

21st Century COE Program

Center for Evolutionary Cognitive Sciences at The University of Tokyo

**Third International Workshop on Evolutionary Cognitive Science:
*"Social Cognition: Evolution, Development, and Mechanism"***

March 9-10, 2006

The University of Tokyo, Japan

■ Schedule

Thursday, 9 March

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Human infants' perceptual and cognitive biases reflect their readiness to learn from teaching
- 12:15 - 13:45 Lunch
- 13:45 - 14:30 ■ **Shoji Itakura (Kyoto University, Japan)**
Understanding of Nonhuman Agents by Infants and Adults
- 14:30 - 15:45 ■ **Orsolya Koós (Hungarian Academy of Sciences, Hungary)**
Contingency detection and self development: Applications to developmental psychopathology
- 15:45 - 15:55 Break
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Two Types of "Others": Temporal Aspect of Social Contingency
- 16:40 - 18:30 Coffee & Poster Session
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Perceiving intentionality: a core mentalistic primitive in primates
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Chimpanzee Attention Captured and Disengaged by Social Stimuli
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- 15:00 - 15:45 ■ **Akira Murata (Kinki University, Japan)**
Bodily self and others representation in the parietal cortex
- 15:45 - 17:00 ■ **György Gergely (Hungarian Academy of Sciences, Hungary)**
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Human infants' perceptual and cognitive biases reflect their readiness to learn from teaching

Gergely Csibra

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Young infants' social cognitive competence is usually attributed the function of allowing them to understand, and learn about, the people around them. An alternative, though not incompatible, view is that the function of these early abilities is to allow infants to learn *from* people, especially when they explicitly manifest their knowledge (i.e., when they "teach", see Csibra & Gergely, 2006). I outline a theoretical framework that specifies the cognitive requirements for such a social learning system, and report four recent studies that confirmed predictions derived from this theory. The first study demonstrates that newborns' face preference is sensitive to contrast polarity, indicating that they are biased towards finding gaze information, or more generally, towards communicative signals (Farroni et al., 2005). The second study confirmed that whenever infants follow the gaze of others, they expect to find a referent, even at 8 months age when they do not display evidence for understanding what others can see. The third study tested whether 9-month-old infants can discriminate between object-directed and non-object-directed gaze. We found that they not only discriminated between these two types of gaze, but also preferred to observe object-directed gaze when it was preceded by eye contact. The fourth study demonstrated that communicative cues shift 9-month-old infants' object processing from location-based towards feature-based representation, which is a requirement for acquiring generalizable knowledge from communicators. I argue that these biases serve social learning in environments where people tend to communicate generalizable knowledge towards infants.

References

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Farroni, T., Johnson, M. H., Menon, E. Zulian, L., Faraguna, D., & Csibra, G. (2005). Newborns' preference for face-relevant stimuli: Effects of contrast polarity. *Proceedings of the National Academy of Sciences of the United States of America*, 102, 17245-17250

Understanding of Nonhuman Agents by Infants and Adults

Shoji Itakura

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There are two main questions in the development of mentalizing. (a) When do human first attribute mental state to others? (b) When they do so, to whom or what do they attribute such mental state?

In this presentation, I will report two studies concerns to these issues. In the first study, infants were tested whether they have sensitivity to the possible movements and impossible movements of a human. In the second study, adults' gaze behavior was examined in a face-to-face situation with android.

Preference for human movement.

The participants were aged from 12 months to 18 months. They were divided into three age groups, 12-, 15-, and 18-month-olds. We used preferential looking method in this study; infants were exposed a video showing simultaneously pairs of both possible and impossible movements of human. There was a stimulus of robot version. In each video condition, infants looked at the possible movements longer than the impossible one. We interpreted these results as follows: 1) the infants preferred the movements that match with their own movement rather than novelty. 2) The shape of robots used in this study, were very similar to that of human body, so that infants might have thought that these robots move just like humans.

Thinking eyes.

Subjects sat and faced to a questioner (android or human). Subjects' eye movements were measured while they were thinking of the answers to the questions posed by the questioner. There were two types of questions: know questions and think questions. Subjects already know the answer to know questions (e.g., "How old are you?") but not to think questions because they force the subjects to derive the answer (e.g., "Please tell me a word that consists of eight letters."). The eye movements coded into eight directions by the coder. There were some differences of eye movement's directions between human questioner condition and android questioner condition. I will discuss of these results from the perspectives of android science.

First study was supported by Nissan Science Foundation and collaborated with Komori, N., Katayama, J. & Kitazaki, M. Second study was collaborated with Shimada, M., Minato, T. & Ishiguro, H.

Contingency detection and self development: Applications to developmental psychopathology

Orsolya Koós

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This talk will summarize a new theory of an innate information processing mechanism, the so-called Contingency Detection Module (CDM) (Gergely & Watson, 1999; Watson, 1994), that is specialized for the detection and representation of the degree of causal relatedness and control between human infants' responses and environmental stimulus events. First, the input conditions, the computational architecture, the motivational parameter settings and the '3-months' contingency switch' hypothesis that characterize the structure and early development of the CDM will be briefly described. Then the basic developmental functions of the CDM - such as establishing the primary representation of the bodily self, constructing primary self-other representations in terms of habitual patterns of contingent reactivity - will be summarized. The second part of the talk will describe three lines of empirical applications of the CDM theory to different domains of developmental psychopathology. First, the "faulty CDM switch" hypothesis of childhood autism as blindness to social contingencies will be presented together with some supporting preliminary empirical evidence. Second, the "flickering CDM switch" hypothesis (Koos & Gergely, 2001) and its causal relation to the early development of attachment disorganization will be presented and some supporting evidence from our new Mirror Interaction Procedure with 6-month-olds will be summarized. Finally, the social biofeedback theory of affect-mirroring (Gergely & Watson, 1996, 1999) as a contingency-based mechanism of introspective socialization of attentional orientation in the service of the development of emotional self-awareness and self-control will be presented. Some new empirical findings to test predictions of the model using a new operant learning paradigm will be discussed showing differential sensitivity to exteroceptive vs. interoceptive facial cues as a function of secure vs. insecure attachment in 12-month-olds.

Two Types of "Others": Temporal Aspect of Social Contingency

Kazuo Hiraki

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Suppose that you must find yourself in a large mirror that reflects you with many other people. It is not so difficult because you can expect visual-feedbacks based on your actions. Also, suppose you must find a long-lost friend in a very crowded place. It might be a hard work to recognize the old friend because her appearance might have changed dramatically. The only consolation is that your friend is also looking for you. You can expect her responses based on your actions.

The above two expectations should have something in common, but also have differences. In my presentation, I will report three recent studies on detection of contingency with focusing on temporal aspect of the expectations. The first study aimed to investigate young children's performance in a mirror mark test when their feedback was presented with a short temporal delay (Miyazaki and Hiraki, in press). We found that even 3-year-olds showed great difficulty to recognize the 2-sec delayed visual-feedback as a reflection of their current state. The second study used NIRS (Near-Infrared Spectroscopy) to investigate adult's parietal cortical activity during a visual-proprioceptive synchrony judgment task (Shimada, Hiraki, Oda, 2005). The result revealed that the right inferior parietal areas were strongly activated when discrepancy between the two feedbacks was detected. The third study explored neural correlates of adult-infant interaction comparing delayed interactions with live interactions. By measuring 5-month-old infant's brain electric activity (EEG), we revealed that the parietal and posterior temporal regions at both hemispheres were more active during delayed interactions than during live interactions.

Based on the results of these studies and related preceding research, I will discuss the developmental process of detecting social contingency in relation to neural basis.

References

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Perceiving intentionality: a core mentalistic primitive in primates

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The extent to which non-human primates and other animals are able to represent mental states -Theory of mind- has been one of the key, unresolved issues of comparative cognitive research in the last years. In this paper I propose that current evidence overwhelmingly suggests that non-human primates (and maybe other animals) do have a core component of Theory of mind -the ability to perceive and represent behaviour in intentional terms. Intentionality (in Brentano's sense of "aboutness") is the defining feature of mental states. Such intentional perception of others' behaviour is manifest in a variety of primate skills.

Primates (and other animals) follow other's gaze, as expressed through a variety of behaviours, ranging from eye direction to body orientation. I will review evidence suggesting that, at least some species follow gaze intentionally, i.e., they expect gaze to be directed at particular targets. Moreover, evidence suggests that the intentional perception of gaze may not be linked to particular behavioural configurations, but be an abstract, mentalistic property attributed to others.

Is intentional understanding limited to the immediate perception of attentional behaviours? I will review evidence suggesting that in some primates intentional understanding may extend to coding some epistemic states similar to "knowing" and "not knowing". For example, chimpanzees and orangutans code whether others did or did not see potential targets in the past. It is unclear if monkeys can achieve this level of mentalistic representation.

A level of theory of mind that may be beyond the reach of non-humans is the representation of false-beliefs -"wrongly knowing" something. Recent experiments with looking-time measures suggest that human babies may understand false-belief as early as 15 months of age. However, looking measures applied to a rhesus monkey have failed to uncover evidence of false-belief understanding.

Chimpanzee Attention Captured and Disengaged by Social Stimuli

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In everyday life, our attention is captured by various kinds of social stimuli such as faces. It is also very common that captured attention is readily disengaged by the other types of social stimuli such as gaze. Capture and shift of "social" attention is an important basis for social interactions in humans. Since the understanding of the other's mental state (theory of mind) may contribute to the social interactions in humans, the study of social attention in nonhuman primates would be critical for the evolution and development of theory of mind. This presentation summarizes a series of studies investigating the chimpanzee social attention in the laboratory from the comparative-cognitive-developmental perspective.

Capture of attention by social stimuli

Infant gibbon (*Hylobates agilis*) and chimpanzees (*Pan troglodytes*) look at direct-gaze face than averted-gaze face (Myowa-Yamakoshi & Tomonaga, 2001; Myowa-Yamakoshi et al., 2003), suggesting that they can discriminate gaze direction and detect direct gaze already in early infancy. We also investigated how efficient an adult chimpanzee detected direct gaze in visual search tasks. The chimpanzee showed more efficient search for direct gaze than for averted gaze (so called "stare-in-the-crowd effect"), but her performance was mainly controlled by the local features in the eye regions: she detected the face with black iris at the center of sclera. These results suggest that (human) direct eye gaze is not so strong to capture the chimpanzee's attention. However, the other experiments clearly indicated that face per se readily captured attention of chimpanzees during visual search performances. This finding is also supported by the other experiments with a young chimpanzee using cueing paradigm. As in humans, face captures the chimpanzee attention, but direct gaze does not. This contrast is also observed in the attention shift experiments.

