

Animal Communication

Do animals use language?

- ▶ Almost all creatures have some sort of communication system.
- ▶ No other animal uses a system that we can call “language.”
- ▶ No animal has been taught human language to the same extent and degree of sophistication that a human child acquires it naturally without instruction.
- ▶ René Decartes “Discourse on Method”
 - ▶ It is a very remarkable fact that there are none [among people] so depraved and stupid, without even excepting idiots, that they cannot arrange different words together, forming of them a statement by which they make known their words together, forming of them statement by which they make known their thoughts; while, on the other hand, there is no other animal, however perfect and fortunately circumstanced it may be, which can do the same.
 - ▶ Fixed stimulus-bound messages of animals vs creative linguistic ability of humans: one of the major differences between humans and animals is that human use of language is not just an immediate response to external, or even internal, emotional stimuli, as are the grunts and gestures of animals.

Communication and language

- ▶ 9 design (definitional) features of language (Charles Hockett)
 - Mode of communication
 - Interchangeability
 - Semanticity
 - Pragmatic function
 - Cultural transmission
 - Arbitrariness
 - Discreteness
 - Displacement
 - Productivity
- ▶ No animal communication system has been identified to date that has all nine design features; animal communication systems are not language.

Shared by all communication systems

- ▶ Semanticity (meaning): eating, mating, deciding to fight, flee
- ▶ Pragmatic function (purpose): helping others find food, warning others of danger
- ▶ Mode of communication
 - Sound:
 - birds, whales, frogs, rattlesnakes, crickets
 - elephants: infrasound (low pitched sounds [<20 Mz], travel several miles)
 - bats, whistling moths: ultrasound (high pitched sounds [$>20,000$ Hz], not much energy)
 - kangaroos, hares, rabbits thump hind legs as a warning signal
 - death-watch beetle bangs head against wood to communicate

- Visual cues
 - Dogs, apes use facial expressions and body postures to express submission, threat, playing, desire
 - Female rabbits use the white tail as a flag to lead their young to the safety
 - Fireflies produce light to find mates
 - Male spiders use elaborate gestures to attract female
 - Fiddler crabs wave their claws to communicate
- Touch
 - Monkeys hug
 - Big cats and rhinos nuzzle each other
 - Bees use touch to communicate the food source
- Odor
 - Insects secrete pheromones to attract mates
 - Ants use scent trails to communicate paths
- Electrical signals
 - Fish and amphibians use electrical signals to identify mates, broadcast territoriality, and regulate schooling behavior

Exhibited by some animal communication systems

- ▶ Interchangeability: not all animals can both send and receive signals
 - Silkworm moth: only females secrete chemical; males are receivers
 - Whistling moth: only males rub their wings to make a sound
- ▶ Cultural transmission (learn through interaction with other users)
 - The actual signal code itself is innate, or genetically programmed:
 - Fireflies are not taught to produce/interpret light displays
 - Cow birds lay their eggs in other birds' nests, not raised by adult cow birds, but still produce cow bird calls
 - Aspects of communication systems seem to be learned
 - Regional dialectal variation: bird species' songs, killer whales' communication, chimpanzee gestures
 - Learn from hearing/watching other users
 - Finches isolated until adulthood learn simple calls, not as complex as those of finches raised in groups

- ▶ Arbitrariness (symbol not inherently or directly related to meaning/function ↔ Iconicity)
 - Most animal systems use iconic signals; most animal signals are not arbitrary
 - Dog bares teeth: 'I will bite you'
 - Dog roll over and show belly: submission
 - Snake, lizard, frog stand up, puff out their features, look larger: threat
 - Some signals are arbitrary
 - Western fence lizard: male turn its dorsal region into different shades of blue to indicate territoriality: darker blue indicates territorial ownership; light blue indicates non-territorial
 - Primates: alarm calls
- ▶ Discreteness (composing complex messages out of smaller units: compositionality)
 - Each message of most animal communication system is an indivisible unit.
 - Limited discreteness
 - Bees' dances: dance pattern, direction, vivacity of the dance

