

COMPARATIVE COGNITION 2 – SPATIAL AND SOCIAL KNOWLEDGE AND REASONING

Essay (no 8 on the March 15th list)

“Apes cannot be taught language, but there is evidence that they have special abilities in the areas of social learning, imitation, and self-recognition.” Discuss.

1. Copies of selected Overheads are attached.
2. There are notes in the Easter Handout for Summer Term Lectures
3. Updated versions of these notes are given below.

“A third hypothesis proposes that *there are, in fact, neither quantitative nor qualitative differences among the intellects of non-human vertebrates.*” (Macphail, 1985; p.37)

Theoretical positions which assume differences in cognitive mechanisms available to different vertebrate species are summarised below.

Abstraction. Learning may be tied to specific physical stimuli to a greater or lesser extent. This is one way of characterising the position of Mackintosh (1988 and et al. 1985). Premack (1983) took the position that “only primates have abstract codes” and his 1986 view could be interpreted as an extension of this. Thompson and Oden (2000) and Vonk and Macdonald (2004) have re-iterated the position that abstract knowledge of ‘relations between relations’ is a speciality of great apes, but Fagot et al. (2001) found a method of demonstrating ‘abstract conceptualization’ in baboons, dolphins (Mercado et al, 2000) show evidence of generalising “same-different” relationships, and something behaviourally rather similar appears to be obtainable in honey bees (Giufra et al., 2001). However it is still often argued that primates have a greater abstract knowledge about physical objects than other mammals, and this makes sense in the context of the tool-using which takes place both in the wild and in the laboratory (Cunningham et al., 2006; Penn & Povinelli, 2007; Phillips & Santos, 2007; and see pp. 15 and 16).

Piagetian stages. Piagetian theories of mental development can be applied to species differences – although in most cases it is development only during the human sensory-motor period which is relevant. The theoretical content (Piaget, 1971) is less important than the use of Piagetian tests of cognitive attainment, mostly connected with the attainment of different levels of object permanence. Great apes appear to be closer to human infants in the development of this than other primate or mammalian species (Redshaw, 1978, Deblois and Nowak, 1994, Wise et al., 1974; Call, 2001b; Shumaker et al., 2001; Mendes and Huber, 2004; Beran et al., 2005; Gomez, 2005; Suda and Call, 2006; Matzuzawa, 2007).

Social skills. Although there are many other highly social vertebrates primate intelligence in particular has been related to the learning of social skills and strategies (e.g. Byrne and Whiten, 1988; Cheney and Seyfarth, 1992). This hypothesis is interesting but difficult to test (Kudo and Dunbar, 2001; Reader and Laland, 2002; de Waal and Davis, 2003, Deaner et al., 2005; Wich and de Vries, 2006; Pika and Mitani, 2006). Sub-categories of social skills include “theory of mind”, self-recognition, and imitation.

“Theory of Mind” hypotheses. These variants of “social skills” idea suppose that only some species have a functional concept of “self” (Gallup, 1970) or that only particular species (usually only the great apes) are able to make inferences or assumptions about the goals and intentions of conspecifics or human experimenters (Premack and Woodruff, 1978; Hare et al, 2001; Tomasello, Call and Hare, 2003). This has attracted extra interest because of the hypothesis that human autism is characterised by a lack of this capacity (e.g. Leslie, 1987). The social cognitive features of “shared-reference” (or “shared-attention”) and “proto-declarative” communicative acts have been proposed as important pre-conditions both for the development of a “theory of mind” and for the development of human language (Baron-

Cohen, 1992; Savage-Rumbaugh et al., 1983; see also Flombaum & Santos, 2005; Keysers & Perrett, 2004; Tomasello et al., 2005; Moll & Tomasello, 2007; Whiten, 2005)

Self-recognition, and interpretation of the behaviour of others. Naturalistic observation of groups of chimpanzees and vervet monkeys (Cheney and Seyfarth, 1992) suggests that individual animals come to possess a rich representation of their own social relationships to others in the group, and of the intentions and perspectives of other individuals. Laboratory tests indicate that chimpanzees, but no other non-human species tested until recently except orang-utans, recognise their own images in mirrors and video displays (Gallup, 1970; Menzel et al., 1985; Povinelli, 1989, Povinelli et al., 1993). It is suggested (e.g. Povinelli et al., 1990) that this ability may be related to a capacity for understanding how objects and events appear from another's perspective, the "mind-reading" (Whiten and Byrne, 1988) of another animal's (or a human experimenter's) intentions and the ability for deception or pretence about one's own intentions (Woodruff and Premack, 1979). However, these forms of social cognition may be interpreted as special purpose, species-specific adaptations for social organization, rather than aspects of general-purpose learning. (Seyfarth and Cheney, 2003). Some authors (e.g. Heyes, 1994, 1996, 1998) argue that there is no satisfactory evidence that primates have any special abilities in the area of social learning and imitation, or self-recognition, whereas primatologists typically believe the cognitive capacities of the monkeys and apes can be regarded as the precursors of human cognition (Whiten et al., 1999; Tomasello, 2000). It remains the general consensus that chimpanzees, and possible orang-utans, are more likely to show evidence of recognizing themselves in mirrors than other primates (Povinelli et al., 1993; Povinelli et al., 1997; Tomasello and Call, 1997). This is not necessarily inconsistent with evidence that other highly social and large brained animals, in particular dolphins and other toothed whales, and elephants, may have convergent cognitive abilities, including self-recognition in mirrors (Reiss and Marino, 2001, Plotnik et al., 2006).

Imitation. Especially given the argument that 'language-trained' apes such as Washoe and Nim Chimsky imitated their trainers, there is a surprising degree of difficulty in establishing to what extent apparent imitation in primates should count as true imitation as opposed to 'emulation' or social facilitation (see p. 17 for more detail on this). "Emulation" refers to behaviour that is influenced by observing goal achievement rather than the details of the actions preceding the goal. Imitation of action details is sometimes observed in chimpanzees (Whiten, 1998) and capuchins (Custance et al., 1999; see also Cunningham et al., 2006), but in general human infants are much more attentive to action details than non-human primates (Tennie et al., 2006). Observational learning of some kinds may occur in dogs (Topal et al., 2007) and therefore this should not be regarded as a capacity that is unique to primates.

Conclusions

- Even after extensive training, there appears to remain an immense gap between the linguistic abilities of trained apes and human infants. (Week 10)
- However, chimpanzees, and other great apes, are more similar to humans than other species in some non-linguistic cognitive abilities, such as those involved in object properties (and other Piagetian tests), social skills, and self-recognition (Week 11 – Call, 2001a, 2001b; Gomez, 2005; Povinelli et al., 1997; Whiten et al., 1999; Tomasello Call & Hare, 2003; Tomasello et al., 2005; Moll & Tomasello, 2007)

Main references

- Walker, S.F. (1985). *Animal Thought*. Routledge & Kegan Paul: London pp 305- 388
- Walker, S.F. (1987b). *Animal Learning*. Routledge & Kegan Paul: London. pp. 332- 357.
- Roberts, W.A (1998) *Principles of Animal Cognition*. Boston: McGraw-Hill. Chapter 12.(1 SLC; 4 loan copies)

Further Reading (Alternatives)

- Boysen, ST and Himes, GT (1999) Current issues and emerging theories in animal cognition. *Annual Review of Psychology*, Vol.50, Pp.683-705.
- Heyes, C.M. (1998) Theory of mind in nonhuman primates. *Behavioural and Brain Sciences*, 21, 108-148.
- Pearce J.M. (1997) *Animal Learning and Cognition* 2nd Edition. Hove: Psychology Press. Chapters 9.10 & 11, pp225-287
- Tomasello, M. (2000). Primate cognition: Introduction to the issue. *Cognitive Science*, 24(3), 351-361.

More Additional References (Not normally for further reading)

