: Implications for episodic memory.

**KAZUO FUJITA, AYAKO MORISAKI, & AKIKO TAKAOKA**

*Kyoto University, Japan*

Spontaneous recall of unique past events is one of the key properties of episodic memory. This is often useful for animals to solve unexpected challenges without relying upon potentially risky and/or time-consuming trial and error. We asked whether domestic dogs would use their memory of a single event they had experienced in a later food exploration game. In the Exposure Phase, leashed dogs were led by the owner to 4 different open containers in sequence. Each container had a piece of food in it. The dogs were allowed to look into all of the containers but were allowed to eat only 2 of the 4 rewards. In the Test Phase, which was given as a surprise after leaving for a walk outside, the dogs were unleashed and allowed to explore the containers, which were emptied during the dogs' absence. Eleven out of 12 dogs went first to one of the containers from which they had not eaten food in the Exposure Phase. This behavior cannot be explained by reward learning but is consistent with the view that the dogs spontaneously recalled the single past episode and used this episodic-like memory to adapt their behavior in this simple food exploration game.

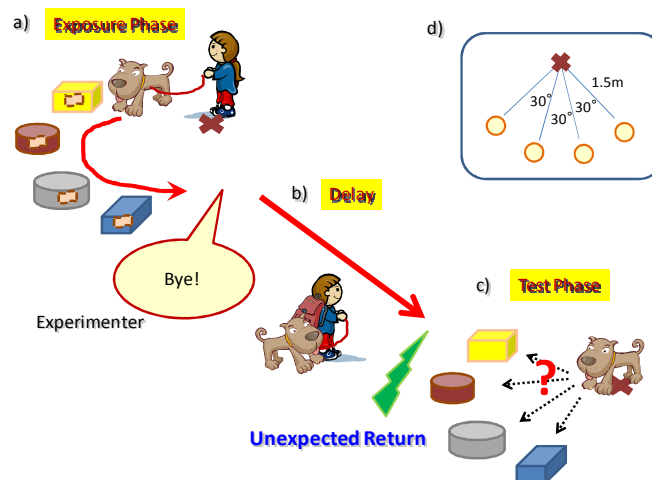


Figure 1. a-c: A schematic drawing of the testing procedure. d: Arrangements of apparatus.

## Recognition of live and delayed self-images in chimpanzees.

**SATOSHI HIRATA**

*Hayashibara Biomedical Laboratories, Inc., Japan*

Great apes can use a mirror to inspect areas of their body not visible without the aid of the mirror, suggesting that they have the capacity for self-recognition. Since the pioneering work with chimpanzees, many studies have attempted to probe self-recognition in non-human animals. The majority of these studies have used a mirror as the test device. Little is known, however, about the responses of non-human animals toward their own images in media other than mirrors. I conducted two studies to investigate chimpanzees' recognition of self-images presented on television monitors. The first study examined the behaviors of chimpanzees in response to live self-images presented on two monitors; one of these showed their own faces and the other showed their entire bodies. These images were approximately one-fifth of their actual sizes and were viewed from behind at a diagonal angle. The results indicated that the chimpanzees were able to immediately recognize live images of themselves even though several features of these images differed from those presented in their previous experience with mirrors. The second study investigated whether chimpanzees used video feedback as a reflection of their current state even when this feedback was presented after a short temporal delay. The experiment examined 1-, 2-, and 4-s delayed feedback with an analog of the mark test. The results indicated that the chimpanzees were able to recognize themselves even when the images were delayed for 4 s, suggesting that detection of visual-proprioceptive contingency is not the only factor contributing to their capacity for self-recognition.

## [SYMPOSIUM #3]

### “Comparative Studies of Animal Communication”

Chair: **Stan Kuczaj** (*University of Southern Mississippi, USA*)

Tactile contact exchanges between dolphins:  
self-rubbing versus inter-individual contact in three species from three geographies.

**KATHLEEN M. DUDZINSKI<sup>1,2</sup>**, J. D. GREGG<sup>1</sup>, K. E. MELILLO<sup>1</sup>, & STAN A. KUCZAJ<sup>1,2</sup>

<sup>1</sup>*Dolphin Communication Project, USA*, <sup>2</sup>*University of Southern Mississippi, USA*

Dolphins are tactile mammals often observed to exchange rubbing or static contact behaviors. Video data from four delphinid study groups representing four geographic locations were examined and tactile behaviors documented for comparison. The four study groups include the Indo-Pacific bottlenose dolphins (*Tursiops aduncus*) from around Mikura Island, Japan; the Atlantic spotted dolphins (*Stenella frontalis*) from around Bimini and along the White Sand Ridge, The Bahamas; and bottlenose dolphins (*Tursiops truncatus*) from a captive group resident to the Roatan Institute for Marine Sciences (RIMS), Roatan, Honduras. Pectoral fin contact between individuals at each location were investigated as were self-contact behaviors for each group. The latter are represented by sand or substrate rubbing, rubbing on floating objects or other non-dolphin items. Pectoral fin contact was mostly conserved between groups - wild to wild and captive to wild - with more similar behaviors observed than differences. Self-contact behaviors were similar in distribution but substrate differed between study sites. Within-group, between-group and inter and intra-individual differences will be presented and discussed.

The ecological design of the affiliative vocal communication style in wild Japanese  
macaques - behavioral adjustments to social contexts and environments.

**HIROKI KODA & HIDEKI SUGIURA**

*Kyoto University, Japan*

Coo calls, contact calls used by Japanese macaques for intra-group vocal communications, have been proposed as functioning to maintain inter-individual spatial cohesion in wild populations and have served as the primary focus of previous investigations. Whereas behavioral variations in communication have been reported on the basis of group membership, social status, and individual differences, accumulating evidence generally shows that macaques adjust their communication style to avoid spatial separation from group members. We propose that two fundamental causes underpin these phenomena: the risk for separation and the internal motivation to coordinate the group. Separation risks and internal motivation induce variations in vocal communications relying on contact calls and likely determine the type of vocal communication used in wild primate social groups.

## Touch and communication in Asian Elephants (*Elephas maximus*).

**RADHIKA MAKECHA<sup>1</sup>, STAN KUCZAJ<sup>1</sup>, & OTTO FAD<sup>2</sup>**

*<sup>1</sup>University of Southern Mississippi, USA, <sup>2</sup>Busch Gardens, USA*

Elephants use a variety of sensory modalities to communicate, including touch. The current study examined the tactile interactions of six Asian elephants (*Elephas maximus*) to better understand their role in communication. The body parts that were involved in these tactile interactions were examined, as were sequences of behavior surrounding target tactile behaviors. All findings are discussed in light of their implications and significance for elephant communication.

## Acoustic communication by dolphins: An evolutionary perspective.

**TADAMICHI MORISAKA**

*Kyoto University, Japan*

Dolphins are known to exchange or mimic one another's whistles, and it is likely that these whistles are used for communication. Morisaka & Connor (2007), however, found that predation pressure by killer whales resulted in some dolphin species losing their whistles in order not to be overheard by killer whales. Why did these dolphins evolve a whistle communication system? How do these dolphins compensate for the loss of this whistle system? In this talk, I will introduce my recent studies, such as beluga's acoustic communication, and discuss the evolutionary history of dolphin acoustic communication.

## Behavioral factors governing song complexity in Bengalese finches.

**KAZUO OKANOYA**

*RIKEN Brain Science Institute, Japan*

Bengalese finches (BF) are the domesticated strain of the wild white-rumped munias (WRM). BF had been domesticated for over 250 years from the wild strain WRM and during this period the courtship song became phonologically and syntactically complex. The purpose of this study is to understand proximate and ultimate causes for song complexity in BF. Field observation of WRM in Taiwan suggests that populations of WRM show a gradient of song syntactical complexity: when the population has more sympatric species, the population showed less syntactical complexity, suggesting that syntactical complexity does not develop under the pressure for species recognition. Laboratory study of cross-fostering between the two strains revealed that WRM are more specialized in accurately learning own-strain phonology while BF learned equally but less accurately learned phonology of both strains suggesting that BF lost species-specific bias to accurately learn own phonology. By a nest-building assay, we found that females work more when stimulated with complex songs but not with simple songs. Breeding experiments in the laboratory showed that males reared in nutritiously competitive environment tend not to develop longer song bouts. Since longer song bouts give more opportunity for demonstrating song complexity, males under less competitive environment have a room to develop syntactically complex song. Furthermore, when given a choice, male chicks are more likely to learn from complex singers. Taken these evidences together, we suggest that phonological and syntactical complexity in BF songs evolved first because domestication freed them from pressure for species recognition based on song characteristics and then sexual selection advanced the complexity. This is by large enabled by longer song learning period in BF. Neural and molecular studies also support the notion that BF keeps more song plasticity as adult. In conclusion, song complexity in BF provides a unique opportunity for integrative study of animal communication.

## [SYMPOSIUM #4]

### “Conditioned Taste Aversion in Rats”

Chair: KOSUKE SAWA (*Senshu University, Japan*)

Activity-based taste aversion learning in rats:  
Some tests of the energy-expenditure hypothesis.

**SADAHIKO NAKAJIMA**

*Kwansei Gakuin University, Japan*

Since the discovery of Lett and Grant (1996), a number of experimental studies have been published on activity-based taste aversion learning in rats (See Boakes & Nakajima, 2009, for a review). For example, voluntary running in a wheel results in aversion to a taste substance consumed immediately before the running. Because the correlation of taste and physical activity is necessary to establish taste aversion, this phenomenon has been considered as a type of Pavlovian conditioning with the taste as a conditioned stimulus (CS) and the activity as an unconditioned stimulus (US).

Despite the many features of activity-based taste aversion learning having been investigated in the last decade, it is still unknown why physical activity works as a US agent. I have claimed that energy expenditure caused by running induces avoidance from the paired taste (Nakajima et al., 2000). This hypothesis led to the discovery of taste aversion learning based on another exhaustive activity, i.e., swimming in a water pool (e.g., Nakajima & Masaki, 2004).

In this paper, the energy-expenditure hypothesis will be further assessed with the following three research questions. First, if running- and swimming-based taste aversions share the same underlying mechanism of energy expenditure, then prior familiarization to running would interfere with taste aversion learning based on swimming, and vice versa. Second, the energy supply may attenuate activity-based taste aversion learning. The third question is whether taste aversion learning is establishable by conspecific fighting, another physical activity.

Representation-mediated flavour aversion as a window into the contents of  
Pavlovian conditioning and instrumental learning.

**YOSHIO IGUCHI**

*Kanazawa University, Japan*

A conditioned flavor aversion is acquired through pairings with an illness-inducing agent (e.g., lithium chloride: LiCl) not only of a flavored appetitive stimulus (A), but also of an exteroceptive associate of A (X; a stimulus having been paired with A): an excitatory link could be established between a representation of A activated by presenting either A itself or A's associate and illness (e.g., Holland, 1981, 1990). In other words, when animals show an A-aversion after undergoing a contingency between X and A, and subsequent X-LiCl pairing, it is suggested that an A-representation would be activated in the presence of X. Here, I report our two studies concerning representation-mediated learning. In the first study using three flavors, rats received a Pavlovian inhibitory conditioning of X for A (i.e., YA/XY discrimination). In the second study, rats received an instrumental discrimination learning with X and A: they were trained to perform an instrumental behavior reinforced with A under the presence of X. Consequently, in both studies we observed the A-aversion after X-LiCl pairings, suggesting that the representation encoding the detailed information concerning A would be activated by X, irrespective of whether X was trained as a conditioned inhibitor or discriminative stimulus. Furthermore, we examined the effects of the X-LiCl pairing on performing the behaviors reinforced with A in order to reveal the behavioral properties of the A-representation. The implications of these results for the way that representation-mediated flavor aversion identifies the contents of associative learning, or associative and representational structures, are discussed.

Learned aversions to flavors signaling reduction in a nutrient:  
The missing calorie effect.

**ROBERT A. BOAKES**

*University of Sydney, Australia*

Inhibitory flavor learning, i.e. acquired avoidance of a flavor such as almond or saline that signaled the absence of high concentration nutrient, occurred in a series of experiments in which hungry rats were given maltodextrin (M) solutions. Flavor avoidance was acquired both as a result of (a) *explicitly unpaired* training, in which sessions in which rats were given unflavored 20%M alternated with sessions in which they were given the flavor in 2%M; and (b) *differential conditioning* in which one flavor, CS+ e.g. almond, was mixed with 20%M and a second flavor, CS- e.g. saline, was mixed with 2%M. The latter training produced both a conditioned preference for the CS+ flavor and aversion to the CS- flavor, relative to a *non-differential* control group that received both flavors in 2%M. Further experiments found that such inhibitory learning failed to occur on the basis of reduced palatability or when the rats were sated. Thus, an unexpected decrease in calories for a hungry animal appears to be critical for such learning to take place. These experiments appear to provide the first demonstration of taste avoidance based on inhibitory learning. Its properties will be compared to those of extensively studied types of taste aversion learning. The present effects suggest an animal model of how individual humans come to dislike particular foods or flavors.

Context-switch effects upon performance on rats' conditioned taste aversion.

**JUAN M. ROSAS, SAMUEL P. LEÓN, & JOSÉ E. CALLEJAS-AGUILERA**

*University of Jaén, Jaén, Spain*

Renewal of conditioned taste aversion has been reported when conditioning occurs in one context (A), extinction in a different, but equally familiar, context (B) and testing is in the original context (ABA renewal). It also occurs when conditioning and extinction are in one context and testing is in a different one (AAB renewal). It has been suggested that renewal appears whenever subjects are tested outside the extinction context, regardless of whether the test context matches the acquisition context or not (e.g., Bouton, 1993). It has been found that AAB renewal is initially weaker than ABA renewal, and the former seems to disappear earlier when the number of extinction trials is increased. This result has also been reported in conditioned taste aversion (Rosas, García-Gutiérrez & Callejas-Aguilera, 2007). Differences between ABA and AAB renewal would be easy to explain if information were processed as context-specific at the beginning of conditioning. This context-dependency would disappear when the experimental design ensures that the predictive power of the contexts is low. Three experiments in taste aversion manipulated the predictive power of the contexts in which taste aversion was learned by exposing rats to the contexts before and after flavor conditioning. Taste aversion was found to be context-dependent except when rats received additional context exposure suggesting that acquisition contexts are processed. The implications of these results for the concept of context and for the explanations of renewal are discussed.

## [SYMPOSIUM #5]

### **“Neural Mechanisms of Behavior: Recent Approaches in Behavioral Neuroscience”**

Chair: YUKIO ICHITANI (*University of Tsukuba, Japan*)

Prefrontal neuronal activity in the monkey  
during competitive and noncompetitive video shooting games.

**MASATAKA WATANABE & TAKAYUKI HOSOKAWA**

*Tokyo Metropolitan Institute for Neuroscience, Japan*

Humans and animals must work to support their survival and reproductive needs. Since resources are limited, competition is inevitable, and competing successfully is vitally important. While there are many psychological and sociological studies on competition, the brain mechanisms of competitive behavior are poorly understood. Competition occurs predominantly in social interactions. However, competition-related neuronal activities in monkeys have previously been examined without social interaction, i.e., with only one monkey playing a game against an inanimate computer. Brain mechanisms of human competitive behavior have also been investigated without face-to-face interaction due to constraints of neuroimaging methods. Competition involves both cognitive (such as rules and strategy) and motivational (desire to win) components. The prefrontal cortex is involved in the processing of social information as well as in the integration of cognitive and motivational information. We examined primate prefrontal neuronal activities during a socially interactive competitive game. Monkeys played video games in a competitive situation either with another monkey or with the computer. In order to obtain a reward, the monkey had to win the competition. Monkeys also played alone without a rival in a noncompetitive situation. Monkeys' performance was quicker and more accurate in the competitive than in the noncompetitive games. Prefrontal neurons represented winning and losing the competition, and responded more vigorously when the competition was between monkeys than when the monkey competed with the computer. Prefrontal neurons may play an important role in both monitoring the outcome of competition and supporting better survival in socially competitive environments.

Modulation of brain reward system by cholinergic neurons in the mesopontine  
tegmentum: intracranial self-stimulation studies in the rat.

**DAIICHIRO NAKAHARA**

*Hamamatsu University School of Medicine, Japan*

Cholinergic neurons in the mesopontine tegmentum (MPT) are in a position to critically influence the activity of dopamine neurons in the ventral tegmentum (VTA), and thereby play an important role in the brain reward system. Intracranial self-stimulation of the medial forebrain bundle, a brain area supporting typical self-stimulation, activates nerves descending to mesopontine cholinergic neurons that projects back and activates dopaminergic neurons in the VTA, innervating the nucleus accumbens, thus leading to increased release of dopamine in the nucleus accumbens. Local infusion of scopolamine, muscarinic receptor antagonist, and mecamylamine, nicotinic receptor antagonist, into the VTA both increased the threshold for self-stimulation reward in rats. Thus, acetylcholine released in the VTA appears to facilitate, through both muscarinic and nicotinic receptors, the rewarding effect of intracranial self-stimulation. On the other hand, local infusion of scopolamine into the MPT dose-dependently reduced the threshold for self-stimulation reward in rats, whereas locally infused mecamylamine did not alter the threshold. However, intra-MPT infusion of mecamylamine dose-dependently inhibited the nicotine-potentiated self-stimulation reward. Thus, acetylcholine released in the MPT seems to suppress the rewarding effect of intracranial self-stimulation through the inhibitory muscarinic autoreceptors. Nicotine in tobacco smoke is possible to enhance, through the overactivation of cholinergic neurons by upregulated nicotinic receptors in the MPT, the rewarding effect of intracranial self-stimulation.

