Mindful Apes

Reaching into Thought:The Minds of Great Apes *is a book which provides a theoretical and data rich foundation for many of the current experiments and interpretations seeking to understand the cognitive capacities of apes. It begins with an historical discussion allowing the reader to see how our ideas about ape cognition have changed from the time of Darwin and Yerkes to the end of the 2oth century. It explores data presented from two perspectives; one which contends that ape mental abilities are based on independent problem solving skills, while the other argues that behaviours observed represent generalized capacities based on hierarchical mental constructions of greater or lesser complexity. This latter position arises from a continuity model, in which the abilities of our closest genetic relatives are seen to be foundational steps for the complex physical and intellectual processing exhibited by humans. In many of the chapters this approach is supported by the inclusion of comparative evidence from work with children. One of the most useful insights of this work is the notion that, because children develop their mental and physical capacities (such as fine motor control and hand eye co-ordination, as well as self representation) much more rapidly than young apes, the feedback between learning, capacity development and the physical parameters of neuron development interact to allow or even promote a much faster and more integrated capacity for children to utilize multi-level problem solving skills. This difference in the speed of development means that apes do not express the equivalent problem solving skills of children at a comparable age, but by the age of 7 or 8 years can solve problems that they could not as younger animals. Of course they do not flower into the level of meta-awareness and symbolic processes that children attain as they grow up, but testing them at an age of appropriate level will give us a better indication of their eventual capabilities. However, this is not the only position advanced in this book. Considerable evidence is presented to support the environmental and social complexity argument suggesting that it is the direct need for complex foraging skills and social interaction required to survive in many groups of wild primates that are the foundation for the problem solving skills exhibited by apes. This viewpoint argues that ecological differences between ape living environments and foraging tactics are responsible for perceived differences in intellectual skills and the multiplicity of layers and transfer of problem solving skills (such as tool use) from one situation to another. Some comparative work with monkeys is used to support this argument, such as the differences between capuchin and chimpanzee tool use. In addition, data on comparisons of social intelligence between macaques and chimpanzees is also used to support the argument that primate intellect is domain specific. In particular, social intelligence is investigated by looking at third party consolations in macaques and comparing this with the situation in chimpanzees. It is argued that there are significant differences in the underlying motivations of similar appearing behaviours, based on the differences in hierarchical structures organizing the social groups in the two cases.*

Russon has a chapter on metacognitive levels which draws its data from her work on rehabilitant orang utans. She investigates levels of imitation under semi free ranging conditions where the orang utans have the opportunity to observe other orang utans and humans in the course of their daily lives. She includes both the form of the behavior as well as the goals in her understanding

of imitation and suggests that true imitation will require practice, which is a somewhat different position than is taken by many lab researchers. Russon's argument breaks down imitation into a variety of cognitive stages, but the really interesting aspect is that the goal of imitation is not necessarily the replication of an action or result, but participation in the demonstrator's 'social circle' and that the social aspects of imitation are at least as important as the ability to learn how to solve problems by observation. Imitations seen in young children (such as 'peek-a-boo' or 'wave bye-bye') also have major social rather than functional content.
Chapters on Gorilla and Bonobo material are also included both from wild and captive situations and thus the whole range of great ape abilities are represented in this book. It is an excellent source for those wishing to investigate ape cognition from a non linguistic viewpoint. Current work is supporting some of the positions put forward here as well as expanding on the foundations this presents.

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The last two decades of this millennium has seen the resurgence of research focussed on the question of how similar to our minds are those of the Great Apes. This topic has considerable impact in terms of changing values in society concerning human rights, animal welfare legislation, conservation and changing moral values. When Huxley and Yerkes and other early psychologists first began such studies they were exploring the unknown, and what for many people was the unthinkable. In this densely presented book, 25 researchers have contributed their recent observations and ideas to the problem. They are predominantly psychologists with some anthropologists and ethologists, mainly from the United States but some from Canada, Italy, Scotland, Germany and Japan. It is definitely a book by and for researchers and those seriously interested in current work, and theoretical views reflecting the obsession of Western culture with defining the characteristics of the human species and looking at how our closest relations measure up to the abilities that we often see as unique to ourselves. The editors propose to look at ape minds as distinguished from human ones, but nearly half the chapters consider comparison with humans in one form or another. One of the strengths of the book is that it focuses on observation and experiment and leaves aside data and arguments based on the nature of brain and the development of linguistic skills. All four species of great ape are included combining data from all species in wild or free ranging conditions. The other four environmental situations include zoo animals, colony animals, laboratory studies and some home raised individuals. This range of 5 conditions permits a variety of comparisons to be made from relatively undisturbed mother-infant teaching to highly structured human intervention. Some data on monkeys is also included, particularly from Cebus, the capuchin, which is a New World monkey often considered second only to the chimpanzee in the frequency and variety of tool use.

