Lecture 4: Evolution III and Learning I

Contents

Sociobiology

Some of the concepts of ethology have been extended to the study of much less stereotyped behaviours. In particular, in the last 20 years or so, the study of **sociobiology** has attempted to examine social behaviours from an evolutionary perspective.

Sociobiology focuses on mating, aggression, and cooperation - behaviours that are obviously critical for survival and reproductiuon. The basic idea is that patterns of behaviour within a society exist because evolutionary pressures have determined these patterns. That is, if the society operates in a particular manner, it is because it increases the likelihood of survival of the soceity - or at least the genes of the individuals that make up the society.

Social Dominance

The males of many species establish hierarchies of social dominance by aggressive encounters called social aggression. These encounters are rich in displays (e.g., threats) but typically involve little damage, particularly once a dominance hierarchy has been established. For example, in wolves, behaviours indicating aggression and submission are very ritualized and well-understood. If this was not the case, the wolves might end up ripping each other to shreds. This social behaviour influences the genetic makeup of the species, because the dominant males get to copulate more.

Patterns of Mating and Parental Investment

Trivers (1972) examined mating strategies and "parental investment". He noted that parental investment is associated with a loss of future reproductive capacity because of the time taken in nurturing off-spring.

Trivers found that the more invested sex will be (a) more vigorously competed for than the other sex and (b) more discriminating than the other sex when coosing a mate. This pattern makes sense - in many mammals the femal invests more so they are very selective when choosing a mate. The males, who are less choosy, must compete for the opportunity to pass on their genes. (Also, choosy females may make demands of loyalty upon males, in order to help with the rearing of the offspring.)

The basic idea is that the ability to spread our genes, tempered by the needs of rearing our offspring will influence our behaviour.

Polygyny. High female & low male investment. In general, the more polygynous a species, the bigger the size difference between males and females (males bigger) because males adapt for competition to mate.By mating with the biggest male, the female also improves her chances of passing on her genes.

Polyandry. High male & low female investment. More likely in egg-laying species. Females may be bigger, more aggressive, and brightly coloured.

Monogamy. Equivalent female and male investment. Is seen in species where a great deal of parental investment is required and there is too much to do for one parent. In this case, monogamy is a good reproductive strategy.

Polygynandry. Seen in chimps and bonobos. Group investment.

Patterns of Mating & Parental Investment in Humans

Humans appear to have evolved to be moderately polygynous:

- In many cultures, there is a mix of monogamy and polygny.
- Males are slightly larger than females on average.
- Fathers are either equally or less invested than mothers.

Male Violence

Daly and Wilson (see Gray for reference).

In human, men are much more likely to kill women than the other way around. Daly and Wilson suggest this is due to stronger sexual jealousy in males - males are more jealous because they cannot be certain that children are their own (unlike women).

Murder rate of children by their biological parents is roughly 1 in 100,000 - the murder rate of children by their stepfather is 10 times greater. Daly and Wilson suggest that this is analogous to male lions who kill the off-spring of a previously dominant male - the child represents a barrier to propagation of one's own genes.

However, caution must be exercised here! Whereas every male lion kills the off-spring of the previously dominant male, step-fathers very rarely murder their step-children. Daly and Wilson's argument is based on analogy, not homology! Lions, for example, have a vastly different social structure than humans.

Definition of Learning

In the last couple of lectures on evolution, we have discussed adaptation of species, usually over a long time period. The focus was on the changes in genetic structure brought about through the combination of natural selection and random variation.

We now turn our attention to adaptation at the individual level and examine changes that occur within the lifespan of an individual. In particular, we will look at change and adaptation brought about through learning.

A Definition of Learning:

Learning occurs when there is a more or less permanent change in behaviour or behavioural potential that results from experience.

- "**More or less permanent**" is used because we sometimes forget what we have previously learned.
  However, the idea is that the change in behaviour should be long lasting and stable. (Example: learning to ride a bike.)
- It can be a change in "**behaviour**" (e.g., new ability to ride a bike) or "**potential behaviour**".
  So, for example, if you were to watch me go through the steps needed to activate the video system in Humphrey 102, you would know how to do it, even without indicating this through your behaviour. This is learning by observation.
- Learning results from "experience" and does not deal with changes associated with maturation which occur regardless of experience (e.g., baby's rooting reflex).

