京都大学霊長類研究所 共同利用研究会

『視線、共同注意、心の理論』

― 共同利用計画研究「チンパンジー乳幼児期の認知行動発達の比較研究（H13-15)」、「チンパンジーの認知や行動とその発達の比較研究（H16-)」研究成果発表会 ―

PRI Cooperative Research Workshop

“Gaze, Joint Attention, and Theory of Mind”

日時： 2005 年 8 月 1 日（月）～8 月 2 日（火）

場所： 京都大学霊長類研究所大会議室

世話人：友永雅己、田中正之、松沢哲郎、吉川左紀子

Program and Abstracts

プログラム

8 月 1 日（月）

12:00-　受付開始

13:00-13:30　黒木 美紗（九州大）: 乳児の視線転換に及ぼす情動の影響 ―始発的共同注意の獲得の観点から

13:30-14:00　常田 美穂（北海道大）: 共同注意の発達における養育者の役割

14:00-14:30　仲川 こころ・小嶋 秀樹（情報通信研究機構）・安田 有里子（近江八幡市立心身障害児通園センター）: ２項関係への気づき・３項関係への気づき ―ロボットから見た自閉症児のコミュニケーション発達

14:30-15:00　長井 志江（情報通信研究機構）: ロボットによる視覚的共同注意の学習

15:00-16:30　共同利用計画研究「チンパンジーの認知や行動とその発達の比較研究」
および関連研究成果発表ポスターセッション

16:30-17:00　白井 述（中央大）・小沼 裕子（中央大）・金沢 創（淑徳大）・山口 真美（中央大）: 乳児の視線知覚における部分処理と全体処理

17:00-17:30　瀬山 淳一郎（東京大）: 視線方向残効

17:30-18:30　Langton, S. R. H.（Univ. Stirling）: Faces, gaze and visual attention.

19:00-　懇親会

8 月 2 日（火）

9:00-10:00　チンパンジー実験見学

10:00-10:30　久世 濃子・幸島 司郎（東京工大）: オランウータンの凝視行動の特徴と社会的機能

10:30-11:00　橋彌 和秀 （九州大）・小林 洋美（科学技術振興機構）: The evolution of “social eyes” in primates.

11:00-11:30　野村 光江（京都大）: 伝達行為としての顔面表出

11:30-12:00　友永 雅己（京都大）: チンパンジーにおける視線認知

12:00-13:00　昼食＆ポスターセッション

13:00-13:30　佐藤 弥（京都大）: 表情と視線の交互作用：心理学研究と脳画像研究からの知見

13:30-14:30　Adams, R. B., Jr. （Tuffts Univ.）: Feed-forward versus feedback threat responses show differential attunement to clear versus ambiguous threat

14:30-15:00　総合討論

Program

August 1 (Monday)

12:00- Registration

13:00-13:30 Kuroki, M. (Kyushu Univ.) The effect of emotion on infants' gaze shift: Related to the acquisition of initiating joint attention.

13:30-14:00 Tsuneda, M. (Hokkaido Univ.) The role of caregiver's supportive behavior for development of joint attention in early infancy.

14:00-14:30 Nakagawa, C. (NICT), Kozima, H. (NICT), and Yasuda, Y. (Omihachiman-city Day-care Center for Children with Special Needs) Emergence of dyadic and triadic interactions between a robot and children with autism.

14:30-15:00 Nagai, Y. (NICT) Robots that learn to establish joint visual attention.

15:00-16:30 Poster session for the Cooperative Research Program of PRI "Comparative studies on behavioral and cognitive development of chimpanzees" and related research.

16:30-17:00 Shirai, N. (Chuo Univ.), Konuma, H. (Chuo Univ.), Kanazawa, S. (Shukutoku Univ.), and Yamaguchi, M. K. (Chuo Univ.) Analytical and configural processing in infants' gaze perception.

17:00-17:30 Seyama, J. (Uinv. Tokyo) Eye direction aftereffect.

17:30-18:30 Langton, S. R. H. (Univ. Stirling) Faces, gaze and visual attention.

19:00- Party

August 2 (Tuesday)

9:00-10:00 Demonstration of Chimpanzee Experiments.

10:00-10:30 Kuze, N. and Kohsima, S. (Tokyo Inst. Tech.) Characteristic and social function of gazing behavior in orangutan.

