Culture, Religion, and Belief Systems
Rituals of Humans and Animals

Ethologists and anthropologists have long recognized that human and animal rituals have remarkably similar forms and functions. Consider the following rituals: In the Pentecost Islands of the South Pacific, adolescent males take part in an annual ritual called *naghol* aimed at ensuring a bountiful yam crop for the coming year. The ritual requires that adolescent and young adult males construct tall pole platforms, some reaching 25 meters in height. Accompanied by the singing and dancing of all the villagers, the males ascend these platforms and, with only a vine rope tethered to their ankles, plunge into the air. Males who successfully complete their first "dive" are considered to have made the transition from childhood to adulthood. They are congratulated by the villagers and, as adults, are able to take a wife.

Australian golden bowerbirds also construct tall pole platforms as part of their annual rituals. Bowerbird males gather brightly colored feathers, shells, and ornaments to create the most beautiful and eye-catching "maypoles" possible. As in the Pentecost Islands, bowerbird poles are used as staging areas for the male's ritual performance. This includes singing as well as an energetic dance performed before a single female. Successful bowerbirds conclude their courtship ritual with a new mate.

Rituals such as these are not confined to bowerbirds or an unusual human group; they occur across widely divergent animal species and in nearly all human cultures. Just as you find many Americans singing on a Sunday morning in church, humpback whales have collective singing rituals as well. In Western societies when we meet with friends we stick out our arms, clasp them, and pump our joined hands up and down a few times; chimpanzees have their own ways of ceremoniously greeting each other, which also includes hand-clasping. Why do humans and animals alike engage in these behaviors? And why do these rituals have similar forms and functions? In what ways do human and animal rituals differ? Fortunately, ethologists and anthropologists have begun to answer these questions.

Ritual is a universal feature of human behavior. Rituals differ from culture to culture, but the defining features that distinguish them from "ordinary" behaviors are surprisingly consistent across all human societies. Rituals tend to be formal, stereotyped, repetitive, and established by someone other than the performer. They are therefore easily distinguished from other behaviors. Rituals help pattern and predict social interactions. For example, when two people meet they have expectations about how the social interaction will proceed. In Western societies, meetings commence with a handshake and a simultaneous "How are you?" or some similar formality. While none of us invented the handshake, we all recognize it as a greeting ritual.

Religious rituals are particularly easy to detect as they tend to be more elaborate than other rituals. They also generally include music, chanting, or dance, which further distinguishes them from other behaviors. While religious rituals frequently appear to be shrouded in mystery, their formality and elaborateness make it clear to participants and observers alike that they are rituals. Nobody mistakes Sunday morning church for the Sunday afternoon football game.

These same underlying features of ritual also enable us to recognize ritual in nonhuman species, as well. Wolf spiders, salamanders, and Sandhill cranes all perform intricate dances as part of their courtship rituals. Parrots and Pacific humpback whales engage in improvisational, synchronized singing during mating and group rituals, and wild dogs, wolves, and chimpanzees all perform highly ritualized greeting ceremonies, including muzzle-to-muzzle contact and choral vocalizations whenever the members of a group meet. From bees, to birds, to baboons, ritual in both human and animal groups conveys significant information between individuals. Ritual permits and promotes social interaction by creating "frameworks of expectancy" that lay the foundation for the prediction of behavior by others. But to fully appreciate the similarities between human and animal rituals, and why they are similar, we first need to understand ritual's less complicated parent: signals.

Signals as Cooperative Communication

Animals and humans use many different kinds of signals to communicate with other members of their groups. The scent marking of dogs, the alarm calls of monkeys, and human facial expressions are all social signals that convey information to others. The information communicated may be about the condition, state, or intent of the sender, or it may be information about the surrounding environment. Some signals convey information about the sender's condition because they are a direct result of the physical and physiological characteristics of the sender. The croak pitch of male frogs is an example of such a signal. Croak pitch is a direct function of body size, with larger males producing deeper croaks. This direct relationship between body size and sound pitch makes it possible for both females and competitor males to estimate the size of unseen males based on their croaking. Such "indexical" signals convey reliable information about a signal sender because they are directly linked to attributes that cannot be concealed or manipulated.