Disengagement of Attention by Social Stimuli

Using cueing paradigm, we tested reflexive shift of attention triggered by gaze cues in the chimpanzees. Interestingly, the eye gaze alone did not trigger the chimpanzee's attention but head orientation caused attention shift *voluntarily* but not *reflexively*: attention shift caused by head orientation acted slowly and affected by the cue validity. Similar results were obtained when using human gestures such as pointing with looking at an object. Chimpanzees showed voluntary shift of attention but humans showed reflexive shift. These results may be related to the possibility of (less) importance of eye gaze in their daily life derived from their eye morphology.

Bodily self and others representation in the parietal cortex

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Recently, it is claimed that automatic simulation of the inner state in other's brain is very important neural mechanism for social interaction. The idea is on the lines of simulation theory. Mirror neurons in the ventral premotor cortex (F5) and inferior parietal cortex (PF) of the monkey are considered to be neuronal correlates of this simulation mechanism. Mirror neurons that were active during execution of action were also activated during observation of same action made by others. This means that mirror neurons are concerned to encoding other's visual action on one's own motor representation. Anatomically F5 and area PF have reciprocal connection, then the circuit designated mirror neuron system. It is considered that these neurons may imply the ability of theory of mind, communication, imitation, empathy and/or language in the human. However, these neurons were found in the macaque monkeys, in which these cognitive abilities were not well developed, therefore the function of mirror neurons in the macaque is still uncertain. Since these neurons were included in the visuo-motor control system, we should discuss the function in relation with motor control system.

Recent imaging experiments suggested that motor control system was not just for execution of movement but also involved in recognition of agency of action or ownership of one's own body parts. The hypothesis is that the system may be related to matching actual and predicted sensory feedback. We speculate mirror neurons in the parietal cortex would be also involved in monitoring own body action. Actually, we found that some neurons in the parietal cortex related to the hand manipulation task responded to the movies of own hand action. These neurons were also active during observation of other's hand action, showing properties as mirror neurons. These results suggest that matching between efference copy and sensory feedback (visual and somatosensory) may occur in the parietal cortex. This may be neural bases of self-other distinction that should be necessary in social interaction.

We also hypothesized shared representation of self and other's body in a part of the inferior parietal cortex: ventral intraparietal area (VIP). In this area, there are visual-somatosensory bimodal neurons of which receptive fields anchored on particular body parts. Recently, we found that these neurons showed visual receptive field on the corresponding other's body parts. I would like to discuss functional property of the inferior parietal cortex for the self-other distinction and matching.

Beyond imitative learning: Human 'pedagogy' as a mechanism of cultural transmission

György Gergely

Institute for Psychological Research
Hungarian Academy of Sciences, Budapest

The talk will critically examine recent theories of human cultural learning which propose that an identification-based automatic drive to *imitate* conspecifics evolved in humans as a species-specific adaptation to ensure cultural reproduction. I shall challenge both the motivational and cognitive-structural assumptions of this position by reviewing new data demonstrating the *selective interpretive nature of imitative learning of novel means and artifact functions* in 14-month-olds. These studies also highlight the crucial role that the model's *ostensive communicative cues* play in inducing the selective interpretive inferences by the learner to identify what new and relevant information is conveyed 'for' him to be selectively imitated and acquired.

Then I shall outline our new theory of human cultural learning called human 'pedagogy' (Csibra & Gergely, 2005; Gergely & Csibra, 2005). This human-specific cognitive adaptation is hypothesized to be an innate, cue-driven, dedicated communicative system of mutual design selected and specialized for the fast and efficient transmission of new and relevant cultural knowledge from knowledgeable to ignorant conspecifics. The talk will summarize the design specifications of the system of pedagogical knowledge transfer and recent empirical evidence supporting its early existence in ontogenetic development. In closing, I shall outline our just-so-story of the possible evolutionary conditions that may have led to the selection of pedagogy during hominid evolution.

Evolutionary foundation and development of social cognition

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I present a series of experiments on the development of social-cognitive abilities in chimpanzees (*Pan troglodytes*) reared from birth by their biological mothers. The recent findings suggest that humans and chimpanzees may have similar abilities in the early stages of their lives.

For example, the chimpanzee neonates in the experiment were able to imitate several human gestures such as tongue protrusion and mouth opening (Figure 1). Regarding the ability of facial recognition, the chimpanzees began to discriminate between their mothers' faces from 4 weeks of age. Moreover, by 10 weeks of age, they preferred looking at faces with their eyes open or with a directed-gaze rather than with their eyes closed or with an averted-gaze. However, in the context of scrambled faces, they did not show such preferences. These findings suggest that gaze perception may not merely be a product of an innate module that is automatically processed; instead, this ability may depend on prolonged exposure to faces and develop through face-to-face social interactions during the first few months of life. I discuss the adaptive significance of these abilities by focusing on the role of "facial expressions" in great apes in mother-infant face-to-face interactions with mutual gazing.

Finally, I present evidence of developmental continuity in sensorimotor activities in humans and chimpanzees from prenatal to postnatal stages. Using four-dimensional (4D) ultrasonography, we observed fetal bodily movements, including those of their faces and extremities. We found that human fetuses perceive how they should move their hands so as to make contact with their mouths (HMC). It is possible that human neonates use HMC to explore the intersensorimotor relations of their bodies. The prenatal use of HMCs may be responsible for the highly organized behavior and its possible functions that are observed immediately after birth.

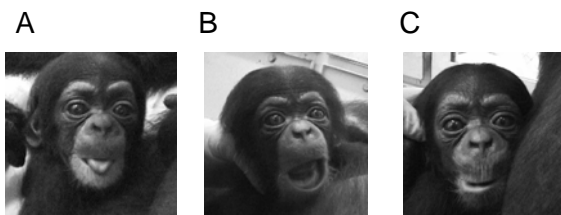


Figure 1 The imitative responses of the three demonstrated facial gestures. A, tongue protrusion; B, mouth opening; and C, lip protrusion (Pal, two weeks of age).

【Note】 The research reported here and the preparation of the manuscript were financially supported by JSPS and MEXT (nos. 09207105, 10CE2005, 12002009, 16002001, 13610086, 16203034, and 16683003), the 21st Century COE Programs (A2 and D2 to Kyoto University), the research fellowship from JSPS for Young Scientists, and JSPS core-to-core program HOPE, a Grant-in-Aid for Creative Scientific Research, and The Cooperation Research Program of the Primate Research Institute, Kyoto University.

Poster Presentation

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- P9** Masculine/feminine face preference diversity with the difference in sexual orientation and relationship context
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- P16** Highly schizotypal people are less affected by the visual motion in dynamic-ventriloquism: Is this showing the evolutionary advantage of schizotypy ?
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- P18** Interpersonal identification through interaction with dancing agent
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- P21** Electrophysiological abnormalities of spatial attention in individuals with autism during the gap overlap task
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- P22** From social conformity to canalized knowledge - A computational study of evolution of linguistic knowledge
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- P23** The promoter of gender stereotype-activation: The examination from the perspective of Terror Management Theory
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- P28** Mother-infant interaction of chimpanzees in a competitive situation
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- P30** Investigating the laterality effect on the self-relevant face and object recognition
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- P33** Factors of omission errors
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- P34** Emotional valence of messages influences facial displays
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- P35** Infants' recognition of upright and inverted faces measured by near infrared spectroscopy
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- P36** Human friendship estimation model for communication robots
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- P48** Hearing your action: seeing action modulates auditory processing
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P1

Effects of types of figures and patterns of movement on attributing mental states to moving figures

Masuo Koyasu & Asuka Tatsuwa

Graduate School of Education, Kyoto University

Aims: The present study investigated how people attribute mental states to a moving figure which is bouncing up and down on a computer screen. The figures used were a ball (a black circle), a rabbit, and a human silhouette. The moving patterns are made physically predictable, psychologically predictable, or unpredictable (random).

Method: Twenty-eight university students (14 males and 14 females; mean age was 18.7 years) participated individually in the experiment. They were given nine trials. In each of nine trials, one of three bouncing figures (a black ball, a cartoon-like rabbit, or a human silhouette) was presented on a computer screen in one of three conditions (physically predictable, psychologically predictable, and unpredictable movements), and the participant was asked to rate it on 14 items (e.g., like a living thing, have a mind, predictable, active, enjoying and so on). The stimuli were made by using Macromedia Director 8.5. Each figure was presented at the rate of 45 frames per second. Participants were asked to rate the movement on each of 14 items by a five point rating scale.

Results: A factor analysis was administered on 14 items, and three factors were extracted: animacy (4 items), regularity (2 items), and activity (4 items). Analyses of variance revealed the main effects of types of figures (on factors of animacy, regularity, and activity) and patterns of movement (on factors of regularity and activity). The rabbit figure in particular tended to elicit attribution of mental states to its movement.

Conclusion: The present experiment made it clear that attributing mental states to moving figures is composed of at least three factors, animacy, regularity, and activity. Though the movement pattern itself elicits attribution of mental states to the figure, it is also important what figure it is.

P2

Asymmetric role of knowledge in mental attribution to a moving object

Yukio Maehara & Asuka Tatsuwa

Kyoto University

As children grow, they gradually stop believing that the inanimate possesses life (Hatano & Inagaki, 1999). This is because increasing knowledge about various types of creatures facilitates the regulation of the degree to which children attribute mental properties to the inanimate (Tatsuwa, 2004). Moreover, it is known that an instruction regarding an animation could influence the manner in which observers interpret the animation (Dittrich & Lea, 1994). Therefore, "knowledge" appears to play an executive role in the attribution of animacy or mental properties to objects. In this study, we investigated the role of incidental knowledge in mental attribution to a moving object. Fifty-four university students observed a simple animation in which a black ball jumps either regularly or randomly across the

screen. The mental attribution is estimated for the jumping ball with regard to four mental properties (i.e., mind, intelligence, intention, and emotion) and four motion properties (i.e., height, speed, bounce, and prediction) with 5-point likert scales. Before beginning the experiment, 18 participants were given Instruction A: "higher animals such as rabbits and kangaroos jump regularly, on the other hand lower animals such as fleas jump randomly," another 18 participants were given Instruction B: "higher animals such as rabbits and kangaroos jump randomly, on the other hand lower animals such as fleas jump regularly," and the remaining 18 participants were given no instruction. The results demonstrated that Instruction A reduced the evaluation values of mental properties for randomly jumping balls, which were interpreted to have high animacy under the control condition. However, Instruction B did not cause any difference in the evaluation values of mental properties for all animations compared with the control condition. This suggested that knowledge about the behavior of the creatures could suppress, but not promote, the attribution of mental properties to a moving object.

P3

Can social anxiety students disengage from social threat words?

