


 PROFILE

Profile of Dorothy L. Cheney and Robert M. Seyfarth

Jennifer Viegas, *Science Writer*

Field studies in Africa over the past four decades by ethologists Dorothy Cheney and Robert Seyfarth have uncovered a trove of insights into the behavior, communication, and social cognition of nonhuman primates. The pair's research further reveals evolutionary antecedents of the human mind. University of Pennsylvania professors emeriti, Cheney and Seyfarth are both elected members of the National Academy of Sciences. For her Inaugural Article cowritten with Seyfarth, Cheney strengthens the hypothesis that many primate vocalizations shape social interactions. Factors driving the early stages of language evolution may therefore be associated with primate social challenges.

Inspired by Darwin

As youths, Cheney and Seyfarth enjoyed travel and nature. Cheney's father was in the US Foreign Service, so her family moved to a different place every few years before returning to Washington, DC. "My parents' rather *laissez faire* approach to child-rearing allowed my sister and me to travel alone around India in our teenage years," says Cheney. "We were given complete independence, for which I've always been grateful." Seyfarth's father was a Chicago-based businessman. "He also loved the outdoors, and on fishing trips to Canada and the Caribbean, taught me how to enjoy the wilderness even when we didn't catch fish," Seyfarth says.

Cheney and Seyfarth were not initially drawn to science. Cheney preferred history at her preparatory school in Massachusetts, Abbot Academy, and Seyfarth at first struggled with science. He says, "I found science courses difficult and unappealing until, in my senior year at Phillips Exeter Academy in New Hampshire, I took a course on Darwin. The theory of evolution brought everything into focus and made all that memorization seem worthwhile." Cheney's "Darwin moment" happened in the spring term of her Wellesley College senior year. She explains, "I took a history of science course on evolution and genetics that finally revealed to me the 'big why,' the narrative and coherence that I'd missed in my previous classes. Darwin's theory of natural selection provided the framework for



Dorothy Cheney and baboons. Image courtesy of Keena Roberts (photographer).

everything in biology. Suddenly, I wanted to retake all of my science classes."

A Transformative Experience

Cheney earned a bachelor of arts degree from Wellesley College in 1972 and planned to attend law school. When she met Seyfarth, he was a Harvard University undergraduate majoring in biological anthropology. Seyfarth, having taken courses from anthropologists William Howells, Irven DeVore, and other primatologists, became fascinated with wild primates. Seyfarth hesitated to pursue a career in academia, however. A friend's uncle urged Seyfarth to follow his passion. "So, with the advice of the paleontologist Bernard Campbell, who was visiting Harvard at the time, and the generous support of my parents, I applied to work with Robert Hinde at Cambridge University." Hinde, a noted animal behaviorist and foreign member of the National Academy of Sciences (NAS), supervised Jane Goodall's dissertation on the behavior of chimpanzees in the mid-1960s. Hinde accepted Seyfarth's request.

When Seyfarth arrived at Cambridge University in the fall of 1970, it was already a mecca for primate studies. Most of Hinde's students wanted to follow Goodall to the Gombe Stream Reserve in Tanzania, but Seyfarth, now married to Cheney, conceived another plan: to conduct research on baboons

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Robert Seyfarth and baboons crossing water. Image courtesy of Dorothy L. Cheney.

at Mt. Zebra National Park in South Africa, which he did from 1972 to 1974. He invited his wife along. Cheney recalls, "I thought, 'What the hell, this could be fun for a year or two,' so I decided to put off law school and join him. It was a transformative experience, and I loved it." After 18 months in the field, she wrote to Hinde asking if he would accept her as a graduate student, and Hinde agreed.

Synthesis of Experimental Psychology and Ethology

The couple returned to Cambridge to write up their results. Hinde had recently authored a textbook, *Animal Behavior: A Synthesis of Ethology and Comparative Psychology* (1), which attempted a synthesis of the laboratory-based experimental psychology then dominant in the United States and the field-based research on animals developed in large part by European scientists such as zoologist Konrad Lorenz and biologist Nikolaas Tinbergen. The book influenced Cheney and Seyfarth, as did biologist E. O. Wilson's *Sociobiology: The New Synthesis* (2). Cheney says, "Hinde, Lorenz, Tinbergen, and Wilson recognized that the most significant ideas in science and medicine emerge from observation of the natural world. Hinde was also a pioneer in appreciating the importance of social relationships in the lives of animals."

Seyfarth's first two articles reflect Hinde's mentoring and the then-emerging field of cognitive ethology. Both concern social relationships among female primates and focus on grooming. Seyfarth created a computer model showing how rank-related access, attractiveness, and competition among adult female baboons may interact to perpetuate the distribution of grooming over time (3, 4). Seyfarth says, "The paper was a harbinger of work, many years later, on the adaptive value of friendships, biological markets, and the application of network analysis to primate social structure."

