

PSYC2081 – Learning and Physiological Psychology

The Psychology of Animal Learning

LECTURE 1 – THE 19TH CENTURY

Natural Sciences: Physics and Chemistry

- Science was that endeavour which met with unqualified success
- The laws of motion of material bodies, from pendulum clocks to the solar system, had been formulated and an account of matter given in terms of elementary particles.
- Instrumentation and measurement, combined with experimentation and the formulation of mathematical models, appeared able to resolve any complex physical system into its elementary component parts.

Science and Psychology

- It was natural that many came to believe that the application of scientific method to human affairs was the only hope for understanding people and changing society for the better.
- However, this caused problems: could psychology be a science? Could the mind be subjected to scientific enquiry?

The study of the body: Physiology

By the late 19th century, the study of physiology had progressed. Much was known about the sense in our body that detect heat, stretch, acceleration, sound light, smells, tastes and other forms of energy, and that transmit this energy in a form that can be understood by our brains.

The study of the mind: Psychology

- The study of sensory systems led to Psychophysics. The central questions asked by psycho physicists around the late 19th century was that: How do the physical measurements of energy (e.g. light, sound) correlate with measurements of experienced sensations?
- You have energy which is being measured by physicists and sensory coding done in physiology. How is this information correlated to our sensations? Well, the mental could be measured and subjected to mathematical treatment (e.g. Weber's law). This led to the thinking that maybe, psychology could be classified as a quantitative science.
- A threefold arrangement formed: Energy was being measured by ohsyncists, sensory coding was carried out by physiologists and psychologists would measure the experienced sensation.

The Study of Life: Biology

In the 19th century one of the central questions within biology was the, origin of species:

- One view was that species were immutable, having been fixed by any act of creation. Humans were unique, distinct from all other species in their possession of a conscious mind.
- The alternative was that present species (perhaps including humans) had descended from earlier ones through some process of evolution.

Jean-Baptiste de Lamarck (1774-1829) – Professor at Museum of Natural History of Paris was the first to propose a mechanism for evolutionary change. His theory known as Lamarck's theory proposed that:

- Organic and inorganic matter are fundamentally different, primarily in that each living species possesses an innate drive to perfect itself. The drive to perfection results in changes in its body and in its mentality.
- These acquired characteristics are hereditary, so that the physical and mental efforts made across the course of an individual's life are reflected directly in the physical and mental organs of the progeny.

Lamarckian Inheritance

1. Environmental changes can produce new habits
2. New habits produce physical changes: Law of Use and Disuse.
3. Physical changes are heritable: Inheritance of acquired characteristics

The idea is that the shorter giraffe keeps trying to stretch up to the trees, improving the strength of its neck muscles. Its children will inherit its strengthened muscular changes and eventually, you get a giraffe who can reach and eat food from a tree.



A very different view was proposed by **Charles Darwin (1809-1882)**.

- Darwin studied medicine at Edinburgh University but was repelled by surgery and bored by the lectures
- He then studied at Cambridge University with the aim of becoming a country priest. This occupation would allow him to indulge his passion for natural history.
- This interest in natural history brought him into contact with Henslow, Professor of Botany at Cambridge, who recommended Fitzroy, captain of HMS Beagle, Darwin was appointed as the ship's naturalist on a surveying voyage.
- The Voyage of the Beagle (1832-1836).
- After his return in 1836, Darwin wrote several works on geology, edited all the work done by various specialists on the zoological material that he had collected, and wrote a popular account of the voyage.
- He also obsessed about how species of animals came to be how they are.
- In 1838, he read *An Essay on the Principle of Populations* (published in 1798) by the economist Thomas Malthus.

Malthus (1766-1834)

- Malthus agreed that in nature plants and animals produce far more offspring's that can survive, and that humans likewise are capable of overproducing if left unchecked.