Effects of the application of radiofrequency lesions to the nucleus basalis magnocellularis or the medial septum on short-term memory for visual and auditory stimuli in rats.

**YUJI TSUTSUI**

*Fukushima University, Japan*

The delayed conditional discrimination (DCD) task is useful for evaluating short-term memory (STM) processes in animals. We used this task to examine STM for visual and auditory stimuli in rats. Rats were made to press 1 of 2 levers depending on the discriminative stimulus, i.e., light or tone stimulus, after a retention interval of 0.25, 3, 6, or 9 seconds. When a light stimulus was presented (V-trials), the percentage of correct responses decreased as the retention interval increased. This was also observed when a tone stimulus was presented (A-trials), but the decrease was slower than that in the V-trials. This result indicates that in rats, STM is better for auditory information than for visual information. Next, we examined the relationship between 2 major central cholinergic pathways and STM for visual and auditory stimuli in rats. One projects from the medial septum (MS) to the hippocampus, and the other, from the nucleus basalis magnocellularis (NBM) to the cortex. A radiofrequency lesion applied to the NBM reduced the percentage of correct responses in the longer retention intervals in both trials, whereas a lesion applied to the MS reduced the percentage of correct responses in the V-trials, depending on the length of the retention interval, but the percentage of correct responses in the A-trials was constant. These results suggested that the cholinergic pathway projecting from the NBM is important for STM and is independent of the stimulus modality, whereas the pathway projecting from the MS is related to STM for visual information.

Spontaneous object recognition and object-in-place recognition for testing memory function of the hippocampus and related structures in rats.

**YUKIO ICHITANI**

*University of Tsukuba, Japan*

Spontaneous object recognition is used for testing memory function of various brain regions in rats and mice. The test utilizes the rodents' innate tendency to explore novel stimuli longer than familiar stimuli, and have several advantages compared with traditional memory tasks. I will show two studies in which I used the task to investigate the roles of the hippocampus (HPC) and retrosplenial cortex (RS). In the first study, rats were allowed to explore the arena in which two identical objects were presented (sample phase). Then after a delay period (5-20 min), they were introduced again in the arena in which one of the two objects was replaced by another object (object recognition) or moved to a different place (object-in-place recognition), and their exploration behavior to these objects were analyzed (test phase). Hippocampal administration of a N-methyl-D-aspartate (NMDA) receptor antagonist decreased the exploration of object in a new place, while it did not affect the exploration of a novel object, suggesting that hippocampal NMDA receptors are involved in recognition of place rather than that of object itself. In the second study, amnesic effects of lesions of the rat HPC and RS in the spontaneous object recognition with longer delay periods (1-4 weeks) were investigated. RS-lesioned rats showed a delay interval-dependent impairment of exploration of a novel object in the test phase, while HPC-lesioned rats showed an impairment regardless of the interval, suggesting that HPC and RS have different roles in long-term object recognition memory.

## [SYMPOSIUM #6]

### “Understanding Animal Thinking”

Chair: **ROBIN A. MURPHY** (*Oxford University, UK*)

Rational rats: Causal inference and representation.

**AARON P. BLAISDELL**

*University of California-Los Angeles, USA*

David Hume posed a dilemma: How do we derive cause-effect relationships in the absence of direct causal perception? His answer was that knowledge of the causal texture of the world was merely an illusion derived from observed statistical regularities. Recent challenges from Philosophy, Statistics, and Psychology argue that we can go beyond the information given (i.e., contingency) by dissecting cause-effect relationships using our own actions (i.e., interventions) on the world. I will present evidence that like humans, rats 1) build causal models of the world, 2) use actions as causal interventions in a rational manner, 3) evaluate what constitutes a good intervention, 4) yet demonstrate a tentative failure of rats to use interventions to investigate causal structure, and 5) show how rats are sensitive to hidden causes. While rats may not be as functionally sophisticated as the scientists who study them, these experiments a) raise important questions about the interface between learning and cognition, and b) highlight the utility of rational models in uncovering the right questions to ask about mechanism.

A comparative approach to causal cognition.

**ANDREW G. BAKER<sup>1</sup>, IRINA BĂETU<sup>1</sup>, & ITSASO BARBERÍA<sup>2</sup>**

*<sup>1</sup>McGill University, Canada, <sup>2</sup>University of Barcelona, Spain*

There has been a recent attempt to model human causal reasoning using bottom up associative models derived from research on animal cognition. It has been argued that these models are inadequate and that some sort of top down process is necessary to understand causal induction. For example, it has been argued that a set of propositions similar to the scientific method are necessary to infer causal status from empirical observations of the world. We will report some data that is inconsistent with this propositional account. We will show some simulations that are derived from our associative model – the autoassociator. Moreover, we will argue that most of the empirical phenomena used to investigate the propositional account do not provide enough information to provide premises that would make the propositional interpretation unequivocal. Finally, we will argue that it is not appropriate to compare the associative stance with most present top-down formulations because they represent different levels of analysis. The associative models represent something analogous to what Marr has called an algorithm whereas these top-down models are at the computational level. The propositional model asks whether people and animals are sensitive to rules in the world. Associative accounts and some parts of the current Bayesian analysis provide a mechanism from which this sensitivity might emerge.

## Rules: Associations or computations.

**ROBIN A. MURPHY<sup>1</sup> & IRINA BÄETU<sup>2</sup>**

*<sup>1</sup>Oxford University, UK, <sup>2</sup>McGill University, Canada*

One aspect of the propositional learning approach to cognition recently invoked to explain aspects of human and animal learning is the acquisition of Rules. The problem for the study of cognition is that we are never sure whether we are simply using the term Rule to characterize a simple production system involving a sensory precondition (like an If statement) and an action (like a Then statement). With this definition much of animal behaviour can be characterized. The term rule can also be used to reflect a type of 'rewrite rule' like those used in formal grammar. These latter type of rule are used in generative grammar to allow If-Then conditionals in which the content of the rule is independent of the rule itself. The question posed by my talk will be whether associative principles can account for learning in this latter case and whether any predictions can be made about how animals might learn if they possessed such rule learning ability. I will discuss evidence from my lab on discriminations acquired by rats involving three element serial presentations (e.g., A->B->A) and the results of generalization tests in relation to simulations using an autoassociator that predicts how the learning might be predicted.

## [SYMPOSIUM #7]

### “Comparative Hippocampus Functions”

Chair: SHOGO SAKATA (*Hiroshima University, Japan*)

Immunohistochemical identification of telencephalic neurons expressing c-Fos protein during learning and memory in the mudskipper.

#### TAKAO MUKUDA

*Hiroshima University, Japan*

We investigated the brain loci involved in spatial memory in the mudskipper and the correlation between the concerned regions and the mammalian hippocampus. Spatial memory is a basic brain function established throughout the vertebrates including fish and is well known to be involved in the hippocampi in mammals and birds. In fish, however, it remains unclear whether the brain loci comparable to the hippocampi of mammals are present or not, and where such loci are localized in the brain if present. We have examined the brain loci activated during spatial memory in an euryhaline teleost, mudskipper *Periophthalmus modestus*, which shows unique behavioral pattern. The mudskipper is active dweller in tidal flat and spends considerable time on land, but frequently dives into sea to ingest water and electrolyses or to avoid from predators. A binary preference test in salinity revealed that the mudskipper prefers seawater diluted into 30% to fresh water. Based on their preference and behavioral pattern, a dry version of the Morris water maze task was assigned to learn a place where a dish filled with the diluted seawater was positioned. Following this, the neuronal activation elicited during the spatial memory was explored by detecting an immediately early protein, c-FOS, immunohistochemically.

Molecular asymmetry in mouse hippocampal circuitry.

#### ISAO ITO

*Kyushu University, Japan*

Left-right (L-R) asymmetry is a fundamental feature of higher-order neural function. However, the molecular basis of brain asymmetry remains unclear. We recently found that the synaptic distribution of N-methyl-D-aspartate receptor (NMDAR) GluR $\alpha$ 2 (NR2B) subunits in the adult mouse hippocampus is asymmetrical between apical and basal dendrites of individual neurons and between the left and right hemispheres. These asymmetrical allocations of  $\alpha$ 2 subunits affect the properties of NMDARs in hippocampal synapses and generate two populations of synapses. The NMDAR-mediated excitatory postsynaptic currents (NMDA EPSCs) of the ' $\alpha$ 2-dominant' population are highly sensitive to Ro 25-6981, a  $\alpha$ 2 subunit-selective antagonist. The plasticity of these synapses develops rather early. The other population is ' $\alpha$ 2-nondominant'. The NMDA EPSCs of these synapses are less sensitive to Ro 25-6981 and the plasticity of these synapses develops slowly. These two populations of synapses are distributed asymmetrically between the left and right hippocampus. Next we examined the hippocampal circuitry of the inverses viscerum (iv) mouse that has a randomized laterality of internal organs. We found that the iv mouse hippocampus lacks L-R asymmetry, it exhibits right isomerism in the synaptic distribution of the  $\alpha$ 2 subunit, irrespective of the laterality of visceral organs. This independent right isomerism of the hippocampus indicates that the mechanism generating L-R asymmetry differs between visceral organs and the brain. Furthermore, the iv mouse exhibited inferior ability in behavioral experiments testing reference memory and working memory, suggesting that the L-R asymmetry in hippocampal circuitry is critical for higher-order functions of the brain.

## Expression of the immediate-early genes *c-fos* and *Arc* reveal distinct mechanisms for place and response navigation in the hippocampus and striatum of female rats.

**CHRISTINA L. WILLIAMS & KRISTEN E. PLEIL**

*Duke University, USA*

Experimental studies reveal that the hippocampus supports learning of spatial representations to navigate toward hidden goals (place), whereas, the striatum supports learning of stimulus-response associations to navigate toward visible goals (response). High estradiol levels bias female rats towards using place navigation when both place and response strategies are possible. Using expression of the immediate early gene (IEG) *c-fos* to assess neural activation after training on place or response tasks, we found that estradiol increases hippocampal and decreases striatal activation, regardless of strategy used, suggesting that activation alone cannot explain how estradiol modulates neural function and spatial strategy selection. We have also examined expression of the IEG *Arc*, which plays an important role in mediating experience-induced neural plasticity. *Arc* was visualized via in situ hybridization (catFISH) in the hippocampus and striatum of cycling female rats trained on a T-maze such that either place or response strategies could be used, and then probed 20 min later for strategy use and immediately sacrificed. All behaviorally-trained rats had the same proportion of CA1 neurons expressing *Arc*. However, high but not low estradiol place strategy users had a greater proportion of *Arc*<sup>+</sup> neurons that expressed the gene in response to both training (cytoplasmic localization) *and* the probe (intranuclear localization) than response strategy users, suggesting that place strategy users have a more reliable hippocampal network throughout learning. Low estradiol increased network reliability in the dorsal striatum. These data suggest that region-specific network reliability, not neural activation per se underlies successful use of place versus response strategies.

## Dissociative contributions of medial temporal and frontal regions to prospective remembering.

**SATOSHI UMEDA**

*Keio University, Japan*

Prospective memory is memory of future intentions or plans in everyday life. Although some previous neuropsychological studies have stated that the prefrontal cortex and the medial temporal lobe including hippocampus are essential for successful prospective remembering, how the two regions contribute to prospective remembering remains unclear. We therefore used prospective memory training in the present study to investigate the neural mechanism of two components of prospective remembering: remembering to remember and remembering content. Two brain-damaged patients participated in this study: patient Y.O., who had lesions in the medial temporal lobe bilaterally and patient T.K., who had a lesion in the basal forebrain and right medial frontal lobe. The results of the training task for three months showed that Y.O.'s memory performance had gradually improved across all sessions of training, but T.K.'s improvement was not as marked. Further analysis revealed that Y.O.'s memory performance was better for recalling time than for recalling content, whereas T.K.'s memory performance was better for recalling content than for recalling time. These results provide some evidence that these two remembering components of prospective memory have independent neural bases, with the basal forebrain and right medial frontal lobe being required for remembering to remember and the medial temporal lobe being required for remembering content. The results also suggest that the memory training is an effective means of improving everyday memory.

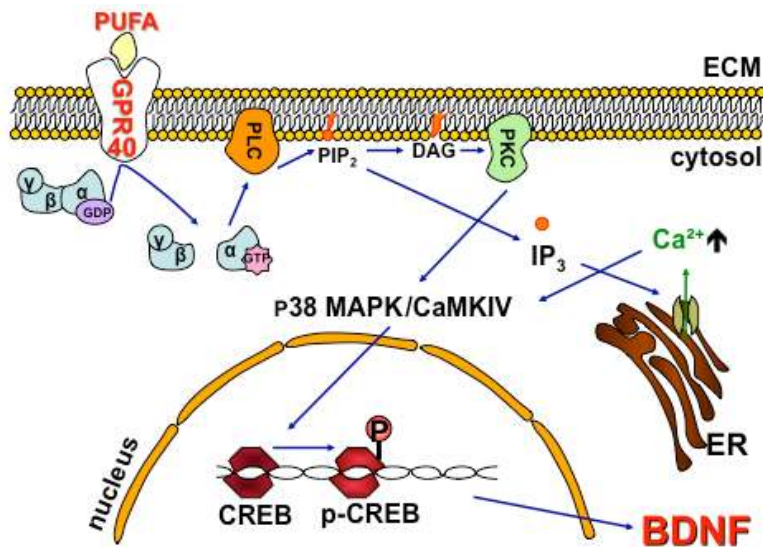
## PUFA, GPR40 and adult-born hippocampal neurons for memory.

**TETSUMORI YAMASHIMA**

*Kanazawa University, Japan*

Poly-unsaturated fatty acids (PUFA) such as docosahexaenoic and arachidonic acids, are crucial for neuronal development and function including neurite outgrowth, signal transduction and membrane fluidity. PUFA are known to improve hippocampal LTP, learning ability of aged rats, and cognitive function of humans with memory deficits, although the underlying mechanisms are unknown. There are many reports studying physiological roles of G-protein coupled receptor 40 (GPR40) in the pancreas, but no one has ever focused on the function of free fatty acid receptor GPR40 in the brain. As GPR40 was recently identified in neurons throughout the brain, it is probable that certain PUFA may act, as endogenous ligands, on GPR40 at their cell surface. However, the effects of PUFA upon neuronal functions are still not understood. Here, a combination of *in-vitro* and *in-vivo* data in the primates is introduced to consider the effects of docosahexaenoic and arachidonic acids on brain functions. GPR40 was found in the newborn neurons of the normal and post-ischemic hippocampus of adult macaque monkeys, while the positive effects of PUFA upon  $Ca^{2+}$  mobilization and cognitive functions were demonstrated in both GPR40 gene-transfected PC12 cells and human patients with memory deficits. The purpose of my talk is to propose a putative link among PUFA, GPR40, and hippocampal newborn neurons by discussing whether PUFA can improve memory functions through GPR40 activation of newborn neurons. As shown below, PUFA-GPR40 interaction might be crucial for adult neurogenesis or memory through CREB phosphorylation and BDNF synthesis.

(Ref: Prog Neurobiol 84: 105-115, 2008)



## [SYMPOSIUM #8]

### “Social Cognition in Nonhumans“

Chair: IKUMAADACHI & MASAKI TOMONAGA (*Kyoto University, Japan*)

#### Social cognition in dolphins?

**STAN KUCZAJ**

*University of Southern Mississippi, USA*

Although dolphins are thought to be intelligent animals, relatively little is known about their capacity for social cognition. In order to summarize what is known about dolphin social cognition, I will consider findings from both wild and captive dolphins. Wild dolphins are thought to be empathetic to conspecifics, and have even been reported to assist humans in distress or danger. They may also engage in teaching, another form of social cognition. Although interesting and informative, such anecdotes are open to multiple interpretations, which is also often true for observations of captive dolphin spontaneous behavior that seem to indicate some form of social cognition. Controlled studies of dolphin cognition are rare, but suggest that dolphins are capable of visual perspective taking and may even understand when they know the location of an object that another observer does not. I will conclude with suggestions about possible future studies on dolphin social cognition.

#### Development, environment, and experience are important contributors to canine social cognition.

**MONIQUE UDELL**

*University of Florida, USA*

Pet domestic dogs have been recognized for their responsiveness to human stimuli for over a decade. For much longer dogs have displayed qualities that have allowed them not only to survive but to thrive in human societies and even human homes. However the mechanisms underlying the domestic dog's social cognition are still under debate. Through a series of studies, investigating the performance of wolves and dogs from different environmental populations on human guided tasks, we have demonstrated that domestication alone is neither necessary nor sufficient to explain dogs' social behavior. Instead we propose that domesticated and non-domesticated canids share the capacity for human oriented social behavior. The expression of this behavioral phenotype, however, depends on life experiences from socialization as young pups up to the last experimental trial. Our findings demonstrate the importance of viewing canine social cognition as a fluid interaction between inheritance, development, environment, and experience.

## Raven social cognition: generally Machiavellian or context specific?

**THOMAS BUGNYAR**

*University of Vienna, Austria*

Predicting individuals' behaviour by integrating observable features from their current and past behaviours is a key element of social interactions and provides the basis for any form of cooperation, competition and culture in human and non-human societies. The level of sophistication non-human animals may reach in predicting others' behaviours has been linked to the degree of complexity in the species' social life. Yet there are open questions concerning the extent and quality of mental representations as well as the socio-ecological conditions that promote investment in 'intelligence'. Ravens *Corvus corax* are renowned for their Machiavellian behaviour during group-foraging, notably their deception and attribution skills in outwitting others for hidden food. Here, I focus on their behaviour during and after conflicts outside foraging. I present observational data on two groups of captive ravens collected over a time period of 3 and 2 years, respectively. Coalition formation was a prominent feature in dominance-related aggression, with social relationships and severity of the conflict determining the likelihood of getting help. Males tended to form stable same-sex alliances, whereas females appeared to rely on kinship and partnership relations. Post-conflict management involved reconciliation and, frequently, consolation of the aggression's victim by a third party. In either case, post-conflict affiliation was expressed via contact-sitting and allo-grooming. Taken together, ravens' social manoeuvres during and after conflicts show striking parallels to that of primates and supports the idea of a convergent cognitive evolution.