Jun Moriya & Yoshihiko Tanno

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Social anxiety is associated with selective attention to social threat stimuli in the environment. But it is not clear whether social anxiety is characterized by a shift of attention to threat-related stimuli or a failure of disengagement from them. The present study investigates whether social anxiety students can disengage from social threat words or not. The experimental design is similar to that of Fox, Russo, Bowless, & Dutton (2001), and the prime stimulus (social threat word, neutral word, or symbol) is presented in the center of the computer screen. Then target stimulus is presented the left or the right of the prime stimuli. Participants have to judge where the target stimuli appear. Results indicate that high social anxiety students, in contrast to low social anxiety students, take longer to classify peripheral target stimuli when social threat words appear for 800ms, and high social anxiety students also show slower response latencies on social threat words than neutral words or symbol. But there are no different reaction times between high social anxiety students and low social anxiety students when prime stimuli are presented for 100ms. These findings suggest that individuals with social anxiety may have difficulty disengaging their visual attention system away from social threat words, and dwell on social threat stimuli when individuals attend to stimuli for enough time.

P4

The co-occurrence of vocalization and pointing in infants

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Some previous studies have demonstrated that infants' pointing gestures have the function of provoking adults to comment (Hannan, 1992; Kishimoto et al., under revision). However, it is not clear whether the provoked comments are due to the infants' pointing or their vocalization associated with pointing. In this study, we attempted to clarify whether infants' vocalization associated with pointing gestures have effects on provoking caregivers to comment. Additionally, we attempted to understand why infants associate vocalization with pointing gestures. To achieve these, we compiled 284 120-second post-pointing and control data from 18-month-old infants (7 boys and 6 girls) during free-play time in a nursery classroom. The results revealed that the temporal distributions of the caregivers' first utterances toward the focal infants in the post-pointing sequences differed from those in the control sequences. The greatest distance in the cumulative distributions was observed within the first 5 seconds; therefore, it was indicated that the caregivers' comments provoked by the infants' pointing gestures occurred within 5 seconds after these gestures. The rate at which the caregivers made a comment within 5 seconds after the infants' pointing gestures without vocalization was not significantly different from that after the infants' pointing gestures with vocalization; however, both rates were significantly greater than that of control. This result indicates that infants' pointing gestures provoke their caregivers to comment, irrespective of whether or not vocalization is associated. Additionally, we compared the rate at which infants produced pointing gestures with vocalization around the caregivers and that when they were away from the caregivers. The result revealed that infants associated vocalization with pointing gestures more often when they were away from caregivers. This result suggests that the infants made vocalizations with pointing gestures in order to manipulate the caregivers' attentional states when joint attention was difficult to achieve.

P5 Persecutory ideation and big five of personality

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Recently, it has been reported that healthy people also have ideas similar to delusions of persecution (persecutory ideation). Studies have been conducted on personality trait related to the development of persecutory ideation. This study examined the relationship between persecutory ideation and Big Five (BF) of personality trait. A questionnaire was designed based on data from 165 university students (117 males, 48 females) to measure BF and persecutory ideation. Results of multiple regression analysis using BF as explanation variables indicated that "Neuroticism" and "Conscientiousness" of BF were positively and significantly associated with persecutory ideation. Results suggested that people with strong "Neuroticism" tend to have persecutory ideation. It was expected to clarify personality trait related to the persecutory

ideation in more detail by comparing it with depression and anxiety.

P6 Chaotic itinerancy as catalyst of intrinsic diversification of syntax

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We applied the associative dynamics of chaotic neural network to model the intrinsic diversification of syntax observed in the development of Bengalese finch. We call the established model the chaotic Elman network.

We investigated the dynamics of chaotic Elman network at the neighborhood of an invariant subspace. We characterized the chaotic wandering states of the model as the dynamics among attractor ruins, and its relation to the diversification of syntax. The chaotic wandering state was peculiar to its global orbital stability and local orbital instability.

The result is an application of the dynamics of chaotic neural network with dynamical associative memory, and the itinerant dynamics of chaotic Elman network can be interpreted as the dynamical recombination of stochastic finite-state automaton.

P7 When a toddler starts handling multiple detached objects

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Longitudinal observation of a toddler's act of collecting toy blocks into a box from 14 months to 24 months of age revealed that the toddler's posture during the act gradually gets functionally coupled to the spatial layout of surrounding objects. Also, it was found that the toddler modifies and maintains the layout of the objects so as to handle them with the toddler's preferred right hand. These results suggest that the toddler is actively exploring the environmental layout for opportunities for actions, and is flexibly organizing actions with respect to those opportunities of which the toddler is aware. Gestalt Psychologist Wolfgang Kohler (1917) long ago suggested that the association of non-functional elements cannot itself account for such flexible organization of actions. Following Kohler's line of thought, theoretical account for animal's flexible organization of actions in an everyday complex situation is further explored.

P8 Perception and neural correlates of biological motion in adults and infants: A NIRS study

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Studies on infant perception of biological motion are important to know the perceptual world of infants. Although neural correlates to biological motion in adults have been extensively studied, only limited studies (e.g. Hirai, 2005) examined the developmental process on it.

In the present study, we studied functional brain imaging of normal adults and young infants using multichannel NIRS (near-infrared spectroscopy), and compared the amount of oxygenation of temporal lobe when they watch the stimuli of biological motion (BM) and scrambled motion (SM). We tested eleven right-handed adults and infants at 7 to 17 month-old. Our results revealed that, the amount of oxy-hemoglobin in the areas of right and left Superior Temporal Sulcus (STS) significantly increased in response to BM for the adults. The infants showed significant oxy-Hb response to BM in the right STS. And we also performed the behavioral experiment for infants, by measuring looking time toward BM and SM presented with counter-balanced order. There is no significant difference between these two stimuli. They spent longer time watching the stimulus that was firstly presented, which suggests that they can discriminate these two stimuli.

These NIRS and behavioral results show that, by when infants develop to discriminate BM and SM, dynamic change in cerebral blood oxygenation like normal adults has been initiated in processing BM.

P9

Masculine/feminine face preference diversity with the difference in sexual orientation and relationship context

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Evolutionary psychologists maintain that masculine looking men should be attractive to females, because the phenotype advertises biological wellness. Though there are contradictory reports to the hypothesis, it is generally agreed that females turn to prefer more masculine-looking men in short-term mating context (little necessity for personal quality exists). In this research, we investigated whether such patterns of preference differ with sexual orientation.

Based on the Kinsey Scale, participants were divided into four groups: 134 heterosexual men (M = 21.9 yr), 194 gay men (M = 28.4 yr), 167 heterosexual women (M = 22.2 yr), and 101 lesbians (M = 28.5 yr). Participants selected the best target from five pictures of male faces differed in masculinity, in four different relationship context: attractive, preferable as a friend, preferable as a short-term sex partner, preferable as a long-term sexual partner. The latter two were answered only by gay men and heterosexual women. The survey was conducted on paper & web. Most heterosexual participants were students. Gay men and lesbians were recruited through collaborations by sexual minorities' meetings and educational institutions.

Heterosexual men and women, and lesbians tended to rate feminine male faces more attractive. Lesbians were the most extreme in the preference. On the other hand, gay men rated the super-masculine face as the most attractive. In the friend choice context, all four groups sifted their preference to gender-neutral faces, though lesbians' still remained to prefer feminine faces. In the short-term sexual partner choice context, heterosexual women tended to prefer more masculine men than other three contexts. On the other hand, super-masculine faces were popular among gay men. In the

long-term sexual partner choice context, gay men did not show the preference to masculine faces so much.

The results demonstrated the uniqueness and conditional shift of masculinity preference by gay men and lesbians.

P10

Cognitive and emotional components of implicit stereotypes: Which is the dominant component in automatic activation?

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Stereotypes include both cognitive (semantic) and emotional (evaluative) components. The aim of this study is to identify the dominant component that automatically activates stereotypes. Participants (N = 98) completed three Implicit Association Tests (IAT; Greenwald, McGhee, & Schwartz, 1998) that measured automatic stereotyping toward the young and the elderly. The pleasant-unpleasant IAT was used to measure emotional components of automatic stereotyping. The strong-weak IAT and the sturdy-gentle IAT were used to measure both emotional and cognitive components, but these two IATs were opposite in emotional directions. Both "strong" and "sturdy" are stereotypes toward the young, and both "weak" and "gentle" are stereotypes toward the elderly. However, "strong" has more positive meaning than "weak", whereas "sturdy" has relatively more negative meaning than "gentle". Results showed strong evidence of automatic stereotyping favoring the young. Participants responded faster in the young-positive (gentle) task than in the young-negative (sturdy) task, as well as in the pleasant-unpleasant IAT and in the strong-weak IAT. These results support the hypothesis that the emotional component is more dominant in the automatic activation of stereotypes.

P11

Neuroeconomics of social memory and intertemporal choice

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Social memory plays a pivotal role in social behaviors, from mating behaviors to cooperative behaviors based on reciprocal altruism. More specifically, social/person recognition memory is supposed, by behavioral-economic and game-theoretic analysis, to be required for tit-for-tat like cooperative behaviors to evolve under the N-person iterated prisoners dilemma game condition. Meanwhile, humans are known to show a social stress response during face-to-face social interactions, which might affect economic behaviors. Furthermore, it is known that there are individual differences in a social stress response, which might be reflected in individual differences in various types of economic behaviors, partially via different capacities of social memory. In the present study, we investigated the acute effects of social stress-induced free cortisol (a stress hormone) elevation on hippocampus-dependent social memory by utilizing the Trier social stress test (consisting of a public speech and a mental arithmetic task). We also examine the correlation between an economic behavior-related

personality trait (i.e., general trust scale) and social stress-induced cortisol elevations. We found that (1) social stress acutely impairs social memory during social interaction and (2) interpersonal trust reduces social stress response. Together, interpersonal trust may modulate economic behaviors via stress hormones action on social cognition-related brain regions. We will also present neuroendocrine and neuropsychopharmacological modulation of decision over time and under uncertainty.

P12

Motion induced animacy perception as optimal inference

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We often attribute the state of mind to inanimate things. This type of perception is called animacy perception. Animacy perception is thought to be a part of theory of mind module as Fodor's sense and is attracted much attention in function to social perception. Animacy perception was once said to be misleading perception because it was automatically triggered by inanimate thing. The range of parameter's change which was used in previous studies was too small compared with that of actual living things and the interaction of the parameters that effect animacy perception was not considered. We used wide-range parameters and determined animacy perception's psychometric function in this study. Then we got the function of animacy perception that might be appropriate to determine whether the stimulus was a living thing or not. This function was similar to the deference of two Gaussian. If animacy perception is optimal in the sense that perception reflects the probability that the object is alive, the function of animacy perception expresses the distribution of the difference between the motion of actual living things and that of inanimate things. The distributions of living things and inanimate ones come to be approximated by the Gaussian and the deference of the two distributions comes to approximated by the deference of two Gaussian. So it is possible that animacy perception is correspond to the probability of environment. This result suggests that animacy perception is not misleading but optimal when there is little information. Moreover, animacy perception is not response to only one parameter but inference by considered several parameters.