- Amodio, D. M., & Frith, C. D. (2006). Meeting of minds: the medial frontal cortex and social cognition. *Nature Review Neuroscience*, 7(4), 268-277.
- Anderson, U. S., Stoinski, T. S., Bloomsmith, M. A., & Maple, T. L. (2007). Relative numerosness judgment and summation in young, middle-aged, and older adult Orangutans (*Pongo pygmaeus abelii* and *Pongo pygmaeus pygmaeus*). *Journal of Comparative Psychology*, 121(1), 1-11.
- Baron-Cohen, S (1992) How monkeys do things with “words”. *Behavioural and Brain Sciences*, 15, 148-9.
- Behne, T., Carpenter, M., Call, J., & Tomasello, M. (2005). Unwilling versus unable: Infants' understanding of intentional action. *Developmental Psychology*, 41(2), 328-337.
- Beran, M. J. (2001). Summation and numerosness judgments of sequentially presented sets of items by chimpanzees (*Pan troglodytes*). *Journal of Comparative Psychology*, 115(2), 181-191.
- Beran, M. J., Beran, M. M., & Menzel, C. R. (2005). Spatial memory and monitoring of hidden items through spatial displacements by chimpanzees (*Pan troglodytes*). *Journal of Comparative Psychology*, 119(1), 14-22.
- Boesch, C., & Tomasello, M. (1998). Chimpanzee and human cultures. *Current Anthropology*, 39(5), 591-614.
- Bonnie, K. E., Horner, V., Whiten, A., & de Waal, F. B. M. (2007). Spread of arbitrary conventions among chimpanzees: a controlled experiment. *Proceedings of the Royal Society B-Biological Sciences*, 274(1608), 367-372.
- Boysen, ST, Berntson, GG, Shreyer, TA. and Hannan, MB (1995) Indicating acts during counting by a chimpanzee (*Pan troglodytes*). *Journal of Comparative Psychology*, Vol.109, No.1, Pp.47-51.
- Brannon, E.M. and Terrace, H.S. (1998) Ordering of the numerosities 1-9 by monkeys. *Science*, 282, 746-749.
- Brauer, J., Kaminski, J., Riedel, J., Call, J., & Tomasello, M. (2006). Making inferences about the location of hidden food: Social dog, causal ape. *Journal of Comparative Psychology*, 120(1), 38-47.
- Byrne, R. & Whiten, A (eds) (1988) *Machiavellian Intelligence: social expertise and the evolution of intellect in monkeys, apes and humans*. Oxford: Clarendon Press.
- Byrne, R. (1995) *The Thinking Ape : the evolutionary origins of intelligence*. Oxford : Oxford University Press
- Call, J. (2001a). Chimpanzee social cognition. *Trends in Cognitive Sciences*, 5(9), 388-393.
- Call, J. (2001b). Object permanence in orangutans (*Pongo pygmaeus*), chimpanzees (*Pan troglodytes*), and children (*Homo sapiens*). *Journal of Comparative Psychology*, 115(2), 159-171.
- Call, J., Hare, B., Carpenter, M., & Tomasello, M. (2004). 'Unwilling' versus 'unable': chimpanzees' understanding of human intentional action. *Developmental Science*, 7(4), 488-498.
- Cheney, D.L. and Seyfarth, R.M. (1992) Précis of *How monkeys see the world*. *Behavioural and Brain Sciences*, 15, 135-182.
- Cunningham, C. L., Anderson, J. R., & Mootnick, A. R. (2006). Object manipulation to obtain a food reward in hoolock gibbons, *Bunopithecus hoolock*. *Animal Behaviour*, 71, 621-629.
- Custance, D., Whiten, A., & Fredman, T. (1999). Social learning of an artificial fruit task in capuchin monkeys (*Cebus apella*). *Journal of Comparative Psychology*, 113(1), 13-23.
- Custance, DM, Whiten, A & Bard, KA (1995) Can young chimpanzees (*Pan-troglodytes*) imitate arbitrary actions – Hayes and Hayes (1952) revisited. *Behaviour*, Vol.132, 837-859
- de Waal, F. B. M., & Davis, J. M. (2003). Capuchin cognitive ecology: cooperation based on projected returns. *Neuropsychologia*, 41(2), 221-228.
- de Waal, F.B.M. and Berger, M. (2000) Payment for labour in monkeys. *Nature*, 404, 583.
- Deaner, R. O., Khera, A. V., & Platt, M. L. (2005). Monkeys pay per view: Adaptive valuation of social images by rhesus macaques. *Current Biology*, 15(6), 543-548.
- Deblois, ST. and Novak, MA (1994) Object permanence in rhesus-monkeys (*Macaca-mulatta*). *Journal of Comparative Psychology*, Vol.108, No.4, Pp.318-327

- Dehaene, S., Dehaene-Lambertz, G., & Cohen, L. (1998). Abstract representations of numbers in the animal and human brain. *Trends in Neurosciences*, 21(8), 355-361.
- Dore, F.Y. (1986) Object permanence in adult cats (*Felis catus*) *Journal of Comparative Psychology*, 100, 340-47.
- Dumas, C. (1992) Object permanence in cats (*Felis catus*): An ecological approach to the study of invisible displacements. *Journal of Comparative Psychology*, 106, 404-10
- Eddy, TJ, Gallup, GG and Povinelli, DJ (1996) Age-differences in the ability of chimpanzees to distinguish mirror- images of self from video images of others. *Journal of Comparative Psychology*, Vol.110, No.1, Pp.38-44
- Elston, G. N., Benavides-Piccione, R., & DeFelipe, J. (2001). The pyramidal cell in cognition: A comparative study in human and monkey. *Journal of Neuroscience*, 21(17), U1-U5.
- Epstein, R., Lanza, R.P. and Skinner, B.F. (1981) "Self-awareness" in the pigeon. *Science*, 212, 694-5.
- Fagot, J., Wasserman, E. A., & Young, M. E. (2001). Discriminating the relation between relations: The role of entropy in abstract conceptualization by baboons (*Papio papio*) and humans (*Homo sapiens*). *Journal of Experimental Psychology-Animal Behavior Processes*, 27(4), 316-328.
- Flombaum, J. I., & Santos, L. R. (2005). Rhesus monkeys attribute perceptions to others. *Current Biology*, 15(5), 447-452.
- Gallistel, C.R. (1990) *The Organization of Learning*. Cambridge, Mass.: MIT Press
- Gallistel, C.R. and Gelman, R. (2000) Non-verbal numerical cognition: from reals to integers. *Trends in Cognitive Sciences*, 4, 59-65.
- Gallup, G.G., Jr. (1970) Chimpanzees: self-recognition. *Science*, 167, 86-7.
- Giurfa, M., Zhang,S., Jenett,A., Menzel,R. & Srinivasan, M.V. (2001) The concepts of 'sameness' and 'difference' in an insect *Nature* 410, 930 - 933
- Gomez, J. C. (2005). Species comparative studies and cognitive development. *Trends in Cognitive Sciences*, 9(3), 118-125.
- Hare, B., Addessi, E., Call, J., Tomasello, M., & Visalberghi, E. (2003). Do capuchin monkeys, *Cebus apella*, know what conspecifics do and do not see? *Animal Behaviour*, 65, 131-142.
- Hare, B., Brown, M., Williamson, C., & Tomasello, M. (2002). The domestication of social cognition in dogs. *Science*, 298(5598), 1634-1636.
- Hare, B., Call, J., & Tomasello, M. (2001). Do chimpanzees know what conspecifics know? *Animal Behaviour*, 61, 139-151.
- Hare, B., Plyusnina, I., Ignacio, N., Schepina, O., Stepika, A., Wrangham, R., & Trut, L. (2005). Social cognitive evolution in captive foxes is a correlated by- product of experimental domestication. *Current Biology*, 15(3), 226-230.
- Hauser, M., & Spaulding, B. (2006). Wild rhesus monkeys generate causal inferences about possible and impossible physical transformations in the absence of experience. *Proceedings of the National Academy of Sciences of the United States of America*, 103(18), 7181-7185.
- Hauser, M.D., MacNeilage, P. and Ware, M. (1996) Numerical representations in primates. *Proceedings of the National Academy of Sciences of the United States of America*, 93, 1514-1517.
- Heyes, C. (2001). Causes and consequences of imitation. *Trends in Cognitive Sciences*, 5(6), 253-261.
- Heyes, CM (1996) Self-recognition in primates - irreverence, irrelevance and irony. *Animal Behaviour*, Vol.51, No.Pt2, Pp.470-473 (copy in Short Loan collection)
- Holekamp, K. E. (2007). Questioning the social intelligence hypothesis. *Trends in Cognitive Sciences*, 11(2), 65-69.
- Humle, T., & Matsuzawa, T. (2004). Oil palm use by adjacent communities of chimpanzees at Bossou and Nimba Mountains, West Africa. *International Journal of Primatology*, 25(3), 551-581.
- Inoue-Nakamura, N, & Matsuzawa, T (1997) Development of stone tool use by wild chimpanzees (*Pan troglodytes*). *Journal of Comparative Psychology*, Vol.111, No.2, Pp.159-173.
- Jensen, K., Hare, B., Call, J., & Tomasello, M. (2006). What's in it for me? Self-regard precludes altruism and spite in chimpanzees. *Proceedings of the Royal Society B-Biological Sciences*, 273(1589), 1013-1021.
- Jolly, A. (1966) Lemur social behaviour and primate intelligence. *Science*, 153, 501-6.
- Kawai, N., & Matsuzawa, T. (2000). Cognition - Numerical memory span in a chimpanzee. *Nature*, 403(6765), 39-40.
- Keyser, C., & Perrett, D. I. (2004). Demystifying social cognition: a Hebbian perspective. *Trends in Cognitive Sciences*, 8(11), 501-507.
- Kudo, H., & Dunbar, R. I. M. (2001). Neocortex size and social network size in primates. *Animal Behaviour*, 62, 711-722.
- Leslie, A.M. (1987) Pretence and representation: The origins of "theory of mind". *Psychological Review*, 94, 412-26.
- Limongelli, L, Boysen, ST, Visalberghi, E (1995) Comprehension of cause-effect relations in a tool-using task by chimpanzees (*Pan-troglodytes*). *Journal of Comparative Psychology*, Vol.109, No.1, Pp.18-26 Is: 0735-7036.
- Marino, L. (2002). Convergence of complex cognitive abilities in cetaceans and primates. *Brain Behavior and Evolution*, 59(1-2), 21-32.
- Matsuzawa, T. (1985) Use of numbers by a chimpanzee. *Nature*, 315, 57-59.
- Matsuzawa, T. (2007). Comparative cognitive development. *Developmental Science*, 10(1), 97-103.
- Mendes, N., & Huber, L. (2004). Object permanence in common marmosets (*Callithrix jacchus*). *Journal of Comparative Psychology*, 118(1), 103-112.
- Menzel, C. R. (1999). Unprompted recall and reporting of hidden objects by a chimpanzee (*Pan troglodytes*) after extended delays. *Journal of Comparative Psychology*, 113(4), 426-434.
- Menzel, E.W., Jr., Savage-Rumbaugh, E.S. and Lawson, J. (1985) Chimpanzee (*Pan troglodyte*) spatial problem solving with the used of mirrors and televised equivalents of mirrors. *Journal of Comparative Psychology*, 99, 211-217.
- Mercado, E., Killebrew, D. A., Pack, A. A., Macha, I. V. B., & Herman, L. M. (2000). Generalization of 'same-different' classification abilities in bottlenosed dolphins. *Behavioural Processes*, 50(2-3), 79-94.