Not found in animal communication systems

- ▶ Displacement (not present in space or time)
 - ▶ No animal system appears to display this feature.
 - ▶ Bees and apes exhibit it to a limited degree?
 - ▶ Menzel et al. (2002). Bonobos' spatial memory. Kanzi could use the information on the road signs with arbitrary symbols (lexigrams) to find hidden food. BUT ambiguous: 'There's food hidden at this location.' ↔ 'Perform this behavior now/Go to this location now.'
- ▶ Productivity (rule-based expression of an infinite number of (novel) messages)
 - ▶ Closed communication system: In all animal communication systems, the number of signals is fixed.
 - ▶ There is no mechanism for systematically combining discrete units in new ways to create new signals.
 - ▶ Birds' or whales' songs are composed of different units that are combined in various ways, BUT no difference in meaning

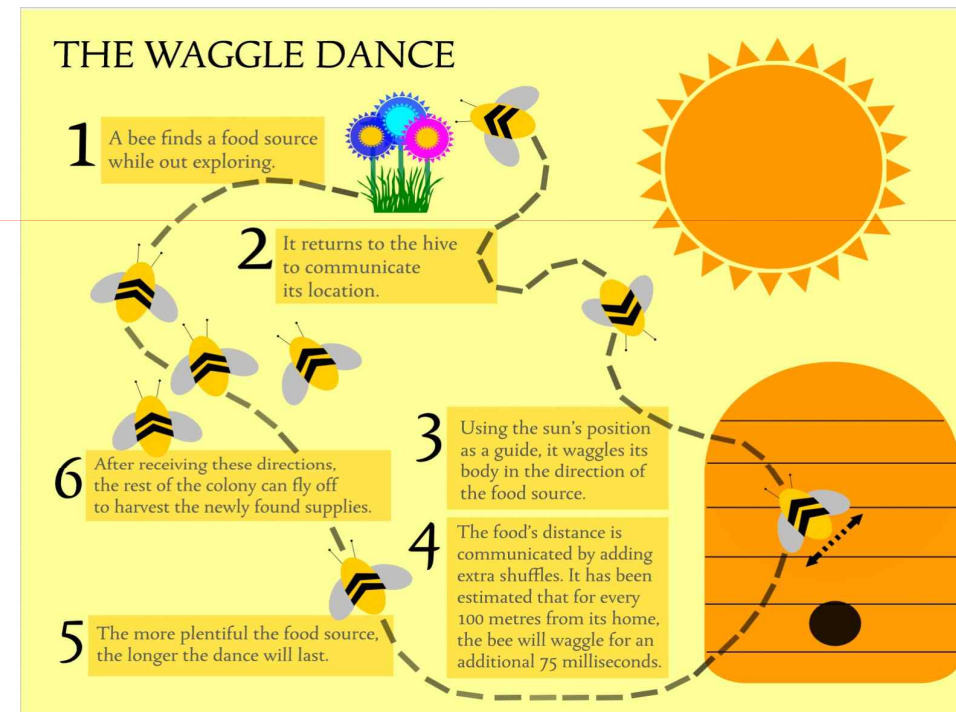
How do animals communicate?

- ▶ No animal communication system is qualitatively the same as human language?
- ▶ Italian species of honeybee (*Apis mellifera ligustica*)
- ▶ European robin (*Erithacus rubecula*) and other bird species
- ▶ Rhesus monkey (*Macaca mulatta*)