Almost all of psychology is concerned in one way or another with learning. Indeed, by looking at how something is learned, we can often gain insights into the way in which that thing functions once it has been learned.

Of course, learning can be extremely adaptive in many cases and thus there is an intimate link between evolutionary adaptation and adaptation through learning.

Historical Background

Nativists and Empiricists

Philosophers have been concerned about the problem of knowledge and learning for a long time.

Recall René Descartes' conception of the body as a reflex-machine. He believed that reflexes - including sophisticated reflexes capable of generating complex behaviour - were "built-in". Thus, we would refer to Descartes as a nativist. According to the strict nativist view, learning is not relevant to behaviour.

We also mentioned the empiricists such as Thomas Hobbes, John Locke who took the opposite view and argued that humans are born without "ideas" or "knowledge" of behaviour. According to this view, all knowledge is learned through experience.

These empiricists are also referred to as associationists because they believed that everything is learned by association.

Three Perspectives on Learning

- Behavioural Perspective - attempts to characterize learning in terms of observable stimuli and responses.
- Cognitive Perspective - characterizes learning in terms of hypothetical

mental entities - such as cognitive maps.
- Ecological Perspective - focuses on specialized learning mechanisms that have evolved through evolution to solve specific survival problems.

The focus of this lecture is on the basic and important findings that came out of the research of the early behaviourist including people like Pavlov.

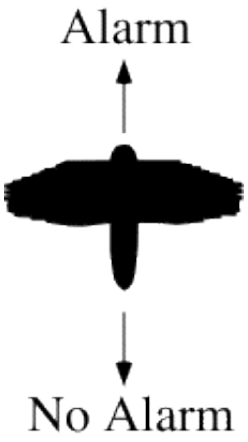
Habituation

Perhaps the simplest form of learning is habituation. This is the decline in the tendency to respond to stimuli that have become familiar due to repeated exposure.

> e.g., a sudden noise usually startles us but if we hear it repeatedly, we gradually get use to it so that we are less startled the second time we hear it and eventually just ignore it.

Habituation has some adaptive significance in that we don't want to respond to everything around us. Habituation allows us to ignore the familiar and focus our emergency reactions on things that are new and may signal danger.

A good example of the role of habituation in focusing escape reactions is the response of ground-living birds to the sight of birds flying above.



Tingbergen (1951) showed that when young turkeys see a silhouette model pulled in the direction that makes it look like a hawk, they were terrified and ran for cover. However, when it was pulled in the other direction, which makes it look like a goose, they were nonchalant (i.e., didn't react).

Tinbergen initially interpreted this as a built in response (fixed action pattern) to a very specific moving stimuli which has to be moving in the right direction.

However, subsequent studies showed that the direction tuning was a result of habituation. In the area that the initial studies were done, there are many geese and the young turkeys could have habituated to the "goose" silhouette.

Indeed, in experiments where young turkeys were not exposed to either flying geese or flying hawks, they ran for cover regardless of the direction in which the silhouette was pulled.

Short- and long-term habituation

Short-term habituation dissipates very rapidly whereas long-term habituation may persist for a long time. Leaton (1976) studied these two forms of habituation in two groups of rats.

Group 1: Short-term habituation

- The rats received 300 tones in 5 minutes
- Rats habituated after about 100 tones (under 2 minutes)
- Startle returned twenty-four hours later (spontaneous recovery)

Group 2: Long-term habituation

- 11 tones, one a day, over 11 days
- Rats habituation over several days
- Illustrates that the rats have a long-term memory for the stimuli.

Classical Conditioning

In habituation, the animal learns to recognize an event as familiar but doesn't learn anything about the relation between that event and an other circumstances. Such learned relationships among events linked in space and time are often called associations.

People - i.e., philosophers - have long understood the importance of associations in learning but the experimental study of associations did not begin until the end of C19 (the 19th century).

A major step in this direction was the work on conditioning carried out by the Russian psychologist Ivan Pavlov (1849 - 1936).