- Moll, H., & Tomasello, M. (2007). Cooperation and human cognition: the Vygotskian intelligence hypothesis. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 362(1480), 639-648.
- Nakahara, K., Adachi, Y., Osada, T., & Miyashita, Y. (2007). Exploring the neural basis of cognition: multi-modal links between human fMRI and macaque neurophysiology. *Trends in Cognitive Sciences*, 11(2), 84-92.
- Nieder, A. (2005). Counting on neurons: The neurobiology of numerical competence. *Nature Reviews Neuroscience*, 6(3), 1-14.
- Pack, A. A., & Herman, L. M. (2007). The dolphin's (*Tursiops truncatus*) understanding of human gazing and pointing: Knowing what and where. *Journal of Comparative Psychology*, 121(1), 34-45.
- Papademetriou, E., Sheu, C. F., & Michel, G. F. (2005). A meta-analysis of primate hand preferences, particularly for reaching. *Journal of Comparative Psychology*, 119(1), 33-48.
- Penn, D. C., & Povinelli, D. J. (2007). Causal cognition in human and nonhuman animals: A comparative, critical review. *Annual Review of Psychology*, 58, 97-118.
- Pepperberg, IM, Garcia, SE, Jackson, EC and Marconi, S (1995) Mirror use by African grey parrots (*Psittacus-erithacus*). *Journal of Comparative Psychology*, Vol.109, No.2, Pp.182-195
- Phillips, W., & Santos, L. R. (2007). Evidence for kind representations in the absence of language: Experiments with rhesus monkeys (*Macaca mulatta*). *Cognition*, 102(3), 455-463.
- Pika, S., & Mitani, J. (2006). Referential gestural communication in wild chimpanzees (*Pan troglodytes*). *Current Biology*, 16(6), R191-R192.
- Plotnik, J. M., de Waal, F. B. M., & Reiss, D. (2006). Self-recognition in an Asian elephant. *Proceedings of the National Academy of Sciences of the United States of America*, 103(45), 17053-17057.
- Povinelli, D.J. (1989) Failure to find self-recognition in Asian elephants (*Elephas maximus*) in contrast to their use of mirror cues to discover hidden food. *Journal of Comparative Psychology*, 103, 122-131
- Povinelli, D.J., Rulf, A.B. and Bierschwale, D.T. (1994) Absence of knowledge attribution and self-recognition in young chimpanzees (*Pan-troglodytes*). *Journal of Comparative Psychology*, 108, 74-80.
- Povinelli, D.J., Rulf, A.B., Landau, K.R., and Bierschwale, D.T. (1993) Self-recognition in chimpanzees (*Pan troglodytes*): distribution, ontogeny and patterns of emergence. *Journal of Comparative Psychology*, 107, 347-372.
- Povinelli, DJ, Gallup, GG, Eddy, TJ, Bierschwale, DT, Engstrom, MC, Perilloux, HK. and Toxopeus, IB (1997) Chimpanzees recognize themselves in mirrors *Animal Behaviour*, Vol.53, No.Pt5, Pp.1083-1088.
- Povinelli, DJ, Preuss, TM (1995) Theory of mind - evolutionary history of a cognitive specialization. *Trends in Neurosciences*, Vol.18, No.9, Pp.418-424.
- Premack, D. and Woodruff, G. (1978) Does the chimpanzee have a theory of mind? *Behavioural and Brain Sciences*, 4, 515-526.
- Reader, S. M., & Laland, K. N. (2002). Social intelligence, innovation, and enhanced brain size in primates. *Proceedings of the National Academy of Sciences of the United States of America*, 99(7), 4436-4441.
- Redshaw, M. (1978) Cognitive development in human and gorilla infants. *Journal of Human Evolution*, 7, 133-41. (Short Loan Collection).
- Reiss, D., and Marino L. (2001) Mirror self-recognition in the bottlenose dolphin: A case of cognitive convergence. *Proceedings of the National Academy of Sciences of the United States of America*, 98, no 10(May 1). 5937-5942
- Rizzolatti, G., & Craighero, L. (2004). The mirror-neuron system. *Annual Review of Neuroscience*, 27, 169-192.
- Russon, AE and Galdikas, BMF (1993) Imitation in free-ranging rehabilitant orangutans (*Pongo-pygmaeus*). *Journal of Comparative Psychology*, Vol.107, No.2, Pp.147-161
- Santos, L. R. (2005). Primate cognition: Putting two and two together. *Current Biology*, 15(14), R545-R547.
- Sawamura, H., Shima, K., & Tanji, J. (2002). Numerical representation for action in the parietal cortex of the monkey. *Nature*, 415(6874), 918-922.
- Schino, G. (2007). Grooming and agonistic support: a meta-analysis of primate reciprocal altruism. *Behavioral Ecology*, 18(1), 115-120.
- Seyfarth, R. M., & Cheney, D. L. (2003). Signalers and receivers in animal communication. *Annual Review of Psychology*, 54, 145-173.
- Shumaker, R. W., Palkovich, A. M., Beck, B. B., Guagnano, G. A., & Morowitz, H. (2001). Spontaneous use of magnitude discrimination and ordination by the orangutan (*Pongo pygmaeus*). *Journal of Comparative Psychology*, 115(4), 385-391.
- Silk, J. B., Brosnan, S. F., Vonk, J., Henrich, J., Povinelli, D. J., Richardson, A. S., et al. (2005). Chimpanzees are indifferent to the welfare of unrelated group members. *Nature*, 437(7063), 1357-1359.
- Suda, C., & Call, J. (2004). Piagetian liquid conservation in the Great Apes (*Pan paniscus*, *Pan troglodytes*, and *Pongo pygmaeus*). *Journal of Comparative Psychology*, 118(3), 265-279
- Suda, C., & Call, J. (2006). What does an intermediate success rate mean? An analysis of a Piagetian liquid conservation task in the great apes. *Cognition*, 99(1), 53-71.
- Sulkowski, G. M., & Hauser, M. D. (2001). Can rhesus monkeys spontaneously subtract? *Cognition*, 79(3), 239-262.
- Tennie, C., Call, J., & Tomasello, M. (2006). Push or pull: Imitation vs. Emulation in great apes and human children. *Ethology*, 112(12), 1159-1169.
- Thompson, R. K. R., & Oden, D. L. (2000). Categorical perception and conceptual judgments by nonhuman primates: The paleological monkey and the analogical ape. *Cognitive Science*, 24(3), 363-396.

- Tomasello, M., Call, J., Hare, B. (1998) Five primate species follow the visual gaze of conspecifics. *Animal Behaviour*, Vol.55, No.Pt4, Pp.1063-1069.
- Tomasello, M. (1998). Uniquely primate, uniquely human. *Developmental Science*, 1(1), 1-16.
- Tomasello, M. (2001). Cultural transmission - A view from chimpanzees and human infants. *Journal of Cross-Cultural Psychology*, 32(2), 135-146.
- Tomasello, M. and Call, J. (1997) *Primate Cognition*. Oxford: Oxford University Press. (599.81513 TOM – I week loan)
- Tomasello, M., & Carpenter, M. (2007). Shared intentionality. *Developmental Science*, 10(1), 121-125.
- Tomasello, M., & Rakoczy, H. (2003). What makes human cognition unique? From individual to shared to collective intentionality. *Mind & Language*, 18(2), 121-147.
- Tomasello, M., Call, J., & Hare, B. (2003). Chimpanzees understand psychological states – the question is which ones and to what extent. *Trends in Cognitive Sciences*, 7(4), 153-156.
- Tomasello, M., Carpenter, M., Call, J., Behne, T., & Moll, H. (2005). Understanding and sharing intentions: The origins of cultural cognition. *Behavioral and Brain Sciences*, 28(5), 675-+.
- Tomasello, M., Hare, B., & Agnetta, B. (1999). Chimpanzees, *Pan troglodytes*, follow gaze direction geometrically. *Animal Behaviour*, 58, 769-777.
- Topal, J., Byrne, R. W., Miklosi, A., & Csanyi, V. (2006). Reproducing human actions and action sequences: "Do as I Do!" in a dog. *Animal Cognition*, 9(4), 355-367.
- Visalberghi, E., Frigaszy, DM, Savage-Rumbaugh, S (1995) Performance in a tool-using task by common chimpanzees (*Pan-troglodytes*), bonobos (*Pan-paniscus*), an orangutan (*Pongo-pygmaeus*), and capuchin monkeys (*Cebus-apella*). *Journal of Comparative Psychology*, Vol.109, No.1, Pp.5260.
- Vonk, J., & MacDonald, S. E. (2004). Levels of abstraction in orangutan (*Pongo abelii*) categorization. *Journal of Comparative Psychology*, 118(1), 3-13.
- Waller, B. M., Vick, S. J., Parr, L. A., Bard, K. A., Pasqualini, M. C. S., Gothard, K. M., et al. (2006). Intramuscular electrical stimulation of facial muscles in humans and chimpanzees: Duchenne revisited and extended. *Emotion*, 6(3), 367-382.
- Want, S. C., & Harris, P. L. (2001). Learning from other people's mistakes: Causal understanding in learning to use a tool. *Child Development*, 72(2), 431-443.
- Want, S. C., & Harris, P. L. (2002). How do children ape? Applying concepts from the study of non- human primates to the developmental study of 'imitation' in children. *Developmental Science*, 5(1), 1-13.
- Warneken, F., Chen, F., & Tomasello, M. (2006). Cooperative activities in young children and chimpanzees. *Child Development*, 77(3), 640-663.
- Warneken, F., & Tomasello, M. (2006). Altruistic helping in human infants and young chimpanzees. *Science*, 311(5765), 1301-1303.
- Whiten, A (1998) Imitation of the sequential structure of actions by chimpanzees(*pan troglodytes*). *Journal of Comparative Psychology*, Vol.112, No.3, Pp.270281.
- Whiten, A, Custance, DM, Gomez, JC, et al., (1996) Imitative learning of artificial fruit processing in children (*Homo-sapiens*) and chimpanzees (*Pan-troglodytes*). *Journal of Comparative Psychology*, Vol.110, No.1, Pp.3-14.
- Whiten, A. (1998) Imitation of the sequential structure of actions by chimpanzees (*Pan troglodytes*) *Journal of Comparative Psychology*, 112, 270-281
- Whiten, A. (2000). Primate culture and social learning. *Cognitive Science*, 24(3), 477-508.
- Whiten, A. (2005). The second inheritance system of chimpanzees and humans. *Nature*, 437(7055), 52-55.
- Whiten, A. and Byrne, R.W. (1988) Tactical deception in primates. *Behavioural and Brain Sciences*, 11, 233-273.
- Whiten, A., & Byrne R, W. (1997). *Machiavellian Intelligence II : Extensions and Evaluations*. Cambridge: Cambridge University Press. (Senate House 67 IQD Mac)
- Whiten, A., Goodall, J., McGrew, W. C., Nishida, T., Reynolds, V., Sugiyama, Y., Tutin, C. E. G., Wrangham, R. W., & Boesch, C. (1999). Cultures in chimpanzees. *Nature*, 399(6737), 682-685
- Whiten, A., Horner, V., & de Waal, F. B. M. (2005). Conformity to cultural norms of tool use in chimpanzees. *Nature*, 437(7059), 737-740.
- Wich, S. A., & de Vries, H. (2006). Male monkeys remember which group members have given alarm calls. *Proceedings of the Royal Society B-Biological Sciences*, 273(1587), 735-740.
- Wise, K.L., Wise, L.A. and Zimmermann, R.R. (1974) Piagetian object permanence in the infant rhesus monkey. *Developmental Psychology*, 10, 429-37.
- Zentall, T. R. (2006). Imitation: definitions, evidence, and mechanisms. *Animal Cognition*, 9(4), 335-353.