P13

Do human infants preplan the solution of a maze task on the LCD monitor?

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We examined how human infants 2-4 years of age perform on a computerized maze task and whether they preplan its solution before starting to solve it. After a few practice trials, these infants were given maze tasks in which they were asked to move a picture of a dog to that of a bone on a touch screen. Between these two pictures lay an L-shaped blue line that obstructed the movement of the dog, which forced the infants to make a detour to complete the task. We also presented the task in pale colors before they were allowed to solve it in half of the trials, examining

whether this preview phase facilitated their performance on the task. We found that 12 out of 19 participants completed the test trials, and that these infants chose the "direct" routes more frequently than the "indirect" routes. Their route choices suggest that these children may have planned the route they would take before or during solution of the task. However, as to the effect of the preview phase, we found no significant results showing better performance in the "with preview" than in the "without preview" condition, although there were a few individuals whose performance was better when they had chance to preview the task. We suggest that further modification to the procedure is necessary so as to make the children attend to the preview stimuli.

To assess the children's spatial ability in multiple tasks, we also exposed the same participants with another task: to retrieve a small toy hidden in one of the paper cups after they were rotated. Although we failed to find any positive correlation between the two tasks, we suggest that testing the same ability in different situations is an important way to understand the development of spatial cognition.

P14

Infants' recognition of spatial discontinuity between TV and the real world

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Recognition of the spatial discontinuity between images on television and the real world by infants was investigated.

Experiment 1: Participants were 12-month-olds. They were assigned to Real or TV conditions. The infant sat on the floor. In trials of Real condition, the infant was presented an event in which a toy car run and disappeared behind a screen. After the car disappeared, it was recorded whether the infant tried to look behind the screen searching for the car or not. Each infant experienced three trials. TV condition was identical to Real condition, except that the event was presented via TV. Only the screen was real. Mean numbers of trials in which the infants made the searches were compared between conditions. Most infants in Real condition made the search in all three trials. In contrast, no infant in TV condition tried to search.

Experiment 2: Participants were 10-month-olds (Exp.2-1) and 6-month-olds (Exp.2-2). They were assigned to Real or TV conditions. The infant sat on the mother's lap. In Real condition, the infant was presented with an impossible event after a habituation event. A toy car run and disappeared behind a screen. Then, the screen was raised and they found that nothing existed behind the screen. TV condition was identical to Real condition, except that the first parts of the events, until the car disappeared, were presented on TV. This event was possible because the car on TV could not appear in the real world. Infants' looking times were measured., 10-month-olds in Experiment 2-1 dishabituated only in Real condition, whereas 6-month-olds in Experiment 2-2 dishabituated in both conditions.

General Discussion: These results suggest that infants develop their knowledge on TV images in the later half of their first year, and become sensitive to the discontinuity between the TV and real worlds.

P15

Spatial differentially of televised image affects self-recognition in 2-year-olds

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By 18-24 months, young children recognize themselves in a mirror. When a spot of rouge is covertly placed on the children's face, they touched the rouge by referencing their mirror reflection. However, in the case of real-time video, more than 60% of 2-year-olds are failed to pass the test. In this study, to examine the underlying factors of their failure, we focused on two potential sources contributing to self-recognition.

In Experiment 1, we examined the effect of eye contact with televised self-image using a modified mark test. Participants were 24 children, aged from 24 to 29 months. The experimenter covertly placed a sticker on the children's head and presented them with their televised image. Half of them were presented with televised image, which were able to get eye-to-eye contact with themselves (eye-contact condition), whereas others' presented image were not so (without eye-contact condition). The results showed that most of the children did not reach for the sticker regardless of whether or not the self-image kept eye contact with them.

In Experiment 2, to examine the effect of spatial differentially of the self-image, same aged 12 children were newly recruited and presented with their self-image in mirror like view (ipsilateral condition). Then, we compared this ipsilateral group with the eye-contact group in Experiment 1. Because the image of eye-contact group in Experiment 1 reflected in reverse mirror view (contralateral condition). The results showed that 67% of the children in the ipsilateral group reached for the sticker whereas only 8% in the contralateral group did so. The Fisher's exact test revealed a significant difference between these conditions ($p < .05$).

These results revealed that the ipsilateral relationship between the televised self-image and selves was a critical factor for 2-year-olds in recognizing a self-image as a reflection of current state of self.

P16

Highly schizotypal people are less affected by the visual motion in dynamic-ventriloquism: Is this showing the evolutionary advantage of schizotypy ?

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Introduction: The present study examined the relationship between schizotypy and the audio-visual integration. Schizotypy may be an indicator of the predisposition to schizophrenia. The disconnection hypothesis explains that schizophrenia can be understood as a failure of proper functional integration in the brain. If schizotypy is the predisposition to schizophrenia, there is a possibility that people who have schizotypal traits have also deficits in integrating information between different functions. Dynamic-ventriloquism is a multi-modal task, which can reveal the integration of the information between different modalities. When the visual and the auditory dynamic stimuli are presented simultaneously, we may perceive that

the auditory stimuli moved with the visual stimuli all together even though their trajectories are different. This visual capturing of auditory perception is the result of the integration of visual and auditory modalities.

Method: Two hundred and twenty-four students were rated with Schizotypy Traits Questionnaire. Ten of each two group (the high and low schizotypy groups (the top and bottom 25%)) participated in the experiment. They were presented the dynamic audio-visual stimuli and asked the moving direction of the auditory stimuli with ignoring the visual stimuli. Visual stimuli (small white disk) moved on the screen horizontally (in a direction from left to right, or from right to left) or didn't move at the center. Auditory stimuli (white noise) moved also horizontally on the headphone.

Results and Discussion: In the same direction conditions and the opposite direction conditions, the performance of the high schizotypy group was more close to that in the control conditions than the low schizotypy group. This indicated that the high schizotypy group was less affected by the visual information. The present study suggested that people who have schizotypal traits have deficits in integrating information. Their unaffected perception may have an evolutionary advantage in the course of living.

P17

How many speakers and messages can we perceive at the same time?

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We can easily select and attend to one speaker and message and filter out other speakers and messages competing for our attention (see The Cocktail Party Effect). However, it is not yet clear how many simultaneous speakers we can distinguish and how many distinct messages we can process at the same time. To examine these questions we conducted two experiments. In Experiment 1, on each trial, thirty participants were presented with 2 to 5 words spoken simultaneously by different speakers and originating from different spatial locations. Participants' task was to report how many distinct words they could hear on each trial. The results showed that the mean number of reported words increased from 2 to 3.5 as the number of presented words increased from 2 to 5. In Experiment 2 employed the same method as Experiment 1 but participants were asked to report as many words as they could hear. In contrast to Experiment 1, participants reported only 1.6 words on the average regardless of the number of presented words. We discuss implications of our findings on theories of auditory attention span.

P18

Interpersonal identification through interaction with dancing agent

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This study explores the emergence of communicative relationship among two persons in different place where can not even share the environment and the context. In order to observe process of the emergence, we conducted a practical experiment that two wired electric drums were located

different place and the subjects beat them. According to result of the experiment, the subjects who mutually referred the percussive sounds of other reciprocally perceived existence of opposite person when they imitated their percussive acts each other. This result suggests that imitation of other's acts strongly facilitate to perceive the existence of other through the mutual reference of the both acts.

P19

Structural characteristics of hearing-impaired children's Japanese reading ability

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It has been pointed out in previous works that hearing-impaired children's Japanese language learning involves numerous problems. In this study, for the purpose of obtaining basic knowledge for Japanese teaching to hearing-impaired children, we focused on Japanese reading ability of those children and investigated its characteristics. We implemented Kyoken-style national standardized diagnostic reading test ("Kyoken-shiki zenkoku hyojun dokusho-ryoku shindan kensa sho-gakko chugakunen yo", Tosyobunka) covering 90 hearing-impaired children from the fifth grade through ninth grade. The score profiles of subordinate tests such as "reading ability in Chinese characters (Kanji)," "vocabulary," "grammatical competence," and "reading ability/appreciation" that constitute the test implied that hearing-impaired children tended to score high on "reading ability in Kanji" whereas low on "vocabulary" and "grammatical competence." Therefore, special education on "vocabulary" and "grammatical competence" was considered to be required. Furthermore, the percentages of questions answered correctly were compared with those of hearing children (84 fourth grade children). The result showed that even for the questions on "vocabulary" which hearing children scored high, hearing-impaired children did not necessarily mark high scores. In other words, it suggested this particular type of response was unique characteristics of hearing-impaired children. This result indicates that there exist vocabularies that are affected by information inputs from hearing in their acquisition process. In order for better Japanese-language education for hearing-impaired children, these vocabularies are required to be classified quantitatively for the future.

P20

How we understand other's emotion?: Emotional expression and inference style in the United States and Japan

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A recent analysis of the media coverage of the Olympics found that when explaining a winning or losing performance, the Japanese media were more likely than the American media to invoke the emotional states of the athletes (Markus, Uchida, Omoregie, Townsend & Kitayama, 2006). In reconciling these different accounts of Japanese emotionality, we suggest that in East Asian contexts,

emotions are not primarily private, internal or subjective events as they are typically understood to be in North American contexts. As a consequence, in Japanese contexts, emotional experiences are likely to occur, to be expressed, and to be inferred when appropriate and relevant others are salient. In three studies, we focused on the Olympics as a prototypical emotional situation. Study 1 was collecting the typical reaction of athlete who just won or lost the Olympic. American athletes typically expressed his or her emotion directly, saying such as "I feel pride" or "I am disappointed" than Japanese. Japanese were more likely to refer to others (e.g., says thanks to others) than Americans, especially when they won a race. In Study 2, units of conversations (question of interviewer and answer of interviewee) in the TV interview of Olympic athletes were analyzed. In Japan, interviewer's question about the others in interpersonal relationships and athlete's answer about their emotion were positively correlated each other. This correlation was negative in the Unites States, showing that the information of others inhibited the expression of emotion. Study 3 confirmed that corresponding type of cultural difference in emotional inference: when we showed the information of an athlete and asked about his emotional state directly, American described more emotional words than Japanese. If they were asked to describe his relationships with others, then Japanese inferred more emotional words than Americans.

