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Nonhuman Primates

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Synonyms

Comparative developmental psychology

Definition

Study of the physical, cognitive, and behavioral development of nonhuman primates, particularly in reference to human cognition and development. Emphasis is placed on understanding similarities and differences between all primate species to better understand the evolutionary origins of these species and their abilities.

Introduction

The study of nonhuman primates (NHP) can include a wide variety of species that vary greatly in their similarity to human development and psychology. Primates include (in order of ascending genetic relation to humans): New World Monkeys, such as capuchin and howler monkeys, Old World Monkeys, such as macaques and baboons, and the Great Apes (GA), orangutans, gorillas, bonobos, chimpanzees, and humans. This entry will focus on Great Apes as they are genetically closest to humans and used most frequently for understanding the evolutionary origins of human physical and psychological development. Nonhuman Great Apes share many physical and psychological traits with humans and human development but also display substantial differences from human abilities. One might be inclined to assume that in the cases of differences with humans, the other Great Apes are deficient in ability. However, in many cases, specific abilities of nonhuman Great Apes exceed human capabilities, suggesting some interesting differences in selection pressures. The study of nonhuman primates is a critical piece of the puzzle in understanding evolution as a process in general, primate cognition and behavior, and human psychology and development.

Physical and Brain Development

GA prenatal timing is remarkably similar to humans. For example, the prenatal gestation period for humans is 266 days on average, with chimpanzee (~235 days), gorilla (~250 days), and orangutan (~260 days) (Martin 1981). However, once born, the timing and stages of physical development differ greatly. Chimpanzees move through three distinct developmental life stages, infancy, juvenile, and adulthood. The end of infancy is marked by the cessation of

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breastfeeding, around 4–5 years, and the end of juvenility is marked by sexual maturity, around the age of 12. Humans, however, have five distinct developmental life stages, Infancy, Childhood, Juvenile, Adolescence, and Adulthood. Human infancy, like that of chimpanzees, is marked by the cessation of breastfeeding. Childhood is a human specific life stage marked by a period where solid foods are eaten but self-sufficiency and survival are impossible. Juvenility in humans is the period between the emergence of adult teeth and the onset of puberty. Adolescence is the period between the onset of puberty and the achievement of consistent reproduction, occurring around the age of 15–16 years and marks the beginning of biological adulthood.

Most noteworthy about comparisons of human physical development with NHPs is the addition of Childhood and Adolescence as life stages and delaying the onset consistent reproductive viability. Given that the process of natural selection ultimately depends upon an individual reproducing, it seems odd that natural selection would favor delaying the ability to create offspring until such a comparably old age. A number of factors likely led to this evolutionary change in human development: humans have large heads relative to body size thus requiring developmentally premature birth when compared to other species, the social complexity of human life requires time for learning, observation, and cognitive development, and allowing humans time to flexibly incorporate environmental cues into their life-history strategies (Bjorklund and Ellis 2014).

Humans and NHPs have very similar brains; specifically, they have a much larger prefrontal cortex than other animals, the area of the brain responsible for complex cognitions such as critical thinking, cognitive flexibility, and decision-making. Humans have, on average, the largest brains relative to body size among the GAs. However, many believe that increases in white matter connectivity (neural connection within the prefrontal cortex and those emanating to other brain areas) are chiefly responsible for the advanced cognitive feats performed by GAs and even more so the complex abilities that often set humans apart from other GAs (Smaers 2013).

Memory

Human memory is conceptualized as a flexible system with numerous interacting components that serve multiple purposes. Long-term memory (LTM) is the storage and retrieval system that allows for remembering information over the course of hours to years; this is typically what is meant when the term "memory" is used in everyday life. Short-term memory (STM) helps remember information in short time frames on the order of seconds or minutes. Finally, working memory (WM) is the system that keeps information activated in the thoughtful and aware mind in order to perform actions with that information; when you are currently "thinking about something" that information is said to be active in working memory. Decades of research have found these systems to be interactive while also cognitively and neurologically separate. Information that humans can remember can further be divided by its qualities or content. Episodic memories are those that retain a personal quality from a specific time and place (e.g., I remember my grandmother making me homemade donuts on my 9th birthday), whereas semantic memories are simply information (e.g., Alexander the Great was Macedonian).

There is no doubt that NHPs, especially GAs, possess all of these systems and use them in very similar ways to humans. GAs remember family members and social others, the locations of food sources, and how to engage in complex tasks such as tool use. In fact, there is evidence that chimpanzee WM has a greater capacity than human WM. However, debate exists about whether any GA memories can be said to be episodic and include a "personal" component rather than simply an informational component (Sellers and Schwartz 2013). Many have come to call their memories "episodic-like" highlighting the fact that these memories share some characteristics with human episodic memories, but it is experimentally difficult to confirm their exact episodic

nature given the limits of communication between humans and GAs.