Critics of the 3rd position (chimpanzees are special) say two kinds of thing:

1) Evidence of exceptional abilities in apes is sometimes weak and/or anecdotal (Heyes, 1998);

2) Other species can in fact do just as well as chimpanzees e.g.

Epstein, R., Lanza, R.P. and Skinner, B.F. (1981) "Self-awareness" in the pigeon. *Science*, 212, 694-5. (listed on the Easter handout. Abstract: Three adult White Carneaux pigeons used a mirror to locate a spot on their bodies that they could not see directly. Although similar behavior in primates has been attributed to a self-concept or other cognitive process, the present example suggests an account in terms of environmental events)

Pepperberg, IM, Garcia, SE, Jackson, EC and Marconi, S (1995) Mirror use by African grey parrots (*Psittacus-erithacus*). *Journal of Comparative Psychology*, Vol.109, No.2, Pp.182-195

Reiss, D., and Marino L. (2001) Mirror self-recognition in the bottlenose dolphin: A case of cognitive convergence. *Proceedings of the National Academy of Sciences of the United States of America*, 98, no 10(May 1). 5937-5942

Heyes, CM (1998) Theory of mind in nonhuman primates. *Behavioural and Brain Sciences*, 21, 108-148

Abstract

Since Premack and Woodruff (1978) asked 'Does the chimpanzee have a theory of mind?' it has been claimed repeatedly that there is observational and experimental evidence that nonhuman apes have mental state concepts, such as 'want' and 'know'.

However, unlike research on the development of theory of mind in childhood, no substantial process has been made through this work with nonhuman primates.

A survey of empirical studies of

- imitation,
- self-recognition,
- social relationships,
- deception,
- role-taking
- and perspective-taking

suggests that, in every case where nonhuman primate behaviour has been interpreted as a sign of theory of mind, it could instead have occurred by chance or as a product of nonmentalistic processes such as associative learning or inferences based on nonmental categories.

Thompson, RKR, Oden, DL. and Boysen, ST (1997) Language-naive chimpanzees (*Pan troglodytes*) judge relations between relations in a conceptual matching-to-sample task. *Journal of Experimental Psychology-Animal Behavior Processes*, Vol.23, No.1, Pp.31-43.

Task 1: Physical matching.

If presented with sample MM, choose 'MM' not 'NO'

Task 2: Relational matching

If presented with sample AA choose 'BB' not 'CD'

and

If presented with sample EF choose 'CD' not 'BB'

5 chimpanzees, one of which was juvenile male with little previous experience.

One adult was Sarah, previously trained by Premack (e.g.1976). Sheba, Darrel and Kermit had a long history of using tokens and object pairs

Apparatus and stimuli. Real objects were display on a shelf and were visible through a window. Digitized images of the alternative choice pairs were presented on a color computer monitor. Rewards (candies) were delivered through a tube, only for physical matching.

Examples of objects are a yellow talcum powder can and a green tin cup

Results. The four adult animals were all between 75% and 95% correct in all cases

Abstract

Three chimpanzees with a history of conditional and numeric token training spontaneously matched relations between relations under conditions of nondifferential reinforcement. Heretofore, this conceptual ability was demonstrated only in language-trained chimpanzees. The performance levels of the language-naive animals in this study, however, were equivalent to those of a 4th animal-Sarah whose history included language training and analogical problem solving. There was no evidence that associative factors mediated successful performance in any of the animals. Prior claims of a profound disparity between language-trained and language-naive chimpanzees apparently can be attributed to prior experience with arbitrary tokens consistently associated with abstract relations and not language per se.

Tomasello, M. (2000). Primate cognition: Introduction to the issue. *Cognitive Science*, 24(3), 351-361.

Abstract: I introduce the special issue by: (1) outlining something of the relationship between mainstream cognitive science and the study of nonhuman primate cognition; (2) providing a brief overview of the scientific study of primate cognition and how the papers of this special issue fit into that scientific paradigm; and (3) explicating my own views about the relationship between nonhuman primate cognition and human cognition.

Some notes

Human cognition is a specific instance of primate cognition.

p351 “human cognition is thus not just similar to primate cognition, it is identical in many of its structures.” p. 351.

p 356. TWO HYPOTHESES

Tomasello and Call (1997) argued that only primates form relational categories. Quote discrimination learning expts plus knowledge of social relationships. The evolutionary argument is that relational categories developed to deal with social relationships, as in Humphrey (1976)

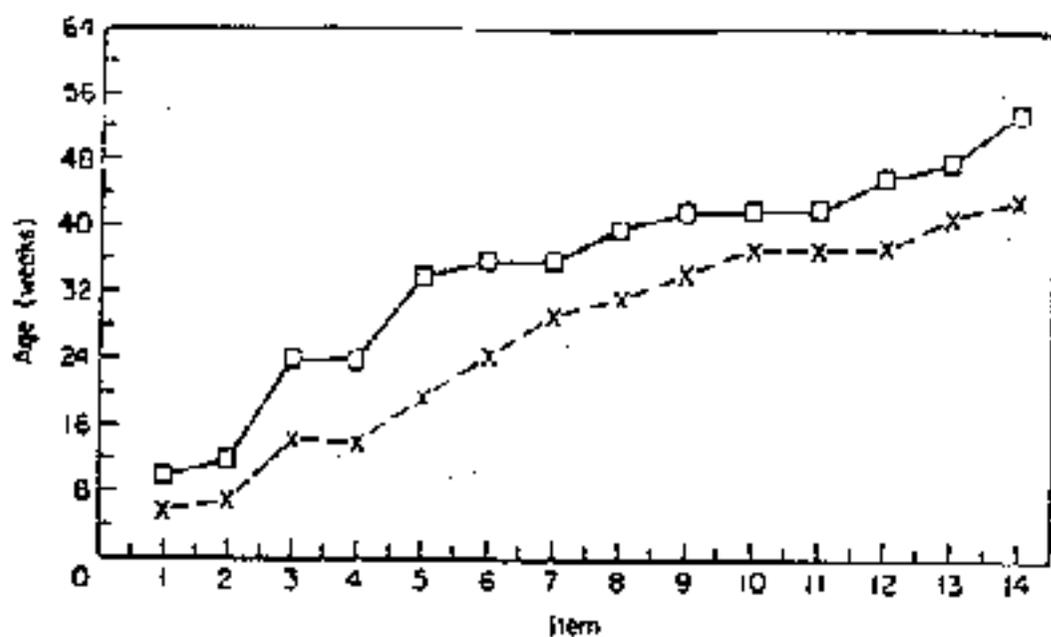
But humans are unique because they understand “intentionality in the social domain and causality in the physical domain.”

Following Vygotsky (1978) and other cultural psychologists, “what makes human cognition unique, more than anything else, is its collective nature.”

Thompson and Oden start with the following quotation from a book on sameness (1995) by RM French.

“I hope to have given you a better appreciation of our remarkable --- yet largely unconscious and virtually automatic --- ability to perceive one place or object or situation, however vast or insignificant, as “the same” as some other. It is this subtle ability, perhaps more than any other, that sets human cognition apart from any other on our planet”