P21

Electrophysiological abnormalities of spatial attention in individuals with autism during the gap overlap task

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Neuropsychological investigations have suggested impairments of attentional disengagement in individuals with autism, which may be responsible for their inflexibility, repetitive behavior and overselectivity. However, the neurophysiological basis of these impairments is poorly understood. We evaluated neurophysiological abnormalities using event related potentials (ERPs) elicited by attentional disengagement in individuals with autism. To clarify whether the physiological abnormalities of visuospatial attention were specific to autism, we compared the data on adults with autism with those on IQ-matched adults with mental retardation. Sixteen adults with autism, 17 adults with mental retardation whose chronological age and IQ were matched to the autism group and 14 age-matched healthy adults participated in this study. We recorded saccadic reaction times (SRTs) to a peripheral stimulus presented subsequent to a stimulus in the central visual field and analyzed the pre-saccade positive ERP components during the gap/overlap task. Under the gap condition, the central stimulus disappeared 200 msec before the peripheral stimulus was presented; under the overlap condition, the central stimulus remained during the presentation of the peripheral stimulus. For the overlap condition participants

need to disengage their attention in order to execute the saccade to the peripheral stimulus. SRTs in the autism group were significantly longer than those in the normal group under the overlap condition, but not under the gap condition. The autism group elicited significantly higher pre-saccadic positivity during a period of 100 to 70 msec prior to the saccade onset than both the mentally retarded and the normal control groups only under the overlap condition. The higher amplitude of pre-saccadic positivity in the overlap condition was significantly correlated with more severe clinical symptoms within the autism group. These results demonstrate that adults with autism have deficits in attentional disengagement and that the physiological substrates underlying the attentional deficits in autism and mental retardation are different.

P22

From Social Conformity to Canalized Knowledge - A computational study of evolution of linguistic knowledge

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It has been argued that developmental process of linguistic ability is non-trivially canalized (i.e., the possible search space in the developmental process is biased to a certain extent). For example, through his entire research life, Chomsky (2002) has claimed that humans share the same seed of linguistic knowledge in their genes, hence every child can develop her language with allegedly insufficient inputs. However, from an evolutionary perspective, it remains a mystery that how such canalized knowledge was induced. According to Chomsky linguistic knowledge was independently created from communicative acts; it was somehow “popped-up” sometime in the evolutionary history of human being. However, as Waddington (1975) succinctly discussed in his essay, it is more natural to assume that such canalized knowledge was gradually built from social conformity created through spontaneous communicative acts. In other words, linguistic knowledge is a set of norms of communication which are a reflection of linguistic conformity spontaneously created through a tremendous amount of communications.

For this view to be feasible, apparently it requires a mechanism that supports somewhat Lamarckian flow of information; communicative conformity created in a population is somehow reflected in canalized knowledge in later generations. In this presentation, we show that the theory of Niche Construction (Laland et al., 2001, Odling-Smee et al., 2003) can be used for this purpose, and examined with computer models. In particular, we will present the following three important aspects derived from this type of evolution. First, “learning” is the key process of this type of evolution. Secondly, the canalization process can take place in a cyclic manner so that more and more communicative conventions can be reflected in canalized knowledge. Finally, if learning is somehow biased, such a tendency can be faithfully reflected in the canalized knowledge through the social conformity.

P23

The promoter of gender stereotype-activation: The examination from the perspective of Terror Management Theory

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This experiment was conducted to identify the factor responsible for stereotype-activation. We examined that the negative feeling caused by mortality leads to more endorsement for sex roles in implicit response level.

Stereotypes are the overgeneralized knowledge about characteristics ascribed to a group of people based on qualities such as race, ethnicity or gender. Stereotypes allow individuals to categorize others quickly and effortlessly. The problem with stereotypes is that they lead to automatic activation of prejudiced thoughts and behaviors toward people out of awareness. The automatic stereotypical response is called stereotype-activation. Terror Management Theory (Greenberg, et al., 1986) insists that a very deeply rooted fear of death unique to our species motivates a great deal of human behavior including prejudice. This theory proposes that the mortality salience rouses our fear of death explicitly or implicitly, and heightens the tendency to support cultural values as a symbol of immortality. Since stereotypes are considered to represent cultural values, the mortality salience would increase the responses consistent with stereotypes. While this prediction has been examined in explicit response level (e.g. oral reports), empirical examinations in implicit response level are scarce. In this study, the degrees of activation of stereotypes of traditional sex roles (e.g. housekeeping is the job for woman) were measured with Implicit Association Test (IAT; Greenwald et al., 1998). Participants were 48 male undergraduate and graduate students. The results showed that participants who answered the questionnaire implying the mortality had larger IAT effect than control group who answered the questionnaire unrelated to the mortality. These results indicated that the negative feeling caused the mortality salience led to the activation of traditional gender stereotype. Theoretical value of Terror Management Theory for studies on stereotype-activation and the influence of negative feeling on stereotype-activation were discussed.

P24

Are there emotion-specific impairments of facial expression recognition?: in the case of Parkinson's disease

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Background: Neuropsychological research has indicated that focal brain damage can cause a disproportionate impairment in recognizing facial expressions of a certain emotion (Calder et al., 2001, *Nat Rev Neurosci*). In patients with Parkinson's disease, it is suggested that the recognition of facial expressions of disgust and fear may be disproportionately impaired (Kan et al., 2002, *Cortex*).

However, previous reports on emotion-specific impairments have been suspected of being confounded with differing levels of difficulty in recognizing different emotions. In this study, using a refined assessment method in which the difficulty factors were controlled by means of mixed facial expressions and item response theory (Suzuki et al., in press, Cognition), we attempted to clarify whether Parkinson's disease disproportionately impaired the recognition of specific emotions. *Methods:* We studied 14 patients with Parkinson's disease and 39 healthy controls who were matched in terms of gender, age, years of education and intelligence quotient. The participants' performance on facial expression recognition was quantified by both our refined method and a conventional method. *Results:* Whereas our refined method revealed that the patients with Parkinson's disease displayed significantly lower scores in disgust recognition alone, the conventional method failed to detect this impairment. In addition, control measures including face recognition abilities did not statistically explain the impairment observed in the patients. *Discussion:* The results indicate that Parkinson's disease can indeed selectively impair the recognition of facial expressions of disgust; this provides concrete evidence for emotion-specific impairments that sufficiently withstands criticisms regarding the difficulty artifacts. Furthermore, the results are consistent with the proposed role of the basal ganglia-insula system in disgust recognition.

P25

Perceived relationship with family moderates genetic and environmental influences on negative affect

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The present research examined whether perceived relationship with family moderates genetic and environmental influence on negative affect. Data from a nationwide sample of 562 twin pairs from the MacArthur Foundation National Survey of Midlife Development in the United States were analyzed. Conventional univariate analyses revealed that additive genetic and nonshared environmental factors explained the variability of negative affect. However, analyses of gene-environment interaction revealed that perceived relationship with family moderated the strength of genetic and environmental influences on negative affect: for those who perceived his/her relationship with family as more strained, both genetic and environmental influences on negative affect were greater, resulting in larger phenotypic variances on the measure. These results suggest that risk and protective factors of negative affect, whether they are genetic or environmental, exert their influence more strongly for those who perceived his/her relationship with family as more strained. Implications for molecular genetic research on psychopathology were discussed.

P26

Peer preference in infants based on facial information

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Infants prefer to look at peers to those who are in different developmental stages. We have demonstrated that 6- and 9-month-old infants prefer the same-month-old pictures as themselves, respectively, to younger/older infants' pictures by 3 months in age. The present studies examined infants' peer preference, using facial information.

In Experiment 1, the average faces of infants, children, and adults were presented to 6- and 9-month-old infants one at a time. The looking times and the relative frequency of banging arms were measured. As a result, 6-month-old infants did not show the difference of looking times ($F(2, 28)=0.58$, *NS*), but banged their arms more frequently to infant faces ($F(2,28)=4.54$, $p=.02$). Nine-month-old infants showed more responses both in looking time ($F(2,26)=10.12$, $p<.001$) and banging arms ($F(2,26)=5.41$, $p<.001$) to infant faces.

In Experiment 2, the average faces at 6-, 9-, and 12 months of age were presented to 6- and 9-month-old infants. Nine-month-old infants showed longer looking time and more banging responses ($F(2,32)=2.87$, $p=.07$; $F(2,32)=4.52$, $p=.02$, respectively), while the 6-month-old infants did not ($F(2,36)=1.03$, *NS*; $F(2,36)=1.96$, *NS*, respectively). Nine-month-old infants showed more responses both in looking time and banging arms to 9-month-old faces than to 6- and 12-month-old faces.

These results suggested that infants' ability to detect same-aged peers even when only facial information was demonstrated. The similarity in face might be one critical cue to afford peer detection. However, 6-month-old preference for same-aged peers might be observed on the basis of some constraints; no preference of 6-month-old infants in Experiment 2 might be related to their ability of face processing.

P27

Does altruistic coin-insertion persist alternately?: Experimental study with mother-infant pairs and adult-adult pairs of chimpanzees

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Humans show reciprocity, in which they alternately do altruistic behavior; paying some cost to give some benefit to the other. Is this unique to humans? Are there any differences between developmental stages? In order to answer these questions, we developed a new task using tokens, and investigated whether altruistic behavior persists alternately between two chimpanzees (*Pan troglodytes*). The subjects were a mother-infant pair and two adult-adult pairs of chimpanzees, living together in a community of 14 individuals. We used two adjacent booths separated by transparent panels. In each booth we set a vending machine delivering food rewards to the adjacent booth. After being introduced separately into each booth, one of the two chimpanzees received a coin from the experimenter. In the next trial, a coin was given to the other chimpanzee. We alternated the trials, and supplied up to forty coins in a session. In the mother-infant pair, from the first to 26th

session, the altruistic coin-insertion didn't persist alternately within the session. In these sessions, the infant stopped the coin-insertion first, and then the mother stopped it. In contrast to the mother-infant pair, the two adult-adult pairs continued the altruistic coin-insertion from the first session. The adults sometimes failed to insert a few coins in a session, or took longer to insert a coin in comparison to a control condition where the subjects were tested alone and the amount of labor, reward and latency was controlled. These results showed a difference between the mother-infant pair and the adult-adult pairs in altruistic coin-insertion. Adult chimpanzees continued coin-insertion alternately, although it was influenced by the existence of the other in the next booth. But the infant did not. This difference suggests that developmental or leaning factors have an influence on such a social behavior.

P28

Mother-infant interaction of chimpanzees in a competitive situation

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In the present study, three pairs of mother and infant chimpanzees competed with each other for coins to get food. Three mother chimpanzees were always accompanied with their own infant to participate in the study. The infant chimpanzees were from 43 months to 47 months old at the beginning of the study. All of the infants have been brought up by their own mother and they had not been weaned yet. Each pair of mother and infant was tested in playroom, in which one or two vending machines were installed on the wall. Forty coins were scattered on the floor. The subject got a piece of apple by inserting a coin and pressing a button on the vending machine. A session continued until all coins were consumed by chimpanzees. Three video cameras filmed all interaction between the mother and the infant. The two-vending-machines condition and the one-vending-machine condition were changed every five sessions. Total of 100 sessions were recorded. During this study, typical patterns of mother-infant interaction were changing. In early sessions, the mothers and the infants independently picked up coins without interaction when two vending machines were available. On the contrary, the mothers mainly occupied the vending machine and the infants tended to abandon coins in the one-vending-machine condition. After 40-50 sessions, the mothers picked less number of coins than before, and the infants got more coins than mothers even in one vending machine conditions. From these sessions, two infants (Ayumu and Pal) were sometimes given coins by their mothers. Occurrence of coin delivery increased to 20 (Ayumu), or 16 (Pal). The infants often made a pout face and vocalized weakly (i.e., whimper) when they got coins from their mothers. The results suggest that the infants could control mothers' behavior to increase their gain.