The introductory chapter by the editors provides a very useful framework for the book. It clearly lays out the two main issues being considered which are: 1. What is the scope of ape intellectual abilities? and 2. How are these abilities

organized in terms of phylogeny, ontogeny, interdependencies and developmental processes? (I have paraphrased these somewhat). They begin with a brief history of studies of ape intelligence since Darwin anddevelop the current idea that ape intelligence is related to their skills as social beings. This is the more broadly accepted of two main views on the subject, the other being that ecological requirements of foraging have promoted ape intellectual skills. The sociality approach is reflected in the three main research perspectives underlying this book. The first is that underlying intellectual abilities concerning imitation, pedagogy and culture can be investigated through examining skills involved in making and using tools. The second investigates social dynamics as a source of intellect by researching such mental aspects as conflict resolution, theory of mind, imitation and deception. The third research direction is to examine intelligence by looking at developmental stages, based on Piagetian levels of object concept, causal reasoning and conceptualizing intellectual abilities, based on sensory-motor and logical concept stages. This approach accepts the continuity model of intellectual development between apes and humans and recasts the argument to one of degree rather than kind. Some researchers might consider this a little premature in the introduction, but it certainly is the focus of the book, and clearly arises from a continuist perspective. From these three research perspectives four spheres of intellect are identified as foci of discussion. These include multi-level social and physical problem solving (including tool use); social intelligence; meta-representation; and abilities that hinge on symbolic processes such as self awareness, pretense, logical reasoning and teaching. In terms of these foci of discussion there are two extremes of interpretation of data. One is that whatever abilities are observed are independent problem solving skills which are domain specific. The other end of the spectrum is that the behaviours represent generalized capacities which are based on hierarchical mental constructions of greater or lesser complexity which can be studied by examining developmental models and parallels. When patterns of problem solving skills are examined onto-genetically the sequence of emergence of abilities does suggest interdependence of skills and development of multi layered abilities in apes, even though this occurs at a slower rate than in humans. This delay is referred to as heterochrony and is probably one of the reasons that such skills have not been observed in previous research since advanced levels of ability are not usually manifest before 7 to 10 years old, which is a greater age than many apes are when originally tested.

The second chapter begins with the first research direction, involving a comparison of tool use skills and learning between chimpanzees and capuchins. The chapter demonstrates differences in their abilities which suggest a differing level of mentation although the appearance of the behaviour can be similar. In fact, the behaviour may be based on the same environmental situation of the need for extracting embedded food such as insects and nuts, although the argument is made that capuchins do not really understand the cause and effect details of tool use. Instead it is suggested that a different level of mental mediation occurs in that apes recognize relationships between relationships and can thus solve problems using visual cues, where as although capuchins are used to utilizing a stick to probe with they do not avoid food traps or baffles in the experimental equipment even when they are visually obvious. This discussion is continued in Chapter 3 which discusses how much of tool use suggests mental understanding of problems versus functional understanding. At a level of generalized approach and response to feedback, chimpanzees learn to

do better, while capuchins try harder rather than reorganizing an unsuccessful approach. They do not appear to comprehend why the tool allows success, whereas chimpanzees seem able to generalize the tool's capabilities and approach a problem in a variety of ways.

Chapter 4 compares aspects of social intelligence between apes and monkeys, in this case macaques. The research observes a particular level of social skill in post conflict situations, based on activities of a third party. The two third party behaviours investigated are third party mediated reconciliation and consolation of the loser. The varying levels of these behaviours seen between chimpanzees and macaques may partly rest on social constraints which in the more hierarchically organized macaques may interfere with loser support. In addition the argument is put forward that for chimpanzee consolation is really a more intellectually oriented event in that it involves the idea of comprehending the upset mental state of the recipient of consolation without sharing the emotion and thus becoming involved in the conflict. This ability differs from third party intervention, which is seen in macaques, because of the mental aspect of seeing yourself in another's situation.