Figure 1. Visual pursuit and object permanence.
Human; —□—
Gorilla; —X—



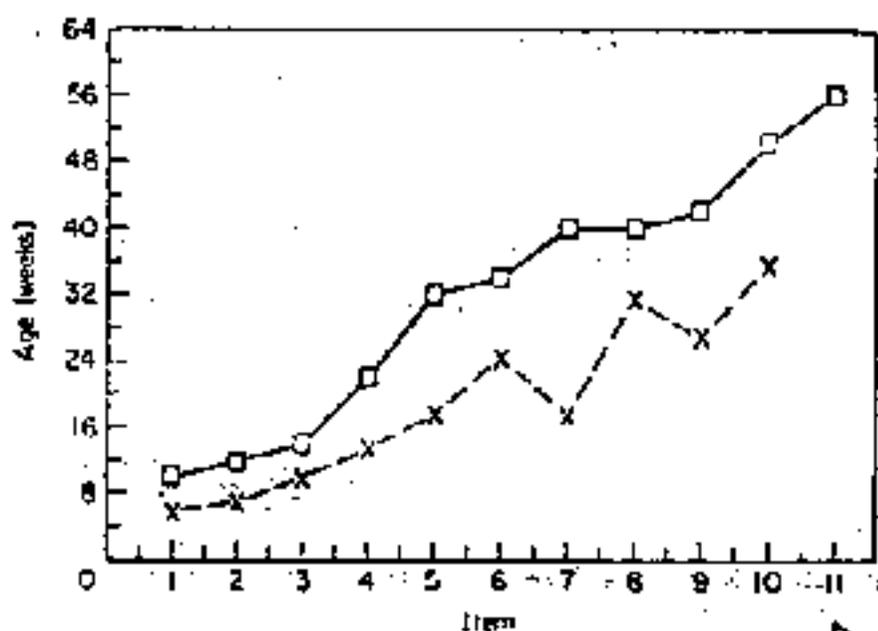
Redshaw (1979)
page 10

Table 1

Scale I: The development of visual pursuit and object permanence

Step	Subject's age in weeks							
	Gorilla					Human		
	A	M	Z	T	Mean	O	S	Mean
1. Follows a slowly moving object through 180° arc smoothly	6	6	6	6	6	10	10	10
2. Gaze lingers at the point of disappearance of a slowly moving object	10	6	6	6	7	10	14	12
3. Finds an object which is partially hidden	14	11	16	14	14.5	26	22	24
4. Gaze returns to starting point on disappearance of a slowly moving object	14	14	16	14	14.5	22	26	24
5. Finds an object which is completely covered by one screen	13	18	24	18	19.5	34	34	34
6. Finds an object which is hidden under one of two screens	22	22	32	22	24.5	38	34	36
7. Finds an object hidden under one of three screens	30	30	32	26	30.5	38	34	36
8. Finds an object hidden under a number of superimposed screens	30	34	32	30	31.5	38	42	40
9. Finds an object following a visible displacement under one of the three screens	34	38	32	34	34.5	42	42	42
10. Finds an object following an invisible displacement under a single screen	38	38	36	30	37.5	42	42	42
11. Finds an object following an invisible displacement under one of two screens	38	38	36	38	37.5	42	42	42
12. Finds an object following one invisible displacement with two screens alternated	38	38	36	38	37.5	46	46	46
13. Finds an object following one invisible displacement under one of three screens	42	42	40	42	41.5	50	46	48
14. Finds an object following a series of invisible displacements under three screens	42	46	44	42	43.5	54	54	54

Figure 2. Means-end behaviour.
Human; —□—
Gorilla; —X—



REDSHAW (1978)

NOT using stick to reach horizontally

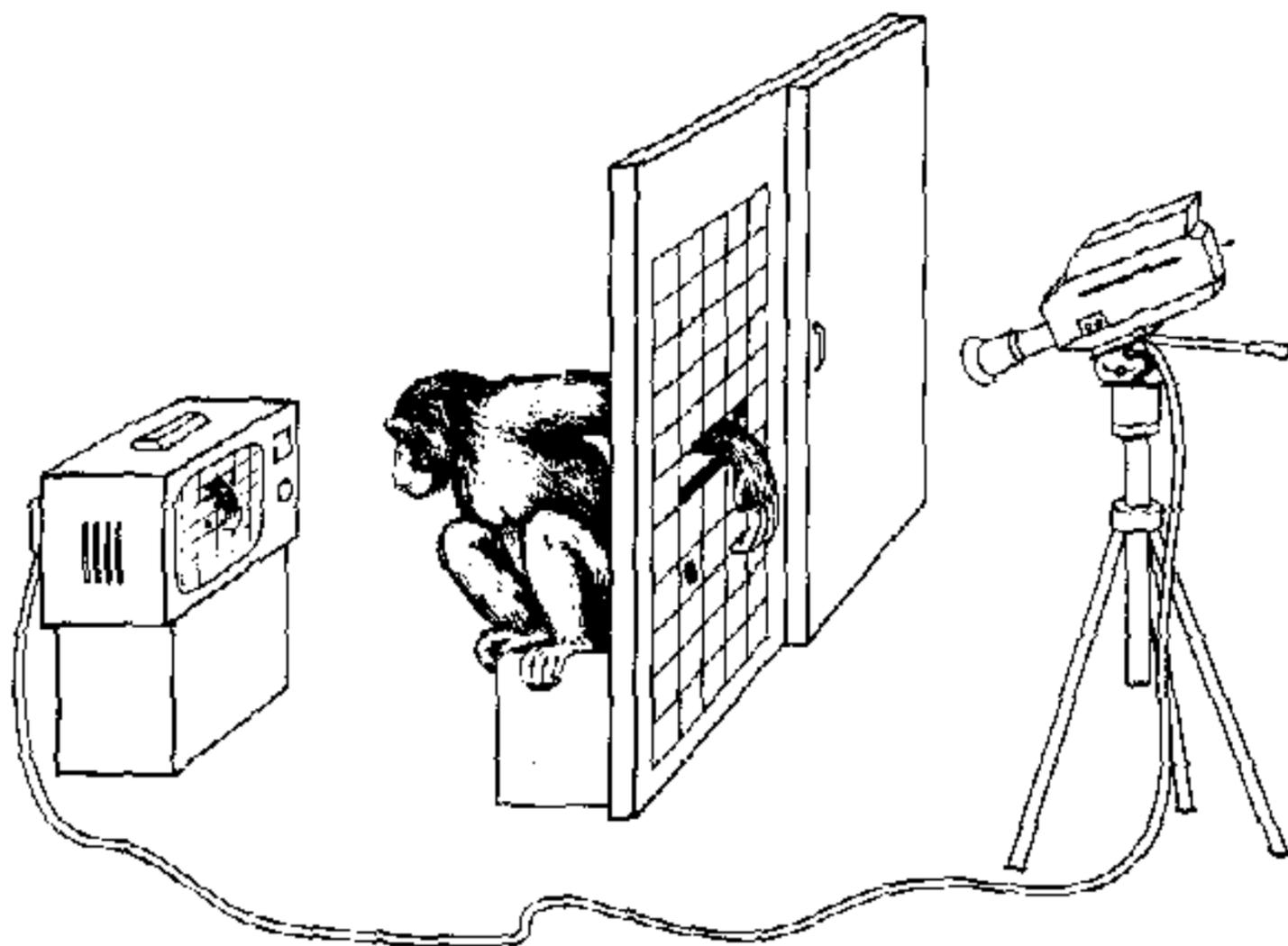


Figure 1. A schematic diagram of one of the tests for chimpanzees. (The position of the video monitor was varied periodically; typically, it was closer to the door and parallel to it. For purposes of illustration, the sliding door is shown, but actually it was between the animal and the panel on which the target dot is located.)

Procedure

To test the animals formally, we placed them in a room that contained only a small hole in one wall; positioned a large, high-quality mirror outside the room, directly facing this hole; and then (with the hole temporarily covered, so that the animals could not see what we were doing) stuck a piece of fruit on the outside of the wall. The fruit was placed in a different location on every trial, and the mirror was periodically moved to a different distance or angle. From the first trial, and throughout the test, each animal immediately detected the fruit by use of the mirror, visually tracked its hand in the mirror, and thus made manual contact with the food within a few seconds.

After a few sessions on this test of mirror-guided reaching, we went on to test them with televised variations on the same task, which afford much more sophisticated and informative controls (cf. Smith & Smith, 1962). Figure 1 shows one of the setups. One or more color monitors with 23 × 18 cm screens were located in the animals' room near a doorway equipped with double sliding doors. The camera was in an adjacent room; its picture covered an area about 160 × 120 cm. An experimenter stayed with the animals to protect the equipment but was not informed as to place where the target object would be located and sat behind the monitor. A second experimenter placed the target (food initially, then a 2-cm spot of black ink) on the backside of the door and operated one of the sliding doors; the other door had a hole in it (33 × 10 cm) through which the animals could reach. The monitor was turned off between trials and until the second experimenter was out of the picture. The animals were given no signal when they had contacted the ink spot;

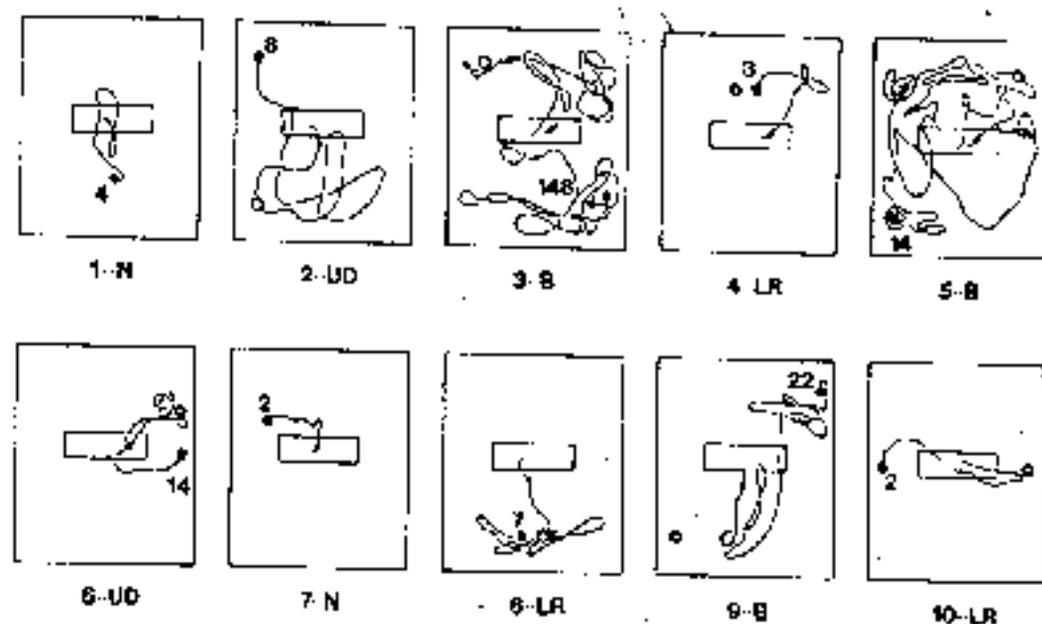
to get food, they stopped working and extended their hands toward the second experimenter. (Although we gave them food whenever we judged that any portion of their hands could possibly have touched the spot, they almost always persisted until they had produced a smudging of the spot, which was clearly discernible on the video picture, if they had not erased the spot completely.) Up to 50 trials were given in a session; most sessions were spaced 1 week apart.

