

Paper -3

Ethology is a branch of [zoology](#) that studies the [behaviour](#) of non-human [animals](#). It has its scientific roots in the work of [Charles Darwin](#) and of American and German [ornithologists](#) of the late 19th and early 20th century, including [Charles O. Whitman](#), [Oskar Heinroth](#), and [Wallace Craig](#). The modern discipline of ethology is generally considered to have begun during the 1930s with the work of the Dutch biologist [Nikolaas Tinbergen](#) and the Austrian biologists [Konrad Lorenz](#) and [Karl von Frisch](#), the three winners of the 1973 [Nobel Prize in Physiology or Medicine](#). Ethology combines laboratory and field science, with a strong relation to [neuroanatomy](#), [ecology](#), and [evolutionary biology](#).

Etymology

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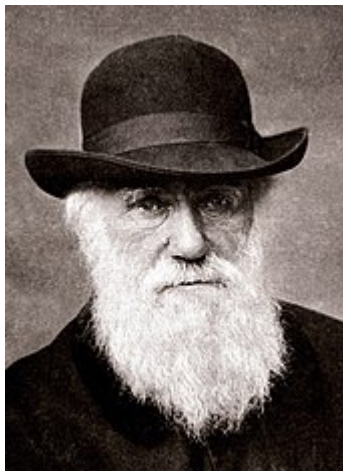
The modern term *ethology* derives from the [Greek language](#): [ἦθος](#), *ethos* meaning "character" and [-λογία](#), *-logia* meaning "the study of". The term was first popularized by the American [entomologist](#) [William Morton Wheeler](#) in 1902.^[1]

History

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The beginnings of ethology

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[Charles Darwin](#) (1809–1882) explored the expression of emotions in animals.

Ethologists have been concerned particularly with the [evolution](#) of behaviour and its understanding in terms of [natural selection](#). In one sense, the first modern ethologist was [Charles Darwin](#), whose 1872 book *[The Expression of the Emotions in Man and Animals](#)* influenced many ethologists. He pursued his interest in behaviour by encouraging his protégé [George Romanes](#), who investigated animal learning and intelligence using an [anthropomorphic](#) method, [anecdotal cognitivism](#), that did not gain scientific support.^[2]

Other early ethologists, such as [Eugène Marais](#), [Charles O. Whitman](#), [Oskar Heinroth](#), [Wallace Craig](#) and [Julian Huxley](#), instead concentrated on behaviours that can be called [instinctive](#) in that they occur in all members of a species under specified circumstances.^{[3][4][1]} Their starting

point for studying the behaviour of a new species was to construct an [ethogram](#), a description of the main types of behaviour with their frequencies of occurrence. This provided an objective, cumulative database of behaviour.^[1]

Growth of the field

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Due to the work of [Konrad Lorenz](#) and [Niko Tinbergen](#), ethology developed strongly in continental Europe during the years prior to [World War II](#).^[1] After the war, Tinbergen moved to the [University of Oxford](#), and ethology became stronger in the [UK](#), with the additional influence of [William Thorpe](#), [Robert Hinde](#), and [Patrick Bateson](#) at the [University of Cambridge](#).^[5]

Lorenz, Tinbergen, and von Frisch were jointly awarded the [Nobel Prize in Physiology or Medicine](#) in 1973 for their work of developing ethology.^[6]

Ethology is now a well-recognized scientific discipline, with its own journals such as [Animal Behaviour](#), [Applied Animal Behaviour Science](#), [Animal Cognition](#), [Behaviour](#), [Behavioral Ecology](#) and [Ethology](#). In 1972, the [International Society for Human Ethology](#) was founded along with its journal, *Human Ethology*.^[7]

Social ethology

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In 1972, the English ethologist John H. Crook distinguished comparative ethology from social ethology, and argued that much of the ethology that had existed so far was really comparative ethology—examining animals as individuals—whereas, in the future, ethologists would need to concentrate on the behaviour of social groups of animals and the social structure within them.^[8]

