

Lecture on: Biological Bases of Cognition (Cognition in Chimpanzees)

Aims: *This lecture aims to review the evidence for cognitive processes in non-human primates, especially chimpanzees, and to evaluate the results of attempts to train chimpanzees to communicate with human-like language systems.*

Objectives: *By the end of the lectures the students should:*

- *know the general outlines of the taxonomy of primates and the time course of life span development in the non-human primates species mentioned in the handout*
- *be able to answer correctly a majority of the questions on the self-assessment test included in the handout*
- *be aware of the sections of the course text (Gleitman, 1999) or alternative texts, where complex cognition in animals and the training experiments on chimpanzees are discussed.*

The references are adapted from **TOPIC 7** in the Seminar List —

Essay Question:

Consider the evidence for cognitive processes in chimpanzees. What aspects of human cognition are unique?

Basic Texts (Alternatives)

Gleitman, H (1995) *Psychology. 4th Edition*. Norton, London. “Complex cognition in animals” pp 142-6; “Language in nonhumans”, pp. 370-375; “Social cognition in primates”, pp 405-407.

Gleitman, H., et al. (1999) *Psychology. 5th Edition*. Norton, London. “Complex cognition in animals” pp. 158-62; “Language in nonhumans”, pp. 393-4; “Social cognition”, pp 429-34.

Gleitman, H., et al. (2004) *Psychology. 6th Edition*. Norton, London. “Complex cognition in animals” pp. 156-60; “Language in nonhumans”, pp. 354-7; “Reciprocal altruism”, pp 438-439

Walker, S.F. (1987) *Animal Learning: An Introduction*. Routledge & Kegan Paul: London. “Memory and cognition in animal learning”, pp 302-57.

Other background sources

Jolly, A. (1972) *The Evolution of Primate Behaviour*. Macmillan: London.

Passingham, R. (1982) *The Human Primate*. W.H. Freeman: Oxford. “Intelligence”, pp. 114-141; “Language”, pp. 190-243.

Povinelli, D.J. (1993) Reconstructing the evolution of mind. *American Psychologist*, 48, 493-509.

Terrace, H.S. (1980) *Nim*. London: Eyre Methuen

Walker, S.F. (1985) *Animal Thought*. Routledge & Kegan Paul: London. “Knowing and meaning in monkeys and apes”, pp 339-381.

More specialized sources

Boysen, ST and Himes, GT (1999) Current issues and emerging theories in animal cognition. *Annual Review of Psychology*, Vol.50, Pp.683-705.

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

Povinelli, D. J., Bering, J. M., & Giambrone, S. (2000). Toward a science of other minds: Escaping the argument by analogy. *Cognitive Science*, 24(3), 509-541.

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

Notes on topics to be covered

Biologically the human species belongs to the order Primates. Although there is fossil evidence for several different 'hominid' (human like) species having occurred during the last 4½ Million years, our closest living relatives are the Great Apes (chimpanzees, orang-utans and gorillas: according to some estimates, the present human species shares 98.4% of its DNA with current chimpanzees)

Because of this biological similarity, it is often assumed that cognitive processes in the great apes) will be noticeably human-like, and distinguishable, quantitatively or qualitatively, from those of non-primate species.

- An extreme case of the notion of primate cognitive superiority was the expectation that, with a sufficiently favourable training environment, infant apes might develop linguistic competence (e.g. Premack, 1976). Studies which attempted to train apes in language-like skills are reviewed in Walker (1985). There is now a general consensus that some or other of the cognitive processes necessary for linguistic communication is innately and exclusively human.
- This consensus is supported by the fact that there is "little credible evidence" that chimpanzees are capable of language-like communication. (Gleitman et al., 2004, p. 357; Gleitman et al., 1999, p. 401; Gleitman, 1995; p.375;)
- A possible framework for comparisons of non-linguistic cognitive capacities across species is supplied by Piagetian tests designed to assess developmental changes in human cognition (e.g. Redshaw, 1978; Call, 2001)
- It has been suggested that non-human primates such as chimpanzees, though lacking language, may have distinctive cognitive capacities for memory, imitation, self-recognition (in mirrors or videos) and the social understanding of other individuals (Menzel, 1973; Gallup et al. 1995, 1970; Menzel *et al*, 1985; Povinelli, 1993; Boysen & Himes, 1999)
- Some authors disagree that primates have any special cognitive advantages over other species. In particular Macphail (1987, 1996) supports a 'null-hypothesis' of equal intelligence across all vertebrate species from fish to mammals (see also Heyes, 1998). Others such as Reiss and Marino (2001) would suggest that there are species differences in cognitive ability, but that certain non-primate species (dolphins, or other large-brained mammals) demonstrate primate levels of performance on complex tasks.
- The short answer to the question posed is that many aspects of human cognition are unique, and that the capacity for language is among the most important and appears to be notably absent in our closest living relatives. It also seems to be the case that the human capacity for imitation is qualitatively different from the social learning found in apes (Inoue-Nakamura & Matsuzawa, 1997; Tomasello and Rakoczy, 2003). Other aspects of human cognition, such as short term memory for the locations of desired food items, the social recognition of other known individuals, and the recognition of objects independently of stimulus modality ('cross-modal' object recognition) are clearly not unique to our species, since they can be demonstrated in chimpanzees and in some cases in other primates and non-primate species as well (Iversen & Matsuzawa, 2003, Farroni et al. 2003; Myowa-Yamakoshi et al., 2003)