Bee communication

Dance pattern

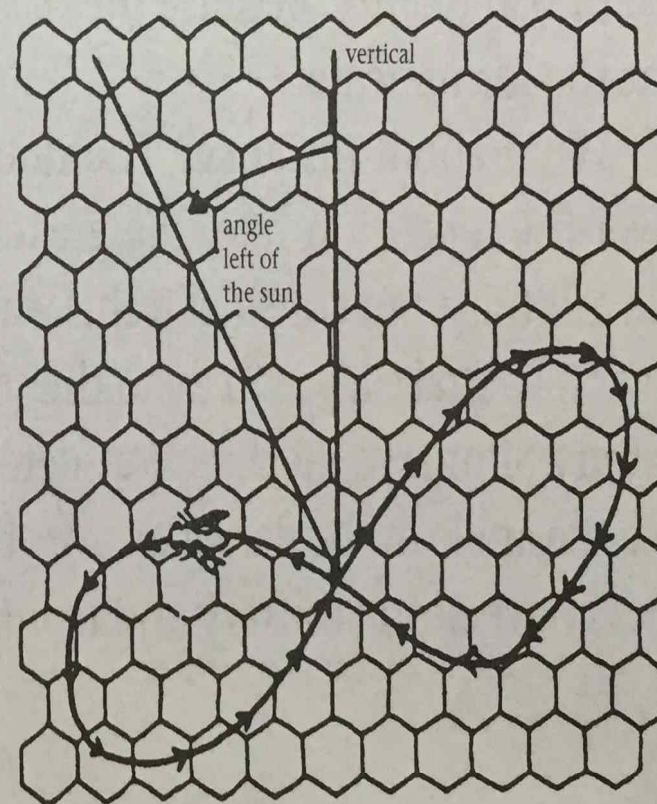
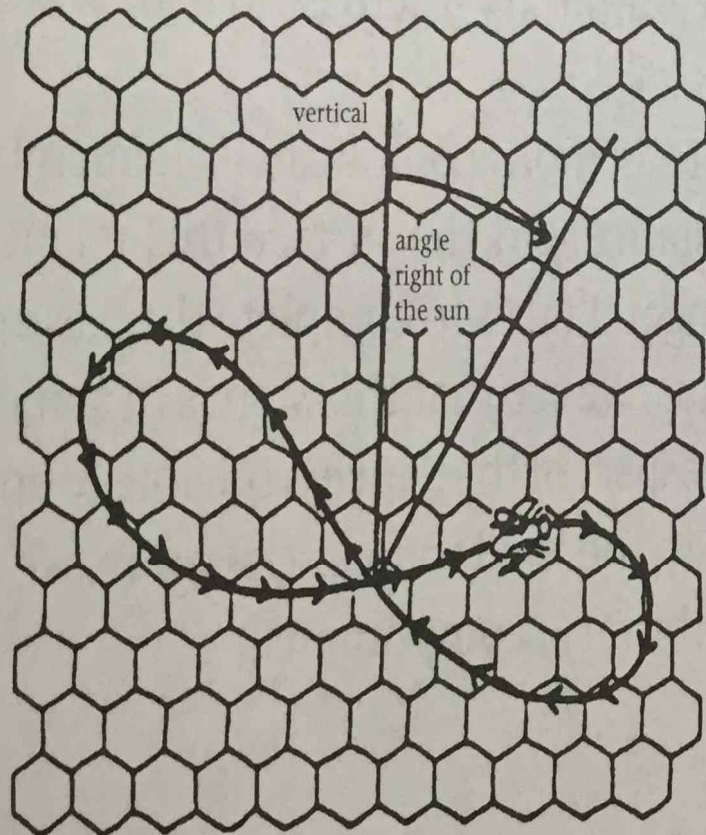
- Distance
 - Round: within 20 feet or so
 - Sickle: 20-60 feet
 - Tail-wagging: beyond 60 feet. The number of repetitions per minute: the slower the repetition, the greater distance
- Quality of food source
 - Number of repetitions of the basic pattern (round, sickle)
 - Vivacity
- Direction
 - Angle of the food source from the sun



- World's Weirdest: Honey Bee Dance Moves—National Geographic
<http://video.nationalgeographic.com/video/weirdest-bees-dance>