The idea of intellect being grounded in social rather than ecological complexity is supported by the situation seen in gorillas. Gorillas do not face complex extractive foraging problems even though it has been argued that their food preparation skills are a little more complex than they seem. However, gorillas do show complex social behaviours and some skill at problem solving. They show first order imitation (copying of actions already in their repertoire). Some researchers have argued that they have a small brain to body size ratio, which would suggest a lower level manifestations of ability, but others have countered with the argument that gorilla neo-cortex, the actual thinking part of the brain, is second onlyto humans in brain weight-body weight comparisons. Recent work has also suggested that gorillas can use sticks in extractive foraging in the wild, and they certainly have been observed to do so in captivity. In Chapter 6 Gomez presents arguments supporting complex abilities in gorilla communication patterns and particularly in terms of eye contact and gaze directions. He calls the making of eye contact by a young gorilla and then pointing to or indicating a goal "ostensive behaviour". He sees this gaze fixing as ability to express and assess communicative intent and pointing as intentional communication. I would agree that this does probably indicate communicative intent but would argue that other home raised animals of different species get their owner's attention, fix their gaze on their owner's eyes and then point their noses or bodies in the direction of a desired object, whether it be food, water, a toy or the door to outside. His hypothesis specifically is that "ostention essentially consists of calling the other person's attention upon one's own attention before performing a gesture or behaviour.....Eye contact is a privileged way to establish this attention contact necessary for inferential communication." (pg 145.) He argues that this is not a banal observation, but rather reflects the expression and attribution of intentions to others. His young gorilla persisted in attempting to get the researchers attention before making the request. Gomez suggests this is not true for monkeys, but this seems contrary to observations that monkeys who are averse to interacting will refuse to look at others, and in some cases the message sender will grab and twist the head of the avoider forcing it to look straight at the sender, thus ensuring the receipt of the message. I have seen this myself in Barbary macaques and Fedigan (1982) records it for Japanese macaques.

In addition in my research on free ranging Barbary macaques in Gibraltar one old low ranking female understood the intent and direction-ality of gaze very well. When the troop was being provisioned I could catch her gaze directly and then look away towards a spot about 50 to 60 feet away from the group where some food had been left hidden for her. She would follow my gaze with hers and then a few minutes later could be found eating the small cache of food undisturbed. This occurred a number of times and the food was always left in different locations around the periphery of the main feeding area, in order to avoid the appearance of her always going to the same place. This behaviour was observed by several other primatologists including Burton (1973). These arguments are not intended to suggest that ostention is not an important factor in assessing intent of communication, but that it does not necessarily demonstrate a cognitive difference between apes, monkeys and other'enculturated' (home reared) mammals such as dogs. Chimpanzees and orangutans can use their fingers to point but almost any gesture can be used to communicate if it is clear that the sender wants to direct attention, and Gomez is arguing that the use of eye contact indicated this. I would argue for non primates that nose pointing or body orientation are equally explicit. He concludes that to engage in ostension one has to be capable of some degree of mind reading and attribute the same abilities to the receiver, which was clearly evidenced in the food indicating situation with the macaque recounted above. He assesses use of attention to indicate intention, requests, and proto-declaratives, as a metacognitive level of interaction, but I am not sure that I agree with him or else there are a number of other animal families who have this level of ability.

