animals,
climate and
civic education

# Learning video 1: Forms and colours of intelligence

## Script

# Imprint

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# Script for the ALICE learning video 1:

# Forms and colours of intelligence

Have you ever wondered what goes on in your neighbours' head when they start the lawnmower on a Sunday morning? Or have you wondered about what the thoughts of a child constructing a small building with wooden blocks are? And what about the dog who sits in front of the sofa with big eyes and - well - looks at you as if it wants something.

The first case is easy - you can go and ask your neighbour. And if you're polite, you're sure to get an answer. It's more difficult with a small child. Especially if they can't speak yet. But we can make certain assumptions because, after all, it concerns our own species. But what about the dog? How can we know what animals think? Do they think anything at all? And to what extent is this comparable to our way of thinking?

In this first part of the ALICE learning videos, we will look at these and similar questions. We will shed light on the topic of intelligence research and discuss what intelligence actually means and how it develops. Using examples from animals, we will then describe the forms it can take.

## Cognitive research

In order to find out more about the intelligence of animals, the so-called cognitive science deals with the topic of how animals perceive their environment, how they then process this perceived information and what behavioural reactions result from this. This research has its origins in the centuries-old question of what goes on in the minds of animals. Do they also have thoughts that enable them to solve problems creatively and flexibly?

The motivations for finding out more about the inner life of animals have become very diverse. For example, efforts are being made to better understand the behaviour of wild animals in order to investigate their position in the ecosystem. Based on these observations, conclusions can later be drawn as to how environmental protection measures can be better implemented. Ultimately, the involvement of the local and global population plays an important role here. Some particularly interesting species, such as the great apes, act as ambassadors for the conservation of an entire ecosystem.

Another important part of cognitive research is concerned with so-called domestic animals - i.e. animal species that have been domesticated by humans. Their behaviour is studied in certain situations. Either to investigate how their domestication history has affected changes in behaviour, or to determine in which husbandry conditions animals fare better or worse. This is particularly important for farmed animals such as bovines, sheep, goats, pigs and chickens. This is because the animals' needs are usually only met on a minimal level. Society's interest is required also in these cases. Because only with a high level of empathy for the interests of animals will these research results be passed on and findings finally put into practice.

Cognitive biology therefore has an important application with regard to the protection of animals. However, its main interest lies one step further ahead, namely to increase our basic knowledge of animal cognition. One of the most fundamental questions in cognitive biology is therefore: What animal species are capable of which mental abilities and what are the reasons for this?

The cognitive abilities of each animal species are closely linked to their ecology. Just as their external appearance has adapted to certain environmental conditions, their cognitive abilities also have adapted. The more varied the environmental conditions are that animals have to deal with, the more flexible they have to remain in their behaviour. This flexibility can then be facilitated and optimised by increased cognitive abilities. But not all animals have evolved in this direction. This is because it is quite expensive to operate a brain with complex thought processes. Brains consume a lot of energy, and the more energy is put into processing information, the less energy is available for other, possibly more vital processes. Animals that have developed a more complex nervous system had to develop in this direction in their evolutionary history due to certain factors, i.e. they had to occupy this ecological niche. It paid off for them to remember and learn from the past, to recognise cause and effect between events and to plan future actions on this basis. These abilities are used in all basic areas of life - for example, when searching for food or choosing a mate, but also when avoiding danger.

# Technical intelligence

Learning from the past is not the only recipe for the success of an animal species. Sometimes new paths must be taken. For example, there are animals with a particularly strong predisposition to explore their environment, and that can pursue this curiosity because they are exposed to relatively few dangers from predators. Such species are very likely to find - or, as one might say, invent - new ways of obtaining food. Technical intelligence plays a special role here. In addition, the physical ability to influence the environment around them, often even with delicate movements, is also necessary. Primates use their hands and often their feet to reach for fruit, crack nuts with stones or catch insects with small branches. But also other animal species have developed into real masters of object manipulation. Birds, for example, can easily hold their own in the technical intelligence category. Although their front extremities have developed into wings, they are also capable of impressive feats. They use their beaks, tongues and feet to do so.

## Tool use

The straight beak of New Caledonian crows, for example, is perfectly adapted to hold thin sticks and then poke them into the wood. This enables them to extract insect larvae from holes that would otherwise be too narrow for their beaks. But that's not all. The crows also make their own tools. For example, they bite off the edges of palm leaves of various lengths and shape these pieces into stepped skewers[1] or they use leaf stalks and twigs to poke at insects[2]. Controlled experiments in captivity have also shown that they can modify their tools to suit the respective conditions. For example, crows can bend straight stems into hooks to fish food buckets with handles out of a tube[3]. They can also combine smaller tool elements in such a way that they become a functional tool[4].