Many signals used in human and animal communication are not indexical, but still provide reliable information. They have evolved over time because they benefit both the sender and the receiver. Numerous conventional signals, such as the pecking response of herring-gull chicks to red dots, are the result of genetically programmed fixed-action patterns. Such signals automatically elicit or "release" evolved preprogrammed behaviors in signal receivers. In the case of the herring chicks, pecking at the red dots on the mother's bill provides the chick with food. Such mutually beneficial signaling systems occur within many species, but they may also facilitate communication between species as well. Grouper fish exhibit innate responses to the "dance" performed by sucker fish. Even when reared in isolation, groupers exposed to the sucker fish dance lie down on the sand, spread their fins, and allow the sucker fish to clean the algae from their scales. Such fixed-action pattern signaling systems have evolved because the benefits they provide for both the sender and receiver outweigh the costs involved in signaling.

Although it was once thought that most animal signals result from these innate "fixed-action patterns," ethologists have since found that many animal signals incorporate both genetic and learned components. The alarm calls of vervet monkeys (*Cercopithecus aethiops*) provide an example of such a signal. Vervets inhabit woodland areas in eastern

Africa and use alarm calls to alert other members of the social troop to the presence of predators. Vervets emit a bark in the presence of a jaguar, a cough in the presence of an eagle, and a chutter in the presence of a snake. Young vervets have an innate tendency to respond to calls and to make different calls in response to different stimuli. However, young monkeys are not born with preprogrammed knowledge of jaguar, eagle, and snake calls. They must learn the specific call to emit for each particular predator. While vervets are "preprogrammed" to learn these calls, young monkeys must hear the different calls used within the appropriate context in order to learn the correct call for each particular predator.

This innate capacity to learn species-specific signals during a particular developmental period is seen in many other species. For example, the courtship songs of many birds exhibit this combination of genetic programming and developmental learning. While male birds are "primed" to learn their species' song, males must be exposed to that song during a specific developmental window in order for learning to occur. Research indicates that both human musical abilities and language learning also combine genetic predispositions and developmental windows for optimal learning.

Signals as Deception

Indexical signals and many conventional signals employed by animals and humans promote communication by providing reliable information that benefits both the sender and the receiver. Some signaling contexts, however, involve senders and receivers who have conflicting interests. The most obvious examples of such conflict are the male contests that occur in many species over females and food. Mating is also a potential source of conflict between males and females. Such conflicts can be expected to escalate as stakes increase and shared individual and genetic interests decrease. Under such circumstances, there is great incentive for signalers to use deception in order to influence receiver responses. The use of deceptive signals by humans to "bluff," cheat, and lie are well-known to poker players and soap opera viewers alike. Deceptive signals are also used by numerous animal species to achieve similar ends. Camouflage and mimicry are widespread throughout the animal kingdom. Many species have evolved color patterns and special structures to deceive potential predators and prey. Angler fish use a specially evolved mouth appendage to "lure" unsuspecting prey. Viceroy butterflies fool potential predators through their mimicry of the unappetizing Monarch. Deceptive signals also include behaviors. Cowbird chicks display open-mouth "begging" signals to induce their unsuspecting "adopted" parents to feed them first and most. Females of the predatory firefly genus *Photuris* mimic the mating flashes of the related genus *Photinus* in order to lure *Photinus* males close enough to attack and consume them. This exploitative use of another species' fixed-action pattern signals, referred to as "code breaking," is a relatively common form of signal deception. Equally common in humans and animals alike are "bluffing" behaviors and deceptive signals used by both males and females in order to manipulate potential and current mates.

Honest Signals

Signal receivers clearly have an incentive to prevent such manipulation. Receivers should seek out signals that provide honest information. In many species this has resulted in the evolution of "quality signals" that provide receivers with reliable information about the general condition of the sender. In birds the intensity of plumage color is negatively correlated with parasite load—the brighter the plumage, the healthier the bird. Females seek out males with the most brilliant plumage. As a result, the color brilliance of males

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While quality signals benefit the receiver, they frequently incur costs for the sender. The large, brilliantly colored tails of male peacocks, like flashy red sports cars, are effective signals, but they require the expenditure of resources. Male songbird acquisition of large song repertoires likewise requires high expenditures of time, energy, and learning effort.