Charles Darwin (Autobiography: 1876)

"A theory by which to work"

- Darwin realised that competition for scarce resources would favour those individuals whose attributes gave them an advantage.
- He knew that plants and animals could be changed over successive generations by artificial selection.
 - He knew that farmers bred animals to achieve certain aims. E.g. cows to produce more milk.
- He saw that the characteristics of animals in the wild could also be changed by natural selection

Darwin's Theory

Darwin's theory is relatively simple:

- There is variation among individuals belonging to any population of animals of the same species.
- Much of this variation is genetically inherited
- More individuals are born that can survive maturity
- Those who possess variations that survival are more likely to have offspring who will inherit these adaptive variations.

Put another way:

- Individuals differ in their likelihood of surviving
- Those whose characteristics are best suited to the environment will be more likely to survive and thus to pass on their beneficial attributes to their offspring.
- Certain attributes will thus be perpetuated or selected through the action of natural selection
- Eventually, there will be distinct species.

What Darwin had done was propose a mechanism for evolution – very different from Lamarck – *natural selection*. This is now completely accepted.

The Origin of Species (1859)

- Darwin committed his ideas on evolution to paper but refrained from publishing
- In 1858, he received a letter from the naturalist, Alfred Wallace, in which he found a description of the theory of evolution by natural selection. Wallace came to this conclusion on his own. Darwin arranged that a paper he read at a scientific meeting in the names of Darwin and Wallace, and proceeded to publish: *The Origin of Species by Means of Natural Selection*

The Origin of Species had two aims:

1. To show that evolution had occurred. This aim was easily accomplished as many people had accepted that the present species of animals had their origins in simple forms of life that existed millions of years ago.

2. The second aim was to show that the mechanism of evolution was natural selection. This was less easily accomplished as evolution by natural selection was not accepted until the 1930s when it became the unifying force in biology.
 - One factor that predisposed against acceptance of the theory was its implications for humans.

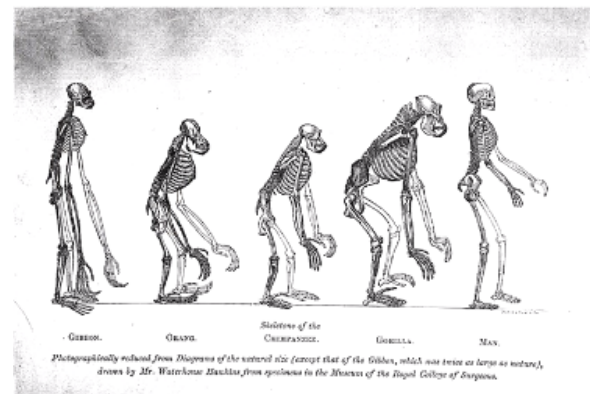
There is in fact no reference to humans in *The Origin of Species*. The only reference to humans was indirect and in the final paragraph:

“Thus, from the war of nature, from famine and death, the most exalted object which we are capable of conceiving, namely, **the production of the higher animals, directly follows.**”

But the implications were clear:

- Shortly after the publication of *The Origins*, an aristocratic lady is said to have remarked: Let us hope that Mr Darwin’s theory is wrong and, if it proves to be true, let us hope nobody hears about it.
- This is still valid. For example, an interesting book, “*Darwin’s Dangerous Idea*” (1995) by the philosopher, Daniel Dennet, uses the metaphor of “universal acid” to communicate its impact on our beliefs about ourselves and place in nature.

Thomas Huxley (1825-1895) – Comparative neuroanatomist. He was known as Darwin’s “bulldog” and relished in his role of public champion of evolutionary theories, while Darwin remained in the country, often ill and avoiding controversy.



Evidence for Man’s Place in Nature (1863) – Huxley argues that humans were the product of evolution. He based this on anatomical evidence.

Alfred Wallace (1823-1913)

- Had the same idea as Darwin that is, evolution by natural selection. However, he had different ideas regarding its implications.
- Maintained (1869) that: natural selection explained the human body but not the human mind.
- Wallace wanted to say that in fact divine intervention had created life and allowed natural selection to be the mechanism. But in fact, divine intervention had created consciousness in the higher animals and divine intervention had created the uniquely human faculties such as language, numbers, music, morals and metaphysics.