A more successful attempt to investigate metacognitive levels of mind is presented in Russon's chapter on imitation in rehabilitant orangutans. This topic is quite controversial because imitation has been divided into a number of levels by various researchers (eg. Galef 1988, Tomasello, et al. 1993). Part of the controversy has concerned the definition of 'true imitation' as it differs between lab induced experimental situations and spontaneous self selected true imitation. True imitation is defined by Russon as "one individual learning new behaviours demonstrated by another, by observation of the demonstration" (153). This includes learning about the form of the behaviour and not just its goals and that the attempt is purposeful and goal directed. One of Russon's observations is that learning by true imitation is likely to require "multiple observational probes". This means that true imitation will usually require rehearsals in which the behaviour comes to match the demonstration more and more closely. The important factor is that the behaviours are novel-outside the general behaviour pattern of the species. Both direct and indirect experiential learning must be eliminated as sources of the behaviour. Russon demonstrates this by arguing that four 'misfit features' - features which would not be relevant aspects of the animal's learning set are characteristic of her episodes of imitation. These include Arbitrariness, Exceptionality, Rapid acquisition of productively novel actions and Atypicality. The demonstrated behaviours such as sharpening an axe blade are observed, replicated, and repeated with closer and closer approximation to the demonstrators form . Exact matches of form were very rare but matches were coded as either being reduced, exact or expanded. Reduced matches show a subset of the demonstrated behaviours and may arise from youth, inexperience, or the behaviour required being far beyond the current capacities of the imitator. Imitatorsoften prefer to reproduce behaviours just beyond their own current capacities, and if the task is too

difficult it is likely to be broken into modules only some of which are reproduced. Expanded matches often involved a substitution of tools or the techniques used to achieve demonstrated goals such as a piece of bark instead of a plate, or a plank instead of a canoe paddle. Russon noted that rehabilant free ranging orangutans at Camp Leakey in Borneo copied behaviour of both other orangutans and humans. She and Galdikas (1993) had previously concluded that imitators respond more actively to particular demonstrators with whom they have an ongoing relationship. Errors in which a reproduction did not achieve a demonstrated goal often failed because of skill level rather than use of material or technique. For example, an orangutan who stole a hammock and tried to suspend it between two trees did not have the knot tying skill required to hold her weight although she wrapped the tie ropes several times around trees an appropriate distance apart. Poor differentiation may reflect conceptual difficulties, but the goal, the material, the sequence of behaviours and the choice of behaviour patterns necessary were often correctly organized and in many cases complex behaviours were successfully imitated. Some substitutions were quite appropriate and suggested considerable cognitive sophistication, such as hanging a sack on a tree branch to swing in instead of a hammock or attempting to unscrew a bolt with a flat piece of wood oriented and moved in the same way as a screw driver (which I saw personally at the research site).

In conclusion Russon argued that the learning involved was not necessarily the main function of the imitation. Rather, by replicating non specific behaviour of favoured demonstrators, such as placing grave markers or sharpening blow gun darts they were participating in the demonstrators social circle. Interpersonal goals are seen in human infants who play peekaboo or replicate the posture and words of others. These interpersonal goals may well reflect the social bases which have been argued to underlay intellectual capabilities in apes. This level of understanding the possible goals of orangutans is quite different from the experimentally induced physically matched, goal directed behaviour regarded as true imitation in many lab situations.

In addition to assessing cognitive skills through tool use and imitation some researchers attempt to elicit higher order intellectual skills through tasks such as counting and evidence of numeric comprehension. In Boysen's research a clear distinction was made between the high affect level elicited when real food was being counted and the more relaxedsituation when arabic numerals representing food were the stimuli. This relaxation allowed the subjects to concentrate on the test parameters more closely and to succeed in tasks such as to reject a larger portion of candies for future gain. The use of mental counting rather than requiring the physical object, might allow higher level future planning and possibly postpone food consumption which might facilitate sharing in hominid ancestors. This ability to separate visceral and cognitive reactions to a stimulus might easily have ramifications for a wide range of other situations if populations were able to develop an increasing referential means of regulating social behaviours.

In terms of developing cognitive skills based on a social foundation, the use of tools by free ranging *Pan paniscus* (the bonobo) is an interesting contrast to tool use as seen in common chimpanzees. Ingmansons' accounts of tools include sticks and leaves used as wipers, toothpicks, fly whisks, scratchers, and rain hats, as well as object use such as directed object dropping, branch waving,