## Auditory-visual individual recognition in rhesus macaques (*Macaca mulatta*).

**IKUMA ADACHI<sup>1</sup> & ROBERT R. HAMPTON<sup>2</sup>**

*<sup>1</sup>Kyoto University, Japan, <sup>2</sup>Emory University, USA*

Human cognitive activities are products of evolution as much as the body and social structure. Influential theoretical papers and empirical reports have hypothesized that the relatively sophisticated learning and cognitive abilities of primates have been selected for by virtue of their usefulness in the social domain. The comparative study of social cognition is therefore critical to advancing our understanding of the evolution of human cognitive abilities. Findings from field studies often suggest that animals have sophisticated recognition skills for social objects and events. However, many questions remain that require experimental approaches; for example, how do individuals garner information about their companions, and how do they store such information in memory? In the current study, to test for individual recognition, we examined the extent to which rhesus monkeys form cross-modal representations of familiar conspecifics in the lab. Monkeys were trained to match a video of a familiar individual to a still image of that individual presented among 4 distracter images in a delayed Matching to Sample task (MTS task). In the later probe trials, a voice, either matching (congruent trial) or mismatching (incongruent trial) the sample video, was played during a memory interval. We assessed cross-modal recognition by determining: 1) the extent to which monkeys were more accurate or responded more quickly on congruent trials, 2) whether errors on incongruent trials were to the image of the monkey whose voice was heard during the memory interval.

## Perception of social stimuli in chimpanzees: From body, face, to gaze.

**MASAKI TOMONAGA**

*Kyoto University, Japan*

For understanding the evolution of social intelligence, it should be examined how nonhuman animals process the social stimuli from the comparative-cognitive perspective. In this presentation, I summarize our findings on social perception in chimpanzees. Selected topics are as follows. 1) Finding a face from the junk. Search for a specific face among faces is not so easy also for humans although these are socially relevant. However, chimpanzee's attention is readily captured by the face, and they detect the face embedded in the non-face object array much faster than the other targets. The additional tests further suggest that this quick detection is closely related to configural processing of faces. 2) Searching the body. Body also conveys various kinds of information for social interactions. Using the visual search paradigm, we tested how efficiently they found the silhouette of the chimpanzee body among the junk objects. They detected the chimpanzee body faster than the other types of the target, and this performance was generalized to non-primate quadrupedal animals but not to the humans. 3) Discrimination of gaze direction. Face and body contains the information of the direction of attention of the individual. Especially, gaze is quite important information for social interactions both in humans and probably chimpanzees. Using human faces, we tested the ability of gaze discrimination in the chimpanzee. The chimpanzee detected the face with gaze directed to the observer (direct gaze) more efficiently than the averted gaze. But this ability is quite limited. These results may suggest the anatomical constraints (darker sclera) affect the perception.

## [SYMPOSIUM #9]

### “Reasoning and Learning in Nonhuman Animals”

Chair: AARON BLAISDELL (*University of California-Los Angeles, USA*)

#### Difficulties in obtaining some cue-competition phenomena in human associative learning.

**KOUJI URUSHIHARA**

*Health Sciences University of Hokkaido, Japan*

A number of cue competition phenomena have been found in Pavlovian conditioning studies with nonhuman animals since the seminal experimental work by Pavlov. Some of these phenomena such as blocking or overshadowing have been found in human associative learning situations as well, which have implied the commonality of mechanisms underlying nonhuman conditioning and human associative learning. However, some of recent studies cast doubt upon the commonality; for example, it has been reported that blocking, one of cue competition phenomena observed in both nonhuman conditioning and human associative learning, is actually different in the two learning situations with regard to the sensitivity to some constraints of effortful causal processes. Furthermore, it should be pointed out that there still exist some cue competition phenomena which have not been replicated in human associative learning though they have been repeatedly found in animal conditioning. I will present several attempts to replicate in human associative learning tasks two cue competition phenomena, overexpectation and superconditioning. Though the empirical evidence for the two phenomena has been obtained repeatedly in animal conditioning situations, it turned out to be quite difficult to obtain in human causal learning situations.

#### When I cannot be rational; the conditional and unconditional effect of nicotine on intracranial self-stimulation behavior”

**KOSUKE SAWA**

*Senshu University, Japan*

To estimate the reinforcement value seems to be the important psychological faculty for self-controlled and rational behavior. Experiments in rats have shown that the injection of nicotine, the addictive substance in cigarette, can decrease the intracranial self-stimulation (ICSS) threshold (i.e., the lowest frequency of stimulation to maintain lever pressing), implying that nicotine have unconditional effect on reinforce value. A number of studies suggested that addictive drugs, such as nicotine, can work as reward to maintain instrumental behavior and that this reward property activates brain reward circuitry to cause drug seeking behavior.

In present paper, we investigated not only unconditional but conditional effect of nicotine on reinforcement value by using ICSS behavior in rats. In first series of experiments, rats trained to press the lever to receive ICSS reinforcement experienced the nicotine injection in one context and saline injection in another context. After these contextual conditioning, the ICSS threshold was assessed in each context with drug-free situation. In second series of experiments, rats were trained to keep pressing the lever to obtain ICSS stimulation and release the lever after reinforcement. Following this training, subjects required to achieve the same task with or without nicotine injection. As results, the context associated with nicotine decreased ICSS threshold and nicotine injection accelerated to release the lever. These results suggested that the context associated with nicotine can affect on reinforcement value

## Fly decision-making: spontaneous actions or habitual responses?

**BJÖRN BREMBS**

*Freie Universität Berlin, Germany*

To make good decisions, animals and humans learn from the consequences of their earlier choices to guide later decisions. For instance, as toddlers we learn to say “please”, later, we learn how to behave at cocktail parties. Chimpanzees learn how to use a stick for termites. New-Caledonian Crows learn how to bend a wire for a food reward. Honeybees learn at what time of day they have to visit which flower patch. Such learning situations often consist of an early, exploratory phase and a later phase in which the behavior is reliably produced to exploit a resource. Psychologically speaking, animals have to transition from producing spontaneous, exploratory actions, to efficient, habitual responding. Using the genetic tools available in the fruit fly *Drosophila melanogaster*, we discovered that such complex tasks are accomplished by processing them with two separate, but interacting learning systems. The first, dominant system stores any relationships between stimuli in our environment. The second, anatomically and genetically distinct system is subordinate and directly modifies behavioral circuits. Their hierarchical interactions ensure that the information each animal acquires about its environment remains flexible for use in different circumstances (generalization). Prolonged exposure to a given situation reduces this flexibility in favor of a more efficient, stereotyped behavior (habit formation). In *Drosophila*, the molecular mechanisms of these two learning systems are starting to unravel. A prominent neuropil, the mushroom-bodies are mediating some of the interactions between these systems and regulate the balance between flexible exploration and efficient exploitation.

## Reward inference by primate prefrontal neurons.

**MASAMICHI SAKAGAMI<sup>1</sup>, XIAOCHUAN PAN<sup>1</sup>, & KOSUKE SAWA<sup>2</sup>**

*<sup>1</sup>Tamagawa University, Japan <sup>2</sup>Senshu University, Japan*

The category-based inference is a fundamental cognitive function that allows animals to transfer information from a category member to others on the basis of category membership. To investigate neural mechanisms underlying this process, we recorded neural activity from the lateral prefrontal cortex (LPFC) of monkeys performing a sequential paired-association task with asymmetric reward schedule. Monkeys learned two sequences of stimuli: A1-B1-C1 and A2-B2-C2. The asymmetric reward rule was instructed by pairing C (C1 or C2) with the reward block by block. Monkeys could predict reward based on A1 (or A2) just after C1 (or C2) was paired with reward. After confirming monkeys’ ability to infer the reward, we recorded single unit activity from the LPFC. We found a group of LPFC neurons encoded reward value specific to a category of visual stimuli defined by relevant behavioral responses (A1-B1-C1 or A2-B2-C2). These neurons inferred the reward magnitude for new category members that had never been used in the asymmetric reward task, when other stimulus from the same category was paired with a large (or small) amount of reward. Our data suggest that LPFC neurons encode category-based reward information, and relay this information to its members, even to new ones, reflecting a neural mechanism that could be the basis of category-based inference.

## [ORAL PRESENTATION #1]

### “Cognition and Behavior in Primates”

Chair: **SERGIO M. PELLIS** (*University of Lethbridge, Canada*)

Rapid detection of snakes by Japanese monkeys (*Macaca fuscata*):  
An evolutionarily predisposed visual system.

**MASAHIRO SHIBASAKI<sup>1</sup> & NOBUYUKI KAWAI<sup>2</sup>**

<sup>1</sup>*Kyoto University, Japan,* <sup>2</sup>*Nagoya University, Japan*

Primates, including humans, appear extremely sensitive to biologically threatening stimuli, such as snakes. The controversy over whether the fear of snakes is innate or learned in primates still continues. In visual search tasks, humans respond to pictures of snakes faster than pictures of flowers. We report that macaque monkeys, reared in a laboratory and with no experience with snakes, respond, as do humans, to pictures of snakes among flowers faster than vice versa (Experiment 1). The result suggests that experience with snakes and representation of them may not play a major role in monkey's sensitivity to snakes. One may suspect that the result obtained from Experiment 1 was based on specific color tones of the snake pictures that made them easier to detect than the pictures of flowers. However, the same result was obtained when grayscale pictures were used (Experiment 2). These results provide the first evidence of enhanced visual detection of snakes in nonhuman primates and strongly support the notion that snakes are not neutral stimuli for primates. In conclusion, macaque monkeys share the propensity of humans for particularly rapid visual detection of snakes, even with no prior experience with snakes.

Combinatorial, syntactical and prosodic features in vocal exchanges  
of northern miquis (*Brachyteles hypoxanthus*).

**CÉSAR ADES<sup>1</sup>, FRANCISCO DYONÍSIO CARDOSO MENDES<sup>2</sup>, & DIDIER DEMOLIN<sup>1</sup>**

<sup>1</sup>*University of São Paulo, Brazil,* <sup>2</sup>*PUC Goiás, Brazil*

We investigated particularly flexible and not previously described aspects of Northern miquis (*Brachyteles hypoxanthus*) vocal exchange calls. Vocal exchanges occur when one individual vocalizes and others take turn to respond with one call each. 648 vocalizations were recorded in the wild with a single group of miquis. We identified 14 types of acoustic units or syllables. Each of the 12 patterns of call composition (in clusters based on syllable choice) was shared by 5 to 23 miquis; individuals, however, rarely repeated the same vocalization: there were 543 different sequences of syllables in the 658 calls sample. Sequencing of syllables followed restrictive rules analogous to context free and context sensitive syntax of human language. Vocalizations composed of similar sets of syllables varied in prosodic features such as rhythm and pitch/amplitude contour. Finally, we gathered evidence about the possibility that different syllables or combination of syllables could transmit different information contents. Human language uniqueness may not reside in any single feature, such as combinatorial sequencing of vocal elements, syntax or referentiality, but rather on how such features are intertwined to produce an open system of meanings. The study of the vocal exchanges of miquis and of other complex systems of primate vocalizations is relevant to understand how the very special integration of linguistic features came to be in human evolution.

## Finding a ‘detour’ to study of animal play behavior.

**MASAKI SHIMADA**

*Teikyo University of Science & Technology, Japan*

Many ethologists and psychologists have pointed and complained about the multiple difficulties to study animal play behavior so far. I summarized two main substantial difficulties in the study of animal play behavior; the definition and the function of play.

It is logically inevitable for all the ethologists to be restricted by these two difficulties whenever they try to study animal play behavior. It is not fruitful that they face these difficulties straightly, and result in abandoning research. In order to keep studying animal play behavior, it seems important to find a logical “detour,” not addressing these problems directly.

I introduce my recent study “social object play” among provisioned juvenile Japanese monkeys of Arashiyama, Kyoto, Japan, as an example of the detour. I clarified the proximate mechanism which made the interactive features of social object play possible. Most of juveniles participated in social object play and the playful interaction often continued for long periods. The interaction of social object play in Arashiyama had particular features: (1) Multiple juveniles treated only one object as a target of play. (2) The holder of the target escaped from non-holder(s). Since the values of the objects as food juveniles held in play, juveniles did not respect the possession of object and they did not restrain playing with the object holder. This explains why the interactions of social object play in Arashiyama could be continuous.

## From the foot to the hand: The evolution of head scratching in primates.

**SERGIO M. PELLIS & VIVIEN C. PELLIS**

*University of Lethbridge, Canada*

Humans and other apes scratch their heads with their hands, while most other mammals use their feet. How did this transition arise? One possibility is that the increased brain size of humans and apes has allowed them to exercise control over a more convenient appendage in order to carry out this task. However, closer inspection of primates indicates a more complex pattern, as in this order, scratching with the hand occurs more widely than typically thought to be the case. Furthermore, some species that use the hand are not necessarily the ones with the largest brains in their lineage. For many of them, scratching with their hands can occur in conjunction with scratching with their feet. The comparative evidence suggests that scratching with the hand is a novel behavior pattern that supplants scratching with the foot. This transition appears to involve two steps. First, the hand replaces the teeth in scratching the body. Second, the hands gradually encroach on the upper body areas that are scratched by the feet. In intermediate cases of this transition from foot to hand scratching, the hands and feet may compete with one another to scratch the same body area. Eventually, the older pattern, scratching with the feet, comes under complete inhibitory control, leaving the new pattern, scratching with the hands, as the sole pattern. It is suggested that the older behavior pattern serves as a template for the evolution of the new one.

## [ORAL PRESENTATION #2]

### “Evolutionary Aspects of Cognition”

Chair: PAT COUVILLON (*University of Hawaii at Manoa, USA*)

#### Working memory in the honeybee (*Apis mellifera*).

**GENTARO SHISHIMI & PAT A. COUVILLON**

*University of Hawaii at Manoa, USA*

Although there is considerable interest in honeybee memory, there has been little study of working memory. Using delayed-matching-to-sample (DMTS) and symbolic matching-to-sample problems, previous studies reported good performance with delays up to 5s. Using a delayed-nonmatching-to-sample (DNMTS) problem, preliminary experiments in this laboratory found good performance with exceptionally long delays of 4-5min. Although most studies of honeybee choice use sucrose as reward and water as nonreward, a more aversive salt solution was used as nonreward in the DNMTS experiments. The present study compares DMTS and DNMTS performance with a short delay (11s in Exp. 1) and a longer delay (3min in Exp. 2) using an even more aversive nonreward (stevioside). Honeybees were trained individually to visit a laboratory window. In Exp. 1, the subject received a small drop of sucrose on a colored sample (e.g., yellow or blue), then flew to an adjacent window for a choice between yellow and blue. A correction procedure was used so the subject drank the sucrose on the correct color, flew back to the hive to unload, and then returned to the window for another trial. In Exp. 2, the subject found a large drop of sucrose on the sample, returned to the hive and then back to the window for the choice. They solved both problems in Exp. 2 but only DMTS in Exp. 1. The results confirm that the honeybee has a very long working memory. The asymmetry can be understood in terms of reinforcement and proactive interference. (Funded by U.S.NSF IOS08-45116)

#### The unobservability hypothesis in physical causal cognition from developmental perspective.

**YOSHIHIRO NAGAMORI**

*Waseda University, Japan*

The purpose of this study is to elaborate Povinelli's unobservability hypothesis about understanding of physical causality in more detail from developmental perspective. Povinelli(2000; Povinelli & Vonk, 2006; Penn & Povinelli, 2007) hypothesized that human beings can be distinguished from non-human animals in terms of reasoning about unobservable variables such as gravity and support in physical causal relation. According him(e.g., Povinelli, 2000; Povinelli & Dunphy-Lelil, 2001), while in human beings, even young children can reason about causal relation including unobservable variables, chimpanzees can't do so. I agree with Povinelli's distinction between humans and chimpanzees. In this study, I propose a more detailed distinction in human beings. I asked about 100 5-year-olds, 7-year-olds, 9-year-olds, and 12-year-olds to judge whether there was air (=unobservable substance) in a classroom, outside, and an open box, and asked why they judged so. As a result, almost all children claimed that there was air in the room and outside. But, while over the halves of 9-year-olds and almost all 12-year-olds answered yes for the box question, almost all 5-year-olds and 7-year-olds said no and told us that air got out of the box. This result indicates that younger children consider air as wind, or observable substance. In addition, this result is consistent with Carey(1991) and Piaget(1927). These results suggest that it is not until 9-year-olds that children begin to consider unobservable variables as necessary components for causal phenomena. The distinction of cognition between behavior level and representation level could explain the difference between Povinelli's results and mine.