[E. O. Wilson](#)'s book [Sociobiology: The New Synthesis](#) appeared in 1975,^[9] and since that time, the study of behaviour has been much more concerned with social aspects. It has been driven by the Darwinism associated with Wilson, [Robert Trivers](#), and [W. D. Hamilton](#). The related development of [behavioural ecology](#) has helped transform ethology.^[10] Furthermore, a substantial rapprochement with [comparative psychology](#) has occurred, so the modern scientific study of behaviour offers a spectrum of approaches. In 2020, Tobias Starzak and Albert Newen from the Institute of Philosophy II at the [Ruhr University Bochum](#) postulated that animals may have beliefs.^[11]

Determinants of behaviour

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Behaviour is determined by three major factors, namely inborn **instincts**, **learning**, and **environmental factors**. The latter include abiotic and biotic factors. Abiotic factors such as [temperature](#) or [light](#) conditions have dramatic effects on animals, especially if they are [ectothermic](#) or [nocturnal](#). Biotic factors include members of the same species (e.g. sexual behavior), [predators](#) (fight or flight), or [parasites](#) and [diseases](#).^[12]

Instinct

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Main article: [Instinct](#)



[Kelp gull](#) chicks peck at red spot on mother's beak to stimulate regurgitating reflex

[Webster's Dictionary](#) defines [instinct](#) as "A largely inheritable and unalterable tendency of an organism to make a complex and specific response to environmental stimuli without involving reason".^[13]

Fixed action patterns

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Main article: [Fixed action pattern](#)

An important development, associated with the name of Konrad Lorenz though probably due more to his teacher, [Oskar Heinroth](#), was the identification of [fixed action patterns](#). Lorenz popularized these as instinctive responses that would occur reliably in the presence of identifiable stimuli called sign stimuli or "releasing stimuli". Fixed action patterns are now considered to be instinctive behavioural sequences that are relatively invariant within the species and that almost inevitably run to completion.^[14]

One example of a releaser is the [beak](#) movements of many bird species performed by newly hatched chicks, which stimulates the mother to regurgitate food for her offspring.^[15] Other examples are the classic studies by Tinbergen on the [egg-retrieval behaviour](#) and the effects of a "[supernormal stimulus](#)" on the behaviour of [graylag geese](#).^{[16][17]}

One investigation of this kind was the study of the [waggle dance](#) ("dance language") in [bee communication](#) by [Karl von Frisch](#).^[18]

Learning

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Habituation

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Main article: [Habituation](#)

Habituation is a simple form of learning and occurs in many animal taxa. It is the process whereby an animal ceases responding to a stimulus. Often, the response is an innate behavior. Essentially, the animal learns not to respond to irrelevant stimuli. For example, [prairie dogs](#) (*Cynomys ludovicianus*) give alarm calls when predators approach, causing all individuals in the group to quickly scramble down burrows. When prairie dog towns are located near trails used by humans, giving alarm calls every time a person walks by is expensive in terms of time and energy. Habituation to humans is therefore an important behavior in this context.^{[19][20][21]}

Associative learning

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Main article: [Association \(psychology\)](#)

Further information: [Classical conditioning](#) and [Operant conditioning](#)

Associative learning in animal behaviour is any learning process in which a new response becomes associated with a particular stimulus.^[22] The first studies of associative learning were made by the Russian [physiologist Ivan Pavlov](#), who observed that dogs trained to associate food with the ringing of a bell would salivate on hearing the bell.^[23]

Imprinting

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Main article: [Imprinting \(psychology\)](#)



[Imprinting](#) in a [moose](#).

[Imprinting](#) enables the young to discriminate the members of their own species, vital for reproductive success. This important type of learning only takes place in a very limited period of time. [Konrad Lorenz](#) observed that the young of birds such as [geese](#) and [chickens](#) followed their mothers spontaneously from almost the first day after they were hatched, and he discovered that this response could be imitated by an arbitrary stimulus if the eggs were incubated artificially and the stimulus were presented during a critical period that continued for a few days after hatching.^[24]

Cultural learning

[\[edit\]](#)

Main article: [Cultural transmission in animals](#)

Observational learning

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Main article: [Observational learning](#)

Imitation

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Main article: [Imitation](#)