Lecturer's References (Not for further reading)

- Barton, RA (1998) Visual specialization and brain evolution in primates. *Proceedings of the Royal Society of London Series B-Biological Sciences*, Vol.265, No.1409, Pp.1933-1937.
- Boysen, ST and Himes, GT (1999) Current issues and emerging theories in animal cognition. *Annual Review of Psychology*, Vol.50, Pp.683-705.
- Byrne, R. (1995) *The Thinking Ape : the evolutionary origins of intelligence*. Oxford : Oxford University Press
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- 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.
- Iversen, I. H., & Matsuzawa, T. (2003). Development of interception of moving targets by chimpanzees (*Pan troglodytes*) in an automated task. *Animal Cognition*, 6(3), 169-183.
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- Kohler, W. (1925) *The Mentality of Apes*. Kegan Paul, Trench & Trubner: London. (2nd Edn 1927 67 IAV Koe)
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- Myowa-Yamakoshi, M., Tomonaga, M., Tanaka, M., & Matsuzawa, T. (2003). Preference for human direct gaze in infant chimpanzees (*Pan troglodytes*). *Cognition*, 89(2), B53-B64.
- 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.
- Premack, D. (1971) Language in chimpanzee. *Science*, 172, 808-22.
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Copies of 6 overheads, Primate Cognition

Cognitive processes in animals, especially primates.

- Whereas ethologists and behaviourists used to explain animal behaviour in terms of reflexes, it is common now to talk of animal cognition.
- The great apes are more closely related to the human species than other animals, and might thus be expected to have more human-like cognition.
- But hard evidence for this is weak, and some authors reject this idea (Macphail, 1987; Heyes, 1997).

Primate Cognitive Superiority?

- An extreme case of this notion was the expectation that, with sufficient training, infant apes would develop linguistic competence. (E.g. Premack, 1976)
- There is now a wide consensus that what chimpanzees achieve, even after years of training, merely emphasizes the importance of inherited human specialized capacities.

Human-like capacities other than language

- Piagetian tests suggest that ape infants go through similar stages to human infants at least during the sensori-motor period (1st year).
- Imitation and social learning may be primate characteristics.
- Memory for recent events in primates may be very extensive (Menzel, 1973)

Mental attribution and “Theory of Mind”

- Self-recognition in mirrors seems to only occur in apes
- It is suggested that this indicates a broader capacity for introspection and for attributing mental states to other individuals
- Povinelli (1993) reviews this suggestion, but others such as Heyes (1996) are sceptical even about self-recognition.

Attempts at ‘Language’ training

<i>Method</i>	<i>Names of chimps</i>	<i>Names of psychologists</i>
American Sign Language (ASL)	Washoe, Austin & Sherman Kanzi Nim Chimpsky	Gardner and Gardner (1969) Savage-Rumbaugh Terrace <i>et al</i> , 1979
Plastic tokens	Sarah (& others)	Premack (1971, '76 & '86)
“Lexigrams”: visual symbols on a screen	Austin & Sherman, + others	Greenfield and Savage-Rumbaugh (1990)

Conclusion

- Many aspects of human cognition are unique
- The capacity for language is one of the most important
- Other aspects of human cognition, such as object recognition, may be found in many other species
- Some authors believe that the great apes, particularly chimpanzees, exhibit more human-like cognition.

TAXONOMY OF PRIMATES (AN ORDER OF MAMMALS)

There are two sub-orders of the order of Primates. One sub-order includes humans, apes and monkeys, and the other is for Prosimians, and includes the lemurs of Madagascar, lorises (e.g. bushbabies) and tarsiers.

PROSIMII (*The older of the two suborders of Primates*)

Prosimians: = the lemurs of Madagascar, lorises (e.g. bushbabies) and tarsiers.

ANTHROPOIDEA (*A suborder of Primates*)

This includes 3 superfamilies, the superfamily of humans and apes and two superfamilies of monkeys:

Humans and Apes (*Hominoidea*). Includes extinct human species ('hominids'), modern *Homo sapiens* and the apes. "Great apes" are 2 species of chimpanzee, the orangutan and the gorilla, and "Lesser apes" are 7 species of gibbon.

Old-world monkeys: (*Cercopithecoidea* or *Catarrhines*) = dozens of species e.g. rhesus and other macaques, vervets and baboons.

New-world monkeys: (*Ceboidea* or *Platyrrines*) = dozens of species e.g. cebus, squirrel, spider and owl monkeys and marmosets.