(1) The sickle dance (File 14.2.1, p.573)

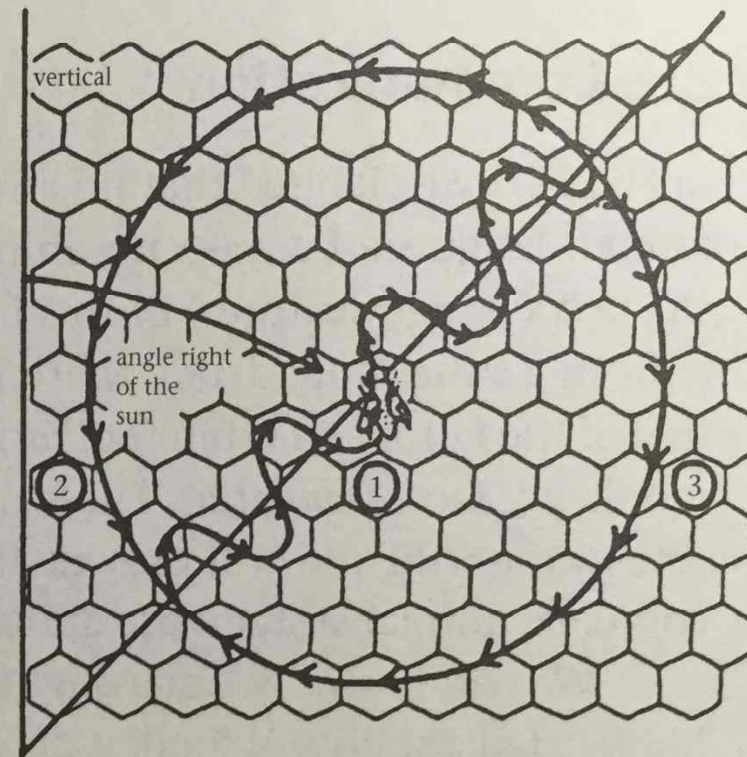
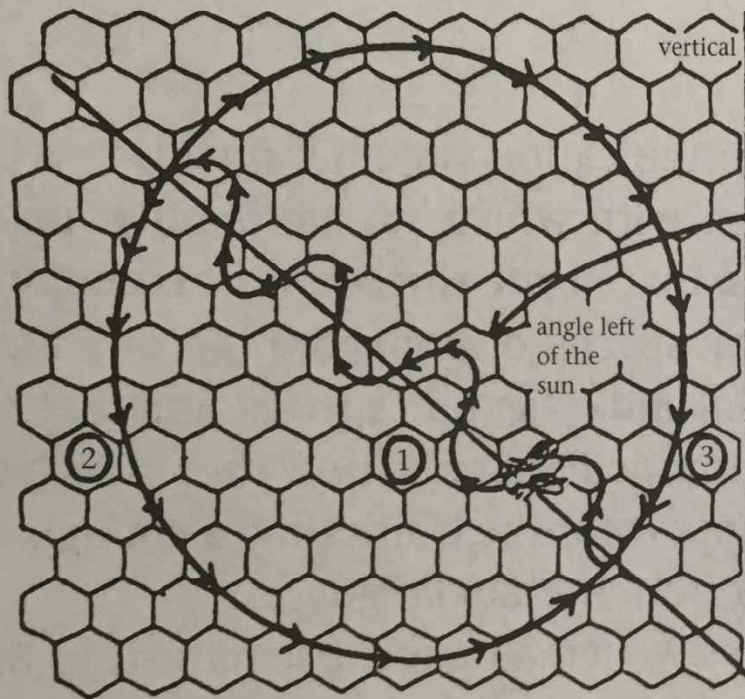
(1) The sickle dance. In this case the food source is 20 to 60 feet from the hive.



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(2) The tail-wagging dance (File 14.2.1, p.574)

(2) The tail-wagging dance. The number of times per minute the bee dances a complete pattern (1-2-1-3) indicates the distance of the food source.