10:30-11:00 Hashiya, K. (Kysgu Univ.) and Kobayashi, H. (JST) The evolution of "social eyes" in primates.

11:00-11:30 Nomura, M. (Kyoto Univ.) Facial displays as communicative acts.

11:30-12:00 Tomonaga, M. (Kyoto Univ.) Gaze perception in chimpanzees.

12:00-13:00 Lunch and Poster Session

13:00-13:30 Sato, W. (Kyoto Univ.) Interaction between emotional facial expression and gaze direction: Evidence from psychological and neuroimaging studies.

13:30-14:30 Adams, R. B. Jr. (Tuffts Univ.) Feed-forward versus feedback threat responses show differential attunement to clear versus ambiguous threat.

14:30-15:00 Discussion

ポスターセッション

１）大野初江・鵜殿俊文・濱田穣 コンピュータ骨密度解析法によるチンパンジー骨格の発達と加齢

２）三上章允・西村剛・三輪隆子・松井三枝・田中正之・友永雅司・松沢哲郎・鈴木樹理・加藤朗野・松林清明・後藤俊二・橋本ちひろ　チンパンジー脳の発達

３）西村剛　チンパンジーにおける声道形状の成長変化

４）田多英興・大森慈子・廣川空美・大平英樹・友永雅己　霊長類の瞬目

５）竹下秀子・明和政子・平田聡　ヒトとチンパンジーの身体行動の発達－胎児期からの比較研究

６）五十嵐稔子・竹下秀子・大城昌平・水野友有・林美里・友永雅己・松沢哲郎　ブラゼルトン新生児行動評価を用いたチンパンジー新生児の縦断的研究

７）川上清文・高井清子・友永雅己・鈴木樹理・日下富美代・岡井崇　微笑と笑いの起源

８）上野有理　チンパンジー乳児における母親への参照行動：食事場面に注目して

９）川田 学　食事場面における母親の開口伝染と乳児の視線パターンの分析

１０）林 美里　物の操作課題からみる認知発達

１１）Crast, J., Fragaszy, D., Hayashi, M., and Matsuzawa, T. Manual dexterity in infant and adult chimpanzees (*Pan troglodytes*)

１２）森村成樹・松沢哲郎　チンバンジーにおける動画の記憶

１３）井上紗奈･松沢哲郎　チンパンジーにおける数字系列の記憶

１４）松野 響・友永雅己　適応的方法をもちいたチンパンジーのコントラスト閾測定

１５）村井千寿子　チンパンジー乳児・ヒト乳児における「動物」カテゴリの形成に関する検討

１６）Martinez, L., & Fagot, J. Discrimination of same-different relation in visual displays by baboons (*Papio papio*) and humans.

１７）小杉大輔・村井千寿子・田中正之・友永雅己　チンパンジー乳児は対象の動きの因果性を認識するか？

１８）足立幾磨・桑畑裕子・藤田和生・友永雅己・松沢哲郎　ニホンザル乳児における感覚統合的概念

１９）伊村知子・山口真美・金沢 創・白井 述・大塚由美子・友永雅己・八木昭宏　ヒト乳児におけるキャストシャドーによる物体の運動軌跡の知覚

２０）白井 述・金沢 創・山口真美　放射運動の速度に対する感度の初期発達

Poster Session Program

1) Ohno, H., Udono, T., and Hamada, Y. **Age change in chimpanzee metacarpal bones evaluated by the modified micro-density method.**

2) Mikami, A., Nishimura, T., Miwa, T., Matsui, M. et al. **Development of the brain in infant chimpanzees.**

3) Nishimura, T. **Developmental changes in the shape of the vocal tract in chimpanzees.**

4) Tada, H., Omori, Y., Hirokawa, A., Ohira, H., and Tomonaga, M. **Eyeblinks in primates.**

5) Takeshita, H., Myowa-Yamakoshi, M., and Hirata, S. **A comparative perspective on prenatal and early postnatal development of motor behaviors between chimpanzees and humans.**

6) Igarashi, T., Takeshita, H., Ohgi, S., Mizuno, Y., Hayashi, M., Tomonaga, M., Matsuzawa, T. **Longitudinal study of the Brazelton Neonatal Behavioral Assessment Scale to a newborn chimpanzee infant.**