[Imitation](#) is an advanced behavior whereby an animal observes and exactly replicates the behavior of another. The National Institutes of Health reported that capuchin monkeys preferred the company of researchers who imitated them to that of researchers who did not. The monkeys not only spent more time with their imitators but also preferred to engage in a simple task with them even when provided with the option of performing the same task with a non-imitator.^[25] Imitation has been observed in recent research on chimpanzees; not only did these chimps copy the actions of another individual, when given a choice, the chimps preferred to imitate the actions of the higher-ranking elder chimpanzee as opposed to the lower-ranking young chimpanzee.^[26]

Stimulus and local enhancement

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Animals can learn using observational learning but without the process of imitation. One way is *stimulus enhancement* in which individuals become interested in an object as the result of observing others interacting with the object.^[27] Increased interest in an object can result in object manipulation which allows for new object-related behaviours by trial-and-error learning. Haggerty (1909) devised an experiment in which a monkey climbed up the side of a cage, placed its arm into a wooden chute, and pulled a rope in the chute to release food. Another monkey was provided an opportunity to obtain the food after watching a monkey go through this process on four occasions. The monkey performed a different method and finally succeeded after trial-and-error.^[28] In local enhancement, a demonstrator attracts an observer's attention to a particular location.^[29] Local enhancement has been observed to transmit foraging information among birds, rats and pigs.^[30] The stingless bee (*Trigona corvina*) uses local enhancement to locate other members of their colony and food resources.^[31]

Social transmission

[\[edit\]](#)

See also: [Cultural transmission in animals](#)

A well-documented example of social transmission of a behaviour occurred in a group of [macaques](#) on [Hachijojima](#) Island, Japan. The macaques lived in the inland forest until the 1960s, when a group of researchers started giving them potatoes on the beach: soon, they started venturing onto the beach, picking the potatoes from the sand, and cleaning and eating them.^[9] About one year later, an individual was observed bringing a potato to the sea, putting it into the water with one hand, and cleaning it with the other. This behaviour was soon expressed by the individuals living in contact with her; when they gave birth, this behaviour was also expressed by their young—a form of social transmission.^[32]

Teaching

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See also: [Animal culture § Teaching](#)

Teaching is a highly specialized aspect of learning in which the "teacher" (demonstrator) adjusts their behaviour to increase the probability of the "pupil" (observer) achieving the desired end-result of the behaviour. For example, [orcas](#) are known to intentionally beach themselves to catch [pinniped](#) prey.^[33] Mother orcas teach their young to catch pinnipeds by pushing them onto the shore and encouraging them to attack the prey. Because the mother orca is altering her behaviour to help her offspring learn to catch prey, this is evidence of teaching.^[33] Teaching is not limited to mammals. Many insects, for example, have been observed demonstrating various forms of teaching to obtain food. [Ants](#), for example, will guide each other to food sources through a process called "[tandem running](#)," in which an ant will guide a companion ant to a source of food.^[34] It has been suggested that the pupil ant is able to learn this route to obtain food in the future or teach the route to other ants. This behaviour of teaching is also exemplified by crows, specifically [New Caledonian crows](#). The adults (whether individual or in families) teach their young adolescent offspring how to construct and utilize tools. For example, [Pandanus](#) branches are used to extract insects and other larvae from holes within trees.^[35]

Mating and the fight for supremacy

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[Courtship display](#) of a [sarus crane](#)

Individual [reproduction](#) is the most important phase in the proliferation of individuals or genes within a species: for this reason, there exist complex [mating rituals](#), which can be very complex even if they are often regarded as fixed action patterns. The [stickleback](#)'s complex mating ritual, studied by Tinbergen, is regarded as a notable example.^[36]

Often in [social life](#), animals fight for the right to reproduce, as well as social supremacy. A common example of fighting for social and sexual supremacy is the so-called [pecking order](#) among [poultry](#). Every time a group of poultry cohabitate for a certain time length, they establish a pecking order. In these groups, one chicken dominates the others and can peck without being pecked. A second chicken can peck all the others except the first, and so on. Chickens higher in the pecking order may at times be distinguished by their healthier appearance when compared to lower level chickens.^[citation needed] While the pecking order is establishing, frequent and violent fights can happen, but once established, it is broken only when other individuals enter the group, in which case the pecking order re-establishes from scratch.^[37]