## Development of probabilistic judgment in humans.

**TOMOKO ITOH**

*Waseda University / Japan Society for the Promotion of Science, Japan*

This study analyzed the development of probabilistic judgment in humans. Natural frequencies are obtained by sampling instances from a population sequentially (Gigerenzer, 2000). 33 junior high school students and 48 university students in Japan answered the Vaccination problem in terms of natural frequencies: It is supposed that in a country, 800 out of every 1000 people have heredity for a disease. If people have heredity, they will definitely contract the disease. Without heredity, they definitely will not. Suppose a vaccination against the disease is developed. If people have the vaccination, of the 800 people with heredity, 120 will contract the disease, and of the remaining 200 people without heredity, 4 will contract the disease. Imagine that no one in the country has the vaccination (case 1). Imagine that everyone has the vaccination (case 2). How many people will contract the disease in each case? The answer is “800 out of 1000” and “124 out of 1000”, respectively.

The proportion of correct answers is shown in Table 1. The difference was marginally significant between participants in case 1,  $p = .08$ , and significant in case 2,  $p = .00$ . Although Gigerenzer & Hoffrage (1995) suggested that the mind is evolutionally tuned to frequencies, children seem to be less tuned than adults. Furthermore, although the information in the problem seems to be important for survival, fewer children answered correctly than adults. The results suggest that both evolutionary (phylogenetic) perspective and developmental (ontogenetic) perspective is important in studies of probabilistic judgment in humans.

Table 1  
*Proportion of Correct Answers* \*N (%)

Case	Junior high school students	University students
1	26 (78.8)	45 (93.8)
2	13 (39.4)	40 (83.3)

## Behavior of dogs facing a difficult situation.

**YUSUKE HORI & KAZUO FUJITA**

*Kyoto University, Japan*

Recent researches have suggested that domestic dogs (*Canis familiaris*) have special social skills to communicate with humans. For example, dogs easily choose the objects pointed by human communicators, whereas their ancestor species, wolves, do not. Dogs also look at human face more often than wolves socialized to humans in a difficult situation. Such referencing behavior has been suggested to be a key difference between dogs and wolves. However, it is still unclear whether this difference is a consequence of domestication of dogs or due to environmental factors. In the present study, we gave a container-opening task to house dogs. In the “easy” condition, dogs were simply required to displace the top of the plastic container to collect a reward. In the “difficult” condition, the container was firmly locked so that subjects could not open it. We conducted this task in Germany and Japan. Owners’ attitudes toward dogs seem to be different between these two countries. We investigated whether this difference of “the dog culture” would affect the dogs’ behavior in a difficult situation. Dogs in both countries looked at humans and there was no significant difference in the percentages of dogs showing this referencing behavior. The result suggests that dogs may have a genetic tendency to look at humans when they face a difficult situation. Furthermore, we discuss what variables affect the behavior of dogs in such a situation.

How do dogs (*Canis familiaris*) recognize what is reachable?  
A comparison between Japanese and German dogs.

**TOMOMI MAEDA & KAZUO FUJITA**

*Kyoto University, Japan*

We examined whether and how dogs recognize what is reachable in Japan and Germany. Dogs were restrained in the cage and rewards were placed at several different distances from it. Dogs were able to extend their paw or muzzle to collect rewards from the opening at the bottom of the cage. Before the test, we measured the maximal reach of dogs, which we refer to as the standard distance (1.0). Then we placed 4 rewards at the distance of 0.75, 1.0, 1.25 and 1.5 times the standard. The owner of the dog sat behind the cage during the test trial. With the experimenter's signal, the owner encouraged the dog vocally to obtain the rewards. During the trial, the owner was allowed to encourage the dog vocally only when he/she looked back at the owner for help. The trial was finished in 3 min or when the dog collected all of the rewards. We recorded the order of dogs' attempts and their reference behavior to the owner. Both Japanese and German dogs initiated their attempts for their reachable rewards, 0.7 and 1.0. This suggests dogs know how far they can reach. Reference behavior was more frequent in German dogs than in Japanese dogs. This suggests there might be some difference between German and Japanese dogs in how they determine what to do; German dogs may be more reliant to their owners. This difference may reflect how people train their dogs.

## [ORAL PRESENTATION #3]

### “Memory and Perception in Birds”

Chair: FRANCISCO J. DONIS (Central Connecticut State University, USA)

#### Do bantams (*Gallus gallus domesticus*) amodally complete?

##### An analysis of line classification performance.

NORIYUKI NAKAMURA<sup>1,2</sup>, SOTA WATANABE<sup>2,3</sup>, TORU BETSUYAKU<sup>3</sup>, & KAZUO FUJITA<sup>3</sup>

<sup>1</sup>Chiba University, Japan, <sup>2</sup>Japan Society for the Promotion of Science, Japan, <sup>3</sup>Kyoto University, Japan

Humans perceive a line touching an edge of a large rectangle longer than the reality (Figure 1). Kanizsa (1979) has suggested that this illusion occurs because we perceive that the line is partly “hidden” behind the rectangle and automatically complete it. We tested whether bantams (*Gallus gallus domesticus*) would experience this perceptual phenomenon using a line classification task on the touch monitor, which was successfully used in our previous study with pigeons (Fujita, 2001; Figure 2). We trained three bantams to classify six lengths of black target lines into two categories, “short” or “long”, ignoring a gray rectangle (Experiment 1) or a gray area (i.e., a left or a right half of the monitor was filled with gray; Experiment 2) located at the same distance (8 pixels) from the target line. In test, the distance between the line and the gray rectangle (or area) sometimes changed (0, 4, or 8 pixels; we labeled these stimuli as D0, D4 and D8 respectively). Both of the two successfully trained bantams showed an illusion for D0, but the direction of illusion was reversed; that is, they judged the line in D0 to be “shorter” than that in D4 and D8. Further analyses proved that neither the distances between the target line and the gray rectangle nor the total widths of the stimuli could account for the bantams’ responses. These results suggest that bantams do not complete the “occluded” portion even when identification of its shape is not required.

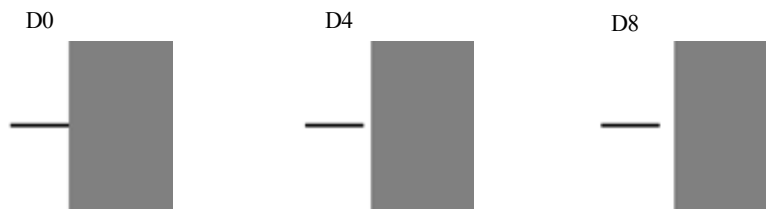


Figure 1.

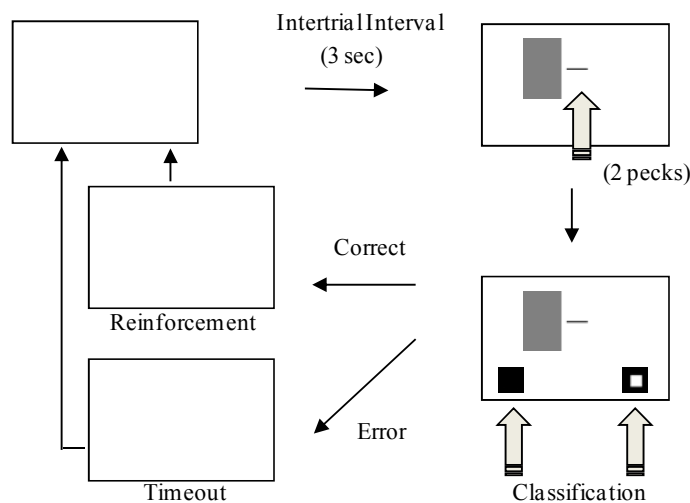


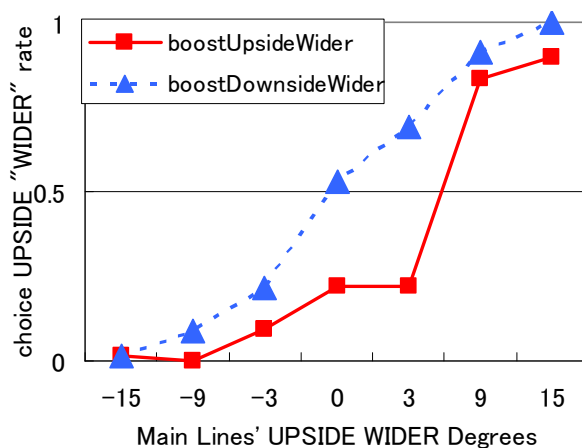
Figure 2.

## Bantams' (*Gallus gallus domesticus*) perception of Zöllner illusion: the tendency is opposite to that of humans.

**SOTA WATANABE**<sup>1,2</sup>, **NORIYUKI NAKAMURA**<sup>2,3</sup>, & **KAZUO FUJITA**<sup>1</sup>

<sup>1</sup>Kyoto University, Japan, <sup>2</sup>Japan Society for the Promotion of Science, Japan, <sup>3</sup>Chiba University, Japan

We examined whether chickens (*Gallus gallus domesticus*) perceive Zöllner illusion in which parallel lines look non-parallel due to numbers of short hatches superimposed on the lines. First, we used a pair of non-parallel lines and trained 2 birds to peck the narrower (or wider) of the two gaps at the ends of the lines. After adapting the subjects to the target lines having random-oriented hatches (which cause little illusion at least to humans), we tested the pigeons' responses in randomly inserted probe trials, in which hatches that should, in human standards, induce Zöllner-like illusion replaced the random-oriented ones. The results suggest that chickens do perceive an illusion from Zöllner figures, but the tendency is contrary to that of humans. In a previous study, we found pigeons' (*Columba livia*) illusory perception of Zöllner figures was also opposite to that of humans (Watanabe, et al, in prep). We can hypothesize the diversity of illusory perception of Zöllner figures across species.



The subjects' mean percentages of "Wider" choices to upside gap in our experiment. The two graph lines means the types of the hatches superimposed in Zöllner illusion shapes. "boost UpsideWider" means the hatch type which induces humans to perceive the upside gap be wider than downside, and "boost DownsideWider", vice versa.

## The oblique effect in pigeons may depend on a perceptual Gestalt.

**FRANCISCO J. DONIS**, **YACIHUILCA MONI**, & **EMILY HALE**

*Central Connecticut State University, USA*

In a previous study with pigeons, Donis (1999) found that in a successive discrimination task it is easier for these subjects to discriminate between two lines in the main axes orientation (i.e., horizontal vs. vertical) than between two obliquely oriented lines (i.e., one line oriented 45° from horizontal vs. a line oriented 135° from horizontal). This so called Oblique effect was obtained by Donis with stimuli consisting of full lines (i.e., Experiment 1) and also when the stimuli consisted of dotted-lines, with each line made up of three dots (i.e., Experiment 3). The present experiment is a replication of Experiment 3 in Donis' (1999) study with the only difference that instead of three dots, each of the stimuli was made up of only two dots. That is, a group of 6 pigeons was trained to discriminate between two obliquely oriented dotted-line stimuli, and a different group of 6 pigeons trained to discriminate between two dotted-line stimuli in the main axes orientation. Unlike the results of the two experiments in the Donis (1999) study, independent t-tests yielded no significant differences for either proportion correct or reaction time data in the present experiment ( $p > .05$ ). These results indicate that the oblique effect in pigeons has some limitations and may depend on the perceptual gestalt of line-stimuli made up of at least three dots.

Perceptual grouping according to the Gestalt factor of similarity  
in pigeons (*Columba livia*).

TOMOKAZU USHITANI & MASAKO JITSUMORI

*Chiba University, Japan*

Objects similar in color and shape tend to be grouped together in human perception (Figure 1). We investigated whether such perceptual grouping according to the *gestalt* factor of similarity would be observed in pigeons. By manipulating the horizontal and vertical separation between elemental figures (small circles), we created six patterns of grids. Because nearby objects tended to be grouped together, elements were integrated into horizontal strings in three patterns in which the horizontal separations were small, and elements were integrated into vertical strings in the remaining three patterns in which the vertical separations were small. Arrays were either homogeneously red or green or a random mixture of these two colors. Pigeons were trained to discriminate between the vertical and horizontal strings in a two-alternative forced-choice task. In the subsequent testing, we manipulated the separations to create five additional grid patterns consisting of rows or columns that alternated between red and green, and characterized by ambiguity about whether they represented vertical or horizontal strings. The pigeons' "vertical" responses occurred more frequently when the columns rather than the rows were alternately colored, suggesting pigeons perceived objects of the same color as grouped together. In the next experiment, we used yellow triangles and crosses instead of green and red circles to investigate whether shape similarity also contributed to grouping elements. The results, however, did not reveal evidence that pigeons engaged in similarity-based grouping with respect to shape. Inter-species similarities and differences in perceptual grouping and the mechanisms underlying these phenomena were discussed.

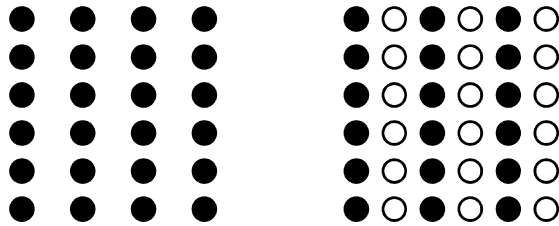


Figure 1. (Left) Because nearby objects tend to be grouped together, elements are integrated into vertical strings when the vertical separations are small.  
(Right) Because objects similar in color tend to be grouped together, elements are integrated into vertical strings when the columns are alternately colored.

Pigeons exhibit higher accuracy for chosen memory tests than for forced memory tests  
in duration matching-to-sample.

**ANGELO SANTI & ALLISON ADAMS**

*Wilfrid Laurier University, Canada*

While a previous temporal discrimination experiment obtained evidence for metacognition in rats (Foote & Crystal, 2007), several visual discrimination studies have failed to obtain evidence of metacognition in pigeons (Inman & Shettleworth, 1999; Sole et al., 2003; Sutton & Shettleworth, 2008; Roberts et al. 2009). Following training in an event duration matching-to-sample task, pigeons were allowed to choose between stimuli that led to a memory test or to escape before the memory test was presented. In different experiments, the effects of sample omission, increases in retention interval, and variation in trial spacing on selection of the escape option and accuracy were studied. During initial testing, neither the frequency with which the escape option was selected, nor the accuracy on forced memory tests versus chosen memory tests varied in a way consistent with metamemory. However, after extended training and testing, pigeons began to exhibit significantly higher accuracy on chosen memory tests than on forced memory tests. Two pigeons also consistently exhibited higher escape responding on trials with the longer retention interval. These results have not previously been obtained in studies with pigeons when the choice to take the test or to escape the test is given before test stimuli are presented. It appears that task specific methodological factors may determine whether a particular species will exhibit a metacognitive performance pattern.

## [ORAL PRESENTATION #4]

### “Spatial Learning in Rodents”

Chair: IAN JOHNSTON (*University of Sydney, Australia*)

Novel object exploration in mice and rats: The role of habituation.

**C. J. HEYSER, D. VISHNEVETSKY, R. E. BLASER, & A. CHEMERO**

*Franklin & Marshall College, USA*

Object exploration is an increasingly popular paradigm because there is no explicit need for food or water restriction and several behavioral endpoints can be obtained (e.g., general activity, reactivity to novelty, and learning). Here we report the influence of familiarization on object exploration in two strains of mice (C57BL/6J and DBA/2J) and in Sprague-Dawley rats. Familiarization is typically a pretest exposure to the open field prior to object presentation. Our standard protocol involves testing rodents in an open field, consisting of 4 6-min trials (Trial 1-no objects; Trials 2,3-two objects are placed into the open field; Trial 4-one object is replaced with a novel object). In the present study, additional groups of animals were included that received differing amounts of pre-exposure to the open field (without objects). DBA mice and Sprague-Dawley rats pre-exposed to the open field exhibited the greatest amount of object exploration. In contrast, C57 mice given the longest pre-exposure to the open field showed the least interaction with the objects and displayed behaviors consistent with an increase in anxiety (e.g., reduced inner square crosses and increased stretch-attend postures). In fact, the amount of object exploration was greatest in C57 mice that were given no prior exposure to the open field. We suggest that pre-exposure can affect the figure/ground relationship between the objects and the open field. Therefore, novelty-induced behaviors can be elicited by an unfamiliar context, stimuli or the alteration of a familiar context, with these results dependent on the genotype of the organism.

Transitive responding and the symbolic distance effect in rats' transitive inference task.

**SUMIE IWASAKI<sup>1</sup> & TOHRU TANIUCHI<sup>2</sup>**

*<sup>1</sup>Kyoto University, Japan, <sup>2</sup>Kanazawa University, Japan*

Present study examined rats' transitive responding and a symbolic distance effect in transitive inference task. We used seven three-step barriers (45 cm high in total) as discriminative stimuli which had different visual appearances and tactile features (Black or white PVC, wire-mesh, brown sandpaper, drawing pins, green artificial turf, and vertical striped wooden board). Four rats were trained to choose and climb over one of the two barriers presented simultaneously to enter a goal box and get food rewards. When rat climbed incorrect barrier, the door connected to the goal box did not open. All of four rats acquired concurrent discrimination learning of four tasks (A+B-, B+C-, C+D-, and D+E-), and showed transitive responding to item B on the novel BD pair in a probe test. Moreover, two rats could acquire six concurrent task (X+A-, A+B-, B+C-, C+D-, D+E-, and E+F-), and one of them showed significant symbolic distance effect in responding to novel test pairs (AC, AD, AE, BD, BE, and CE), a phenomenon of better performance to pairs composed of more distant items in the ordinal position. This is the first evidence of the symbolic distance effect in rats' transitive inference task. These results suggest rats, like as birds, monkeys, apes, and human beings, solve transitive inference task not based on logical reasoning that predicts better performance to item pairs which share close ordinal position.