7) Kawakami, K., Takai, K., Tomonaga, M., Suzuki, J., Kusaka, T., and Okai, T. **Origins of smile and laughter.**

8) Ueno, A. **Infant chimpanzees' referencing behavior to their mothers in feeding context.**

9) Kawata, M. **Maternal mouth movement contagion and infant's eye direction patterns: Its developmental interpretation.**

10) Hayashi, M. **Assessing cognitive development by object-manipulation tasks.**

11) Crast, J., Fragaszy, D., Hayashi, M., and Matsuzawa, T. **Manual dexterity in infant and adult chimpanzees (*Pan troglodytes*).**

12) Morimura, N. and Matsuzawa, T. **Memory of movies by chimpanzees.**

13) Inoue, S. and Matsuzawa, T. **Numerical memory span in chimpanzees.**

14) Matsuno, T. and Tomonaga, M. **Adaptive psychophysical measurements of the contrast threshold in chimpanzees.**

15) Murai, C. **The examination of 'animal' category in chimpanzee infant and human infant.**

16) Martinez, L., & Fagot, J. **Discrimination of same-different relation in visual displays by baboons (*Papio papio*) and humans.**

17) Kosugi, D., Murai, C., Tanaka, M., and Tomonaga, M. **Do chimpanzee infants recognize causality in object motions?**

18) Adachi, I., Kuwahata, H., Fujita, K., Tomonaga, M., and Matsuzawa, T. **Japanese macaques form a multi-modal representation of species in their first year of life.**

19) Imura, T., Yamaguchi, M. K., Kanazawa, S., Shirai, N., Otsuka, Y., Tomonaga, M., and Yagi, A. **Perception of motion trajectory from moving cast shadow in human infants.**

20) Shirai, N., Yamaguchi, M. K., and Kanazawa, S. **Early development of velocity sensitivity to radial motion.**

発表要旨　**ABSTRACTS**

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黒木美紗（九州大学）

乳児の視線転換に及ぼす情動の影響―始発的共同注意の獲得の観点から

Kuroki, M. (Kyushu Univ.)

The effect of emotion on infants' gaze shift: Related to the acquisition of Initiating Joint Attention.

How infants acquire the ability to manipulate other's attention, and get able to direct others attention toward the object which they were interested in? For infants who can't use language, the most useful tool to attract others attention is their expressive eyes. Thus, the primary style of attracting others attention were considered to begin as infant's gaze shift from interesting object to their social partner.

In this study, whether arousal of positive emotion would trigger infant's gaze shift from object to person was investigated. The effects of infants' positive emotion on frequency of gaze shift in 6-, 9-, 12-month-olds infants were examined. The results showed that arousal of positive emotion take off infants' gaze from the toy, which elicit their positive emotion, in all age groups. And also, positive emotion turn infants' gaze especially to person than any other things in 12-month-olds. These findings suggest that arousal of positive emotion could drive infants' gaze shift from exciting toy, and their gaze would be directed to person by 12-month-olds. These results will be discussed, related to the acquisition of initiating joint attention in infancy.

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常田美穂（北海道大）

乳児期の共同注意の発達における母親の支持的行動の役割

Tsuneda, M. (Hokkaido Univ.)

The role of caregiver's supportive behavior for development of joint attention in early infancy

本研究では，乳児期の対面相互交渉において子どもとの注意共有の状態を作り出すための養育者の行動に着目し，養育者の注意に関する支持的行動が二者間の共同注意の成立にいかに寄与しているのか，そのようにして二者間で成立した共同注意の質がいかにして共同注視から心の交流のある共同注意へと発達的に変化していくのかを明らかにすることを目的とした。家庭における 1 組の母子の対面相互交渉場面を 2～9 カ月に渡って縦断的に観察し，乳児の注視パターンおよび情動表出のタイミングと母親の行動との関係を分析した。その結果，2～9 カ月の間に母子間に成立する共同注意には 5 段階の質的変化があり，7 カ月後半から心の交流のある共同注意が成立していた。また子どものできる部分が増えるにつれて母親の支持は減少し，このことが子どもの共同注意行動の変化を導いていた。これらの結果から，共同注意を成立させるための母親の支持的行動には，子どもの共同注意行動を形成する役割のあることが示唆された。