Results

It is most unlikely that the chimpanzees could perceive the ink spots or even discern when they touched them except by visual information from the video monitor. (Nor could we do so ourselves, when we tried the same tasks.) However, on the first trial on which we introduced the ink spots, each animal immediately withdrew his hand on making contact with the spot and (in the same motion) sniffed and then looked at his fingers. This is precisely what Gallup's (1970, 1982) chimpanzees did in tests in which the target spot was on their own faces. It is also very different from what our animals did in other situations after seeing an object other than their own hand—say a stick—touch a strange object. There they did not sniff their hand but

AUSTIN

(Menzel et al., 1985; page 12)



SHERMAN

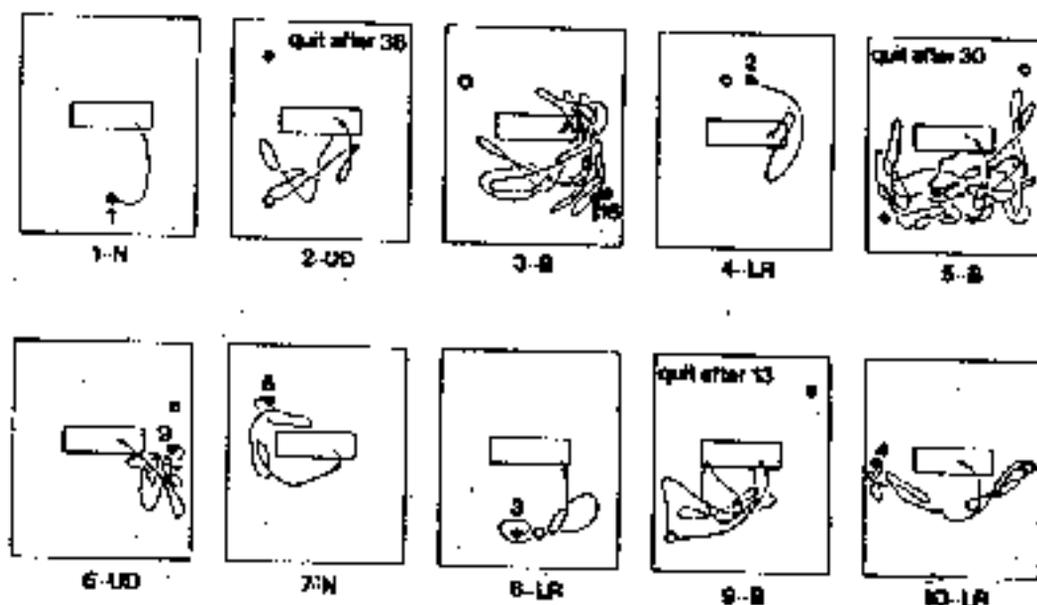


Figure 2. Performances of each of the 2 chimpanzees on their first 10 trials of a session involving video images that were "normal" (N), reversed 180° left to right (LR), inverted 180° (UD), or both reversed and inverted (B). (Each panel shows a rough map of the movements of the chimpanzee's reaching hand on a single trial and latency [in seconds] to first contact the target spot. Solid circles show the actual location of the target; open circles, the apparent location of the target; arrows, the direction of the chimpanzee's initial move.)

rather the part of the object that had made the contact.

Figure 2 shows the first 10 (of 20) trials of one session in which we presented, in quasi-randomized order on a single monitor, a "normal" video image, an image that was reversed laterally (like an ordinary mirror), an image that was inverted 180°, and an image that was both reversed laterally and inverted. Inasmuch as there was (from

one trial to the next) a zero correlation between the loci of the images of the target spots on the monitor and the loci of the "real" targets on the backside of the door, there was no way for the animals to solve this task without moving their hand in whatever way it took to bring its image into contact with that of the target. As the figure reveals, the animals usually started to reach in the direction of the apparent locus of the



Figure 1. Apparatus used to present stimulus pairs to the orangutans.

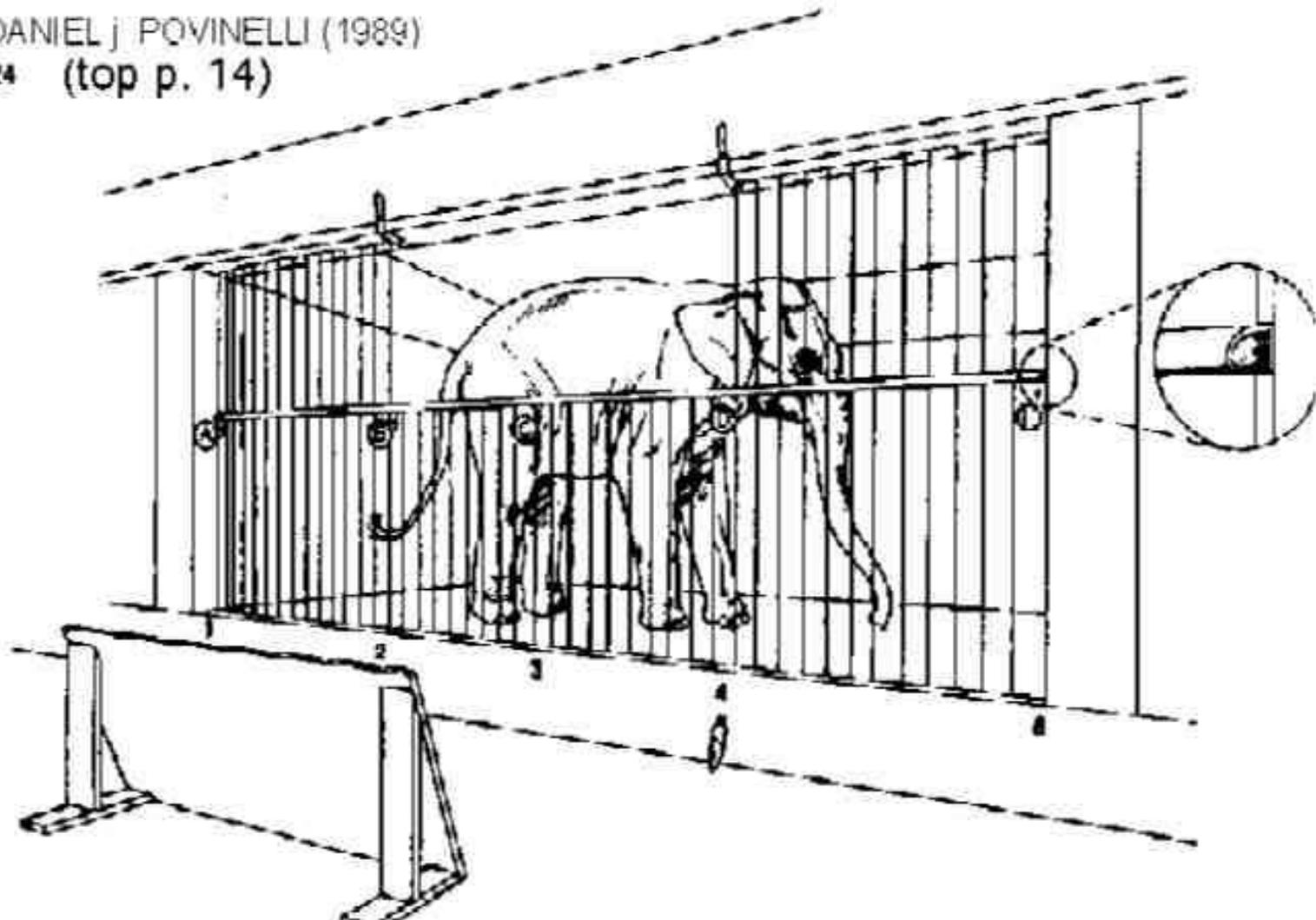


Figure 1 A schematic and location of hidden food items. The positions labeled 1-5 were the locations used for hiding food items in the left enclosure, and A-E mark the positions hidden in the right enclosure. For purposes of simplicity both positions are shown here in the left enclosure. The two novel locations used in the transfer trials are marked above the animal's head by the small boxes.

Povinelli et al 1993

SELF-RECOGNITION IN CHIMPANZEES

on page 14

351

behaviors, which did not meet the formal definitions. Figure 1 provides examples of compelling instances of each of these behaviors.

Examples of weak CF behaviors included certain instances of an animal's lip smacking, sucking on the caging wire while manipulating the lips or tongue, and alternately glancing into the mirror, as well as mild facial contortions seen in other contexts. Examples of weak bouts of CB included an animal's waving its arms in front of the mirror without looking continuously into the mirror or watching itself in the mirror while performing some nonrepetitive action.

Finally, weak bouts of SE were recorded in cases when a chimpanzee was observed scratching its face, head, nose, or body while engaging in VE of the mirror and in cases when a subject actively groomed a part of its body that it could see directly while it alternately glanced into the mirror.