Table of Primate Life-Spans (After Jolly, 1972)

<i>Species</i>	<i>CEBUS (New World Monkey)</i>	<i>RHESUS (Old World Monkey)</i>	<i>GIBBON (Lesser Ape)</i>	<i>ORANG (Great Ape)</i>	<i>CHIMP (Great Ape)</i>	<i>GORILLA (Great Ape)</i>	<i>Homo Sapiens sapiens</i>
Days Gestation	180	168	210	275	225	265	266
Total yrs	30+	28+	29+	30+	40+	35+	70+
Sub Adult yrs	4.0	7.5	8.5	10.5	10.0	11.0	20?
Infancy yrs	0.5	1.5	2.0	3.5	3.0	3?	6?
% Subadult	13%	27%	29%	35%	25%	31%	29%
% Infancy	2%	5%	7%	12%	8%	9%	9%

Terrace, H.S. (1979/1980) *Nim*. London: Eyre Methuen.

Terrace, H.S., Pettito, L.A., Sanders, R.J. and Bever, T.G. (1979) Can an ape create a sentence?
Science, 206, 891-902.

The project lasted 4 years and involved 60 teachers, mostly volunteers. Another group of about 40 volunteers tabulated and analyzed data from daily records and videotapes.

In the *Science* paper more than 19,000 “multi-sign utterances” were analyzed for syntactic and semantic regularities.

There were some regularities, but videotape analyses showed that most of Nim’s utterances were prompted by his teacher’s prior utterances (signs in American Sign Language).

Nim interrupted his teachers to a much larger extent than a child interrupts an adult’s speech.

Typical two-sign combinations were —

“play me” (375)
“tickle me” (316)
“hug Nim” (106)
“tickle Nim” (107)

“more eat” (287)

“banana Nim” (73)
“in pants” (70)

The most frequent three-sign combinations were —

“play me Nim” (81)
“eat me Nim” (48)
“eat Nim eat” (46)
“tickle me Nim” (44)
“grape eat Nim” (37)
“banana Nim eat” (33)
“Nim me eat” (27)
“banana eat Nim (26)
“eat me eat” (22)

The most frequent four-sign combinations were —

“eat drink eat drink” (15)
“eat Nim eat Nim” (7)
“banana Nim banana Nim” (5)
“drink Nim drink Nim” (5)
“banana eat me Nim” (4)
“banana me eat banana” (4)
“banana me Nim me” (4)
“grape eat Nim eat” (4)
“Nim eat Nim eat”
“play me Nim play”
“drink eat drink eat” (3)
“drink eat me Nim” (3)

This is a brief multiple-choice *self-assessment* for the lectures given on December 11th 2003. Completing it is optional and you should not hand it in for marking. For each question there is only one correct answer. You should be able to find the right answer somewhere in the rest of this handout.

1) Modern humans and modern chimpanzees have a great deal of DNA in common: the precise figure is usually quoted as —

- 32.5%
- 99.9%
- 98.4%
- 56.7%

2) Chimpanzees and gorillas are classified as —

- Great Apes
- Old World Monkeys
- New World Monkeys
- Prosimians

3) Rhesus monkeys do not become adult until they are —

- 10 years old
- 7.5 years old
- 2.5 years old
- 18 months old

4) Several attempts have been made to train chimpanzees to communicate using human languages. The results of these attempts can be summarised as —

- most chimpanzees can succeed at this but they need to be trained for several years
- only animals which are trained from a very early age can succeed
- chimpanzees cannot be trained to speak, but they can communicate linguistically by using sign language instead
- there is little or no credible evidence that any chimpanzee can communicate linguistically

5) Piagetian tests suggest that ape infants go through similar stages of cognitive development to those of human infants during the first —

- 12 months of life
- 3 months of life
- 11 years of life
- 7 years of life

6) Apart from humans, there is evidence for self-recognition in mirrors —

- in all mammals
- in all primates
- mainly in apes, and possibly in dolphins
- only in elephants

7) Macphail's "null hypothesis" suggests that —

- there is no difference between humans and chimpanzees in cognitive potential
- all primate species should be regarded as of equal intelligence
- all mammalian species should be regarded as of equal intelligence
- all vertebrate species should be regarded as of equal intelligence

8) The paper titled "Does the chimpanzee have a theory of mind" was written by —

- Kohler (1925)
- Hayes and Hayes (1951)
- Gardner and Gardner (1969)
- Premack and Woodruff (1978)

9) The chimpanzee "Washoe" which learned to make signs using American Sign Language (ASL) was trained by —

- Kohler (1925)
- Hayes and Hayes (1951)
- Gardner and Gardner (1969)
- Premack and Woodruff (1978)

10) The chimpanzee "Vicki" which learned to make only 4 sounds approximating English spoken words was trained by —

- Kohler (1925)
- Hayes and Hayes (1951)
- Gardner and Gardner (1969)
- Premack and Woodruff (1978)