Monkey Semantic Communication

Hinde recommended Cheney and Seyfarth to animal behaviorist Peter Marler at The Rockefeller University, where both subsequently worked as postdoctoral fellows from 1976 to 1979, later becoming assistant professors. Marler, an NAS member, hoped they would continue research conducted by one of his students that suggested East African vervet monkeys emit acoustically different alarm calls upon detecting different predators. Seyfarth says, "Intriguingly, such calls might function as 'primitive words,' but this hypothesis could only be tested by field playback experiments."

So, the duo conducted experiments over 14 months on three groups of free-ranging vervet monkeys in Amoseli National Park, Kenya. In a seminal *Science* article coauthored with Marler in 1980 (5), they reported that the monkeys conveyed vocal information to others in their troop about specific types of predators: leopards, eagles, and snakes. The calls by themselves elicited distinct adaptive responses (5). The findings led to other studies on meaning in animal signals, such as a 1999 collaboration with psychologist Klaus Zuberbüler (6) that concluded monkeys do not solely rely on call acoustic features to adapt behavior, but rather appear to access a common association, possibly a mental representation. The authors theorize that such representations may be similar to the concepts that underlie human words. An article in *Animal Behavior* (7) was later recognized by the journal's editors as one of the publication's 12 most influential papers (8).

How Monkeys See the World

Cheney and Seyfarth next applied their playback techniques to research on social knowledge among vervet monkeys. The work began with a fortuitous experiment. The researchers wanted to test the hypothesis that monkey mothers recognize the calls of their offspring. While Cheney and Seyfarth filmed resting adult female monkeys, they played from a concealed loudspeaker the call of an offspring. The other females served as controls. As predicted, mothers responded more strongly than controls to the playbacks. To the researchers' surprise, the control females responded by looking at the mother (9). Seyfarth says, "They acted as if they associated a specific vocalization with a specific juvenile and that juvenile with its mother. This, in turn, suggested that primates might recognize the relationships that exist among others in their group, and that this social knowledge could be tested experimentally."

From 1981 to 1985, Cheney and Seyfarth served as assistant professors in the Department of Anthropology at the University of California, Los Angeles. They then moved to the University of Pennsylvania in 1985, where Seyfarth joined the psychology faculty and Cheney became a member of the anthropology faculty before joining the Department of Biology in 1991. In 1990, the pair summarized their findings concerning vervet monkey communication, cognition, and behavior in their first book, *How Monkeys See*

the World: Inside the Mind of Another Species (10). Five years later, both were awarded Guggenheim fellowships. In 1997, they were elected fellows of the Animal Behavior Society.

Development of the Social Intelligence Hypothesis

During the years that Cheney and Seyfarth performed research on the behavior and ecology of vervet monkeys at Amboseli, they also conducted field research on mountain gorillas at Parc National des Volcanes, Rwanda, and studied cross-fostered rhesus and Japanese macaques at the California Primate Research Center in Davis, California. Their work during this time addressed the function of gorilla double-grunts (11) and how auditory experience affects monkeys' use of vocalizations (12).

In 1992, Cheney and Seyfarth began research on the vocal communication of baboons at the Moremi Game Reserve in the Okavango Delta of Botswana. The work paralleled an even longer study on baboons in Kenya by evolutionary biologist and NAS member Jeanne Altmann. The pair credit Altmann for devising rigorous methods to quantify field observations of behavior. Seyfarth says that in Botswana, "We continued our experimental studies of social cognition, working in collaboration with a superb group of postdocs. We tested hypotheses about the baboons' knowledge of other individuals' dominance ranks and close social bonds, explored their responses to 'reconciliatory' vocalizations, and asked how their memory of past interactions might affect future behavior."

The research was summarized in their second book, *Baboon Metaphysics* (13). The work drew inspiration from Darwin, who in 1838 wrote, "He who understands baboon would do more towards metaphysics than Locke." Cheney and Seyfarth conclude in the book that among primates, natural selection acts in a social environment such that baboons and other monkeys possess minds specialized for observing social life, computing social relations, and predicting other animals' behavior. The findings lend support to the social intelligence hypothesis, which holds that the need to navigate complex social relationships is a key factor in the evolution of increased cognitive abilities.