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仲川 こころ・小嶋 秀樹（情報通信研究機構）・安田 有里子（近江八幡市立心身障害児通園センター）

２項関係への気づき・３項関係への気づき ―ロボットから見た自閉症児のコミュニケーション発達

Nakagawa, C. (NICT), Kozima, H. (NICT), and Yasuda, Y. (Omihachiman-city Day-care Center for Children with Special Needs)

Emergence of dyadic and triadic interactions between a robot and children with autism

We present some of the preliminary findings in our on-going longitudinal observation of autistic children interacting with a toy-like robot. The robot, "Keepon", is a small (12cm tall), simple (like a yellow snowman), soft (made of silicone rubber), creature-like robot, which was was carefully designed to get autistic and non-autistic children involved in playful interaction. We observed how autistic children (2--4 years old) interacted with Keepon without any experimental setting or instructions in a playroom at a day-care center for children with special needs. From the longitudinal observation for two years (totally, over 500 child-sessions), we found that Keepon's simple appearance and predictable responses gave the autistic children a playful and relaxed mood, in which they spontaneously engaged in dyadic play with Keepon, which would then expand into interpersonal communication where Keepon worked as the pivot of triadic play with adults or other children. Each child showed a different style and a different unfolding of interaction over time, which tell us a "story" of his or her personality and developmental profile, which would not be explained thoroughly by a diagnostic label like "autism".

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長井 志江（情報通信研究機構）

ロボットによる視覚的共同注意の学習

本講演では、共同注意の発達メカニズムの理解を目指したロボティクスからのアプローチを紹介する。著者は、発達心理学研究で発見されたさまざまな知見に注目し、それを基にロボットの発達モデルを構築することで、人間の幼児の認知発達の仕組みを理解しようと試みてきた。その中で一つの注目すべき知見は、幼児が他者の視線変化を観察したときに視覚から検出される動きの情報が、共同注意の学習を促進していることである。本講演では、このメカニズムを説明するロボットのモデルを紹介する。ロボットは、人間の視線方向を追跡して共同注意を成立させることを目的とし、そのためのセンサーモータ関係を学習する。センサ情報として、ロボットは人間が視線を変化させたときのカメラ画像から、オプティカルフローとエッジ情報を検出し、これらをもとに人間の視線方向を正しく追従するためのモータコマンド（目、首の回転運動）を生成する。ここで、モデルの重要な特徴は、ロボットが適切な運動出力を生成しようとする上で、(1)オプティカルフローからは、人間の視線方向に関して、大まかではあるが、容易に理解可能

な情報が得られること、また、(2)エッジ特徴からは、解釈が複雑ではあるが詳細な情報が得られることである。つまり、二つの入力情報が相補的な関係にあることによって、幼児の発達と同様に、ロボットの学習も促進されることが期待できる。実験の結果は、オプティカルフローが学習の加速に役立っていること、そして、エッジ特徴が獲得される共同注意のパフォーマンスを向上させていることを示している。この結果は、幼児の共同注意の発達メカニズムを理解するうえで、重要な示唆を与えると考えられる。

Nagai, Y. (NICT)

Robots that learn to establish joint visual attention.

I present my robotics approach to understanding the developmental mechanism of joint attention. Many findings from the studies of developmental psychology have motivated me to investigate the development in human infants by constructing artificial developmental models for robots. One of the important knowledge about joint attention is that movement information which infants detect when looking at an action of gaze shift of another person facilitates their learning to follow the direction of the person's gaze. This talk presents my robotic model to explain this mechanism. The learning model enables a robot to acquire the sensorimotor mapping for joint attention with a human. To generate an appropriate motor command to follow the direction of human gaze, a robot detects the optical flow and the edge feature from its camera image obtained when looking at the person who is shifting his/her gaze. The significant points of the model are that (1) the optical flow yields rough but easily understandable information to generate the motor command, and (2) the edge feature provides the detail information though the difficulty of interpreting. These complementary characteristics facilitate the robot's learning as in infants. Experimental results show that the optical flow accelerates learning while the edge feature improves the performance of joint attention.