Similar abilities have recently been observed in Goffin's cockatoos. This parrot species has a beak with a completely different shape. Still, also these birds produce sticks to get to food that would otherwise be out of reach[5]. Observations in their natural environment have shown that these birds even produce a whole set of different tools - each with its own function[6]. To reach the nutritious inside of the sea mango fruit, the cockatoos produce three different types of tools. The first tool, a wide, short piece of wood, is used to open the fruit. It is wedged into a gap to make room for the next steps. The second piece of wood is narrow and long and is used to break through an inner skin to expose the centre of the fruit. Once this is done, the third tool comes into play. Like a kind of spoon, this slightly wider piece of wood is used to remove the inside piece by piece. The spoon is constantly moved and turned with the tongue. Whether this behaviour is continuously invented by some talented individuals or whether it is learned from observing others is still being investigated.

# Social intelligence

Learning through observation is part of another form of intelligence - social intelligence. Alongside technical intelligence, it has emerged as an important driving force behind animal behaviour. Particularly animals that live in groups have to find their way through complex living conditions. As a result, certain forms of social interaction have developed over thousands of years. Although group living brings many advantages, such as protection from predators or increased success in the search for food, conflicts with others are also inevitable. Various strategies have evolved to minimise these conflicts. In addition to lose group associations, such as those formed by crows outside the breeding season, some animal species live in fixed groups, often on a kinship basis. This requires the animals to be able to recognise each other as group mates - either through a general characteristic, such as group odour, or through the ability to recognise each other individually. If animals recognise each other individually, they may be able to memorise certain encounters, which in turn makes it easier to predict the behaviour of their conspecifics. This system then makes it easier to avoid conflicts. In addition, rigid social structures such as hierarchy or castes help to regulate group life. Here, different members of a group also take on different social roles. They then often retain these roles for the rest of their lives.

## Learning through observation

When living together in a social group, observing other group members is a regular occurrence. Learning through observation can not only make it easier to obtain food, for example to master more effective methods of nut-cracking, but also to make it easier to live together. Certain behavioural rules that typically occur in a group can be learned this way. Particularly for species in which individual animals repeatedly migrate to other groups, this adaptation to new rules can be essential for survival. Learning different behaviours over generations can lead to a kind of tradition. In these cases, we speak of cultures or protocultures. These protocultures are characterised by certain behaviours that are typical of precisely this group of individuals. These traditions have been observed in primates. For example, the hand-holding behaviour of some chimpanzee groups in Zambia[7], or the washing of sweet potatoes in the sea by Japanese macaques[8]. However, other animal species also exhibit forms of tradition. For example, when travelling, it can be observed that songbirds of the same species sing different variations of their songs in different regions[9]. A similar phenomenon can also be observed in humpback whales[10] - but only with the right equipment. In this case, a hydrophone.

## Cooperation

Animals do not only learn from others through observation to copy their behaviour. They are also able infer the inner state of others, or even their intentions, through observation. Being able to assess the intentions of others is particularly important to adjust to one another - for example, to synchronise or coordinate joint actions. A certain degree of synchronisation is particularly important for cooperation to be successful. Animals usually cooperate by working towards the same goal, sometimes even with different roles. Cooperation can be important in rearing young, or when dealing with social conflicts whereby alliances may help to prevail against competitors. But it can also be useful for easier acquisition of food. Many animal species, including chimpanzees, hyenas, wolves and whales, for example, hunt their prey together and have to coordinate their actions and roles during the hunt. But non-hunting animals also co-operate with each other. For example, New Zealand mountain parrots - also known as keas.

Keas are true artists of object manipulation and are known for their endless curiosity. They live in relatively loose groups and get up to all kinds of mischief together. In a behavioural experiment, it has now been observed that the birds can cooperate with each other in a coordinated manner in order to achieve a common goal[11]. Not only do they cooperate in pairs, but they can also coordinate their actions in groups of three and even four individuals. To obtain peanuts - a highly valued reward - the birds have learnt to pull on a chain. The chain then triggers a built-in mechanism inside a box to drop down a plate. Once this has been achieved, the birds can get the peanuts from this plate. The box is designed so that up to four chains have to be pulled at the same time in order to reach the reward. However, the highest-ranking birds initially found it difficult to let the lower-ranking birds get to the box, as they would have loved to have the food for themselves. After a few attempts, however, they realised that they needed the other group members to get to the food. And so they finally allowed them to approach in order to cooperate and share the reward. The birds are therefore not only able to carry out actions at the same time, i.e. to coordinate their actions. They also realise that the cooperation of the others is important in order to reach the common goal.