Pavlov

Pavlov was carrying out research on the digestive system of dogs - work for which he latter won a Nobel Prize. His initial interest was in the built-in nervous control of various digestive reflexes including the secretion of saliva by the salivary gland. He surgically removed one of the ducts of the salivary gland and channeled part of the salivary flow to a glass tube outside the body where the saliva could be measured. Pavlov showed that salivation was produced by several reflexes and serves to prepare the mouth for digestion. (Most of us have experienced salivating while waiting for a good meal!)

Pavlov noticed that dogs that had been in the lab for a while started salivating to a host of stimuli that had no effect on new arrivals. These stimuli included the bowl that was used to feed the dogs meat, the sight of person who feed them, and even the sound of the footsteps of that person. Pavlov decided to systematically study these effects as he recognized that they provided a means of extending the reflex concept to embrace learning as well as innate responses. His goal was to systematically examine the principles underlying this type of learning.

Pavlov set up an experiment in which he would repeatedly sound a bell and follow it with food. Later he observed what happened when the bell was sounded but no food was given. The fundamental finding was that after repeated bell-food pairings, salivation was produced when the bell was presented alone.

As Pavlov understood it, the dog has learned to associate the bell with the food

and because food produced the salivation reflex, the bell also came to produce the reflex. According to Pavlov, this involves newly formed connections in the brain.

Key terms in Classical Conditioning

- Unconditioned Reflex: the reflex the occurs naturally.
- Conditioned Reflex: the reflex that is acquired.
- Unconditioned Stimulus (US): the stimulus that produces the response in the unconditioned reflex (e.g., food).
- Unconditioned Response (UR): the response in the unconditioned reflex (e.g., salivation).
- Conditioned Stimulus (CS): the stimulus in the conditioned reflex (e.g., the bell).
- Conditioned Response (CR): the response in the conditioned reflex (e.g., salivation).
- Classical conditioning is learning an association between a neutral stimulus and a reflexive response.

Also, the US and the CS must be presented closely in time for classical conditioning to work well.

So, to recap the process called classical conditioning: (see Gray, Figure 5.2)

1. We have two stimuli. One stimulus (US) must evoke behavioural response (meat) while other evokes little or no response (bell or light).
2. The CS must be paired with the US.
3. We repeatedly present the bell then the meat powder (CS + US)
4. Will eventually elicit a response (salivation) just to the bell (CS) which is similar to the response elicited by the meat (UR). This response is referred to as CR and is usually not as strong as the original UR.

Note that learning was **operationally defined** by Pavlov in terms of salivation.

Wolf and sheep example from Garcia and colleagues (1985).

These researchers fed a wolf a muttonburger containing lithium chloride, a chemical that induces nausea. The wolf "wolfed" down the burger but a half hour later became sick and vomited.

Several days later the researchers put a sheep into the wolf's compound and the wolf went straight for the sheep's throat. But on contact, the wolf abruptly drew back. It slowly circled the sheep and attacked again from another angle, but again drew back. After an hour, the wolf had still not attacked the sheep - in fact the sheep had made a few short charges at the wolf.

Here the lithium is the US, vomiting (or feeling bad) is the UR, and the sheep (or muttonburger) is the CS.

Example of Classical Conditioning

Classical Conditioning and Emotions: Baby Albert and John B. Watson

Emotional responses can also be classically conditioned. One of the most famous examples of classical conditioning was the case of little Albert. The study was carried out by John B. Watson - considered the founder of American behaviourism - and his colleague Rosalie Rayner and was published in 1920.

The methodology and ethics of the study can and have been questioned but the study was nonetheless influential.

When Albert was 9 months old, Watson and Rayner presented him with a variety of objects including a dog, a rabbit, a white rat, masks, and a fur coat. Albert showed no fear in response to these objects and in fact played regularly with the rat. A few days later, they tested Albert's response to a loud noise (produced by banging on a steel bar) directly behind his head. Albert reacted by jumping, falling forward, and crying. About two months later, Watson and Rayner presented the loud noise and the rat together - as Albert reached out for the rat, they banged the steel bar. After only a few pairings of the rat and noise, Albert learned to fear the rat.

Reflexes and Classical Conditioning

Virtually all reflexes can be conditioned, e.g., eye blink, air puff, and tone.

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