and use of other individuals as animate stepladders. None of these are related to subsistence activity although they may make the individual more comfortable. In social terms object use is seen in play at a fairly low frequency, (about once per 5 hours of observation), and about half of these are incidents of social play. A more common social situation involving object use is branch dragging. In one 2 month period over 600 episodes were observed in social contexts and of all these over 60% were in association with initiating group movement. Sometimes two branch draggers would run off in different directions and the group would have to decide which one to follow. Directions were established which frequently led to well known resources such as a large fruit tree. Occasionally changes in direction of group progress were indicated by noise of branch dragging going off at an angle to the original direction in front of the group and the group would gradually shift direction. In some cases a male would drop to the rear of the group and branch drag behind the slow moving females carrying young keeping them going in the right direction. In the thick vegetation of the Zairian rain forest the noise element of this pattern of object use was as important as the visual element in keeping the group cohesive and moving together. The other 40% of branch dragging seen was in episodes of social excitement when feeding or in dominance interactions. Behaviour such as this is a frequent, cohesive, socially relevant use of a detached object to gain a goal, not necessarily directly beneficial to the actor, which is a more abstract behaviour than cracking nuts to eat. In some ways these object behaviours bridge the two theoretical positions suggested as potential underlying requirements forcognitive development; the use of tools and the development of social complexity.

This material on *Pan paniscus* is in distinct contrast to the material on tool use compared between two populations of common chimpanzees by Matsuzawa and Yamakoshi. They are particularly interested in potential ecological differences in resource base and tool use in two closely spaced but behaviourally distinct populations at Bossou and Nimba, about 10 km apart. They crack different nuts, termite dip in different ways and one group uses a folded leaf as a cup to dip up water. The effect of possible genetic differences is discounted because the groups are so close together that the potential for migration is great. There are ecological differences in landscape and altitude between the two populations which may account for different choices of which nuts to crack, but the authors conclude that basic adult chimpanzee conservatism "neophobia" accounts for a large part of the difference. New behaviour and food patterns can be introduced by migrant females (as was demonstrated in a field experiment) but it is usually younger animals who pick up the behaviours. This may be very similar to the transmission of the use of leaf 'rain hats' by bonobo females to new groups discussed in the previous chapter. In other words, these are behaviours governed more by learning and habit than by ecological imperatives.

Until this point the first section of the book has been focused on exploring the scope of great ape intellect. Part two examines the organization of intelligence from a developmental, cultural and evolutionary perspective. In this section the data arise from laboratory studies of developmental stages, and comparisons with the various skill levels found in children. Other areas of investigation concern the theoretical aspects of evolution both phylogenetically and cognitively, as well as the impact of human enculturation on the abilities of apes. Experimental evidence on differing captive environments suggest a major

influence on behavioural organization in baby chimpanzees as young as 30 days. This supports the viewpoint that cultural aspects of behaviour development may be very important to chimpanzees. Infants from three laboratory rearing conditions - Responsive, Standard and Late Arrival were compared with each other and human children by using the Bayley Scales of Infant Development. The comparison with humans suggested that all the chimpanzees fell behind at about 10-12 months of age. However, the responsive raised ones although not cognitively advanced were behaviourally less fearful, more co-operative, co-ordinated and energetic and had a more stable affect. These would all be characteristics which could allow learning to take place more efficiently. By age 12 months human children have begun to establish their own pattern of enculturation, depending on the cultural practices of their care givers. This is particularly evident in gaze pattern and orientation. The variability present in the 3 rearing situations as well as comparisons with monkeys do suggest that similar variables may affect individuals differently rather than operating as environmental determinants. This discussion of developmental parameters continues in the next chapter in a discussion of the comparative rate of developmental Piagetian sensori-motor levels and logicomathematical cognition. When examining the formation of sets by chimpanzees and children it becomes evident that while both can construct social sets, the concept of overlapping and contrasting sets takes much longer to develop in the chimpanzee than in the child. In particular, human children are often capable of second order classification by 18 months while it often does not appear in young chimpanzees until 5 years of age. It is worth noting that these are approximate ages of normative weaning in both species. Thus when they would be in the wild at a stage to begin early foraging they are at a stage of developing direct functional dependancies (eg. the harder I push, the farther it goes). In addition, it is suggested that second order operations and functions are needed to establish even protogrammar and since chimpanzees have only rudimentary second order skills they can only develop a rudimentary proto-grammatical level. However, the author promotes an originalist hypothesis that "logico-mathematical cognition is a primary and initial development in humans, just as physical cognition is." (pg. 268) These abilities are therefore open to similar environmental influences and to each other's influence, and thus become progressively interdependent . Children can begin to map first order operations onto each other and to form second-order operations, which can begin to demonstrate the recursive development marking human cognition. Monkeys on the other hand, develop their physical cognition initially followed by logicomath-ematical cognition which does not really allow the two to influence each other. Chimpanzees begin with development of physical cognition and before it is complete begin logicomath-ematical development, which does permit some level of interdigitation and recursiveness between the two. This means that children can begin early to detach operations and functions from concrete object referents and begin to apply them abstractly thus enhancing their learning curve. Evolving cognition is thus seen as a developmental phenomenon rather than a genetic or maturational one, and due to the serious time lag occurring before chimpanzees can beginthis process they slowly develop some abstraction skills, but to a lesser degree.