## Free operant procedure for studying spatial learning in the laboratory rat.

IAN JOHNSTON

*University of Sydney, Australia*

In this talk I will describe some experiments in a custom-built Olton 8-arm radial maze that study free-operant spatial behaviour in the rat. On each trial, one arm of the maze was randomly designated the ‘active’ arm, and the rat received 10-sec access to sucrose from an automated fluid dispenser in a magazine at the end of the arm. After the reinforcer had been delivered, the next trial began and another arm was randomly designated as the active arm, and this procedure was repeated for each subsequent trial. In addition to this, white curtains surrounded the maze and an overhead data projector with a wide-angled lens projected visuospatial black and white cues onto the curtains, and/or onto the floor of the maze itself. On each trial, these cues were rotated so they remained in a consistent spatial configuration with the active arm. The results of these experiments indicate that: 1. The rats made significantly fewer errors in finding the active arm in the presence of the visuospatial cues compared to trials when they were absent; 2. The number of errors increased in probe trials when elements of the visuospatial configurations were removed; and 3. In probe trials when only single elemental cues of the configuration were shown, errors increased the further the test cue was from the target arm. These studies suggest this would be a useful technique for studying how rats learn to integrate visuospatial cues to find a location in space.

## How Syrian hamsters (*Mesocricetus auratus*) use various cue-objects in finding targets?

TOMOYUKI TAMAI<sup>1</sup>, TORU BETUYAKU<sup>1</sup>, NORIYUKI NAKAMURA<sup>2,3</sup>, & KAZUO FUJITA<sup>1</sup>

<sup>1</sup>Kyoto University, Japan, <sup>2</sup>Chiba University, Japan, <sup>3</sup>Japan Society for the Promotion of Science, Japan

Cook and Tauro (1999) suggest that rats use both spatial information and visual cues when they search for targets, and that it is easy for rats to use visual clues placed close to targets but difficult to use distant clues. We replicated their experiments in Syrian hamsters with some modifications, in which hamsters searched for milk pellets in cups on the top of poles arranged in a circular arena. We divided 20 subjects into three groups, “Proximal group”, “Distal group”, and “Landform group” (Figure 1). Each group was trained in the following conditions. In Proximal group, 4 different objects were placed next to the four target poles. In Distal group, the objects were placed at the poles next to the targets. In Landform group, there was a mound covering the area of four central poles, and the pellets were deposited in the same position as in Distal group (this test is ongoing for this group). Hamsters in Proximal group learned the position of targets earlier than animals in Distal group. In the test after training, in which the objects were removed, these two groups searched near the targets in training. In the test in which the objects were relocated, Proximal group often visited poles next to the relocated objects whereas Distal group visited original targets. These results suggest that hamsters have difficulty in using objects distant from targets as cues, though they are able to use both objects next to the targets and spatial arrangement as cues.

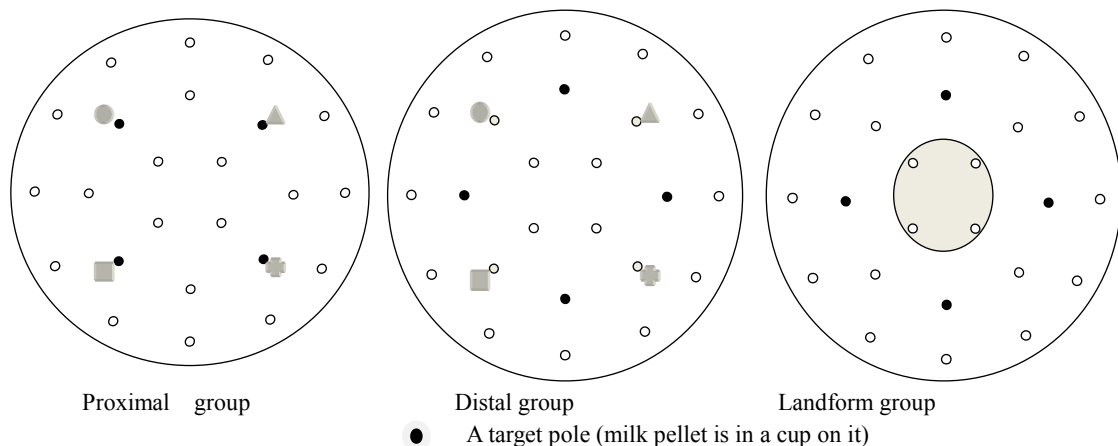


Figure 1

## Spatial navigation in Syrian hamsters: Flexible use of beacon and geometric cues?

TORU BETSUYAKU<sup>1</sup>, NORIYUKI NAKAMURA<sup>2,3</sup>, & KAZUO FUJITA<sup>1</sup>

<sup>1</sup>Kyoto University, Japan, <sup>2</sup>Chiba University, Japan, <sup>3</sup>Japan Society for the Promotion of Science, Japan

Flexible use of various internal and external cues should be adaptive for animals to navigate in changeable environments. Syrian hamsters, which are known to use Path Integration (PI), are also said to update their PI information by landmarks depending on the context (Etienne et al., 2004). Here, we investigated how they would use beacon and geometric information in a simple spatial navigation task. The apparatus was a semicircle-like arena having 3 exit doors (Fig.1). We first trained subjects to get out of the arena through the door, and then tested which door they would choose in the contexts of different information. During training, one of the three doors was unlocked, whereas the others were locked. An object was located near the unlocked door as a beacon. Animals were rewarded after getting out of the door. In Test 1, all 3 doors were unlocked and the beacon was relocated near one of the doors which were not the correct goal in the training. All subjects chose the doors indicated by the beacon or geometry. When the beacon was removed from the arena in Test 2, some subjects changed their strategy. In Test 3, which was identical to Test 1, most subjects reinstated their original strategy in Test 1, though some made irrelevant choices. Taken together, these results suggest that hamsters may flexibly use several cues for spatial navigation, depending on environmental context.

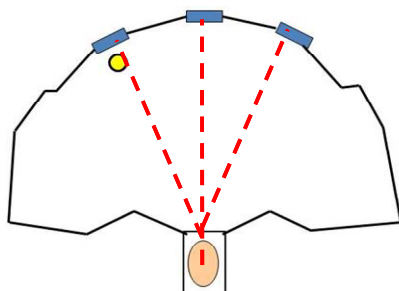


Figure 1.

## City rats:

Utilizing rat's cognitive mapping to study principles of urban design and city planning.

DAVID EILAM, OSNAT YASKI, & JUVAL PORTUGALI

*Tel-Aviv University, Israel*

Humans and animals establish a representation of the space they live in, an environment image or a generalized 'mental map' of the exterior physical world, which is utilized for wayfinding. Accordingly, the relation between subjects and their surrounding is a main theme in ethology as well as in urban planning. In both fields, there is a main interest in spatial representation and its effect on orientation. In the present study, we introduced rats into environments which model specific urban designs. For example, an arena with a grid of objects which we termed "Manhattan layout", or an arena with a random layout of objects, which we termed "Old-Jerusalem layout". We found that "Manhattan rats" explored all objects in the arena, whereas "Old-Jerusalem rats" hardly explored half of the objects despite their similar activity. We also illustrate that humans and animals share similar mechanisms of cognitive mapping when introduced unsighted into an unfamiliar environment. One mechanism is looping back to the start point. Another mechanism is wall following (perimeter walk) which provides the navigator with information on the geometry and size of the environment. Finally, humans and animals seem to use odometry (counting steps) in order to assess the size of the environment and distances among objects. Since humans and animals utilize similar navigation mechanisms and seem to similarly perceive specific environmental designs, we argue that rats' behavior may be utilized to test concepts and designs of urban planning, and wayfinding in city dwellers.

## [POSTER SESSION #1]

**#1.**

Obsessive-compulsive disorder (OCD):  
From animal model to behavior of human patients.

**DAVID EILAM, RAMA ZOR, JOEL MORT, HENRY SZECHTMAN, & HAGGAI HERMESH**

*Tel-Aviv University, Israel*

We applied a methodology that was developed in the framework of an animal model to study motor rituals in obsessive-compulsive disorder (OCD) human patients. We found that their OCD behavior is based on two cardinal processes: (i) numerous repetitions; (ii) inflated performance on idiosyncratic non-functional acts that are not necessary for task completion. Specifically, acts dichotomize into functional acts that are compulsory for task completion, and idiosyncratic non-functional acts that are not essential for task completion. In OCD, non-functional acts break down the functional structure of behavior, turning OCD motor behavior into a pessimal (antonym of optimal) behavior with reduced functionality. Moreover, non-functional acts amalgamate mainly after the natural end of the performed task, in accordance with the notion of lack of sense of task completion in OCD. When OCD rituals were compared with normal daily routines that, like the rituals, are executed in a relatively fixed form, we found again a dichotomy to functional and non-functional acts, but with a lesser idiosyncratic component compared with the abundance of these acts in OCD rituals. Nevertheless, this comparison supports the view that routinization in everyday life and ritualization in pathology are opposite cognitive processes, although they both feature rigid behavioral sequences. Finally, we present data on how exposure of patients to their video recordings may facilitate behavioral therapy, and how human ethology is applicable in the assessment of the efficacy of anti OCD treatments.

**#2.**

The role of within compound associations in backward blocking revisited.

**DAVID LUQUE, JOAQUÍN MORÍS, PEDRO L. COBOS, & FRANCISCO J. LÓPEZ**

*University of Málaga, Spain*

Recently it has been obtained blocking even when the learning phases are inverted (i.e., AX-1/A-1/X?). This effect, namely backward blocking (BB) has been obtained in both human and non human animals. All current models that account for BB established that the formation of a within compound association in the first phase (i.e., A-X association) is a necessary condition for obtaining BB. Indeed, these models predict a negative relationship between the strength of X-1 and A-X associations. This critical feature of theories has been studied in the past using manipulations of the strength of the within compound association or measures of its strength that had several problems. In this experiment, we further analyzed this hypothesis, measuring the A-X association in a quantitative way that can solve many of the problems of previous studies. The results are discussed in terms of current models of BB.

#3.

Transfer of non-extinguished CSs to new contexts after extinction:  
Comparative results in humans and rats.

JUAN M. ROSAS<sup>1</sup>, SAMUEL P. LEÓN<sup>1</sup>, JOSÉ E. CALLEJAS-AGUILERA<sup>1</sup>, & J. BYRON NELSON<sup>2</sup>

<sup>1</sup>University of Jaén, Spain, <sup>2</sup>University of the Basque Country, Spain

In order to explain context-switch effects after extinction, it has been suggested that the ambiguity produced when a CS acquires a new meaning triggers attention to the context, leading all information learned within an extinction context to become context-specific, so that a context change produces a performance decrease. We present two studies in human predictive learning and one in rat conditioned taste aversion in which non-extinguished CSs were shown to be context dependent when they were trained either during, or after, extinction of an alternative CS. The results of these experiments are compared with the results of two experiments on rat appetitive conditioning. There, responding to a non-extinguished CS, concurrently trained with an extinguished CS, increased mildly, rather than decreased, when tested outside the training context. The generality across tasks and species of the idea of extinction increasing attention to the contexts as an explanation of context switch effects is discussed.

#4.

Visual priming in pigeons and humans:  
A facilitating effect in humans and an inhibiting effect in pigeons.

KATSUO SEKIGUCHI, TOMOKAZU USHITANI, & MASAKO JITSUMORI

*Chiba University, Japan*

The present study compared the effectiveness of visual priming in pigeons and humans under the condition that would rule out the facilitating effect attributable to learned expectancy or a long-term association between a priming event and a particular target. Pigeons and human participants were trained to search for “A” among “Y”s or “E” among “D”s, with the search display always preceded by a particular stimulus; i.e., a small square; that was unrelated to the targets. Subsequently, a letter prime was tested on trials that were inserted among baseline training trials. The letter prime physically matched the target on target-priming trials, whereas it matched the distractors on the distractor-priming trials. The human participants initially showed the priming advantage only on target-priming trials, an expected finding attributable to early encoding of the target itself (Figure 1). Later in the testing phase, however, a similar facilitation effect occurred on distractor-priming trials as well, suggesting that the letter primes had been learned to predict the targets (the prime “Y” had come to predict the target “A” and the prime “D” had come to predict the target “E”). In contrast, the pigeons’ responses were faster on distractor-priming trials than target-priming trials, an effect inverse to that shown by the human participants, throughout the testing phase (Figure 2). That is, the letter prime identical to the target in the subsequent display interfered with the pigeons’ visual search. Possible mechanisms underlying the inhibitory effect shown by the pigeons will be discussed.

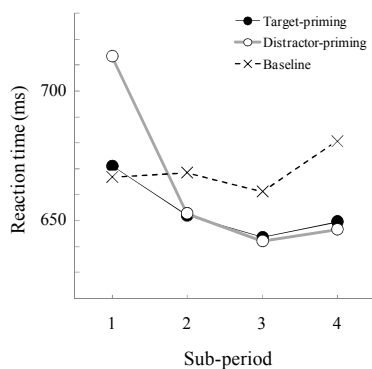


Figure 1.

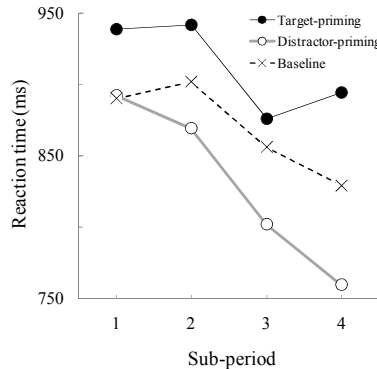


Figure 2.

## #5.

### Double alternation learning in pigeons: A preliminary experiment.

**KYOICHI HIRAOKA**

*Hirosaki University, Japan*

Four pigeons were trained on a double alternation learning task in a standard two-key operant chamber. Every trial, responding on the present and receding three trials was monitored as a “window”. If the response sequence, “RRLL” or “LLRR”, had been made following a reinforced trial or response switching, the last response within the sequence was reinforced. Following every response or reinforcement, there was a 1-sec inter trial interval (ITI). A daily session consisted of 252 trials. After a minimum of 60 sessions of the initial acquisition, where the responding got stable, two pigeons were extinguished with no reinforcement at all, while the other two pigeons were given a similar training except that ITI was changed up to 10 sec only when a reinforcement was given.

Part of the results were as follows: 1) During acquisition, pigeons showed fairly good performance, i.e., they earned about 60~80% of possible maximum rewards, 2) During extinction, run lengths of responding got longer, e.g., from “RRLLRRLL···” to “RRRRRRRLLLLLLLLRRR···”, 3) Longer ITI after a reinforced trial seemed to have no effects on response patterns.

The experiment will be continued, where some other variables will be manipulated with within-subject designs, and some more results may be presented at the meeting.

## #6.

### Directed forgetting in two different memory tasks in rats: delay-interposed radial arm maze and delayed nonmatching-to-position tasks.

**MASAMI KAKU, KAZUO YAMADA, & YUKIO ICHITANI**

*University of Tsukuba, Japan*

“Directed forgetting (DF)” is shown as impaired performance on a memory test following an instruction that the presented item(s) will not be tested. In animal studies, DF has been mainly found only in a situation that proactive interference (PI) arises during performance of the task. Thus, we examined DF using two different kinds of tasks, radial arm maze (RAM) task and delayed nonmatching-to-position (DNMTP) task in rats. In the RAM task, 2h delay was interposed after the four correct choices, and rats were placed in either white or black box that signaled whether the second-half performance will be required (remember (R)-trial) or not (forget (F)-trial). After R- and F-trials were repeated, we made a probe test in which the second-half was conducted although F-cue was presented in delay period (Kaku et al., 2009). In the DNMTP task in an elevated plus-maze, a forced run to the right or left arm was given and then rats were placed in either white or black box, the color of which instructed whether a free-choice test would follow (R-trial) or not (F-trial). In R-trials, rats’ choice of the opposite arm against the forced run after delay was rewarded. After these trials (10 trials/day), we conducted a probe test in which a free-choice test occurred although F-cue was presented in delay period. DF shown in these two tasks was discussed in terms of the occurrence of PI during performance.

## #7.

### Hippocampal theta activity during Negative, Positive, and Elemental task in the rat.

YUYA SAKIMOTO, MINORU HATTORI, and SHOGO SAKATA

*Hiroshima University, Japan*

According to configural association (CAS) theory, a hippocampus plays an important role in solving the nonlinear task in rat. To solve nonlinear task, it is necessary for the configural processes and this theory defined that this processes was involved in hippocampus. This theory investigates the nonlinear tasks in hippocampal lesion rat. It is one of the typical negative patterning tasks. Although it has been supported in some studies in hippocampal lesion rat, it has not been examined, the relation configural processes and hippocampal electroencephalograms (EEGs). It is thought that hippocampal EEGs may reflect hippocampal activity. Thus, the purpose of this study is to examine whether hippocampal EEGs related the configural processes. A total of twenty-four rats were assigned to either the negative patterning task group (n=12) or the positive patterning one (n=12). In the negative patterning task, a lever press response was reinforced when either a single stimulus A (tone) or stimulus B (light) was presented, but was not reinforced when the compound stimulus AB (tone + light) was presented. EEGs were recorded from the hippocampal CA1 during the performance of negative patterning, positive patterning, and elemental task. The amplitude of theta activity in the hippocampal CA1 increased during the compound stimulus in the negative patterning task. This result revealed a relation between hippocampal EEGs and learning that required for configural processes. Thus, this study supported hippocampus is required for configural processes on the CAS theory.

## #8.

### Interference effects by spatial proximity and age-related declines in spatial memory by Japanese monkeys (*Macaca fuscata*): Deficits in integration of multiple spatial cues.