P29

Children's understanding of intention: How children monitor their own intention and actions?

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This study aimed to investigate (a) children's ability to recognize intention, as distinct from outcome, and (b) the relationship between this ability and the ability to monitor a series of actions in the process leading to the intended outcome. Children at 3 to 7 years of ages were tested if they were able to recall, after completing the picture puzzle of X, that they intended to produce Z (based on negotiation). The child and the experimenter placed the pieces of the puzzle alternatively until completing a puzzle. After the puzzle was completed, the two kinds of memory tests were carried out: a prior intention test and an action (source) monitoring test. In the prior intention test, the child was asked what animal s/he meant to make. In the action (source) monitoring test, s/he was shown a stack of pieces and asked whether each piece was used to make the puzzle. If the child responded yes, then was asked who put this piece on the board. As a result, the analysis of this study showed that (1) even for children at the age of 6, it's quite difficult to recognize their own prior intention, and that (2) the ability to monitor their own intention was related to the ability to select relevant actions (from among many actions in the process leading to the outcome) with respect to prior intention, which might enable them to perform complex activities.

P30

Investigating the laterality effect on the self-relevant face and object recognition

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Previous psychological studies have shown the right hemisphere dominance in self-relevant recognition in self-relevant face recognition. In order to examine it further, we have been carrying a psychophysiological experiment. In the experiment, stimuli were self-relevant, familiar, and unfamiliar faces and objects presented in either right visual field (RVF), left visual field (LVF), or bilateral visual fields (BVF). The task was to press keys to judge the self-relevance / familiarity of the stimulus. During the experiments, electroencephalogram (EEG) was recorded. We have collected only five data yet, but the result of behavior performance showed that the self-relevant stimuli presented in LVF showed faster reaction times (RTs) than RVF, supporting the previous studies. Notably, our data showed that this LVF advantage, i.e. right hemisphere dominance involved in self-relevant recognition, was not confirmed in object recognition. This seems to indicate the essential difference in self-relevant recognition between face and objects. Further, relatively longer RTs for stimuli in RVF was associated to the lower P3 amplitude at fronto-central electrodes. The result of further analysis on both behavior data and EEG data will be presented.

P31

Food-related interactions between human infants and their mothers: A preliminary report of a longitudinal comparative study

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Meal time seems to be a valid situation to investigate the development of social interactions that presumably reflects the development of social cognitive ability in human infants. Human infants tend to have social interactions over foods repeatedly in their everyday life. From an evolutionary perspective, we can assume that food-related interactions between infants and their mothers are enhanced for facilitating the infants' food learning. In humans, indeed, it has been stated that several kinds of food-related interactions strongly influence the infants' learning of food. When roughly compared with chimpanzees, some qualitative differences seem to exist in food-related interactions between the two species.

To explore the development of food-related interactions between infant and mother in humans and to compare it directly with that in chimpanzees, we conducted a longitudinal observation based on a procedure almost identical with that of a study in chimpanzees (Ueno & Matsuzawa, 2004). The participants were 16 infants (5~10 months old) and their mothers. All the participants were Japanese. Each infant-mother pair was tested separately once a month. In a single test session, one of stimuli (food or non-food, e.g., banana) was presented to a mother and the following interactions between the mother and her infant were observed. The mother was instructed not to interact with her infant during the initial 1 min of the observation and subsequently, she was allowed to interact freely with her infant. After the test sessions, we asked the mother about her infant's daily meals and degree of weaning, using a questionnaire.

As a preliminary report, we present the infants' responses toward the mother's behaviors and the food/non-food stimuli. The infants inspected their mothers and the stimuli, extended their arms toward the stimuli, and vocalized in various ways. We will show the developmental course of such behaviors and compare the results with those in chimpanzees.

P32

Attention to other people's face in children with autism

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It has been clinically observed that individuals with autism exhibit an abnormal looking behavior toward others. In fact, some studies revealed that children with autism had lower frequencies of looking at other people's face. By contrast, others have reported their normal frequencies of looking at other people's face. To investigate their attention toward other people's face, we used a change blindness paradigm. Participants were 16 children with autism (mean 12.7 years; range 9-15 years) and 16 typically developing children (mean 11.7 years; range 8-15 years) matched on non-verbal IQ (Raven's Colored Progressive Matrices). Single change was made to either of central faces, central objects or marginal objects in photos. As a result, first, children with autism took more reaction time and made more errors than typically developing children for detection of the face change. But for detection of the object change

both groups behaved similarly. Second, while typically developing children detected the face change faster than the central object change, children with autism did not. These results suggest that children with autism had an atypical attention toward other people's face.

P33

Factors of omission errors

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In a previous study, we revealed both enacting repeatedly in the learning phase and counting numeral as a dual task in the performing phase was needed for omission error to occur. In this study, we investigated how performing a dual-task influences output monitoring, that is, whether dual-task in performing phase increases omission error. We used experimental paradigm consisting of 3 phases, learning phase, performing phase, and monitoring phase. We had participants not enact but imagine in performing phase. The results was that proportion of response to "Performed" in enacting 3 times in learning phase and performing the act they remembered with dual task condition was higher than any other condition. It was revealed that dual task in performing phase weaken the strength of memory in performing phase, and participants rely on their beliefs that they must have performed what they enacted three times in learning phase.

P34

Emotional valence of messages influences facial displays

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Gaze and facial expressions of emotion provide various types of information in social interaction. However, we do not fully understand how these facial displays changes depending on the verbal expressions of emotional episodes during speaker-listener interaction. The present study investigated whether the emotional valence of verbally-described emotional episodes would influence the gaze direction and facial expressions of speakers, and whether there could exist a pattern of interaction between gaze and facial expression. The thirty-nine undergraduate students told the three emotional episodes (joy, angry, and sad) and the non-emotional control episode to the listener. Their facial displays were videotaped via the prompter. The amount of gaze directed toward the listener increased when describing the episode of joy compared with the control condition. When describing the episode of anger or sadness, the gaze toward the listener didn't differ from the control condition. Although the cheek raiser movements (AU6), which imply positive emotion, were equally frequently observed in all the emotional episodes, they tended to be intensified during the joy episode. Additionally, the intense cheek raiser movements were more likely to co-occur with directed gaze when joy episode was talked, than other three episodes. The inner brow raiser and brow lower movement, which imply negative emotion, (AU1, 4) were rarely observed, and they were likely to be accompanied with averted gaze or closed eyes. These results suggested that

when a speaker conveys some messages to a listener, the emotional valence of messages would influence facial displays of the speaker, and the production of facial expressions might be linked to gazing behavior.

P35

Infants' recognition of upright and inverted faces measured by near infrared spectroscopy

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Recently, Csibra et al. (2004) demonstrated that near infrared spectroscopy (NIRS) can detect differences in stimulus processing induced by such a complex visual stimulus as faces. In the present study, we further examined infants' face recognition by showing infants upright and inverted faces. Behavioral studies have demonstrated inversion effect in infants face recognition at around 4- to 5-months of age (Turati, et al. 2004; Bhatt, et al., 2005). Thus, we hypothesized that differential brain response would be found for upright and inverted faces. As several previous studies indicated that there are some interhemispheric asymmetry in infant face recognition (de Schonen & Mathivet, 1990; de Haan & Nelson, 1999), we compared the brain responses from left and right lateral areas.

By using NIRS, we measured changes in cerebral oxygenation in 5-8-month-olds' left and right lateral areas while they were looking at upright and inverted faces. For each measurement area, we obtained concentration changes in oxygenated hemoglobin (HbO₂), deoxygenated hemoglobin (HHb), and their sum (HbT) from 12-channels. In each trial, 5 faces were shown in a random order at a rate of 1 Hz. The faces were shown upright in the half of the trials, and they were inverted in the rest half of the trials. The upright and inverted face stimuli were presented on alternating trials. The duration of the trials was fixed for 5 sec. During the inter-trial intervals, 5 objects were shown in a random order. The inter-trial interval was controlled by the experimenter and its duration was at least 10 seconds.

We found that (1) the concentration of HbO₂ and HbT increased significantly in the right lateral area during the upright face condition, and that (2) the concentration of HbO₂ and HbT in the right lateral area differed significantly between the upright and inverted conditions.

P36

Human friendship estimation model for communication robots

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This paper reports about the analysis of inter-human interaction in the presence of a humanoid robot, as well as the model for communication robot to estimate friendships among humans around. Recognition of inter-human

relationship is an important function for social robot, though to achieve this it is necessary to observe non-verbal interaction among human. We applied the observation method, which is a common psychological method for analyzing qualitative data, to analyze the interaction among children and robot in a field trial held in an elementary school, and reveal what interactive behavior is essential for robots to estimate inter-human relationships. Furthermore we established a model to estimate friendships among children from their non-verbal interaction with each other; e.g. touching, distance, and gaze, and found a gender difference in their non-verbal interactions. By separating the model for each gender, we achieved to discriminate friendly and non friendly relationship among children with 74.5% accuracy for male, and 83.8% for female.

This research was supported by the Ministry of Internal Affairs and Communication of Japan.

P37

The relationship between performance of biological motion detection and autism-spectrum quotient score

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Recent behavioral study has shown that the children with autism have difficulty in detecting global motion pattern such as biological motion (BM) (Blake et al., 2003). However, whether the phenomenon is also true of normal adults with high Autism-Spectrum Quotient (AQ) score is not clear. The aim of this study is to clarify how the AQ score affects the global processing of motion perception. To investigate this point, we used visual search paradigm for detecting the target of BM and scrambled motion (SM). The target could be either a rightward gait or leftward gait while the distractors had the opposite gait. In the SM, each point had the same velocity vector as in BM, but the initial starting points were randomized. Before experiment, we hypothesized that if the AQ score is high, the performance of local processing is superior to the global processing, then the performance of BM detection would be reduced. To verify this hypothesis, we analyzed the experimental data based on AQ score. In the experiment, participants were presented 2- or 4- items of BM or SM, and participants were required to report whether the target is exist or not as fast as possible. Contrary to our hypothesis, the result showed that no significant differences were observed between high-AQ group and low-AQ group. For all averaged data, in both BM and SM stimuli, the reaction time in 4-item condition was significantly longer than in 2-item condition and the error rate in 2-item condition was significantly lower than in 4-item condition. We also found that the error rate in the BM condition in 2- and 4-item condition was significantly lower than the SM condition. The reaction time in the BM condition is significantly shorter than in the SM condition for 2- and 4- item condition. These results are consistent with recent behavioral study (Cavanagh et al., 2001) and imply that participants with high-AQ score would process the BM as a global motion pattern.