These experiments with chimpanzees are supported by the investigation of a human enculturated orangutan by Miles, Mitchell and Harper. The orangutan named Chantek was sign language trained and could respond to the sign message "do the same thing", which provided a base to assess his abilities to

imitate in various modalities. He used visual-kinesthetic matching, copied the movement of objects, responded by pointing to similar body parts, and repeated activities, such as putting food in a pot on the stove. After age 55 months he could copy actions seen in photographs and repeat things days after he had seen them. He was also asked to copy simple drawings and to make noises. His responses varied from full imitation (56.2%) to part imitation (34.4%) to nonimitation (9.4%). In some cases he did not seem to understand what the salient aspect of the request was, as in trials where he was asked to stamp his foot on a step, and he clapped his foot with his hand to make a noise. After the demonstration was repeated several times he banged his foot on the step. The development of this level of imitative skill was based on earlier episodes of bodily matching of behaviour and mirror self recognition which came before he could and would respond to the requests to match behaviour. The fact that many of these behaviours were novel, difficult for him to execute (such as jumping up and down) and that he solved some problems rather differently than his caretakers, (as in pushing down his eyelid with a finger to cause a blink because his eyelids were difficult to control) suggest that his understanding of imitation went beyond bodily mapping. Chantek did use emulation to solve some problems when he was shown the problem without the 'do the same thing' request, and if he did not have a close personal relationship with the demonstrator, which as Russon noted above is an important aspect of eliciting true imitation. The patterning of his successes at increasing imitative skills reflects a developing ability similar to that hypothesised as underlying the developmental processes discussed above for chimpanzees, in which the recursiveness of physical and logicomathematical systems was not established in young apes until about 5 years of age. As an older animal he used pretense, deception and role playing in interacting with his caretakers to the extent that he reversed roles and signed to his caretaker 'Do-the-same-thing'. In some cases after 58 months of age he would orient the caretakers gaze towards himself before signing and use a mirror for self exploration or for examining the results of putting on dark glasses. These are all complex cognitive behaviours with cultural implications and are similar tobehaviours seen in many children.

The topics of imitation, pretense and mind reading were also generally surveyed by Whiten who asked whether all three abilities derive from a major cognitive base common to great apes. He defined mind reading as "the ability to recognize states of mind (mental states) in oneself or others" (pg 301). The idea behind this ability is to discern whether apes can correctly attribute knowledge or ignorance to others or whether they can discern the true state of mind of signalers. This ability is often referred to as having 'a theory of mind' from Premack and Woodruff's (1978) early work with the chimpanzee Sarah who was asked to solve visual problems concerning which choice made by a human would solve a particular problem. Whiten surveys a series of experiments on role reversal in which monkeys, apes, and human children were paired with humans and had to take turns with the human in acting appropriately to solve the problem. In some cases the animal had to decide which of two potential assistants was more reliably informed. The monkeys and children less than 3 years old could not make this discrimination but several of the chimpanzees could. Monkeys can solve problems of differing visual perspective, but do not show evidence of 'cognitive empathy' suggested in chimpanzees and the few gorillas and orangutans that have been tested. As can be imagined this level of ability is a strong cognitive underpinning to successful deception and pretense. Pretend play involved role taking and thinking about what another individual