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白井 述（中央大）・小沼 裕子（中央大）・金沢 創（淑徳大）・山口 真美（中央大）

乳児の視線知覚における部分処理と全体処理

Shirai, N. (Chuo Univ.), Konuma, H. (Chuo Univ.), Kanazawa, S. (Shukutoku Univ.), and Yamaguchi, M. K. (Chuo Univ.)

Analytical and configural processing in infants' gaze perception

Perceiving gaze direction is important for human adults and infants. Human adults process gaze direction by using the configural information of the face. In the face cognitive developmental studies, 7-8-month-old infants showed configural processing in upright faces, while analytical processing in inverted faces. But until now, there are no developmental studies about the interaction of gaze perception and configural information processing. The present study examined whether 6-8-month-old infants (N=96) process gaze direction configurally or analytically. The face stimuli of schematic faces drawn by Wollaston were used in our experiments. In habituation period, a schematic illusion face was shown. In this face, human adults perceive direct gaze by analytical processing of only eyes, and averted gaze by configural processing with facial contour. In the test period, two mirror images of this face were

shown; one had a mirror image (Eye Switch face), and the second had a mirror image except eyes (Gaze Switch face). If infants process gaze direction configurally, they show novelty preference to a Gaze Switch face. By contrast, if infants process gaze direction analytically, they show novelty preference to an Eye Switch face. An upright face was used for experiment 1, and inverted faces used for experiment 2. Results suggest that only 8-month-old infants could process gaze direction configurally in an upright face, and process gaze direction analytically in an inverted face.

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瀬山 淳一郎（東京大）

視線方向残効

Seyama, J. (Uinv. Tokyo)

Eye direction aftereffect.

We found that after a prolonged observation of eyes looking to the left (or right), eyes looking directly toward the viewer appeared directed to the right (or left). This phenomenon, which is called the eye direction aftereffect (EDAE), will be presented in my talk. Observation of an arrow directed to the left or right did not induce this aftereffect on the perceived eye direction. Happy faces produced the aftereffect more effectively than surprised faces, even though the image features of the eyes were identical for both the happy and the surprised faces. In another experiment, the adaptation stimuli were rotated 90° (clockwise or counterclockwise) relative to the viewer, and the EDAE was measured using upright test stimuli. Prior observation of the 'leftward' and 'rightward' eye directions (they were actually upward and downward directions relative to the viewer) biased the perceived eye directions of the upright test stimuli to the right and left respectively. Thus, the EDAE showed orientation invariance (at least up to 90°). Our findings on the EDAE suggest that this aftereffect may reflect the adaptation of relatively higher-level mechanisms analyzing the other's eye direction.

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Langton, S. R. H. (Univ. Stirling)

Faces, gaze and visual attention

In this talk I will present data from a number of experiments which have explored how faces are able to influence the allocation of visuo-spatial attention. First, these studies have suggested that the direction of another’s attention, as signalled by their eye-gaze and head orientation, triggers a shift of a viewer’s visual attention both when the faces are presented in simple displays and when they compete for attention with other objects in more complex visual scenes. Contrary to expectations, there is little evidence that this effect is modulated by the facial expression

worn by the gazer. Second, our studies suggest that faces themselves capture attention when in competition with other natural objects and that the deployment of attention to faces can also be influenced by the expression worn by these faces. However, this effect does not seem to be modulated by eye-gaze; a threatening face that is looking at you is no more likely to capture your attention than one which is directing attention elsewhere. Together, these studies suggest that attention can be deployed independently toward a face and toward whatever the face is looking at. I will conclude by discussing these findings in relation to a simple model of face processing.

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久世濃子（東京工業大）

オランウータンの凝視行動の特徴と社会的機能

単独性の強いオランウータンでは、音声信号の種類も非常に限られており、その頻度も低い。またグルーミングなどの身体接触を伴う社会交渉は、飼育下であっても稀にしか観察されない。一方で優位オスの Flange（顔の両側の大きなヒダ）に代表される、特定の性や成長段階、社会的地位を示す顔形態があり、これらは視覚信号として社会的な機能を担っている可能性が高い。オランウータンの社会や行動を理解するうえで、視覚コミュニケーションは重要な手がかりになると考えられる。そこで視覚信号が利用されている可能性が高い、他個体を長時間見つめる行動、つまり凝視行動に注目し分析を行った。リハビリテーション出身の 3 歳～22 歳の計 36 個体（コドモ 24 頭、ワカモノ 8 頭、オトナ 4 頭）を対象として、2000 年～2004 年にリハビリセンターに隣接する森林内で観察を行った。1 日に 1 個体を追跡し、ビデオカメラで行動を記録した。「凝視行動」を「静止した状態で 3 秒以上、視線を固定する行動」と定義すると、次の 3 つに分類することができた。Staring：30 ㎝以上離れた相手を凝視、Peering：30 ㎝以内にいる相手の顔または手元を凝視、Mutual Gazing：同時に互いの顔を凝視。