A subsequent series of papers written jointly with anthropologist Joan Silk provide evidence that social bonds hold adaptive value in a range of taxa, from mice to humans (14–16). For their achievements, Cheney and Seyfarth were elected to the American Academy of Arts & Sciences in 1999 and 2012, respectively. They also received honorary doctorates in 2013 from the University of Neuchâtel, Switzerland, and jointly received the American Society of Primatology's Distinguished Primatologist Award in 2016.

Factors Driving Language Evolution

Cheney and Seyfarth retired from teaching in 2016 but remain active in research. For her Inaugural Article cowritten with Seyfarth, Cheney reviewed studies supporting the hypothesis that although monkeys have a small repertoire of calls, they use them in a learned, flexible manner to facilitate social interactions (17). The authors also reviewed related studies of the neural mechanisms that underlie primates' decisions. The data suggest that, similar to humans, activity in the brain's anterior cingulate cortex may mediate social decisions, including the decisions to call or remain silent, to use one call rather than another, and to respond to another individual's calls. Cheney says, "It seems possible that the cognitive mechanisms underlying call usage, response, and the judgment of contextual factors may have set the stage and created selection pressures leading to the evolution of learned, flexible production." Cheney and Seyfarth elaborate on the subject in their lead chapter of the edited book entitled *The Social Origins of Language* (18).

The couple's work has influenced their family. As children, their daughters accompanied them during fieldwork. One of their daughters is now a lawyer at the US State Department, while the other has authored an upcoming book, *Wild Life* (19), about her family's experiences in the Okavango Delta. The duo's postdoctoral fellows and graduate students, with whom they are close, have conducted research not only on primates but also on dogs, horses, and many other animals. As Cheney says, "We recognize that close bonds contribute to health, longevity, and reproductive success in both humans and other animals."

1 Hinde RA (1970) *Animal Behavior: A Synthesis of Ethology and Comparative Psychology* (McGraw-Hill, New York), 2nd Ed.

2 Wilson EO (1975) *Sociobiology: The New Synthesis* (Belknap Press, Cambridge, MA).

3 Seyfarth RM (1976) Social relationships among adult female baboons. *Anim Behav* 24:917–938.

4 Seyfarth RM (1977) A model of social grooming among adult female monkeys. *J Theor Biol* 65:671–698.

5 Seyfarth RM, Cheney DL, Marler P (1980) Monkey responses to three different alarm calls: Evidence of predator classification and semantic communication. *Science* 210:801–803.

6 Zuberbühler K, Cheney DL, Seyfarth RM (1999) Conceptual semantics in a nonhuman primate. *J Comp Psychol* 113:33–42.

7 Seyfarth RM, Cheney DL, Marler P (1980) Vervet monkey alarm calls: Semantic communication in a free-ranging primate. *Anim Behav* 28:1070–1094.

8 Searcy WA (August 2016) 2016 career awards. *Newsletter Animal Behavior Society*, Vol 61. Available at www.animalbehaviorsociety.org/NEWSLETTERS/61-3/careerandfellows.php. Accessed March 16, 2018.

9 Cheney DL, Seyfarth RM (1980) Vocal recognition in free-ranging vervet monkeys. *Anim Behav* 28:362–364.

10 Cheney DL, Seyfarth RM (1990) *How Monkeys See the World: Inside the Mind of Another Species* (Univ of Chicago Press, Chicago).

11 Seyfarth RM, Cheney DL, Harcourt AH, Stewart KJ (1994) The acoustic features of gorilla double grunts and their relation to behavior. *Am J Primatol* 33:31–50.

12 Owren MJ, Dieter JA, Seyfarth RM, Cheney DL (1993) Vocalizations of rhesus (*Macaca mulatta*) and Japanese (*M. fuscata*) macaques cross-fostered between species show evidence of only limited modification. *Dev Psychobiol* 26:389–406.

- 13 Cheney DL, Seyfarth RM (2007) *Baboon Metaphysics* (Univ of Chicago Press, Chicago).
- 14 Silk JB, et al. (2009) The benefits of social capital: Close social bonds among female baboons enhance offspring survival. *Proc Biol Sci* 276:3099–3104.
- 15 Silk JB, et al. (2010) Female chacma baboons form strong, equitable, and enduring social bonds. *Behav Ecol Sociobiol* 64:1733–1747.
- 16 Silk JB, et al. (2010) Strong and consistent social bonds enhance the longevity of female baboons. *Curr Biol* 20:1359–1361.
- 17 Cheney DL, Seyfarth RM (2018) Flexible usage and social function in primate vocalizations. *Proc Natl Acad Sci USA* 115:1974–1979.
- 18 Seyfarth RM, Cheney DL (2017) *The Social Origins of Language* (Princeton Univ Press, Princeton).
- 19 Roberts KC (2019) *Wild Life* (Grand Central Publishing, New York).