NAMIKO KUBO-KAWAI<sup>1</sup> & NOBUYUKI KAWAI<sup>2</sup>

<sup>1</sup>*Aichi Shukutoku University, Japan*, <sup>2</sup>*Nagoya University, Japan*

Primates, including humans, appear extremely sensitive to biologically threatening stimuli, such as snakes. The controversy over whether the fear of snakes is innate or learned in primates still continues. In visual search tasks, humans respond to pictures of snakes faster than pictures of flowers. We report that macaque monkeys, reared in a laboratory and with no experience with snakes, respond, as do humans, to pictures of snakes among flowers faster than vice versa (Experiment 1). The result suggests that experience with snakes and representation of them may not play a major role in monkey's sensitivity to snakes. One may suspect that the result obtained from Experiment 1 was based on specific color tones of the snake pictures that made them easier to detect than the pictures of flowers. However, the same result was obtained when grayscale pictures were used (Experiment 2). These results provide the first evidence of enhanced visual detection of snakes in nonhuman primates and strongly support the notion that snakes are not neutral stimuli for primates. In conclusion, macaque monkeys share the propensity of humans for particularly rapid visual detection of snakes, even with no prior experience with snakes. Spatial information processing was assessed in three young (4-10 years old) and four aged (24-25 years old) Japanese monkeys on three delayed non-matching-to-position (DNMP) tests with relatively short delays of 5 sec. Each test had three conditions of different horizontal distances between sample and to-be-non-matched positions. Experiment 1 demonstrated that the performance on the DNMP test in both age groups was impaired when two stimulus positions were located next to each other; however, it was fairly accurate when they were located further apart, suggesting that interference is introduced by spatial proximity. Experiment 2 revealed age-related differences in the situation where an additional spatial cue, depth information, was available by extending the stimulus array of the DNMP test to a 2 x 4 matrix. In this test, young monkeys performed accurately irrespective of position distance between stimuli, whereas the aged monkeys' performance remained the same as before. Experiment 3 confirmed that the recognition ability in aged monkeys was well preserved on DNMP tests with different objects. These patterns of results indicate that the ability to use information from multiple spatial cues is not accessible to the aged monkeys.

## #9.

Effects of dog-assisted therapy on the mood of inmates in a specialized unit of a prison and dog handlers.

**NAOKO KODA**<sup>1</sup>, **YOSHIO MIYAZI**<sup>2</sup>, **MIYAKO KUNIYOSHI**<sup>3</sup>,  
**HISASHI UEHARA**<sup>3</sup>, **GEN WATANABE**<sup>1</sup>, & **CHIEMI MIYAZI**<sup>2</sup>

<sup>1</sup>*Tokyo University of Agriculture and Technology, Japan*, <sup>2</sup>*Japan Animal-Assisted Therapy Council, Japan*,

<sup>3</sup>*Harima Rehabilitation Program Center Japan*

We conducted a dog-visiting program whereby male inmates with mental retardation and/or psychiatric problems could interact with dogs and their handlers in a specialized unit of a prison, Harima Rehabilitation Program Center, in Japan. As one of the rehabilitation programs, this program was provided as preparatory education for the specific training afterward. A total of 40 inmates were divided into 4 groups (10 persons in each group), and participated in the program once a week for 70 minutes per session for a total of 12 sessions per course to improve their skill of stress management and human-dog and human-human communication. Five or 6 volunteer handlers (3 males and 24 females in total) participated in each session with their trained pet dogs. As a part of program assessment, questionnaire surveys regarding the moods of both inmates and handlers were conducted before and after each session. As the results, the inmates' mood improved after sessions in terms of tension, depression, irritation, fatigue, concentration, and anxiety. The handlers' mood also improved after sessions in terms of Tension and excitement, Refreshing mood, Fatigue, Depressive mood and Anxious mood. These results indicated that the program was effective for not only the inmates but also the handlers. This is the first animal-assisted therapy conducted in a Japanese prison, and we will improve the program and clarify its effects further.

## #10.

The effect of nicotine on rats' impulsive and timing behavior in intracranial self-stimulation.

**NAOYA MUROTA**<sup>1</sup>, **HISATUGU MIYATA**<sup>2</sup>, & **KOSUKE SAWA**<sup>1</sup>

<sup>1</sup>*Senshu University, Japan*, <sup>2</sup>*Jikei University, Japan*

Impulsivity, the tendency to act without foresight, is a characteristic of behavior that can be seen in everyday life, but high level of impulsivity are associated with a number of psychiatric disorders including attention deficit hyperactivity disorder and drug dependency such as nicotine. The present study assessed the effect of nicotine on the behavior to keep pressing a lever in rats by using intracranial self-stimulation (ICSS) paradigm. In this study, rats were presented with two types of trials. On reinforcement trials, rats were required to keep pressing a lever for 4 seconds to obtain electrical stimulation of medial forebrain bundle, and to release the lever to begin next trial once they obtained electrical stimulation. On non-reinforcement trials, where no reinforcement was available even if they could keep pressing a lever for 4 seconds, were interspersed among the reinforcement trials. On reinforcement trials, nicotine (0.4 mg/kg, s.c.) had no effect on the percentage of responses to keep pressing the lever for 4 seconds, but decreased response latencies, and accelerated to release the lever after they had obtained a electrical stimulation. On non-reinforcement trials, however, nicotine had little effects on behavior to release the lever, which suggested that the effect of nicotine to accelerate releasing a lever was more likely to be mediated by nicotine-induced sensitization of brain reward system, rather than enhancement of motor activity. Implications of the results for the impulsive behavior and the time perception were discussed.

## #11.

### Effects of amniotic fluid, mother's milk, and saliva on preference of mother and father in newborn mice.

**NORIKO KODAMA, SONOKO KIYAMA, & AKIHIRO HIGASHIYAMA**

*Shiga University, Japan*

Newborn mice, sensitive to odor cues at birth, prefer amniotic fluid and mother's milk. In our previous study, we found that amniotic fluid activated movements of newborn pups on Day 0, mother's milk on Day 2, and saliva of mother and father on Day 0 and Day 2. These suggest that newborn pups differentiate their mother from father and other individuals based on these stimuli. This study aimed to assess effects of several stimuli on preference of mother and father in newborn mice. In the first experiment, 2-day-old pups were separated from the mother and warmed for 3 hours. In the 10 min preference test, each pup was placed in the center of the plastic box where its own mother and a virgin female were anesthetized on both sides. There was no difference of pup's choice between mother and virgin female when amniotic fluid, mother's milk, and saliva were applied to the ventral fur of the virgin female. When mother's urine was applied, pups preferred mother to the virgin female. In the second experiment, mother and father were anesthetized and placed in the box. When mother's milk was applied to the father's ventral fur, there was no difference of pup's choice between mother and father. These results indicate that amniotic fluid, mother's milk, and saliva are effective to attract 2-day-old pups and that they differentiate mother from father and other individuals based on the odor of these stimuli.

## #12.

### Facilitation of the performance of honeybees (*Apis mellifera*) in long-delay matching- and nonmatching-to-sample problems.

**AKIRA SHISHIMI<sup>1</sup>, GENTARO SHISHIMI<sup>2</sup>, & PAT A. COUVILLON<sup>2</sup>**

*<sup>1</sup>Hiroshima Shudo University, Japan, <sup>2</sup>University of Hawaii at Manoa, USA*

The nervous systems of vertebrate and invertebrate species are quite different as are their evolutionary histories. Nonetheless, the performance of one invertebrate species, the honeybee, in a variety of learning experiments is remarkably similar to that of vertebrates. There has been recent interest in extending the study of honeybee learning to include the study of memory, particularly short-term or working memory. One of the classic techniques for analysis of working memory in vertebrates is delayed-matching-to-sample (DMTS) as well as its variant, delayed-nonmatching-to-sample (DNMTS). The results of an exploratory nonmatching experiment with honeybees suggested a very long short-term memory capacity under some conditions, lasting for several minutes. In both experiments reported here, free-flying honeybees were trained individually to visit a laboratory window for sucrose reward. A single color (blue or yellow) served as the sample on one visit, followed on the next visit with a choice between the two colors. The delay interval was the time between visits, averaging 4-5 min. For each experiment, there was a DMTS and DNMTS group. In Experiment 1, the sample color provided sucrose, but in Experiment 2, the sample color initially provided an aversive salt solution which was replaced with sucrose after the bee contacted the salt. For both DMTS and DNMTS groups, choice performance was poor in Experiment 1 and substantially better in Experiment 2. The partial reward procedure of Experiment 2 may increase attention to the sample color and facilitate memory during long delays.

### **#13.**

#### **Working memory of numerals in humans: a comparison with chimpanzees.**

**SANA INOUE**

*Hayashibara Biochemical Laboratories, Inc., Japan*

In previous studies about sequential learning in chimpanzees, I have found that young chimpanzees performed better than adult conspecifics and adult humans in a memory task (Inoue & Matsuzawa 2007, 2009). Young chimpanzees could memorize a set of numerals on a monitor even in very short presentation duration of 210ms, latency close to human saccadic eye movement. On the other hand, performances of adult chimpanzees and adult humans were considerably lower in the same duration condition. In the present study, I tested three different age groups of humans (5, 8, and 33 year-old) to see whether age difference have an influence on the performance in this type of memory task. Two tasks were used as in the case of the previous studies: a masking task and a limited-hold task. Both of these tasks required the subjects to remember the locations of numerals that appeared on a monitor at random positions. The subjects had free time to remember the locations in the masking task before their response, while they had limited time (650ms, 430ms, or 210ms) in the limited-hold task. In the masking task, all age group spent long time in watching numerals before starting to touch the numerals. In the limited-hold task, the performance of subjects decreased as the duration became shorter in all age groups. The overall results indicated that performances of human children were closer to those of human and chimpanzee adults than to chimpanzee youngsters.

### **#14.**

#### **The formation of a context-US association in rats' running-based taste aversion learning.**

**TAKAHISA MASAKI**

*Japan Society for the Promotion of Science, Japan, / Nagoya University, Japan*

In two experiments, rats were given a 10-min access to taste solution (3 % sucrose) in a drinking cage, followed immediately by a 60-min running opportunity in an activity wheel. These experimental rats given six taste-running trials drank less of the sucrose solution than did the control rats given no running opportunities (Experiment 1) or an unpaired treatment of the taste and running (Experiment 2), suggesting conditioned taste aversion based on the wheel running (e.g, Lett & Grant, 1996). Furthermore, the intake of tap water in the drinking cage was significantly less in the experimental group than in the control group, while there was no group difference in the intake of tap water in their homecage. This result suggests that the running-induced sucrose aversion did not generalize to tap water, but wheel running caused aversion to the conditioning context after six paired trials. In Experiment 3, the experimental rats were given a 10-min confinement to the drinking cage without the taste solution followed by 60-min wheel running. The control rats were given an unpaired treatment of the confinement and running. After six repetitions of this treatment, there was no group difference in the intake of tap water in the drinking cage. These results were discussed with regard to the context-running association.

## [POSTER SESSION #2]

#15.

The influence of occupation-related gender stereotypes  
on self-reported service satisfaction toward medical professional.

MEIN-WOEI SUEN<sup>1</sup>, YI-CHUN CHEN<sup>1</sup>, SHIN-RU CHEN<sup>2</sup>, WEI-YA WU<sup>3</sup>, & JUI-HSING WANG<sup>4</sup>

<sup>1</sup>*Chung Shan Medical University, Taiwan*, <sup>2</sup>*National Changhua University of Education, Taiwan*,

<sup>3</sup>*Chung Shan University Hospital, Taiwan*, <sup>4</sup>*China Medical University Hospital, Taiwan*

Stereotype Threat Theory indicates that performance of devalued stereotyped individuals can be negatively influenced and conform to their stereotypes (Steele & Aronson, 1995). In addition, having and using an appropriate service satisfaction survey in patients for improving hospital management is very important. This study, thus, aims to tests whether or not the activation of occupation-related gender stereotypes (i.e. doctor is suitable for males & nurse is for females) causes participants' different evaluation in service satisfaction survey about certain targets (e.g. typical targets: male doctors & female nurses; atypical targets: male nurses & female doctors). So, a 2(stereotype activation: control condition vs. experiment condition) × 2(medical professional: typical targets vs. atypical targets) between-participant design was conducted. All participants in this study were asked to read an article as a manipulation, i.e. recognizing a target's photographic, and then rate their satisfaction evaluation pretending they were serviced by above target. The DVs are satisfaction evaluation scores of targets. The results reveal (1) typical gender stereotypes toward medical professionals were successfully supported; (2) Stereotype activation indeed causes lower satisfaction ratings toward medical professionals. So, it is necessary to concern gender stereotype influence while evaluating service satisfaction. Female doctors seem can get benefits on the satisfaction evaluation, but not male nurses. More details and findings are discussed.

#16.

Muridae fear conditioning:  
A comparative study of inbred mice, rats and mongolian gerbils.

CRISTINA VARGAS-IRWIN<sup>1</sup> & J. R. ROBLES<sup>2</sup>

<sup>1</sup>*Fundacion Universitaria Konrad Lorenz, Columbia*, <sup>2</sup>*Virginia Commonwealth University, USA*

Pavlovian fear conditioning has become a standard preparation for the study of both associative learning and emotional processes. In spite of the great advances made in the description of the neural circuitry underlying this form of learning, little systematic comparative work exists on how the freezing response varies between species. What is more, the research literature in the neurosciences and in behavioral pharmacology usually treats fear conditioning in rats and mice indistinctively. In this poster we compare the acquisition, extinction and generalization of pavlovian fear conditioning in three strains of inbred mice, wistar rats and Mongolian gerbils, as measured by automatic recording of the freezing response and species-specific fear behavior such as foot-tapping in the gerbil. Species and strain differences are quantitatively modeled and their implications for the study of the fear response are discussed.

## #17.

### Musical performance of African Gray Parrot (*Psittacus erithacus*).

LUCIANA BOTTONI<sup>1</sup>, DANIELA LENTI BOERO<sup>2</sup>, LAURA HABEGGER<sup>1</sup>

<sup>1</sup>Università degli Studi Milano Bicocca, Italy, <sup>2</sup>Università della Valle d'Aosta, Italy

**Introduction.** African Greys show an outstanding plasticity in imitating heard sound. Trained captive subjects were able to repeat English and Italian vowels, and wild specimen were reported to imitate sounds from sympatric species. A further competence, relating to the functional use of musical notes from the temperate scale is reported in this study.

**Methods.** Teo, a female African grey was trained to answer with sequences of notes to some simple melodies played with an electric piano.

**Results.** We recorded 390 utterances, composed by notes lasting from 0.3 to 2.2 sec., and frequencies ranging from 656 to 3762 Hz. – higher than the ones played by the key board - by means of a digital recorder. An expert musician listened to a subsample of sequences in order to devise tonal aspects and underlying intonation structure, in addition we performed an analysis of Teo's musical scores by means of software Melodyne. This pilot exploration showed that our parrot created intonated sequences never heard from the trainer and inserted them within, after or before the known themes she was replicating after the trainer' stimuli, suggesting a cognitive ability in understanding the deep structure of the temperate scale.

## #18.

### Backward blocking associative representation measured with a recognition priming task.

JOAQUÍN MORÍS, DAVID LUQUE, PEDRO L. COBOS, & FRANCISCO J. LÓPEZ

*University of Málaga, Spain*

Backward blocking is a retrospective reevaluation learning phenomenon, in which two cues A and B are presented together with an outcome I, AB-I. In a second phase, one of the cues, A, is paired again with the same outcome, A-I. This produces a decrease in responding to the other cue, B, when it is presented alone, compared with its overshadowing control. According to associative theories this occurs because trials A-I in the second phase reduce the net associative strength of the association B-I. Recently, priming paradigms have been used to test the existence of associative representations after human contingency learning, but never using a retrospective reevaluation phenomenon. In the present study, an associative repetition priming task was used to test if a backward blocking design would produce the pattern of associative representations that associative learning theories predict. The results found support this, and pose an important challenge to non associative theories. Both sets of theories are presented and their ability to explain the results discussed.

**#19.**

Olive oil concentration and induced response biases  
independently affected sensory and decision indexes in olive oil tasting.

M. MANUELA MORENO-FERNÁNDEZ, CONCEPCIÓN PAREDES-OLAY,  
**JUAN M. ROSAS**, & MANUEL M. RAMOS-ÁLVAREZ

*University of Jaén, Jaén, Spain*

Two experiments evaluated Signal Detection Theory (SDT) as a methodological framework for psychological research on sensory analysis of olive oil. A detection task in which participants had to identify the presence or absence of olive oil within a mixture of sunflower oil and paraffin was used. In both experiments olive oil concentration was manipulated at two levels, high and low (.4% and 1.6%, and .8% and 3.2%, in Experiments 1 and 2, respectively). Manipulations of the olive oil concentration prompted changes in the SDT index for sensitivity  $A'$ . Manipulations of the proportion of samples with olive oil (Experiment 1) and of economic incentives associated with each type of performance (Experiment 2) induced response biases also captured by the SDT index for response criterion  $B'_D$ . An increase in the proportion of olive oil samples led participants to be more conservative in their performance, while a decrease in the proportion of olive oil samples led them to be more lenient. Equivalent results appeared when participants received incentives for being either conservative or lenient. In agreement with predictions of SDT theory, the two manipulations had independent effects on sensitivity and response criterion indexes. Implications for psychological research in olive oil tasting are discussed.

**#20.**

Do monkey's scream calls directly change receiver's emotional states?