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- ▶ Absence of creativity: the communication system of the bees has limited semantic value.
 - Experiment to force a bee to walk to a food source → It indicated 25 times
 - farther away than the food source actually was →
 - no way of communicating the special circumstances or taking them into account in its message
- ▶ Arbitrariness
 - Vivacity of the dance: quality of food source (arbitrary)
 - Distance: the longer it takes to complete the basic pattern, the longer it will take a bee to fly to the source (non-arbitrary)?
 - Direction: the angle of the dance mirrors the angle to the food source (non-arbitrary)

Bird communication

- ▶ Bird calls: short, simply sounds that warn of predators, express aggression, coordinate flight activity, or accompany feeding or nesting behavior
 - ▶ Flight calls: short sounds, easy to pinpoint
 - ▶ Predator warning calls: thin, high-pitched, difficult to locate
 - ▶ Not completely arbitrary
- ▶ Bird songs:
 - ▶ Only males sing, to delimit their territory or attract a mate
 - ▶ Seasonal
 - ▶ Definite meaning: 'let's a build a nest together', 'go get some worms for the babies'
 - ▶ Birds cannot make up a new song to cope with a new situation.

- ▶ European robin
 - ▶ Complicated patterns have little effect on the message
 - ▶ The rate of alternation between high-pitched and low-pitched notes, the order irrelevant
 - ▶ A higher rate of alternation shows a greater intention to defend the territory
 - ▶ The robin is creative in his ability to sing the same message in many different ways, but not creative in his ability to use the same units of the system to express many different tunes, each with a different meaning.
- ▶ Certain birds combine parts of their songs in different orders, but there is no evidence that different meanings are associated with this recombination.
 - ▶ Branded wren (*Thryothorus pleurostictus*)
 - ▶ No discreteness: Basic chunks or phrases (A, B, C, D) do not carry any meaning on their own
 - ▶ No compositionality: ABABABCCCCD / ABABABABABABCCCD / ABCCCCD
 - ▶ Syntax: A-B(-A-B)-C-C-D cf. gibbons, diana monkeys, whales
 - ▶ The syntax of human languages cannot be explained with such a simple model: we can rarely predict what word will come next based only on the current word