A focal-mirror sampling procedure was also used to record all instances of SE, CF, and CB behaviors not captured on focal-subject records. The subject, type of behavior and a brief description, estimated duration of the behavior in seconds, and the time of no-





Figure 1. Nut cracking by chimpanzees in the outdoor laboratory.

bottom of p. 15

(1995)

D. Povinelli and T. Preuss – Evolution of theory of mind

CORTEX

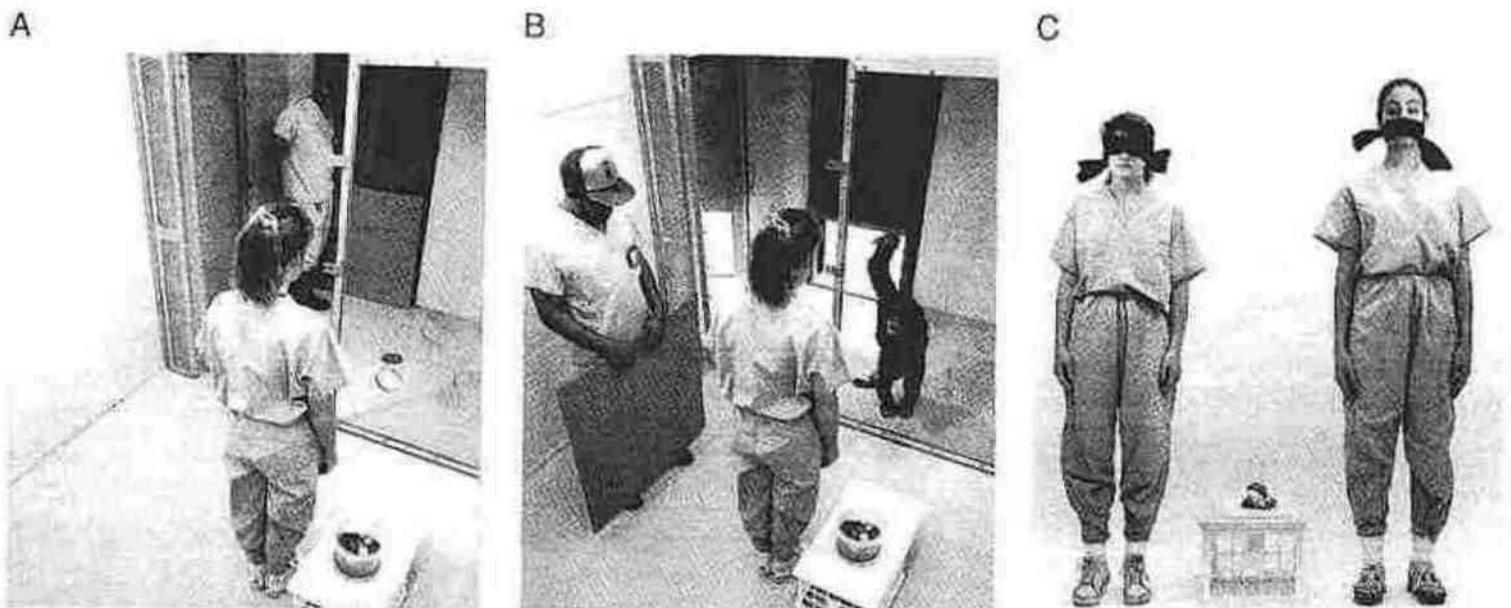


Fig. 5. Although young chimpanzees are very sensitive to the eyes of others, they do not appear to understand them as 'portals' through which the mental state of attention emanates. (A and B) Chimpanzees can be trained to use their natural begging gesture to request food from an experimenter. If an experimenter stands on the left (A and B), the chimpanzee will gesture through the hole on the left side of the partition; if she stands on the right, the subject will gesture there. However, this is no guarantee that the subjects realize that this person is subjectively linked to them via the mental state of attention. (C) When two experimenters are used, one who can see the chimpanzees and one who cannot, the chimpanzees typically respond randomly³⁴. They apparently fail to understand that only one of the experimenters is connected to them through the mental state of attention, perhaps because they simply cannot represent such states. Alternatively, they might simply fail to understand the specific role that eyes play in deploying attention. Young children that are tested similarly reveal an understanding of the subjective aspects of visual attention by about two and a half years of age³⁴.

Inoue-Nakamura, N, & Matsuzawa, T (1997) Development of stone tool use by wild chimpanzees (*Pan troglodytes*). *Journal of Comparative Psychology*, Vol.111, No.2, Pp.159-173.

Since 1987 in Guinea in West Africa, observations have been being made in the centre of free-range area, where experimenters provide stones and nuts.

Nut cracking consists of the following actions:

- (a) picking up a nut
 - (b) putting it on an anvil stone
 - (c) holding a hammer stone
 - (d) hitting the nut with the hammer stone
 - (e) picking up and eating the nut kernel.
- 1) previous studies have shown that infants younger than 3.5 do not crack nuts themselves, but after that age they begin to.
 - 2) The present study focused on 3 infant animals observed for 4 years for 2-4 weeks in 4 dry seasons, when they were aged 0.5, 1.5, 2.5 and 3.5
 - 3) observers stayed 20 m away behind a screen and videotaped from 7am to 6pm: there were about 80 hours of videotape. Using behavioural definitions, there were 159 episodes of infants observing adults crack nuts, and 692 episodes when infants performed actions themselves.
 - 4) at 1.5 yrs, almost 90% of behaviour was with either stones or nuts alone, but by 3.5 80% was with nuts and stones together (still quite a lot 20% of just stones).
 - 5) If they were in contact with another chimpanzee it was their own mother 100% in first year and 90% at 3.5. But observing another chimp went down from 100% own mother to 14% at 3.5

Discussion

The individual actions of ‘Take’, ‘put’ ‘hold’, ‘hit’ and eat, had all been performed by 1.5 yrs

At 2.5 they often put a nut on a stone, hit it with the back of their hand, then picked up a kernel from somewhere else or scrounged a kernel from their mothers

Holding the hammer was the a difficult part – chimps never hit nut with the hammer stone until the last stage.

“True **imitation cannot explain the results** of the present study. The infants showed a variety of fundamental actions. They gradually increased the relative frequency of adequate sequences of the basic actions through each stage of development. They did not copy the motor patterns or the way to relate nuts with stones..... As the present results suggest, they learned the general functional relations of stones and nuts and also learned the goals obtained by the demonstrator. **This learning process might be called emulation.**” (p.172).

IMITATION AND OTHER KINDS OF SOCIAL LEARNING

Roberts (1998) page 394

What appears to be imitation in animals may be due to *social facilitation* or to *stimulus enhancement*. The behaviour of one animal may be changed simply by the presence of another animal (*social facilitation*). When an observer animal observes a demonstrator animal perform an instrumental response, such as bar pressing, subsequent enhanced levels of responding by the observer animal may be due to enhanced interest in the stimulus characteristics of the context (e.g. enhanced interest in the bar) rather than mimicry of the motor pattern of response. change (*stimulus enhancement*).

Evidence for *true imitation* is difficult to find. The criteria for *true imitation* are as follows:

1. The behaviour should be *novel* and *complex*. (To ensure that the behaviours are not simple combinations of natural motor patterns.)
2. The behaviour should be based on *observation* and not on prior practice of reinforced activity.
3. Imitative behaviour should be *seen repeatedly* and should involve imitation of *different behaviours*.

However, the findings reported by Whiten *et al* (1996) cannot easily be explained by social facilitation or stimulus enhancement. In this study chimpanzees observed a human demonstrator opening a box containing food that could only be opened by releasing bolts. One group of animals observed the demonstrator opening the box by poking the bolts out of their holders; a second group observed the demonstrator twisting and pulling the bolts loose. When given the opportunity to open the box themselves, most chimpanzees used the poking or twisting technique which they had seen demonstrated. (In a similar study, Custance *et al*, 1999, showed that capuchin monkeys repeated either the poking or pulling action which they had previously observed, but say that we cannot be sure that this is imitation, as opposed to “object movement re-enactment” They conclude however, that “some monkeys may show more complex social learning than has previously been proposed”).

Heyes (1998)

Commenting on the Whiten *et al* (1996) study above, Heyes says “...it is difficult to rule out the possibility that what the chimpanzees learned by observation was not how to perform the twisting or poking hand movement but that certain movements of the bolts (e.g. rotation followed by lateral displacement towards the actor) were followed by reward. This has been described as emulation learning.” (page 104).

Custance *et al* (1995) trained 2 4-yr old chimps to imitate 15 actions such as raising one or two arms or patting the stomach on the verbal command of “Do this”. The chimps subsequently reproduced 13 and 17 novel behaviours, such as protrude tongue, touch elbow, waggle finger. Of this study, Heyes (1998) says “However, even when they reproduced novel gestures, the chimpanzees may have been engaging in *matched-dependent behavior* (Miller & Dollard 1941), i.e. using the demonstrator's behavior as a discriminative stimulus for the same or similar behavior, without knowing that their behavior was similar to that of the demonstrator.” (p.103).

Byrne (1995)

Byrne uses the terms *stimulus enhancement*, *response facilitation* and *emulation*. He says of stimulus enhancement that “The idea is that the probability of an animal approaching or contacting something in the environment is increasing by seeing an individual of its species interacting with it.” (p.56: this is consistent with Roberts, 1998). “Response facilitation” is similar to what others call *social facilitation* or *contagion*. Examples include synchronous movements of flocks of birds, adult humans collectively yawning. and neonatal human infants reproducing smiles and tongue protrusions. Byrne uses the term *emulation* to mean the influence of observing goal achievement. “duplicating the results of other individuals’ behaviour but not their methods” (pp59-60).

Byrne and Russon (1998)

Byrne and Russon (1998) point out that there is “a long list of hypothetical mental processes that can, independently or in combination, generate copies of demonstrated actions.” They discuss *stimulus enhancement*, and use the term in the same way as others, but stress that it could be considered as a type of *priming*: stimulus input increases the activation of stored internal representations. They similarly say that *response facilitation* (what others tend to call social facilitation) can be regarded as priming of already present responses.

They use the term *emulation* in a way which is more consistent with others such as Heyes (1998) and Tomasello *et al* (1993) — emulation may involve a chimpanzee learning to use a rake as a tool by watching a human demonstration, without being able to imitate in detail the particular actions of the human demonstrator.

They distinguish between “*action-level*” imitation, which involves a detailed specification of sequential acts, and “*program level*” imitation, which they suggest applies to the social learning of foraging behaviour in great apes, and to the imitation of human actions observed in rehabilitant orang-utans by Russon and Galdikas (1993).

Selected Abstracts — Primate Cognition Week 11

Boysen, S.T. and Himes, G.T. (1999) Current issues and emerging theories in animal cognition. *Annual Review of Psychology*, 50, 683-705.

Comparative cognition is an emerging interdisciplinary field with contributions from comparative psychology, cognitive/experimental and developmental psychology, animal learning, and ethology, and is poised to move toward greater understanding of animal and human information-processing, reasoning, memory, and the phylogenetic emergence of mind. This chapter highlights some current issues and discusses four areas within comparative cognition that are yielding new approaches and hypotheses for studying basic conceptual capacities in nonhuman species. These include studies of imitation, tool use, mirror self-recognition, and the potential for attribution of mental states by nonhuman animals. Though a very old question in psychology, the study of imitation continues to provide new avenues for examining the complex relationships among and between the levels of imitative behaviors exhibited by many species. Similarly, recent work in animal tool use, mirror self-recognition (with all its contentious issues), and recent attempts to empirically study the potential for attributional capacities in nonhumans, all continue to provide fresh insights and novel paradigms for addressing the defining characteristics of these complex phenomena.