believes, which is a second order representation. This is clear in human children but more difficult to elicit in a testing situation for apes. What data exists comes from evidence provided by home raised chimpanzees and anecdotes in laboratory newsletters. It is evident that pretend play does occur but its frequency and complexity in apes is not really established. Imitation was previously claimed to be a lower level explanation for many ape behaviours but is now regarded to require a substantial cognitive basis. Some experiments suggest that highly enculturated chimpanzees can imitate novel actions on request at the same level as young children, but mother raised ones cannot. Whiten argues that secondary representation (beliefs about beliefs) is a more accurate assessment of ape capabilities than is actual metarep-resentation (the understanding that another's belief can be false). This is claimed by the author but not clearly demonstrated since there is still considerable argument about the underlying basis of imitation, and whether it is the goal or the exact form of the complex action which define it. In children imitation appears earlier than mind reading and pretense and thus may represent a simpler and developmentally prior achievement from whichinfants can learn. If this is in fact the case, a slower development of mind reading in apes would be expected and if evidence of it and pretense occur, they can be argued to rest on a basis of imitative skills.

The last several chapters discuss in general the evolutionary, ontogenetic and self awareness aspects of imitative and categorical skills. Call and Tomasello discuss differences in various skill levels of object manipulation and symbolic play found under the five rearing conditions being considered (wild, captive, zoo, laboratory, nursery, and home). Their conclusions suggest that high levels of human enculturation affect the acquisition of ape behaviours in the domains of intentional communication and social learning. These are demonstrated by declarative pointing, complex imitation and intentional communication. It is possible that being treated as intentional beings by human caretakers actually changes the nature of young ape learning capabilities by scaffolding the instruction process allowing triadic learning interactions to occur. In a human environment apes are *exposed* to objects, they learn what such objects can do and how to use them *(emulation);* they can be *trained* in their use and finally such *enculturation* may lead to a fundamental change in how apes understand the goals and intentions of others.

This vision of these relationships in stages of ability based on differing timing in the developmental process allows us to envision how these closely related forms could have such widely varying abilities as adults. If a cladistic partitioning of the ape/human taxonomy implies that humans are more closely related to chimpanzees than orangutans are, the general basis for cognitive abilities must be shared by the whole clade . Even if gorillas seem to use tools less in the wild they still have complex social abilities and when raised in human dominated environments can show self recognition, imitation and other higher level abilities. If all 5 of the ape/human species share these general bases for ability clearly some factor discriminates humans, and the major difference appears to be the speed of human infant development. If human developmental stages are collapsed so that we see simultaneous appearance of physical cognition and logicomathematical cognition and the two systems can therefore influence each other recursively in the course of their development the result is a much younger age for second order representation, metarep-resentation, proto grammar, and the set of understandings about self, others and the physical world which allows the young human to have these mental capacities before the

physical growth of the brain is complete. In apes (the evidence is for chimpanzees) the physical and logico-mathematical systems are overlapping rather than sequential (as seen in monkeys) which allowssome recursiveness and the late development of second order representation, but not until about 5 years of age. This slower pattern of development does allow some individuals to develop skills in imitation and develop these into pretense and 'cognitive empathy', but such abilities are not universal in apes and may be highly fostered by an early human enculturated environment in which they are treated as intentional beings. These are the conclusions which I drew from these chapters. The editors of the book focus their conclusions on differences in resource exploitation strategies and demographic differences which structure the potential for information transfer. Orangutans utilize fairly simple harvesting and are not very social so information transfer does not occur widely. Gorillas also utilize a relatively simple diet but males and females who move from group to group will require social skills to help establish social bonds, although these are not as extensive as those found in larger chimpanzee and bonobo groups. Common chimpanzee children have small peer play groups but serve long apprenticeships observing their mothers utilizing tools in specialized feeding context. Because females transfer between groups they can import their skills into new groups and spread cultural information to other population units. Bonobos use their cognitive skills in establishing and maintaining fairly large groups of socially cohesive individuals and their dietary niche is such that they can afford to use tools in a social rather than a subsistence context. These conclusions are derived from the need to account for the original development of cognitive skills in a natural context long before humans had evolved the corkscrew of recursive abilities and increasing brain size that allow us to use cognition to advance our own evolution. A more comprehensive summarizing chapter unifying the themes of both parts of the book would have been a welcome addition, but the wide range of information presented allows the reader latitude for interpreting and concluding from the material presented in a variety of ways. Those interested in a non-linguistic discussion of ape cognitive abilities will find a wealth of information in this collection, and in the extensive referencing provided.

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