Primate communication

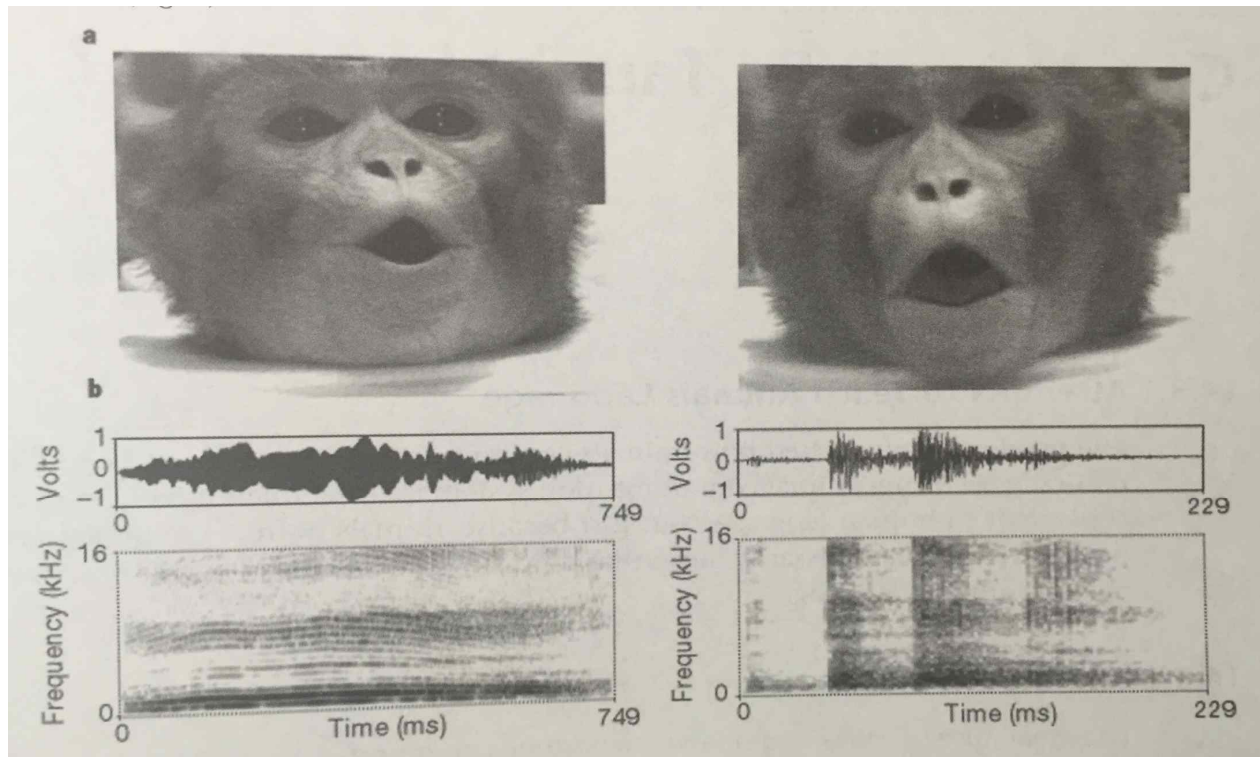
- ▶ Apes (vervet and rhesus monkeys) have elaborate systems of vocal and facial communication
 - ▶ Alarm calls:
 - ▶ a loud bark (leopard) 'go up to the trees';
 - ▶ a short, interrupted, two-part, cough-like sound (eagle) 'cover under thick bushes';
 - ▶ a soft whirring noise (snake) 'stand up and look around the grass'
 - ▶ Calls for social hierarchy arguments, mating rituals, and territorial disputes
 - ▶ The limited "vocabulary" of monkey calls is rigid and fixed.
 - ▶ "cheating" monkeys may emit a false alarm calls to monopolize a food source → for different purposes? 'There's a leopard' / 'go climb a tree.'
 - ▶ Do not represent novel utterances or new signals
 - ▶ Most animal communication systems do not have the sophistication to use the same signal for different purposes

Reveal a human-like ability to enhance the auditory perception of vocal signals with visual cues.

- Cooing call (long tonal sounds) vs threat call (short, pulsating, cough-like sounds)

The great apes (gorillas, chimpanzees, bonobos, and orangutans) also communicate with facial expressions, gestures, and calls to express anger, dominance, fear, danger, acceptance in a group, etc.

They lack displacement and productivity



(4) Facial expressions, waveforms, and spectrograms of rhesus monkeys' cooing (left) and threat (right) calls (File 14.2.3, p.577)

Can animals be taught language?

- ▶ No naturally occurring animal communication system is either qualitatively or quantitatively equivalent to human language.
- ▶ Can animals be taught (human) language?

Primate studies

- ▶ Great apes (gorillas, chimpanzees, bonobos, and orangutans) are *Homo sapiens*' nearest relative; chimpanzees share close to 99% of their genetic material with human beings.
- ▶ Early projects
 - ▶ W. N. and L. A. Kellogg. 1930s. raised Gua, a baby chimpanzee (7 1/2 mo), in a human environment. No “forcible teaching.” Taught *papa*—unsuccessful
 - ▶ Keith and Cathy Hayes. 1950s. Raised Viki, a female chimp, like a human child.
 - ▶ Shaped her lips with their hands into various configurations for consonant sounds.
 - ▶ After 3 years, she could “speak” 3 words: *cup*, *mama*, and *papa*—unsuccessful
 - ▶ Allen and Beatrice Gardner. Taught Washoe, a female chimp, American Sign Language (ASL). Not raised as a human infant but brought up with minimal confinement in a stimulating atmosphere with no spoken English allowed in her presence.
 - ▶ Molded Washoe's hands into the shapes for their signs.
 - ▶ At age 5, learned 132 signs; around the end of her life in 2007, learned 250 words—successful?