Call, J. (2001a). Chimpanzee social cognition. *Trends in Cognitive Sciences*, 5(9), 388-393.

In the late 1970s, Premack and Woodruff asked whether chimpanzees had a theory of mind. The answer to this question has remained elusive. Whereas some authors argue that chimpanzees are capable of mental state attribution, others maintain that they simply learn certain cues in certain situations. Recent studies challenge both views. On the one hand, chimpanzees know much more about seeing than cue-based explanations suggest; on the other hand, this knowledge does not necessarily entail understanding of the mental states of others. The hypothesis I put forward here is that chimpanzees learn cues in social situations but that they are also capable of knowledge abstraction to solve novel problems.

Epstein, R., Lanza, R. P., & Skinner, B. F. (1981). "Self-awareness" in the pigeon. *Science*, 212(4495), 695-696.

Three adult White Carneaux pigeons used a mirror to locate a spot on its body that it could not see directly. Although similar behavior in primates has been attributed to a self-concept or other cognitive process, the present example suggests an account in terms of environmental events.

Humle, T., & Matsuzawa, T. (2004). Oil palm use by adjacent communities of chimpanzees at Bossou and Nimba Mountains, West Africa. *International Journal of Primatology*, 25(3), 551-581.

We investigated oil palm (*Elaeis guineensis*) use for feeding in 3 chimpanzee communities: Bossou and Seringbara in Guinea and Yeale in Cote d'Ivoire. Bossou was used as the benchmark for comparison. Bossou chimpanzees (*Pan troglodytes verus*) exhibit a wide range of oil palm targeted behaviors. We used direct observations of their two tool use, i.e., nut-cracking and pestle pounding, to establish strict and reliable criteria to ascertain the presence of comparable behaviors at the two adjacent Nimba sites. Based on monthly surveys of oil palms across the three sites, significant differences in patterns of use emerged. Bossou chimpanzees demonstrated the greatest frequency of oil palm use, while Seringbara chimpanzees, 6 km away, failed to exhibit any use and Yeale chimpanzees, 12 km away, showed all uses comparable to Bossou chimpanzees except pestle pounding and mature leaf pith-feeding. We examined the density and distribution of oil palms, tool availability for nut-cracking and pestle pounding, fruit, flower and nut availability, competition with sympatric species for fruit and nuts and the diversity of fruit species in the diet across the 3 sites. We found no clear difference in proximate environmental variables underlying observed variations in oil palm use among the 3 sites, yielding the conclusion that the differences are cultural. Assuming individual interchange between communities and the involvement of social learning in the intracommunity transmission and maintenance of oil palm uses, the result raises interesting questions about diffusion of behavior between neighboring chimpanzee communities.

Jensen, K., Hare, B., Call, J., & Tomasello, M. (2006). What's in it for me? Self-regard precludes altruism and spite in chimpanzees. *Proceedings of the Royal Society B-Biological Sciences*, 273(1589), 1013-1021.

Sensitivity to fairness may influence whether individuals choose to engage in acts that are mutually beneficial, selfish, altruistic, or spiteful. In a series of three experiments, chimpanzees (*Pan troglodytes*) could pull a rope to access out-of-reach food while concomitantly pulling another piece of food further away. In the first study, they could make a choice that solely benefited themselves (selfishness), or both themselves and another chimpanzee (mutualism). In the next two experiments, they could choose between providing food solely for another chimpanzee (altruism), or for neither while preventing the other chimpanzee from receiving a benefit (spite). The main result across all studies was that chimpanzees made their choices based solely on personal gain, with no regard for the outcomes of a conspecific. These results raise questions about the origins of human cooperative behaviour.

Povinelli, DJ, Gallup, GG, Eddy, TJ, Bierschwale, DT, Engstrom, MC, Perilloux, HK, Toxopeus, IB (1997) Chimpanzees recognize themselves in mirrors [full text availability]. *Animal Behaviour*, Vol.53, No.Pt5, Pp.1083-1088.

Heyes' (1994, *Anim. Behav.*, 97, 909-919; 1995, *Anim. Behav.*, 50, 1533-1542) recent account of chimpanzees', *Pan troglodytes*, reactions to mirrors challenged the view that they are capable of recognizing the equivalence between their mirror images and their physical appearance. In particular, she argued that observations that chimpanzees touch surreptitiously placed marks on their faces while in front of mirrors can be explained as an interaction between ambient levels of face touching and procedural artefacts of the anaesthetization and markings of the subjects. Using new analytical techniques, data are reported that falsify the central predictions generated by her account and confirm predictions derived from the self-recognition model.

Suda, C., & Call, J. (2006). What does an intermediate success rate mean? An analysis of a Piagetian liquid conservation task in the great apes. *Cognition*, 99(1), 53-71.

The study investigates what an intermediate success rate means in bonobos, chimpanzees, and orangutans. Apes participated in liquid conservation experiments where they had to track the larger of two different quantities of juice after various kinds of transformations [Suda, C., & Call, J. (2004). Piagetian liquid conservation in the great apes (*Pan paniscus*, *Pan troglodytes*, and *Pongo pygmaeus*). *Journal of Comparative Psychology*, 118, 265-279). When making a decision, apes sometimes demonstrated hesitant behavior, concurrently pointing to both alternatives or successively changing their choice. Moderately Successful apes showed more hesitation than highly Successful or unsuccessful apes. The results are consistent with the cognitive conflict model: The experiments created a higher degree of cognitive conflict on moderately successful apes than on very Successful or unsuccessful apes. This indicates that an intermediate performance reflects the joint operation and potential conflict between two different cognitive strategies (identity and appearance) inherent to the Piagetian conservation task. (C) 2005 Elsevier B.V. All rights reserved.

Tomasello, M. (1998). Uniquely primate, uniquely human. *Developmental Science*, 1(1), 1-16.

Proposes 2 hypotheses about primate cognition. First, it is proposed that primates, but not other mammals, understand categories of relations among external entities. In the physical domain primates have special skills in tasks such as oddity, transitivity, and relation matching that require facility with relational categories; in the social domain primates have special skills in understanding the 3rd-party social relationships that hold among other individuals in their groups. Second, it is proposed that humans, but not other primates, understand the causal and intentional relations that hold among external entities. In the physical domain only humans understand causal forces as mediating the connection between sequentially ordered events; in the social domain only humans understand the behavior of others as intentionally directed and controlled by desired outcomes. Both these uniquely primate and these uniquely human cognitive skills are hypothesized to have their origins in adaptations for negotiating complex social interactions. (PsycINFO Database Record (c) 2000 APA, all rights reserved)

Tomasello, M., Call, J., & Hare, B. (2003). Chimpanzees understand psychological states – the question is which ones and to what extent. *Trends in Cognitive Sciences*, 7(4), 153-156.

New data suggest that relatively drastic revisions are needed in our theoretical accounts of what other animal species understand about the psychological states of others. Specifically, chimpanzees seem to understand some things about what others do and do not see, or have and have not seen in the immediate past, as well as some things about others' goal-directed activities. This is especially so in competitive situations. They clearly do not have a human-like theory of mind, however, and so the challenge is to specify precisely how ape and human social cognition are similar and different.

Tomasello, M., Carpenter, M., Call, J., Behne, T., & Moll, H. (2005). Understanding and sharing intentions: The origins of cultural cognition. *Behavioral and Brain Sciences*, 28(5), 675-+.

We propose that the crucial difference between human cognition and that of other species is the ability to participate with others in collaborative activities with shared goals and intentions: shared intentionality. Participation in such activities requires not only especially powerful forms of intention reading and cultural learning, but also a unique motivation to share psychological states with others and unique forms of cognitive representation for doing so. The result of participating in these activities is species-unique forms of cultural cognition and evolution, enabling everything from the creation and use of linguistic symbols to the construction of social norms and individual beliefs to the establishment of social institutions. In support of this proposal we argue and present evidence that great apes (and some children with autism) understand the basics of intentional action, but they still do not participate in activities involving joint intentions and attention (shared intentionality). Human children's skills of shared intentionality develop gradually during the first 14 months of life as two ontogenetic pathways intertwine: (1) the general ape line of understanding others as animate, goal-directed, and intentional agents; and (2) a species-unique motivation to share emotions, experience, and activities with other persons. The developmental outcome is children's ability to construct dialogic cognitive representations, which enable them to participate in earnest in the collectivity that is human cognition.

Tomasello, M., & Rakoczy, H. (2003). What makes human cognition unique? From individual to shared to collective intentionality. *Mind & Language*, 18(2), 121-147.

It is widely believed that what distinguishes the social cognition of humans from that of other animals is the belief-desire psychology of four-year-old children and adults (so-called theory of mind). We argue here that this is actually the second ontogenetic step in uniquely human social cognition. The first step is one year old children's understanding of persons as intentional agents, which enables skills of cultural learning and shared intentionality. This initial step is 'the real thing' in the sense that it enables young children to participate in cultural activities using shared, perspectival symbols with a conventional/normative/reflective dimension—for example, linguistic communication and pretend play—thus inaugurating children's understanding of things mental. Understanding beliefs and participating in collective intentionality at four years of age—enabling the comprehension of such things as money and marriage—results from several years of engagement with other persons in perspective-shifting and reflective discourse containing propositional attitude constructions.

Whiten, A. (2005). The second inheritance system of chimpanzees and humans. *Nature*, 437(7055), 52-55.

Half a century of dedicated field research has brought us from ignorance of our closest relatives to the discovery that chimpanzee communities resemble human cultures in possessing suites of local traditions that uniquely identify them. The collaborative effort required to establish this picture parallels the one set up to sequence the chimpanzee genome, and has revealed a complex social inheritance system that complements the genetic picture we are now developing.