Staring と Peering の平均継続時間は 9 秒、頻度は 0.5 回/時であったが、Mutual Gazing はわずか 7 例しか観察されなかった（Staring484 例、Peering341 例）。コドモとワカモノでは、オスがメスも高い頻度で Staring と Peering を行っていた。さら Staring の対象個体の行動に関しても顕著な性差が観察された。ワカオスは社会交渉を行っている個体を高い頻度で Staring していたが、ワカメスは採食中の個体を高頻度で Staring していた。対照的に Peering ではほとんど場合、採食中の個体が Peering されていた。Peering 後は対象個体のそばで同じ食物を食べる、という行動が最も頻繁に観察され、稀に身体接触を伴う社会交渉や食物の強奪が観察された。最後に他の大型類人猿とオランウータンの凝視行動や社会行動を比較し、凝視行動の社会的機能について考察する。

Kuze, N., and Kohshima, S. (Tokyo Inst. Tech.)

Characteristic and social function of gazing behavior in orangutan

We study gazing behavior of 36 semi-wild orangutans (24 Juveniles, 8 Adolescent and 4 Adults) in Sepilok Forest Reserve, Borneo for 853hr. Gazing behavior, in which an orangutan fixes gaze at other individual for a long time (more than 3 seconds) keeping the body motionless, could be divided into 3 types of behavior; “Staring”: gazing

other individual from a distance of over 30cm, “Peering”: gazing the neighbor within 30cm and “Mutual Gazing”: staring at the partner's face each other. Staring and Peering were obvious behavior that continued about 9 seconds in average and appeared in the frequency of 0.5 times per hour. On the other hand, Mutual Gazing was very rare, and it was observed only 7 cases (Staring 484 cases, Peering 341 cases).

In both adolescent and juvenile stage, males conducted Staring and Peering significantly more frequently than female. Difference by sex and growth stage was observed in the object of Staring. Adolescent males conducted Staring most often to the individuals in social interaction while they stared individuals in feeding much less frequently than females. In contrast, individuals of all sex and growth stages conducted Peering on other individuals in feeding most frequently. After Peering, they often ate food near the individual they peered, and sometimes conducted social interaction with physical contact or forcibly took food from the object. Finally we discuss the social function of Gazing Behavior of Orangutan by comparison to other great apes.

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橋彌 和秀（九州大）・小林 洋美（科学技術振興機構）
Hashiya, K. (Kysgu Univ.) and Kobayashi, H. (JST)

The evolution of “social eyes” in primates.

Kobayashi and Kohshima (1997, 2001) have shown that the human eye has exceptional morphological feature in primates: it has the largest ratio of exposed sclera in the eye outline, and the extraordinarily elongated eye outline in horizontal direction. Furthermore, the exposed white sclera was observed only in humans. They explained such features of human eyes mainly as ecological adaptations, specifically, extending the visual field by eyeball movement, especially in the horizontal direction. In this presentation, we report that the exceptional feature of human eyes should be explained not only by ecological factors but also by “social” factors. We found in primates high correlation between the eye morphology and the parameters reflecting social factors (relative neocortical volume and/or group size). The horizontally elongated eye outline might enable the animal to utilize the eyeball movement (independent of the head movement) to observe the other individual, possibly without being detected by the target. Such a morphological feature should benefit the animal in competitive situation. The evolution of neocortex as an inner device to deal with social problems (Humphrey, 1976) might need outer organs that adapt corresponding problems. The white sclera observed only in humans at least among primates might enhance the signal value of eye gaze. The lack of pigmentation in sclera should enable the gaze to serve as overt signal even from a distance (Hall, 1970), which should lead to multi-layered functions of the human gaze.