- ▶ Some amount of productivity?: dirty Roger, swan = water bird ?
- ▶ Washow taught signs to her adopted son, Loulis (10 mo). 40 signs.
- ▶ Development of lexigrams (a signed language or visual signs)
- ▶ Ann and David Premack. 1966. Sarah, chimpanzee. Tried to find training procedure than raising Sarah as a child.
 - ▶ Instead of ASL, used differently shaped and colored plastic chips and arbitrarily associated an English word with each chip. Taught how to place chips on the “language board” to form a “sentence.”
 - ▶ Claimed to have taught Sarah 130 symbols, including category names such as *color* and concepts such as *same* and *different*, and *insert*. *Sarah banana pail insert*
- ▶ Duane Rumbaugh. Designed an automated ape language experiment taken out of the hands of human trainers. Trained Lana.
 - ▶ Designed a computer that execute certain commands, such as dispensing food or displaying slides in response to an operator given proper commands, which were given by lighting up symbols of an invented “language.”
 - ▶ Lexigrams: 9 different geometric figures.
- ▶ Francine Patterson. 1972. taught ASL to a gorilla Koko.
 - ▶ Koko knows several hundred signs and has invented many of her own combinations, such as *finger bracelet* ‘ring’; insult people a *dirty toilet devil* ;Reported to understand spoken English, rhyme, substitute homophones *eye* for *I*, *know* for *no*
 - ▶ Patterson claimed that “Koko is the first of her species to have acquired human language.”

► Criticisms of the Early Projects

- Herbert Terrace. 1970s. Nim Chimpsky. To prove that a chimp could acquire and display some use of grammar. Like Gardners.
 - Nim acquired 125 signs based on ASL
 - Videotape all instructions between chimp and trainer.
 - Acknowledged that the ape's use of signs was very different from language.
 - Nim almost never initiated signing; only 12% of Nim's signs were spontaneous; full 40% were mere repetitions of what the trainer had just signed.; Nim's spontaneous signing was invariably a request for food or social reward; did not display turn-taking behavior
 - No evidence that Nim knew grammar. *Give orange me give eat orange me eat orange give me eat orange give me you.*
 - Terrace reviewed previous experiments and came to a similar conclusions.

► More recent projects

- Sue Savage-Rumbaugh
 - When apes use a sign, do they know what it means? As a symbol with a mental representation as part of the meaning
 - In all previous experiments, apes were not using their signs symbolically. They merely learned to associate certain behaviors (making or seeing a particular sign) with certain consequences (getting something to eat)

- ▶ Ability to produce a symbol have 4 separate abilities
 - ▶ Using the association of a lexigram and an object to request the object
 - ▶ Naming: providing the lexigram associated with an object without the expectation of consuming or receiving that object
 - ▶ Comprehension of the symbol: linking the symbol to its referent
 - ▶ The role of the receiver or listener
- ▶ A bonobo Kanzi learned to comprehend spoken English just by being exposed to it and has spontaneously begun to use the keyboard with lexigrams to make requests and comment on his environment.
 - ▶ Bonobo Kanzi <https://www.youtube.com/watch?v=jKauXrp9dl4>
 - ▶ Do chimps have accents? <http://www.nbcnews.com/science/science-news/chimps-learn-new-language-when-they-change-locale-n300776>

Parrots

- ▶ Alex the Parrot

https://www.youtube.com/watch?v=7yGOgs_UIEc

- ▶ Parrot Speaks 12 Languages

<https://www.youtube.com/watch?v=dVU9uybsyK4>