**YO MORIMOTO**<sup>1,2</sup>, NOELÉ RENÓ<sup>3</sup>, KAZUO FUJITA<sup>1</sup>, & CARLOS C ALBERTS<sup>3</sup>

<sup>1</sup>*Kyoto University, Japan*, <sup>2</sup>*Japan Society for the Promotion of Science, Japan* <sup>3</sup>*São Paulo State University, Brazil*

Animal vocalizations have two functions, referential and affective. We investigated whether monkeys' vocalizations have a function to directly change emotional states of the receivers, by quantifying attentional and emotional states of them. In our previous observation study, we found affective influence of vocalization in semifree ranging capuchin monkeys (*Cebus apella*); the type of the call had a significant effect on the listeners' subsequent behavior engaged in calm behavior (resting or social behavior). That is, the monkeys showed more vigilance behavior that indicates enhanced attention and self-scratching behavior indicating enhanced stress after hearing distress scream calls than after hearing whistle calls or no calls. However, by observation itself, it is difficult to determine whether screams evoke stress in group members, or, in the other way around, enhanced stress in a group results in more conflicts and scream. In the present study, we examined which is more likely by a simple field experiment. We broadcasted scream calls or whistle calls from a speaker located in the bush. Monkeys increased duration of vigilance behavior when the scream was played back, which imply that monkeys perceived emotional nature of scream calls. However, the type of vocalization failed to affect on the frequency of self-scratch. Thus this playback experiment could not demonstrate that emotional states of the receiver was affected by conspecific vocalizations.

#21.

Effects of mating preference on maternal behavior of female mice.

KAZUYA TOMIHARA

Kagoshima University, Japan

We investigated whether mate preferences in females influenced their maternal behavior. In the present study, we conducted preference tests of female mice toward odors of non-relative male. Then the females were randomly assigned to one of four groups: mating with preferred males and rearing their own offspring (P-p group), or fostered pups that were produced by non-preferred mating (P-np group), mating with non-preferred male and rearing their own offspring (NP-np group), or fostered pups produced by preferred mating (NP-p group). The females of P-np group showed almost the same level of maternal behavior as the females of P-p group, in a maternal behavior test conducted when the pups were 2 days of age. Whereas, the females of NP-np group showed a lower number of maternal behavior than the females of NP-p group. The mean number of maternal behavior in the P-np group was higher than that in the NP-np group. Additionally, the offspring of p groups showed a higher number of ultrasonic vocalizations than the offspring of np groups during the 20 min behavioral test. These results suggested that offspring produced by preferred mating had higher adaptive ability, and that females may adjust their maternal behavior according to their estimations of reproductive success.

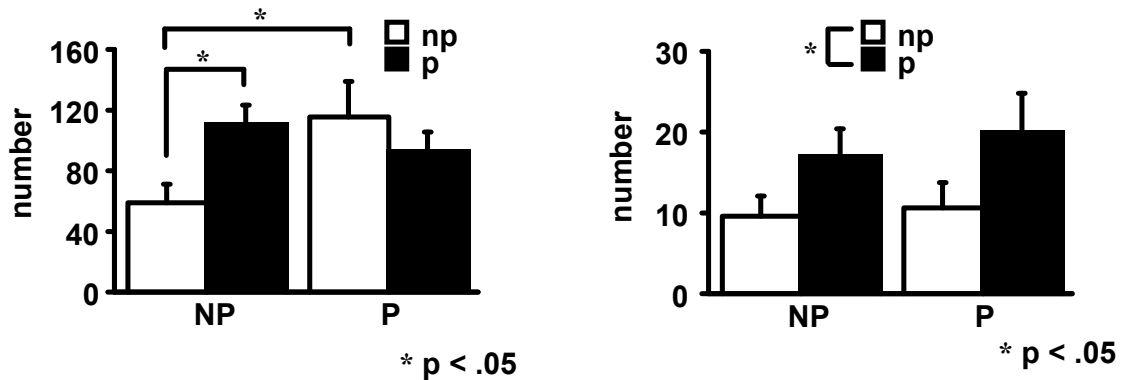


Figure 1. Mean numbers (+SEM) of maternal behavior (left) showed by mothers and ultrasonic vocalization (right) during a 20min behavioral test conducted when the pups were 2 days of age.

**#22.**

**Impaired long-term but intact short-term contextual fear memory  
in *Arc/Arg3.1*- deficient mice.**

**KAZUYUKI YAMADA<sup>1</sup>, CHIHIRO HOMMA<sup>1</sup>, TOSHIO IKEDA<sup>1</sup>, KENTARO TANEMURA<sup>2</sup>,  
SHIGEYOSHI ITOHARA<sup>1</sup>, & YOSHIKO NAGAOKA<sup>1</sup>**

*<sup>1</sup>Brain Science Institute, RIKEN, Japan, <sup>2</sup>Biological Safety Center, NIHS, Japan*

Activity-regulated cytoskeleton-associated protein (*Arc/Arg3.1*) was originally identified in seizure patients; it is densely distributed especially in the hippocampus and amygdala. Because the expression of *Arc/Arg3.1* is regulated by nerve inputs, it is thought to be one of the immediate-early genes. *Arc/Arg3.1* is reported to be involved in synaptic consolidation and regulates some forms of learning and memory in rats and mice. Therefore, we generated *Arc/Arg3.1* knockout animals to clarify the role of *Arc/Arg3.1* in short-term and long-term memory formation, retention and retrieval. As previously reported, the knockout animals exhibited impaired fear memory in both contextual and cued test situations, which were, conducted 24/48 hr after conditioning. Furthermore, in a contextual conditioning situation, *Arc/Arg3.1*-deficient mice showed almost the same performance in a test as wild-type littermates 4 hr after the conditioning trial; however, they exhibited impaired performance in the retention test after 24 hr, and got worse 1 and 4 weeks later while wild-type mice kept their performance. These behavioral data indicate that the *Arc/Arg3.1* regulates not only long-term memory formation but also the memory retention and/or retrieval processes. Although impaired long-term memory formation could be explained by LTP decrement previously reported, impaired memory retention and/or retrieval processes could not be explained by it. Therefore, we performed immuno-histochemical analyses in the hippocampus using several markers for neural and synaptic function. We will discuss the role of *Arc/Arg3.1* for the remote memory. (231 words; maximum 250 words)

**#23.**

**Predictive judgment modulates cue competition in human contingency learning:  
Evidence from overshadowing.**

**KEITARO NUMATA & TSUNEO SHIMAZAKI**

*Kwansei Gakuin University, Japan*

The experiment was conducted to investigate the relation between predictive judgment and cue competition in human contingency learning. In this experiment, participants were required to destroy invaders for increasing their score by pressing the offense button, and to avoid the invaders' attack (outcome) which decreases their score by pressing the defense button. The invaders' attack occurred after colored signals (cues) were presented. Two groups of participants were trained to discriminate between warning signals (Y and AX) and safety signals (B and CD) at conditioning phase. Following conditioning phase, whether they avoid or not for each cue (i.e., Y, A, X, B, C, and D) was measured at the test phase. At the last of the test phase, all participants were asked to rate the predictability of each cue. The experimental task of control group was consisted of conditioning, the test, and the last rating phases. On the other hand, another rating phase was inserted between two learning phases in the task of experimental group. As a result, overshadowing was clearly demonstrated on suppression ratios (the test phase) and ratings (the last rating phase) in control group. In contrast, overshadowing was not demonstrated on both indices in experimental group. These results suggest that predictive judgment modulates cue competition in human contingency learning.

**#24.**

### History of comparative psychology in Japan in terms of generation.

**MIKI TAKASUNA**

*Tokyo International University, Japan*

The history of comparative or animal psychology in Japan could be classified into four distinct generations of comparative psychologists over the past 150 years. The zero generation, spanning the second half of the 19th century, was marked by the import of Darwinian evolutionary theory, which was implemented especially through lectures by American zoologist, Edward S. Morse (1838-1925). The evolutionary theory was accepted by Japanese scholars so easily that it astonished Morse. The first generation appeared in the early 20th century, with Koreshige Masuda (1883-1933) of Tokyo Imperial University heralded as the foremost comparative psychologist during this time. Besides Masuda, Ryo Kuroda (1890-1947) studied auditory abilities of various lower vertebrates and reported these results in English. The second half of the first generation researchers appeared in the 1930s were influenced by Gestalt psychology, especially the Frankfurt/Berlin school of Gestalt psychology which had been developed in Germany. The Society for Animal Psychology was established in 1933 and renamed The Japanese Society for Animal Psychology in 1958. The second generation emerged after World War II with the arrival of neobehavioristic psychology. Originated in the U.S., it was studied by comparative psychologists such as C. L. Hull and B. F. Skinner, who considerably influenced Japan's post-war generation. The third and final generation of comparative psychologists in Japan took root in the 1980s and was characterized by studies of cognitive process.

**#25.**

### Assessment for adaptation process to outdoor semi-natural environment of laboratory rats.

**MIYUKI YASUE & TAKAMASA KOYAMA**

*Japan Women's University, Japan*

In environmental enrichment study, it is important issue what kind of environment can be rich for animals. Although indoor environment is suitable for keeping and observing animals, it is limited in several aspects. It provides animals with little opportunity to change their environment by themselves, to experience natural weather and to contact with neither other sex nor other species. On the other hand, outdoor semi-natural field could bring those environments to animals. In 2008, the authors built the semi-natural enclosure for rats outdoors, which supplied enough space (3.6mx3.6mx1.3~1.8m) for breeding and allowed rats to dig their nest under the ground. In this study we stocked the enclosure with one pair of Long-Evans rats in November 2008, and lasted observation of them and their offspring until May 2009. At the end of observation, the amount of animals increased to 36 individuals, and they used intricate maze nest of about 5.5 square meters area built underground. Though they were allowed to use dried plant put in their field, they came to select paying cost to dig the nest instead of using artificial objects. We often observed them enlarging and rebuilding the nest. It is likely to say that semi-natural field provided 'Selectability' and 'Controllability' Morimura (2000) suggested. Anyway, it is notable that the Long-Evans rat survived a freezing winter and succeeded in breeding even if we had often failed in our laboratory.

## #26.

Time flies when you are busy: An experimental study with a Japanese macaque.

**NOBUAKI OHSHIBA<sup>1</sup> & MASAYUKI NAKAMICHI<sup>2</sup>**

*<sup>1</sup>Baika Women's University, Japan, <sup>2</sup>Osaka University, Japan*

A female Japanese macaque (*Macaca fuscata*) was trained to discriminate between two different durations of sample presentation in a modified symbolic matching-to-sample task. Stimuli were presented on a 15-inch LCD monitor equipped with a touch screen, which was mounted on one of the walls of the subject's home cage. If the sample was a white circle, then she had to touch the sample (busy condition); whereas if the sample was a blue circle, then she must not touch the sample (idle condition). When the sample was presented for 2s or 8s, she should select the red or the green comparison, respectively. When the subject's choice was correct, a small piece of sweet potato was given as a reward. After the subject's performance reached a reliable level, a non-rewarded probe test was administered using intermediate sample durations between 2s and 8s. Bisectional points were calculated using sigmoid regression. The bisectional point for the busy condition was slightly later than that for the idle condition, which suggests that the subjective time passed faster when the subject was engaged. This study was approved by the Animal Research Committee of Graduate School of Human Sciences, Osaka University.

## #27.

Choice between two shared feeding stations that differed in the number of other pigeons.

**TETSUO YAMAGUCHI, MASATO ITO, & DAISUKE SAEKI**

*Osaka City University, Japan*

A novel operant box that contains two feeding stations was developed to assess the choice between two shared feeding stations that differed in the number of other pigeons. At one side of the feeding station (the constant feeding station), the pigeon always shared 4 food pellets with one other pigeon, whereas at the other side of the feeding station (the variable feeding station), the pigeon shared 4 food pellets with a variable number of pigeons, varying from 1 to 5 under four conditions. The pigeon made choices by moving between the two feeding stations. Each session consisted of 8 forced choice trials and 72 free choice trials. Each condition lasted for a minimum of 20 sessions. The results showed that as the number of pigeons at the variable feeding station increased, preference for that side of the feeding station decreased systematically and the generalized matching law was well fitted to the present data. All together, the present results extended the matching relation to shared rewards situation. Moreover, the matching relation obtained here is comparable to the matching relation obtained with reinforcement rate, amount, and delay.

#28.

## Counting of objects by rats.

**TOHRU TANIUCHI & MAKIKO KAMIJO**

*Kanazawa University, Japan*

We trained rats to respond to a “third” stimulus among six same objects arranged in a line. The objects were put in front of one of ten goal boxes and food rewards were given in a correct goal box (behind the third object). Since the assignment of objects to goal boxes was changed trial to trial (third to seventh box could be the correct goal), rats could identify the correct stimulus based on neither location of specific goal box nor distance from start point. After acquisition training with three different types of stimuli, significant transfer effect was observed to a novel object type in a probe test. Rats did not respond to olfactory cue of food reward because they could correctly respond in the probe test in which food rewards were put in goal boxes behind the second to fourth objects. As a next task, we mixed one “odd” object to five same objects and required rats to “ignore” odd one in identifying the third object. Rats could learn this task and significantly transferred to novel stimulus pair. These results ensure that rats can apply abstract number tag to discriminable object stimuli. To exclude the possibility of “subitizing”, an additional examination with “serial presentation” of stimulus is now in progress.

## [POSTER SESSION #3]

**#29.**

Abnormality in the left-right asymmetry of the brain affects spatial learning:  
behavioral studies in iv mice.

**KAZUHIRO GOTO<sup>1</sup>, RYO KURASHIMA<sup>2</sup>, HAYATO GOKAN<sup>2</sup>,  
NAOMI INOUE<sup>2</sup>, ISAO ITO<sup>3</sup>, & SHIGERU WATANABE<sup>2</sup>**

*<sup>1</sup>Kyoto University, Japan, <sup>2</sup>Keio University, Japan, <sup>3</sup>Kyushu University, Japan*

Left-right (L-R) asymmetry is a fundamental feature of higher-order neural function but how it affects learning is yet unknown. We recently reported that the inversus viscerum (iv) mouse hippocampus lacks the L-R asymmetry and that it exhibits right isomerism in the synaptic distribution of NMDA receptor  $\epsilon 2$  (NR2B) subunits. In this study, we examined how the L-R asymmetry in hippocampus affects spatial learning using a dry maze and an operant spatial delayed nonmatching to sample (SDNMTS). In the dry maze, mice were trained to search for a baited food in the open-field and thus examining the acquisition of long-term memory. In contrast, in the SDNMTS, mice were required to remember the lever position and retrieve it after some delay intervals, thus examining the retention in short term. In both tasks, iv mice performed poorer than its control, suggesting that the L-R asymmetry in hippocampal circuitry affects both the acquisition of long-term memory and retention of short-term memory.

**#30.**

Golden ratio and aesthetic based preferences in humans and rats.

**FÉLIX VICO-PRIETO, ANGEL CAGIGAS, JOSÉ E. CALLEJAS-AGUILERA,  
SAMUEL P. LEÓN, & JUAN M. ROSAS**

*University of Jaén, Spain*

The “Golden ratio” is defined as the harmonic division of a line into two segments, A and B, where  $(A+B)/A = A/B$ . This ratio is numerically established from the Phi Fibonacci sequence, although its discovery dates back to Euclid (300 BC). Three experiments are presented that evaluated form preferences in Psychology students, Fine Art students, and Wistar rats. Experiment 1 used three different variations of Mondrian’s paintings adapted to keep golden, 1/2, or 1/6 proportions among its line elements. Two versions of the same painting were presented to Psychology students on a computer screen and they had 1500 ms to choose the one they considered most beautiful. In experimental trials one of the paintings always kept the golden ratio. In control trials both paintings were the same. Psychology students showed a preference for the painting that kept the golden ratio with respect to the one that kept the 1/6 proportion. No preference was observed with respect to 1/2. Experiment 2 compared performance of Psychology and Fine Arts students, finding that Fine Arts students showed a greater preference than Psychology students for the Golden ratio painting. Experiment 3 found that rats spent more time in the aisle of an L-maze that ended with the Golden ratio figure than in the aisle that ended with the 1/6 painting, revealing a striking similarity with the preferences shown by Psychology students.

**#31.**

Capuchin monkeys do not behave prosocially to group members  
at the expense of their own reward's value in an experimental reward sharing situation.

**AYAKA TAKIMOTO<sup>1,2</sup>, KAZUO FUJITA<sup>1</sup>**

*<sup>1</sup>Kyoto University, Japan, <sup>2</sup>Japan Society for the Promotion of Science, Japan*

In our previous study, we demonstrated that capuchin monkeys (*Cebus apella*) are sensitive to others' reward and behave prosocially to group members when the operator monkey can obtain the same reward regardless of his/her own choice in a reward sharing situation (Takimoto *et al.*, in press). In the present study, we investigated whether the same monkeys would provide high-value rewards to familiar group members at a small expense of their own reward's value. Two monkeys faced each other. The operator monkey chose one of two food containers placed between the participants, each containing a food item for him/herself and another for the recipient. The recipient passively received either a high- or low-value reward depending on the operator's choice. The operator obtained the high-value reward and the recipient passively received the low-value reward when the operator made the selfish choice. On the other hand, the operator obtained a middle-value reward and the recipient received the high-value reward when the operator made the prosocial food choice. The recipients were either the highest- or lowest-ranking member of the group, and the operators were middle-ranking. As a result, the operators almost always chose the selfish food container regardless of the presence of the recipient in both recipient conditions. Our study suggests that capuchin monkeys may be able to behave prosocially to other group members only when the value of their own reward is ensured.

**#32.**

Relationship between cooperative choices in the prisoner's dilemma game  
and social discounting rates in pigeons.