Social behaviour

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Several animal species, including humans, tend to live in groups. [Group size](#) is a major aspect of their social environment. [Social life](#) is probably a complex and effective survival strategy. It may be regarded as a sort of [symbiosis](#) among individuals of the same species: a [society](#) is composed of a group of individuals belonging to the same species living within well-defined rules on [food](#) management, role assignments and reciprocal dependence.^[38]

When [biologists](#) interested in [evolution theory](#) first started examining social behaviour, some apparently unanswerable questions arose, such as how the birth of [sterile castes](#), like in [bees](#), could be explained through an evolving mechanism that emphasizes the reproductive success of as many individuals as possible, or why, amongst animals living in small groups like [squirrels](#), an individual would risk its own life to save the rest of the group. These behaviours may be examples of [altruism](#).^[39] Not all behaviours are altruistic, as indicated by the table below. For example, revengeful behaviour was at one point claimed to have been observed exclusively in [Homo sapiens](#). However, other species have been reported to be vengeful including chimpanzees,^[40] as well as anecdotal reports of vengeful camels.^[41]

Classification of social behaviours^[38]

Type of behaviour	Effect on the donor	Effect on the receiver
Egoistic	Neutral to Increases fitness	Decreases fitness
Cooperative	Neutral to Increases fitness	Neutral to Increases fitness
Altruistic	Decreases fitness	Neutral to Increases fitness
Revengeful	Decreases fitness	Decreases fitness

[Altruistic](#) behaviour has been explained by the [gene-centred view of evolution](#).^{[42][43]}

Benefits and costs of group living

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One advantage of group living is decreased predation. If the number of predator attacks stays the same despite increasing prey group size, each prey has a reduced risk of predator attacks through the dilution effect.^{[10][page needed]} Further, according to the [selfish herd theory](#), the fitness benefits associated with group living vary depending on the location of an individual within the group. The theory suggests that conspecifics positioned at the centre of a group will reduce the likelihood predations while those at the periphery will become more vulnerable to attack.^[44] In groups, prey can also actively reduce their predation risk through more effective defence tactics, or through earlier detection of predators through increased vigilance.^[10]

Another advantage of group living is an increased ability to forage for food. Group members may exchange information about food sources, facilitating the process of [resource location](#).^{[10][page needed]} Honeybees are a notable example of this, using the [waggle dance](#) to communicate the location of flowers to the rest of their hive.^[45] Predators also receive benefits from [hunting in groups](#), through using better strategies and being able to take down larger prey.^{[10][page needed]}

Some disadvantages accompany living in groups. Living in close proximity to other animals can facilitate the transmission of parasites and disease, and groups that are too large may also experience greater competition for resources and mates.^[46]

Group size

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Theoretically, social animals should have optimal group sizes that maximize the benefits and minimize the costs of group living. However, in nature, most groups are stable at slightly larger than optimal sizes.^{[10][page needed]} Because it generally benefits an individual to join an optimally-sized group, despite slightly decreasing the advantage for all members, groups may continue to increase in size until it is more advantageous to remain alone than to join an overly full group.^[47]

Tinbergen's four questions for ethologists

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Main article: [Tinbergen's four questions](#)

Tinbergen argued that ethology needed to include four kinds of explanation in any instance of behaviour.^{[48][49]}

- Function – How does the behaviour affect the animal's chances of survival and reproduction? Why does the animal respond that way instead of some other way?
- Causation – What are the stimuli that elicit the response, and how has it been modified by recent learning?
- Development – How does the behaviour change with age, and what early experiences are necessary for the animal to display the behaviour?
- Evolutionary history – How does the behaviour compare with similar behaviour in related species, and how might it have begun through the process of [phylogeny](#)?

These explanations are complementary rather than mutually exclusive—all instances of behaviour require an explanation at each of these four levels. For example, the function of eating is to acquire nutrients (which ultimately aids survival and reproduction), but the immediate cause of eating is hunger (causation). Hunger and eating are evolutionarily ancient and are found in many species (evolutionary history), and develop early within an organism's lifespan (development). It is easy to confuse such questions—for example, to argue that people eat because they are hungry and not to acquire nutrients—without realizing that the reason people experience hunger is because it causes them to acquire nutrients.^[50]