Developmentally, it is very likely that GA memory over the lifespan follows a very similar course to humans. Memories in infancy are probably not episodic nor semantic in nature, they are purely sensory. However, there is evidence that human children as young as 2 months display memories with some episodic qualities, such as context-dependency (Rovee-Collier and Dufault 1991). With age, LTM, STM, and WM all begin to function in rudimentary ways, with capacity and accuracy increasing with age. Human memories are undoubtedly episodic by the age of 1, as they can generalize knowledge learned in one setting to another (Learmonth et al. 2004). However, little definitive information is known about the exact nature of NHP memory development in early life. It is very difficult to study young primates for a number of reasons, and much must be inferred from day-to-day behavior, leaving many questions unanswered.

Language and Communication

All NHPs engage in communication, both verbal and nonverbal, with social others. Obviously, humans have a natural mastery of complex, representational language that far surpasses the capacity of all other NHPS. However, NHPs can engage in quite sophisticated and varied communication, as evidenced by chimpanzees' use of different vocal calls to signal different types of danger (e.g., a certain call is used to alert for danger on the ground while a different call alerts for danger in the air or trees).

The most famous developmental-comparative case of language between humans and nonhuman GAs is the case of Kanzi, a bonobo raised in captivity from birth. Kanzi, currently 35 years of age and living at the Ape Cognition and Conservation Initiative in Des Moines, Iowa, exhibits the most sophisticated language abilities of any known NHP. He is able to communicate using lexograms, complex and abstract symbols that stand for physical items and actions. GAs cannot make human vocalizations due to differences in their vocal tracts. One likely reason for his superior abilities is his early exposure to language; his adoptive mother, Matata, was being trained to learn lexograms when Kanzi was young. This early exposure seems to have provided Kanzi with a developmental advantage in language abilities. This can be viewed as analogous to Noam Chompsky's idea for an early critical period in humans when language is most efficiently learned. There is some debate within the scientific community about whether Kanzi's abilities can rightly be called representational language, but even if they fall short of this high bar, his abilities are no doubt impressive and important to our understanding of the evolution of language.

Social Cognition

Social cognition is a broad construct encompassing the cognitions and behaviors used to interact with or think about others and situations involving them. The cognitive ability most closely associated with social cognition is Theory of Mind (ToM). ToM is the ability to think about the contents of another person's mind (e.g., I know that Johnny knows the answer to the trivia question). This ability is important for predicting the behavior of others based on their held beliefs and personal desires so that an individual can formulate appropriate responses and behaviors in reference to this other person. For example, if I am eating dessert with Erica and I know that she loves ice cream I can give her the ice cream while I eat the brownie. However, I can also purposefully give her the brownie to be mean if I know that she thinks badly of me and has been gossiping behind my back. These decisions rest upon ToM.

Human children typically achieve explicit ToM around the age of 4, with sophistication and proper use increasing with age. There is some debate that perhaps these cognitions occur earlier; however, there is no debate that by 4 years of age children are complex social thinkers who can make appropriate assumptions about the minds of others. Children use this ability to imitate each other and adults in order to learn complex tasks, skills, and appropriate social behavior. They

form complex friendships, social groups, and social hierarchies at a young age. Young GAs also engage in observation and imitation of adults, particularly tool use (i.e., fishing for termites or cracking nuts with stones). They also form social groups, understand the adult social hierarchy, and behave differently towards relatives and nonrelatives. These behaviors suggest that young GAs may have social cognitive abilities comparable to those of young human children.

Adult GAs certainly possess complex social cognitions: they can enlist humans to help them in cooperative tasks, can make assumptions about the desires of a human and assist in completing a task the human cannot do alone, and appear to understand that eyes are a source of another individual's ability to gather information (Tomasello and Call 2010). However, aided by language and communication abilities, human adults achieve much more sophisticated social cognitions and collaborations than GAs.

Conclusion

NHPs and humans share many abilities and characteristics that evidence their common evolutionary history and genetic similarities. However, differences abound in both the developmental course of these abilities and in their final adult complexities. However, humans faced evolutionary pressures that increased the length of childhood and supported an intricately connected frontal cortex, leading to complex, self-referent memory, representational language, and incredibly sophisticated social cognitions.

Cross-References

- ▶ Brain size Growth in Humans and Non-Human Primates
- ▶ Convergent Evolution of Hyena and Primate Social Cognition
- ▶ Convergent Evolution of Intelligence Between Corvids and Primates
- ▶ Cooperation Among Non-Human Primates

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