P38

The perception of motion trajectory of objects from moving cast shadows in human (*Homo sapiens*) and Japanese macaque (*Maccaca fuscata*) infants

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A cast shadow is referred to as pictorial depth cues that provide three-dimensional information from two-dimensional pictures. Previous studies showed that pictorial depth cues develop from 5 to 7 months in human infants (e.g. Granrud et al., 1985) and that nonhuman animals without cultural experiences like humans also are sensitive to these cues (e.g. Imura and Tomonga, 2003). However, very few studies focused on the depth perception from cast shadows and its developmental and evolutionary origins. This study investigated the ability to perceive motion trajectory of the object from moving cast shadow in 4 to 7-month-old humans and 5-month-old monkeys. In Experiment 1, we prepared two kinds of events: one was perceived by adults as moving in “depth”, which contains a ball and a cast shadow with diagonally trajectories, and the other as flowing to “up”, which contains a ball with a diagonally trajectory and a cast shadow with horizontal trajectory. Infants habituated to “depth” event, and then tested with novel “up” and “depth” events. Six-and 7-month-old human infants preferred to look at “up” to “depth” event. These findings suggest that older infants discriminated the motion trajectories of balls from the cast shadow motion. Experiment 2 showed that preferences for “approach-avoidance” motion in “up” event could not account for these looking behaviors using the events in which the spatial relationship between the ball and shadow was reversed from those used in Experiment 1. Experiment 3 revealed that 5-month-old monkeys looked longer at the “up” than “depth” events. The findings from Experiments 1 to 3 suggest that 6- and 7-month-old human infants discriminated the events based on depth impressions. The developmental emergence of depth perception from cast shadows in Japanese macaques seems to be similar to that of humans.

P39

The role of Broca’s area in kinetic process of movement recognition

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For the role of mirror neurons (MNs) in Broca’s area for the modeling of other’s kinetic movement, the direct matching hypothesis (Rizzolatti, G., Fogassi, L., & Gallese, V., 2001) proposed the functional concept of MNs. However, this hypothesis doesn’t interpret how MNs process a series of information presented by model’s kinetic movement in chronological order. We examined the function of MNs with

respect to the temporal processing under observing the kinetic motion pictures. We measured the hemodynamic changes over time in Broca’s area by means of a multichannel near infrared spectroscopy (Hitachi Medico ETG-4000), of which the expose and detect probes are fit on the brain surface on Broca’s area of participants while they are observing the motion pictures of face and finger. And then participants were asked to observe the different motion pictures, which consists of three conditions (15frame condition: smooth movement condition, 5frame condition: sort of awkward movement condition, 3frame condition: awkward movement condition). For means of oxygenated hemoglobin (oxy-Hb) for the differences between the baseline condition and each condition, it is showed that oxy-Hb increased significantly on the 15 frame condition (smooth movement condition). This suggests that MNs could highly activate when model’s movements were smooth. And we inferred that MNs might activate in time with the participant’s optimal movement which is stored as kinetic representation in his brain. Accordingly, it could be considered that the function of MNs is responsible for monitoring the model’s movement by checking the observer’s stored representation.

P40

Processing Japanese derived nouns: An economy-based revision of the Dual Mechanism Model

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Based on the English past-tense formation, Pinker and his collaborators (e.g. Pinker & Prince 1992) have proposed the so-called Dual Mechanism Model (DMM), which claims that the regular/irregular phenomena in inflectional morphology reflect the general opposition of symbolic rules vs. associative memory in human language. According to this Model, it is predicted that memory-based inflected forms are sensitive to lexical frequency while rule-based ones are possibly immune to it, and that the former show a smaller amount of morphological priming effect than the latter, which can prime their stems to the extend to which their stems prime themselves because of the rule-based morphological decomposition. Extending the DMM to derivational morphology, Clahsen and his colleagues (e.g. Clahsen et al. 2003) have conducted a series of lexical decision experiments and revealed that German inflections and derivations exhibit the same patterns as mentioned above except that the rule-based derivations yield lexical-frequency effects.

Along these lines, we performed two experiments on Japanese noun formation: deadjectival *-sa* suffixation, which is known to be rule-based, and deadjectival *-mi* suffixation and deverbal Renyo-form conversion, which are memory-based (cf. Ito & Sugioka 2002). Among other implications of Clahsen et al.’s and our results, we will mainly discuss in our presentation the question why the outputs of derivational rules appear more likely to be memorized than those of inflectional rules. To capture this difference, we will propose an economy-based model, which is based on two assumptions: firstly, that the memorization

of rule outputs depends on the cost balance between computation and memory and, secondly, that derivational computation is more costly than inflection. Thus, rule-based derivation has a memorizing threshold lower in frequency than that of inflection, thereby exhibiting more likelihood of memorization.

P41

Perceiving outcomes of another person's performance: individual difference in the "social brain"

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In our social behavior, it is imperative to recognize the consequence (successes or failure) of other person's behavior, as well as to monitor that of our own performance. However, neural and cognitive substrates in evaluation of non-self performance remain much to be elucidated. Here we conducted a two-person gambling task and examined the neural activities of participants perceiving self's and other's outcomes. In the task, two players took turns performing a lottery game, where one participant of the pair performed the game while the other observed the player's performance outcome (either monetary gain or loss). The neural activities of participants were measured via electroencephalogram. Former studies showed that feedback stimuli regarding the participant's monetary loss elicited more negative deflection of the ERP on the medial frontal site of the head surface, compared to the case of gain. Our study showed this medial-frontal negativity (MFN) was generated in observing outcomes of another person's performance with slight but significant amplitude, as well as the case of self performance. This result suggested that a self-monitoring function that is reflected in the MFN is shared by a mechanism to evaluate other persons' behavior. Furthermore, individual difference is greater in observation of others, compared to that of self performance. As a further study, we made the gamble game as a "competitive" one, where one's monetary gain means the other's loss. In this condition, the MFN showed significant gender difference in the perception of an opponent's, but not self-performed, outcomes. Male brains perceive another's loss as positive for themselves, while female brains showed that they judge another's loss as negative, although it meant their own benefit. Further, the valence (positive-negative direction) and magnitude of that neural activity correlated with the personality scales regarding social behavior. These data suggest that the rapid neural response observed as the MFN maybe a root of individual difference in asocial behavior. Not only that, the individual difference in complex social cognition, for example that in a competitive situation, can be systematically illustrated in terms of an imbalance between self-oriented and other-oriented mental processing.

P42

Cognitive approach to Savant syndromes

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Calendrical calculation, one of common skills show by

savant syndromes, is the unusual ability to name days of the week for dates in the past and the future.

This presentation explains about main cognitive processes which savants diagnosed as Asperger syndromes use when they calculate calendar tasks. As, there are few experiments that focus on superior visual imagery and memory that is characteristic of autism and Asperger syndromes, the purpose of this experiment is to show whether savants have superior visual memory tasks relative to normal subjects group.

At first, these calculation skills were assessed in the oral presentation. The participants of savant syndromes, one was 16-year-old man, another 6-year-old girl, could make a correct answer over half of 48 calendrical tasks. At follow up, the same participants were required to answer the date questions with a computer-presented task in order to scale the time and range of their response. The man was able to calculate 5 years forward and backward, based on the present date. In the case of girl, she could calculate 1 year back and forth.

Secondly, to assess the ability for processing visual imagery tasks, matrix tasks were used. The tasks which were constructed with 2x2 or 3x3 matrix and were filled with a digit or literature in the cells were presented on computer screen 250ms, 1s, 2s, duration time. On digit tasks, 1-9 were arranged at random or canonically. On literature tasks, Japanese character "hiragana" was used. As the girl rejected literature tasks, only savant man was objected of analysis. As a whole, there was no characteristic difference in comparison with control group. In one point, there was tendency that savant were inferior to recognize literature.

Further researches require that visual imagery would be processed in relation with long term memory.

P43

Playing a video game with a human opponent activates dorsal prefrontal cortex

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Our previous studies have shown that sustained deactivation occurs in the dorsal prefrontal cortex (DPFC) while people play video games. However, the games employed in those studies were only for single use. In this study, we examined the DPFC activity during playing a video game with another, an opponent. Recent brain imaging studies have revealed that the dorso-medial prefrontal cortex mediates the ability to predict other's mental state, or "mentalize." We hypothesized that playing a video game with a human opponent activates the dorso-medial prefrontal cortex more than playing the game solely does.

Fourteen males (18 to 22 years old) participated in this study. They played a computerized board game "Reversi", which is well-known as "Othello" in Japan, with a human or a computer opponent for five minutes. Changes in the concentration of oxygenated hemoglobin (oxyHb) in the DPFC were measured by using a near infrared spectroscopy (NIRS) system with 24 channels. Prior to the beginning of the human condition, the subjects were told that they would play the game against another human experimenter via Internet server. However, as a matter of fact, they played the

game against a computer as the same as in the computer condition. Immediately after the NIRS measurement, the subjects were asked to rate the degree of pleasantness and the difficulty for playing the game in each condition using five-point scale.

When we compared mean changes in oxyHb between the two conditions, the right DPFC was activated more in the human condition than in the computer condition. Such tendency was clearly seen, in particular, in seven subjects who answered that the human condition was more pleasant than the computer condition. These results support our hypothesis that playing a video game with a human opponent activates the DPFC. The subjects might predict the opponent's mental state frequently especially while playing the game against the (imaginary) human.

P44

Disappearance of inversion effect for robotic appearance: An ERP study

Masahiro Hirai & Kazuo Hiraki

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Due to the recent development of robotic technologies, modern humanoid robots are looked like really human. Thus the borderline between robots and humans is perhaps becoming obscure. Humanoid robot is an interesting existence because their appearance is looked like humans, but they are not biological objects. Thus one interesting question arises whether our visual system recognize humanoid robot as a human being or not. Both appearance and motion information would play an important role in detection of biological-ness or human-likeness. To date, several studies have tried to clarify the differential processing of human and robot actions. However it is still in controversial and the role of appearance and motion information is not clear.