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野村 光江（京都大）

伝達行為としての顔面表出

Nomura, M. (Kyoto Univ,)

Facial displays as communicative acts

Gaze and facial expressions of emotion provide various information in social interaction. These facial displays do not simply reflect inner states of the person, but can be influenced by his/her communicative intention. However, we do not fully understand how these facial displays changes depending on the verbal expressions of emotional episodes during speaker-listener interaction. In the present study, the author investigated whether the valence of verbally-described emotional episodes would influence the gaze direction and facial expressions of emotion. The thirty-nine undergraduate students told the three emotional episodes (joy, angry, and sad) and the non-emotional control episode to the listener. They were asked to convey each emotion clearly when talking the emotional episodes. 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. While the cheek raiser movements (AU6) were equally frequently observed in all emotional episodes regardless of the valence, they tended to be intensified when talking the joy episode. The inner brow raiser and brow lower movement, which imply negative emotion, (AU1, 4) were very few, and were likely to be accompanied with averted gaze or closed eyes. Results are discussed in the context of the role of facial displays in social interaction.

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友永 雅己（京都大）

チンパンジーにおける視線認知

Tomonaga, M. (Kyoto Univ.)

Gaze perception in chimpanzees.

From the comparative-cognitive perspective, we have studied the various aspects of gaze perception in chimpanzees. In this talk I summarize these studies and discuss the similarities and differences in gaze perception between chimpanzees and humans. Topics are as follows. (1) Direct-gaze preference in infant chimpanzees. Chimpanzee infants aged at around 2 months reliably prefer to human direct-gaze face over averted-gaze face. (2) Extent and limit of gaze following in infant chimpanzees. They began to follow the human experimenter’s social cues (pointing, head turn, and glance) at around 1 year old, but showed delayed emergence in looking-back response by following the pointing to the object behind them (at around 2 years old). (3) Attention shift caused by social cues in adult and young chimpanzees. Chimpanzee adults showed no clear evidence for “reflexive” orienting caused by social cues but their orienting responses were affected by SOA (slow SOA is effective) and cue validity (highly probable cues caused orienting). These results suggest that their orienting responses were mainly controlled in a “voluntary” manner. Gestural cues also caused “voluntary” orienting of chimpanzee’s attention. We will discuss the

relationship between the present findings and the substantial difference in social interaction between the two species.

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佐藤 弥（京都大）
表情と視線の交互作用：心理学研究と脳画像研究からの知見
Sato, W. (Kyoto Univ.)
Interaction between emotional facial expression and gaze direction: Evidence from psychological and neuroimaging studies.

In daily face-to-face communication, we adeptly decode the information from the emotional facial expressions and gaze direction of other individuals. However, little is known about the psychological and neural mechanisms to integrate these two types of information. To investigate this issue, we presented the photos of facial expressions of six emotions looking toward/away from the subject, and asked them to evaluate their experienced and recognized emotion when perceiving each stimulus. While both the experienced and recognized emotions were influenced by gaze direction, the patterns of the interaction differed with the facial emotions. In a subsequent brain-imaging study, we focused on angry/neutral contrast and examined the effect of gaze looking toward/away from the subject. The left amygdala showed the interaction between emotional expression and gaze direction, indicating higher activity for angry expressions looking toward the subjects than those looking away from them. These results revealed the interaction between facial expression and gaze direction, and the involvement of the amygdala in this integrative process at least for angry expressions.

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Adams, R. B. Jr. (Tuffts Univ.)
Feed-forward versus feedback threat responses show differential attunement to clear versus ambiguous threat.

In this talk, I will first review behavioral evidence demonstrating a link between gaze and emotion processing, showing specifically that direct and averted gaze differentially enhance the perceived clarity and processing efficiency of anger and fear, respectively. From this work, it is evident that eye gaze provides a particularly advantageous way to manipulate threat clarity without altering facial morphology. Thus, we used gaze direction as a way to examine differential attunements of bottom-up versus top-down threat processing of clear (direct-gaze anger, averted-gaze fear) versus ambiguous (direct-gaze fear, averted-gaze anger) threat. Results from fMRI and ERP offer evidence that bottom-up responses are preferentially attuned to clear threat cues, whereas top-down responses are preferentially attuned to ambiguous threat cues. We propose that these preferential

sensitivities help threat perception achieve optimal adaptive functioning.