## Theory of Mind

Reading the behaviour of others and interpreting this behaviour can be used not only in cooperative situations, but also in competitive situations. Understanding the beliefs and intentions of others can be particularly beneficial when valuable resources are at stake. Not only knowing your own mental states and processes, but also knowing, or at least assuming, those of others is called theory of mind. In order to get an idea of what the other individual is thinking, animals must observe each other closely and understand that their actions can influence the behaviour of others. To avoid unintended consequences, one's own behaviour should therefore be adapted. In extreme cases, tactical deception can even be used.

Knowledge of the consequences that others draw from the observation of one's own actions can only take place if individuals are able to put themselves in the minds of others and view the situation from their perspective. It is assumed that a clear distinction must first be made between the self and other individuals. Because only those who have self-awareness can also project awareness onto others. Incidentally, human children develop the ability to recognise themselves in the mirror at around 18 months. This is seen as the first sign of self-awareness. At around two years of age, they then develop the ability to attribute mental states to others. Recognising oneself in the mirror has been successfully observed in chimpanzees, elephants, dolphins and magpies. However, it is very likely that even animals that fail this test are able to recognise themselves as a separate entity.

Theory of mind, i.e. the ability to make assumptions about the mental state of others, is primarily researched in primates, especially chimpanzees. Not only do they understand human pointing signals and even gaze directions, for example to determine the position of objects, they are also able to distinguish whether these directional cues come from a knowledgeable or an unknowledgeable person[12]. This is an important indication that they can understand the mental states of others. The same ability to distinguish knowing from unknowing individuals has now also been demonstrated in other animal species. For example in dogs[13,14], and anecdotally in pigs[15].

Common ravens[16-19] also seem to have this ability. These clever birds even go one step further. Not only do they seem to be able to understand the intentions of others, they also use this knowledge to their advantage. Like many other species of corvids, common ravens create food reserves by hiding food items in specific places. Ravens, however, not only hide food, but also plunder the hiding places of others if they get the opportunity to do so. Such an opportunity arises, for example, if they can observe another raven during hiding. However, if the raven hiding the food realises that it is being watched, it may stop hiding. So the

observing raven tries to observer as inconspicuous as possible. In doing so, it either acts disinterested by pretending to be busy elsewhere or it tries to stay out of the hiding raven's line of sight. The hiding raven, on the other hand, has its own strategies for deceiving its competitor. If he feels that he is being watched, he simply pretends to hide the food and then hopes that the other raven will fall for it. While the observing raven now tries to plunder the hiding place and is busy searching, the raven instead hides the well-earned food at a safe distance - and without any meddlesome observers.

## Conclusions

All these impressive forms of intelligence – from technical intelligence, such as tool use, to social intelligence in all its facets – are only a small part of the world of thoughts and feelings of our fellow inhabitants on this planet. The abilities that have been researched so far are often the ones that we find most important and interesting in ourselves. But what if other animal species have completely different forms of intelligence? And what about the many species outside the mammalian class that are less intuitive to us? It was only recently that birds came into focus when researchers discovered that they also have a brain structure that is similar to the prefrontal cortex of mammals[20]. And just as bird brains have previously seemed mysterious to us, we still find it difficult to assess the cognitive abilities of other animal groups. How do fish think, for example? Aren't spiders and insects also more than just instinct-driven machines? And how can we approach completely alien intelligences such as those of octopuses? Moreover, there is not only the intelligence of single individuals, but also a kind of group or swarm intelligence. This research is also still in its infancy. We are only just beginning to scratch the surface of this world, and who knows if we will ever fully understand it before some of these species are lost forever.

We too must finally come to terms with the consequences of our own actions. Not only are we cognitively capable of thinking about what we do to animals, but as moral beings we are also required to take responsibility for our actions. So what can we do to protect animals and the environment in which they live? Is it ethical to use animals? And if so, to what extent? Are we allowed to inflict suffering on animals for our own purposes? Should only humans really have personal rights, such as the right to life or the right to freedom? How much more do we possibly owe animals, in light of their abilities and needs?

If we have piqued your interest, then take a look at the further reading list. There you will find lots more interesting facts about animals and helpful thoughts on the questions we have raised here at the end. We also have other learning materials for you, such as podcasts and a graphic novel. Take a look at our website using this QR code.

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