In addition to their production and maintenance costs, these quality signals may also incur higher vulnerability costs. Male peacocks with the longest, brightest tails not only expend more energy on the development and maintenance of such tails, they also attract more predators and have greater difficulty escaping predation as a result of their heavy, cumbersome plumage. Songbirds with the largest, showiest repertoires not only alert potential mates, they alert potential predators. Biologist Amotz Zahavi has proposed that such high cost signals have evolved and are adaptive for signalers precisely *because* they "handicap" the sender. Because only those peacocks, bachelors, and songbirds with sufficient resources are able to produce and maintain the longest, showiest tails, most expensive sports cars, and the largest and most captivating song repertoires and still evade predation, it would be impossible for less fit competitors to "fake" these signals.

Ritual as a Signal

In terms of time, energy, and resources, rituals are often the costliest of signals. Ethologist W. J. Smith (1979) has described ritual as "behavior that is formally organized into repeatable patterns" (p. 51). This definition includes four basic features of ritual: (1) formality; (2) pattern; (3) sequence; and (4) repetition. These four features make up the structure of ritual in species as diverse as horned-toads, hens, and humans. These four structural components of ritual are optimally effective in engaging and focusing attention, heightening discrimination, enhancing multidimensional generalization, and improving associative learning, thus ensuring that the message sent by the sender is accurately perceived, assessed, and remembered by the receiver. The formality of ritual captures the attention of the audience and focuses it on the signal elements most likely to evoke receiver response. Ordinary traits and behaviors may be exaggerated in order to make them "extraordinary." The "eyes" of a peacock's long, iridescent tail prominently displayed during his ritual dance, the changing body colors of male squid as they gently jet water over a potential mate, and the extraordinary garments worn by human brides and bishops all represent formal elements of ritual that engage and focus the attention of ritual participants. Could anyone really turn their attention away from the Pentecost Island adolescents plunging into the air from their 25 meter poles?

By exaggerating and elaborating the ordinary, the formality of ritual alerts brain areas such as the reticular formation, the basal ganglia, and the amygdala. These neural structures are first-line responders to novel, unusual, and threatening stimuli. They prime emotions and prepare the body to react. Once attention is focused, the sequence, pattern, and repetition of ritual provide an opportunity for the message receiver to absorb, assess, and associate the information transmitted. The sequenced repetition of ritual creates focus time and processing time. Both are critical for memory and learning. At the cellular level, repetition induces changes in long term potentiation, while sequencing allows the brain to recycle CREB, a protein crucial to long-term memory function.

Ritual has other impacts on neuroendocrine function, as well. Changes in levels of neurotransmitters, neuromodulators, and hormones of both the sender and the receiver occur during ritual, resulting in changes in the physiological, immunological, and behavioral responses of ritual participants. Biologist Russell Fernald's studies of cichlid fish (*Haplochromis burtoni*) from Lake Tanganyika in Africa dramatically illustrate ritual's effects on physiology. He found that agonistic displays between cichlid males induce major changes in the hormones, external appearance, brain neuron sizes, and even the gene expression of winners and losers. Fernald observed aggressive and brilliantly colored black, yellow, blue, and red males almost instantly morph into much less aggressive drab brown "satellite" fish when ousted from their territories by rivals. If the "satellite" later acquired a new territory, his color, hormones, hypothalamic neuron sizes, and gene expression again changed. Similar neuroendocrine changes have been recorded in songbird responses to ritual, as well. The ritualized vocalizations of male songbirds impact female sexual receptivity by inducing hormonal changes in the female. They also impact the brain neurons and song-related genes of the signaler. In both wolves and nonhuman primates, ritualized dominance and submission behaviors alter participants' cortisol, dopamine, and testosterone levels. Across animal species, the ability of ritual to alter individual neurophysiology and behavior is critical to its adaptive value.

The Relationship of Human and Animal Signaling Systems

Human signaling systems share many features with those of nonhuman species. As with our chimpanzee cousins, we employ facial expressions, body gestures, and call systems to communicate important information about ourselves and the environment around us. Humans everywhere use similar facial expressions to convey and identify basic emotional states, and laughter, body language, and shouts of alarm are universally understood. These pan-human signals have deep phylogenetic roots shared with our closest primate kin. In contrast, the "distinguishing marks" of human religious ritual—chanting, music, and dance—are notably rare in other primates. While chimpanzees have been observed to engage in occasional "drumming" of tree trunks and sporadic "rain dances," the regular, ritualized use of song and dance is conspicuously absent in gorilla, bonobo, and chimpanzee societies.