**DAISUKE SAEKI, MASATO ITO, TETSUO YAMAGUCHI,  
KUMIKO HARA, & SHOKO KITANO**

*Osaka City University, Japan*

The present study, using pigeons (*Columba livia*) as subjects, examined a relationship between cooperative choices in the prisoner's dilemma game and social discounting rates. In the prisoner's dilemma game condition, six pigeons individually chose between unshared and shared feeding stations where food pellets were presented according to a payoff matrix of the prisoner's dilemma game. At the unshared feeding station, subjects received five or one food pellets, whereas at the shared feeding station, they received three or zero food pellets according to the other player's choices. The other player was either a stooge or a computer. The other player's choices were determined by the random or the tit-for-tat strategy. On the other hand, in the social discounting condition using the adjusting-amount procedure, the subjects chose between the unshared and shared feeding stations. They received adjusted number of food pellets in the unshared feeding station, whereas they received 14 food pellets in the shared feeding station where other pigeons could also eat the food pellets. The number of sharing pigeons was varied from zero to three across four conditions. As a result, there was a negative relationship between cooperative choices (choices for the shared feeding station in the prisoner's dilemma game) and the social discounting rates (estimated by the discount function). This result suggests that the social discounting rate can be an index as a tendency of social behavior (i.e., altruism) in pigeons.

#33.

### Object Displacement in the Ring-tailed Lemur.

**ROBERT L. BOUGHNER & JESSICA A. MARCHEWKA**

*Rogers State University, USA*

In object displacement tasks, animals are required to watch as an object is hidden and then moved. It requires the animal to firstly show object permanence, the ability to recognize that the object is still there despite it being out of sight, and secondly to track the object as it is displaced to a new location. Humans, chimpanzees, gorillas, orangutans, and monkeys have all demonstrated these capabilities. In the current experiment, ring-tailed lemurs were tested for object displacement. Three cups were inverted and a blueberry was placed under one of the cups. The lemurs watched as the cups were rotated 180 degrees. From the first trial, the lemurs showed object permanence; they searched under the cups for the blueberry. However, finding the correct cup proved difficult at the beginning, as the lemurs typically searched the location where they last saw the reward (spatial error). After about 60 trials, performance began improving, and by 100 trials, the lemurs were correctly choosing the baited, displaced cup. That is, object displacement emerged over trials. The pattern of errors also changed. Initially, spatial errors were common, but later training showed the animals choosing a middle cup that had never been baited. The pattern of errors will be discussed. The results demonstrate that lemurs exhibit object displacement capabilities.

#34.

### Tracking of food quantity by coyotes (*Canis Latrans*).

**KERRY E. JORDAN, JOSEPH M. BAKER, KATI RODZON, & JOHN SHIVIK**

*Utah State University, USA*

This experiment tested coyotes' quantitative discrimination abilities. In particular, we tested semi free-ranging coyotes' ability to discriminate between large and small quantities of food items and investigated whether this ability conforms to predictions of Weber's Law. Previous studies have demonstrated that the numerical discrimination abilities across various species—including the nonverbal representations of humans—are mediated by the ratio between numerical options (see Brannon and Roitman, 2003, for one review). We demonstrate herein that coyotes can reliably discriminate between large versus small quantities of food. As predicted by Weber's Law, coyotes' numerical discrimination abilities are mediated by the numerical ratio between the large and small quantities of food. This trend is indicative of an analog magnitude system of number representation. Furthermore, in this task, coyotes were not discriminating large versus small quantities based on olfactory cues alone. In the future, we plan to conduct this same study with domestic dogs, in order to compare quantitative sensitivity between these two closely related species.

**#35.**

The effects of early weaning and neonatal handling on nose-poke operant learning of rats.

**KATSUYOSHI KAWASAKI**

*Hoshi University, Japan*

In this study how the early weaning and neonatal handling affect the operant learning was investigated.

(Methods)

Subjects: Eighteen female rats (F344/Jlc) from 3 litters. Device: Operant chamber. Procedures: The pups of a litter were divided into 3 groups of early weaning (E), neonatal handling (H), and normal (N). E (n=5) and H (n=7) groups were weaned on the 17<sup>th</sup> day after birth. And neonatal handling was treated for only H group from 2<sup>nd</sup> to 7<sup>th</sup> day. N (n=6) group was weaned on the 22<sup>nd</sup> day without neonatal handling. For three days on 8<sup>th</sup> week all subjects were habituated to device and 4mg food reward. The habituation was followed by the 16 days of nose-poke trainings. The subjects were able to get a food pellet by putting the nose in a hole only during CS (tone) stage (20 sec.) following the non-CS stage (3-9 sec.).

(Results and discussions)

Fig.1 shows the percentage of the correct responses of each group. E group showed learning delay while H group showed the same performance as N in the first 4 blocks. Two-factor ANOVA (group x block) showed significant main effects of group and block, and significant interaction. This result implies that early weaning impairs learning, while neonatal handling has defensive effect against learning delays. Since the impairment of learning in E group appeared in the early stage of learning, the causes of that may lie in emotionality alteration.

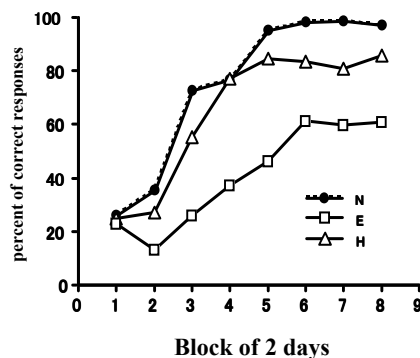


Fig.1 Percentage of the correct responses  
N: normal group, E: early weaning group, H: neonatal handling group.

**#36.**

Individual differences in wild (WWCPS) rat – manifested in the exploration box.

**WOJCIECH PISULA**

*Polish Academy of Sciences, Poland*

Thirty nine WWCPS rats were tested in the exploration box throughout fifteen sessions. Factor analysis was run to extract the main dimensions describing rat behavior. Two factors were extracted, confirming validity of two dimensional structure of individual differences in rats. Hierarchical cluster analysis run on factor scores showed, that only three out of possible four types of factor combinations are actually present within observed group of animals. In terms of individual differences structure, the study provide support for the view that laboratory rats are still rats.

#37.

Analysis of spatial organisation of behavior, physical contact,  
verbal and nonverbal activity in children with autism and their fathers.

**EWA PISULA**

*University of Warsaw, Poland*

The aim of the present study was to compare the activity of fathers and their children with autism with those of children with Down syndrome, and normally developing children during the father-child interaction.

Differences between the groups of fathers were found in terms of three variables under analysis: frequency of looking at the child, physical contact with the child and suggesting play. Children with autism brought objects to their fathers or pointed out objects and directed their fathers' attention by vocalising less frequently than children with Down syndrome and normally developing children. Moreover, children with autism exhibited the fewest vocalisations combined with looking at the father and exhibited many more behaviours involving running and moving about the room than normally developing children. Self-stimulating behaviours were the most frequent in children with autism, with no differences in that respect found between children with Down syndrome and normally developing children.

The analysis of fathers' behaviour demonstrates that fathers of children with developmental disorders focus on observing their children and attempt to keep close contact with them to a larger extent than fathers of normally developing children. The pattern of differences in the activity of fathers of children with autism and children with Down syndrome does not paint a clear picture. In general, fathers from both groups actively sought to maintain contact with their children. Differences in the activity during play between children with autism and the other subjects in the study are consistent with the clinical features of autism.

#38.

Preferred exploration behavior affects results of allothetic and idiothetic navigation  
of three rodent species in the Morris water maze.

**MICHALA ZELENKOVA<sup>1</sup> & FRANTISEK SEDLACEK<sup>1,2</sup>**

<sup>1</sup>*University of South Bohemia, Czech Republic,* <sup>2</sup>*Institute of Systems Biology and Ecology AS CR, Czech Republic*

Allothetic and idiothetic navigations are two systems, which animals can use for reaching their goals in the familiar habitats. They differ in the information sources. While the allothetic navigation system relies on the relationships between available landmarks perceived by external sense organs, the idiothetic navigation system obtains information from the vestibular system, proprioceptors and the muscle spindles. We studied exploration behavior of three wild species, *Microtus arvalis*, *Acomys dimidiatus*, *Mus musculus*, and one laboratory mouse (outbred CD-1 strain). All animals underwent classical training in the Morris water maze (MWM) in a pool surrounded with a non-transparent and non-translucent tent, so any visual landmarks were strictly restricted (idiothetic navigation). We placed three accentuated and contrast landmarks inside the tent when we were carrying out the test for allothetic navigation. We evaluated the frequencies of the repetitious swimming patterns: thigmotaxis, arch near the wall, swimming across, floating, big circles, semicircular swimming, abandoning the platform, return. Different swimming patterns were preferred for allothetic and idiothetic navigation and we also found the difference in the frequencies of some swimming patterns between our species. Moreover, when we analyzed a relation between the path length and swimming patterns, direct, return and semicircular swimming were connected with short path length, whereas thigmotaxis, big circles and arch near the wall lengthened the path length.

**#39.**

Evaluation of reliability of rat P3-like potential in the anterior cingulate cortex.

**MINORU HATTORI<sup>1</sup>, KEIICHI ONODA<sup>2</sup>, & SHOGO SAKATA<sup>1</sup>**

*<sup>1</sup>Hiroshima University, Japan, <sup>2</sup>Shimane University, Japan*

The P3 component of the event-related potentials (ERPs) is a positive going waveform that can be averaged from the EEG approximately 250-500 ms after stimulus presentation. The P3 is considered to be an endogenous component reflecting higher cognitive processing such as attention processes.

In order to understand the neural basis of P3 generation, it is important to establish appropriate animal models. Recently, The rat P3 (so called P3-like) has been studied using the oddball paradigm by several investigators. Previously study provides evidence rat P3-like in the anterior cingulate cortex reflects “attention processes”, which is also the case with the human P3 component. The aim of the present study was to develop an auditory ERP paradigm suitable for use in rats that resembled those used in humans. We analyzed test-retest reliability of rat P3-like potential during active oddball paradigms. Rat P3-like potential were recorded during each of three sessions. Cronbach's alpha was used to assess test-retest reliability across sessions. The results demonstrated that rat P3-like potential showed high reliability (Cronbach's alpha: amplitude .88, latency .75). Rat P3-like amplitude measures were more reliable than the latency. The mean inter-individual coefficient of variation of the P3-like potential was 35.0%. The data suggest that rat P3-like component reliability is comparable to that of human P3, supporting the use of rat P3-like in basic research. The rodents provide a useful model for investigation of the neural mechanism of the human P3.

**#40.**

Covariation vs. temporal order in human causal structure learning.

**MOTOYUKI SAITO & TSUNEO SHIMAZAKI**

*Kwansei Gakuin University, Japan*

The present study investigated the role of covariational data and temporal-order information in causal structure learning. In Experiment 1, participants were told to learn single cause-effect relationship. They were also informed that temporal information was unreliable and that there was no hidden cause. The experimental task consisted of learning phase and test phase; participants observed the occurrence of two events with 40 trials in learning phase and answered whether one event caused the other event for two candidate causes in test phase. Participants correctly answered the causal structure not only where covariation is consistent with temporal-order, but also where covariational information is inconsistent with temporal information. In Experiment 2, the same experimental task was used except for excluding additional information. In line with the findings in Experiment 1, participants used covariational data for inferring causal structure. These results differs from previous studies of causal structure learning in which temporal-order information override covariational data, suggesting the existence of two kinds of processes in human causal structure learning.

#### #41.

### Summation of latent inhibition and overshadowing in human predictive learning.

**TAKATOSHI NAGAISHI & SADAHIKO NAKAJIMA**

*Kwansei Gakuin University, Japan*

In Pavlovian conditioning, exposures to a to-be conditioned stimulus (CS) without any unconditioned stimulus (US) attenuate subsequent development of conditioned responding to this familiar CS (latent inhibition effect). The conditioning of a target CS is also attenuated when another stimulus is co-presented in conditioning trials (overshadowing effect). The extended comparator hypothesis for Pavlovian conditioning (Denniston, Savastano, & Miller, 2001; Stout & Miller, 2007) predict that latent inhibition and overshadowing counteract each other to offset the individual effects, as demonstrated by Blaisdell et al. (1998) with rats' conditioned suppression preparation. Contrary to this prediction, however, we have reported that these effects summate each other in conditioned taste aversion (Nagaishi & Nakajima, 2008; Nakajima, Ka, & Imada, 1999; Nakajima & Nagaishi, 2005). The present study was designed to explore the same question in another preparation, i.e., human predictive learning with a contingency judgment task (Experiment 1) and a role-playing video-game task (Experiment 2). In each experiment, repeated preexposures to a target cue (X-) lowered the rating of X in testing (latent inhibition). Presentation of another cue A with X (AX+) in training also lowered the rating of X in testing compared with X training without A (overshadowing). Furthermore, the latent inhibition and overshadowing effects summed to show the lowest rating for the target X which had been given both the target preexposures and the AX compound training. These results agree with our previous studies in rats' conditioned taste aversion, but not with Blaisdell et al.'s (1998) study in rats' conditioned suppression preparation. (250 words)

#### #42.

### Is full physical interaction necessary for the buffering effects of pair-housing on social stress in rats?

**TOMOHIRO NAKAYASU<sup>1,2</sup> & KATSUNORI KATO<sup>1</sup>**

*<sup>1</sup>University of Tsukuba, Japan, <sup>2</sup>Japan Society for the Promotion of Science, Japan*

Social defeat causes several neuroendocrinal and behavioral changes in rats, such as increases in plasma corticosterone levels and anxiety-related behavior in the elevated plus-maze. Our previous study showed that pair-housing with a familiar conspecific prevented the increase in anxiety caused by social defeat. The present study investigated what kind of social interaction between conspecifics is involved with such effects of pair-housing. In Experiment 1, the subject was separated from a pairmate by a wire mesh partition during pair-housing. This housing condition allowed visual, auditory, and olfactory contact, but limited physical interaction with the pairmate. In Experiment 2, the subject was only exposed to the bedding soiled by a familiar conspecific after social defeat. Neither pair-housing in a cage separated by a wire mesh partition nor mere exposure to soiled bedding prevented an increase in anxiety in the elevated plus-maze test. These results indicate that visual, auditory, and olfactory contact with a familiar conspecific was not sufficient to reduce the anxiogenic effects of social defeat in rats. It appears that full physical interaction is necessary for the emergence of the buffering effects of pair-housing on social stress. The social behaviors during pair-housing should be analyzed to determine the behavioral components responsible for the social buffering effects.

**#43.**

**Recovery from conditioned inhibition in rat's operant conditioning:  
using deflation and inflation.**

**AKIRA KURIHARA<sup>1</sup>, NAOYUKI HIRONAKA<sup>2</sup>, & KOSUKE SAWA<sup>1</sup>**

*<sup>1</sup>Senshu University, Japan, <sup>2</sup>Japan Science and Technology Agency, Japan*

Retrospective revaluation, where post-training episode affects on previously acquired associative knowledge, has been investigated mainly in Pavlovian conditioning settings, especially fear conditioning paradigm (e.g.,). Despite of rich implications for theoretical understanding of associative learning by those researches (e.g., Denniston, Savastano & Miller, 2001; Dickinson & Burke, 1996; Van Hamme & Wasserman, 1994), it seems to be important to extend theoretical findings into instrumental situation in terms of applied use such as behavioral therapy. In present series of experiments, we explored retrospective revaluation, especially recovery from conditioned inhibition effect through post-training episode, in rat's instrumental behavior by using food reinforcement. Following the pilot research of discriminative learning analogous to Pavlovian conditioned inhibition procedure (A+ / AX-), omission trainings to excitatory discriminative stimulus (A-) were introduced. The result of summation test trials showed no attenuation of inhibitory property, which implied that generalized effect through within-compound association. In next experiment, it is examined whether opposite trend of result would be seen in inflation procedure. After previous experiment, the same subjects experienced excitatory discriminative training trials (A+) and responding to target stimulus was assessed. In testing, subjects showed substantial excitatory instrumental responses, which is consistent with the trend of previous finding. Although further research should be conducted with modified procedure, obtained results suggested it is difficult to confirm retrospective revaluation effect in appetitive instrumental behavior.

**#44.**

**Did maternal plasma PCBs contaminations in cynomolgus monkeys affect  
mother-infant behaviour?**

**AKIKO NAKAGAMI<sup>1</sup>, KASTUYOSHI KAWASAKI<sup>2</sup>, TAKAMASA KOYAMA<sup>1</sup>**

*<sup>1</sup>Japan Women's University, Japan, <sup>2</sup>Hoshi University, Japan)*

As widely know, polychlorinated biphenyls (PCBs) function as endocrine disrupting chemicals and they disturb normal development of embryonic brains. In the present study, we evaluated the relationships between plasma contaminations of highly chlorinated PCBs and behavioral characteristics in both mother and infant. We grouped 20 pregnant cynomolgus monkeys (*Macaca fascicularis*) into higher and lower PCB-contaminated mothers; the higher contaminated group having above 15pg/g total plasma PCB concentration which represents a natural exposure level. Thirty eight behavioral categories were observed in mother-infant and peer interactions of both groups. As a result either of mothers and infant showed behavioral differences between higher and lower groups. Especially, infant in the lower group increased interactions with their mother as their locomotion increased ( $p < 0.05$ ), while infant in the higher group did not. PCB concentration correlated negatively with maternal behaviors (approach, look) at the infant age of six months ( $p < 0.05$ ). It showed that maternal behavior had relationship with PCBs level. It was different that mother pay attention to infant. These results suggest that maternal PCBs exposure affect development of an infant's social behavior and affect involvement for mother-to-child, because it may be hard for the infant of mothers with higher levels of contaminated to develop close relationships with their infant even at the stage where more interactions with other animals should normally be observed.