In the present study, to examine above two questions 1) the role of appearance and motion information for detecting human-likeness 2) the differential processing between human and robot, we used the inversion effect as an index. In event-related potential study, the inversion effect is characterized as the face- and body- sensitive component (N170) is delayed and enlarged in amplitude in response to inverted faces and bodies, but not inverted objects. It is interesting because it is confined to processing of the human body and face, thus suggesting it might be a useful index for characterizing whether a target is processed like a human or object. Prior to the experiment, we hypothesized that if robotic walking animation is processed like an object, the inversion effect will not occur. However, in contrast, if it is processed like human information, the inversion effect will be observed as in the human appearance condition. We focused on the confirmation of this hypothesis. In the experiment, we controlled appearance information of walking animation. Participants were presented six kinds of walking animation with different appearance and orientation. All stimuli were generated by combination of two factors: 2 orientations (upright and inverted) and 3 appearances (human, robot and point-light). All walking animation was identical for both anatomical structure and motion properties such as motion trajectory.

The results supported the former hypothesis. That is, the inversion effect occurred only in the human walking condition, not the robot walking and point-light motion condition, even though both walking actions were identical. Thus, our data suggests that the neural responses of the visual system to robot walking animation are different from those to human information.

P45

Effects of basic musical structure on the neural responses: A magnetoencephalographic study

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In theory, music is defined as acoustical events composed of tones unfolded in spectral/temporal domains, following the well-established tonal and metrical systems. The most basic regularity in music is theorized as a pattern called "fundamental structure", composed of linear descending progression on top voice supported by bass arpeggiation. Based on this fundamental structure, we generated three kinds of chord progressions in synthesized piano tones as stimuli: PC that ends in perfect cadence, HC (half cadence) that is suspended half way through the progression and MC (minor cadence) of ambiguously closed character. MEG signals were recorded from trained musicians while they listened to these stimuli presented in random order. In data analysis, we focused on the N1m and P2m responses elicited at about 100 and 170 ms after the onset of each chord in the progressions. We observed that the amplitude of the responses after the first chord was reduced and gradually recovered towards the last chord of PC/MC, and the final tonic of PC had larger amplitude than that for the relative minor of MC. Further, imaginary response appeared in one beat after the final dominant chord of HC, in a latency around which the N1m/P2m would be elicited if there presented one more chord to close the progression. In our separate study, it was observed that when identical tone/chord was repeated sequentially the N1m/P2m amplitude was reduced after the first tone/chord and stayed in a constant level for all the successive tones/chords. It is therefore considered that the amplitude modulation and imaginary response observed in this study were induced by the tonal structures that follow the chord progression.

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When infant watches televised action: A near-infrared spectroscopy study

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Whether human infants perceive televised action of other people in the same way to live action largely remains unknown. In the neuroscience literature, it has been demonstrated that action observation elicits activation of motor areas in the observer's brain. Although larger activation in observing a live action compared to a televised action in adult subjects has been reported, it is unknown

whether the same neural response is obtained from infants. To address this issue, we measured the activity of motor areas in 6- to 7-month-old infants while viewing either a live or televised action by using near-infrared spectroscopy (NIRS). 13 infants (210±6.2 days old, mean±SD) were assigned to either the TV (N=7) or live group (N=6). In the action observation condition, subjects were shown a demonstrator manipulating a toy. In the object observation condition, another toy was manipulated by an invisible experimenter. The activity in the left motor area (2 × 4 cm square area) was measured by a NIRS apparatus (OMM-1080S, Shimadzu). By contrasting activity between action and object observation conditions it is possible to examine whether observation of body movement is effective in activating motor areas. We corroborated that the measured area were activated when the infant themselves performed an action. In the live group, the motor area was significantly activated in the action observation condition ($P < 0.02$), but not in the object observation condition ($P > 0.1$). In the TV group, the motor area was activated in the action observation condition ($P < 0.05$) as well as in the object observation condition ($P < 0.03$). Subsequent waveform analyses revealed that differences between the action and object observation conditions were found during 15-16 s after stimulus onset in the live group ($P < 0.05$), but not in the TV group ($P > 0.3$). Our results are the first to demonstrate activation in motor areas during action observation in human infants. Although we found activation during action observation in the TV group, the difference in activity between action and object observation conditions was significant only in the live group. We suggest that the infant's brain responds differently to the real world and the virtual world.

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Action observation suppresses responses to the sounds made by experimenter in the human auditory cortex

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Objective: We can easily discriminate self-produced from external sensory signals. Recent studies suggest that the prediction of the sensory consequences of their own actions made by forward model can be used to attenuate the sensory effects of self-produced movements and thereby enables differentiating self-produced sensation from externally generated sensation. Here we showed that the responses in the human auditory cortex to the sounds were similarly suppressed both when participants themselves performed a goal-directed action and when they observed experimenter's performing the same action.

Methods: The responses were recorded with a whole-scalp neuromagnetometer from 10 healthy right-handed participants who either themselves triggered a tone by pressing a button once every 2 s, listened to tones produced by experimenter while observing experimenter's button press, or passively listened to externally triggered tones.

Results: Sources of the auditory N100m responses, peaking

approximately 90 ms after sound onset in the supratemporal auditory cortex, were significantly weaker to self-triggered and experimenter-triggered than to externally triggered tones. There was no significant difference in source strengths between self-triggered and experimenter-triggered tones. All participants reported that the tones were produced by experimenter in action observation condition while the tones were produced by themselves in self-triggered tones condition.

Discussion: In this study proprioceptive feedback was not controlled. It is possible that participants judged who produced the tones based on proprioceptive prediction. Thus, these results do not necessarily disconfirm the hypothesis that the sense of agency depend on a comparison between the prediction made by forward model and actual sensory consequences. However, given that suppressed responses to self-triggered sounds in the human auditory cortex could be accounted for by the operation of a forward model, at least these results suggest that action observation activate a forward model via the mirror neuron system, which makes it difficult to differentiate self-generated from other-generated action when we jointly act. It may be why we feel that 'we act' rather than 'I act' in such a situation.

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Hearing your action: seeing action modulates auditory processing

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Objective: Although monkeys have mirror neuron systems, they do not seem to be skilled imitators. But human can easily learn a new skill by imitation. What is the property of the human mirror neuron system that enables imitative learning? In the computational model of motor learning, it is hypothesized that the central nervous system (CNS) requires containing emulators (or forward models) to optimize motor learning and control. In this study we investigated whether the human mirror neuron systems contained the emulator function.

Methods: Two complex sounds with different pitch were used as auditory stimuli, which were presented binaurally to the participants in three different conditions of causal context: self-action (SA), experimenter's action (EA), and autonomous (AT). Auditory stimuli were triggered 200 ms after button press in SA and EA conditions, and inter-trigger intervals (~2 s) were kept as similar as possible between all conditions. Predictive context was conditioned by preliminary short training of button press (i.e., the left and right buttons trigger the higher and lower tones, respectively) and the context was maintained by frequent occurrences (85%) in cross-modal oddball paradigms during data acquisition. Magnetoencephalographic (MEG) responses to each tone onsets were recorded from 10 healthy participants using VectorView (Elekta Neuromag, Helsinki, Finland), and were selectively averaged for each condition of causality and prediction validity. The MEG data were filtered with a band-pass of 1-40 Hz, and the baseline for the waveforms

was defined as the mean amplitude between -50 and 0 ms relative to tone onset. Source analysis was conducted using current dipole assumption and minimum current estimation based on each participant's head shape.

Results & Discussion: Rare occurrences (i.e., the higher or lower tones triggered by the right or left button press, respectively) violating the participant's prediction elicited the cross-modal MMN both in SA and EA conditions. The MMN in SA condition was localized in hand sensorimotor (SM), supratemporal (ST), and posterior parietal (PP) areas, whereas only ST and PP areas were activated in EA condition. Abstract linkage between sensory memory traces of self-action (SM) and tones (ST) might be inter-modally integrated in PP cortex as an emulator for predictive perception of contextual tones. Reduced SM activity in EA condition may suggest that the emulator is still valid without motor contribution. Across all conditions, frequent occurrences in SA condition elicited least brain activity, which was mainly confined in ST areas.

Conclusions: The observed cross-modal MMN in EA condition suggests that at least in human the motor representation activated by action observation acts as an emulator that make predictions of the sensory consequences of actions, and thus modulates in the top-down fashion the ongoing perceptual processing of the observed action. Given that the CNS requires containing emulators (or forward models) to optimize motor learning and control, it is possible that such an emulator function of the human mirror neuron system enables imitative learning uniquely in human.

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Exploring intersubjectivity from cognitive linguistic and artificial life perspectives: Analyses of causal connectives and simulated turn-takings

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Intersubjectivity is an on-going negotiation process that probes mental states to share intentions with others. It develops coordinated pre-verbal and verbal behaviors. To see the process of this development, we studied (i) an atypical usage of causal connectives in Japanese data and (ii) computer simulations of turn-taking behaviors.

(i) Causal connectives (such as English 'because') typically express cause-effect relationship (Sweetser). We, however, point out that there is an atypical usage of the Japanese causal connective '-kara' which express realization of totally contingent relationship (what we call "static relation") instead of causation (Uno & Ikegami).

For example:

aki da kara shimijimi.suru

autumn COPULA because feel. lonely

'I feel lonely because it is autumn.'

Causal connectives which express static relation can be used for sharing intentions. An intensive study on Japanese data suggests that two types of speaker-involvement in expression control the degree of contingency between the expressed events. A certain type of contingency can draw hearer's attention to where the speaker pays attention to, which as a result synthesizing intersubjectivity.

(ii) We simulated a turn-taking pattern of two agents in a computer (Iizuka & Ikegami). A kind of internal dynamics of agents can produce turn-taking. Turn-taking is a cooperative and cocreative activity reflecting intersubjectivity (Trevarthen). Our simulation shows that unstable planning of action can paradoxically lead to turn-taking behavior.

Based on these two studies we argue that the perception/enaction of contingency is the necessary condition of organizing intersubjectivity.

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The relationship between trait procrastination and achievement stressor : the longitudinal study about risk factor for depression in Japanese sample

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This study examined the effect of trait procrastination as risk factor for depression in stress-vulnerability model. In this model, the effect of interaction between specific personality factor and specific domain of stressor on depression has been revealed. It was suggested that trait procrastination may be vulnerability for depression in stressful situation. However, longitudinal study to reveal the interaction has not been conducted. The present longitudinal study was conducted in October and November 2005. Japanese undergraduates completed measures of trait procrastination assessed with General Procrastination Scale and depression assessed with Self-rating Depression Scale, achievement stressor assessed with Scale of Life Events in Interpersonal and Achievement Domains. The result of a set-wise hierarchical multiple regression analysis showed that (1) the main effect of trait procrastination did predict increased levels of depressive symptoms over time and (2) the interaction between trait procrastination and achievement stressor didn't predict ones. These evidences indicate that trait procrastination is a personality factor that may contribute to depression, but it does not moderate the association between achievement stressor and depression in Japanese students.

Supported by:

- MIYUKI GIKEN Co., Ltd.
- SHIMADZU Corporation
- Japanese Cognitive Science Society

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