Yet, song and dance are both found in many other animal species. Wolves and wild dogs engage in choral howling, humpback whales sing synchronized group songs, and a multitude of bird species chorus, sing, and dance. Understanding when and why these types of ritualized behaviors occur in nonhuman species offers insights into our own performance of these rituals.

Numerous bird species exhibit costly rituals, including both song and dance, as part of courtship rituals. Many of the species that engage in such rituals also pair-bond, with a single male and female forming a long-term relationship. Pair-bonding ensures adequate care for the highly dependent baby birds. Not only must young hatchlings be fed and protected, as they mature into fledglings, they must also be taught to fly. Males play an important role in caring for the offspring in these pair-bonded species. It is, therefore, very important for the female to ensure that the mate she chooses as her long-term partner is both fit and reliable. Courtship rituals that require males to sing, dance, and even provide "gifts" offer an opportunity for females to assess both the condition and intent of her male suitors. From the male's perspective, these rituals represent an opportunity to signal his fitness, but they are also critical in inducing female hormone changes that prepare her for mating.

Humans share several important features with pair-bonded birds. We too give birth to relatively undeveloped and highly dependent young that must be taught important life skills before maturation. Humans are also one of a very few primate species that establish long-term bonds between males and females. Because of the long-term investment involved in establishing a pair-bond, it is critical that males and females acquire reliable information about their potential mate. Singing, dancing, and gift-giving are all components of both bird and human mating rituals that serve as reliable indicators of fitness. Female satin bowerbirds evaluate the fitness of potential mates on the basis of their energetic dances. Anthropologists and biologists working in Jamaica have shown that among humans, too, better dancers are rated as more attractive and are preferred as mates. There is increasing evidence that singing and dancing have important neurophysiological effects on humans, as well.

Songs and Sentiments

Music is a fundamental component of human ritual, whether in industrial societies or in traditional cultures. In some societies, such as the Igbo of Africa, music and ritual are inseparable and are defined by the single word "nkwa" (Becker, 2001). Although music has been separated from ritual and secularized in contemporary Western societies, it remains the single most frequent element of religious worship across U.S. congregations. Western secularization of music has not diminished its importance, but, instead, has extended its impacts outside of ritual contexts. What are these impacts?

Music evokes and elicits emotions in listeners. Neuropsychologist Robert Levenson (1994) describes emotions as important evolved adaptations that "alter attention, shift certain behaviors upward in response hierarchies, and activate relevant associative networks in memory" (p. 123). Music has immunological effects on listeners. Music can boost immunological function and induces measurable physiological changes in listeners. Heart rate, pulse, blood pressure, and skin conductance are all affected by music. Traditional cultures have long recognized the ability of music-based ritual to alter emotional, physiological, and immunological systems. Throughout the world, such ritual is intimately associated with healing. In contemporary Western societies, music therapy is a growing field, and empirical studies show a significant, positive association between regular participation in weekly religious ritual and improved health and greater longevity. During ritual, the emotional and physiological effects of music are simultaneously experienced by all ritual participants. These shared neurophysiological states are fundamental to empathy and may contribute to the increased levels of cooperation associated with both music and ritual participation.

Birdsong and the music of human ritual appear to have similar effects on ritual participants. There is, however, an important difference. While most bird courtship displays involve only a single male and female, human rituals across cultures include many individuals. The singing, music, and dancing that accompany marriage rituals in most cultures are also found in many secular and all religious rituals across societies. These rituals, like the synchronized group songs of humpback whales, function to define group boundaries, integrate new members into the group, and strengthen group bonds.

The evolved signals, songs, and sentiments of ritual are shared by humans and animals alike. Across all species, these elements of ritual communicate important information between individuals. They also initiate emotional and physiological responses that impact individual health and behavior, and pattern social interaction. As our understanding of ritual continues to expand, the close relationship we share with all other animals becomes increasingly apparent.

See also

Music, Dance, and Theater—*Music and Animals*
Music, Dance, and Theater—*Music as a Shared Trait among Humans and Animals*

Further Resources

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