Darwin’s Reply to Wallace through two books, one of which was: *Descent of Man* (1871) in which he argued that sexual selection (competition among males for females) is a factor in human evolution and that this can explain certain mental faculties. In contrast to Wallace, Darwin argued that human intellect was not unique, instead there was mental continuity with other species, e.g. reasoning in chimpanzees and apes; speech as being something which you can hear in parrots.

In the second book, *the Expression of the Emotions in Man and Animals* (1872):

- Darwin argued that there was a Similarity in emotional expression across species and emphasised the common function of emotional expression. E.g. if one looks at the kind of behaviours and physiological changes that are elicited by danger, they are remarkably similar across mammals. When you look at closely at the facial expressions that people show, they reflect innate motor programs that are being elicited and the function of these programs is to serve the face against physical danger.
- Darwin argued that emotions in humans, although partly due to social learning are inherited from our animal ancestors. They are instincts that originate in attachments (happiness), loss (sadness), aggression (anger), fear (danger), and disgust (rejection).
 - For example, disgust is you reaction when you eat something bitter which results in a change in facial expression and releasing behaviours to get the food out of your body.

Summary of Darwin's Arguments

- No qualitative differences between animals and the higher animals in mental faculties.
- Behaviour of any species partly instinctive and partly governed by the individuals experience.
- Elements of language present in other animals and these, combined with other mental abilities, led to language in humans
- Moral sense resulted from possession of intellectual abilities in conjunction with processes of attachment
- Basic emotions present in other animals

George Romanes (1848-1894)

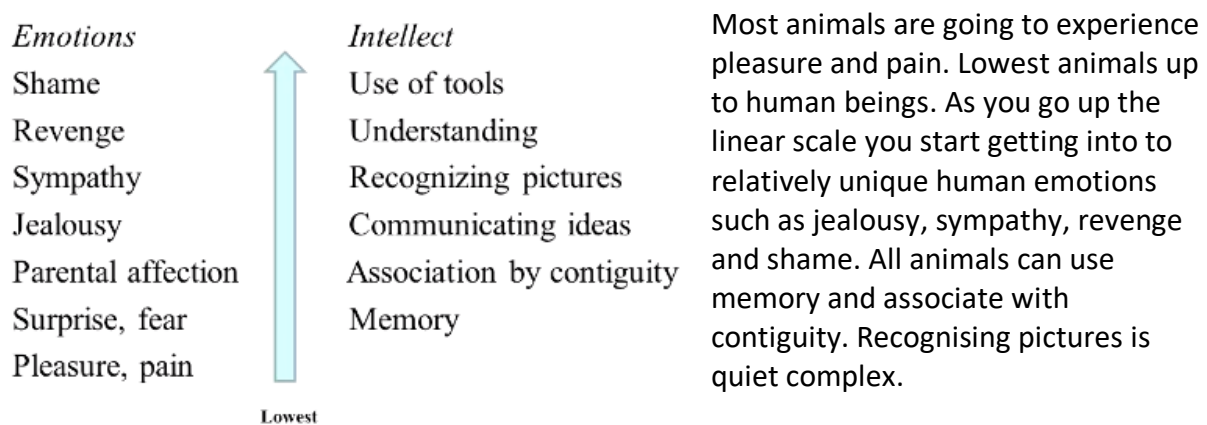
- In 1874, Darwin handed over his notes on animal behaviour to a neurophysiologist, Romanes, who expanded this corpus of anecdotal evidence, adding some experimental results.
- *Animal Intelligence* (1882) reported these observations on a huge range of species

Mental Evolution in Animals (1884) – Romanes in particular had a natural view. The natural view was linear progression of evolution from “lower” to “higher” with humans as the highest form of evolved life. He also wanted to suggest that Lamarckian evolution played a role in mental evolution.

What he wanted to say in regard to the mind were:

1. The organism must have a nervous system
2. Its behaviour must be sensitive to past experience, that is, it must show evidence for learning and memory.

Romanes' hierarchy for emotions and thought:



By the beginning of the 20th century, psychologist shifted away from the kinds of observations that Darwin and Wallace had made of animals to studying the mind systematically in the laboratory.

Lloyd Morgan (1852-1936) – Psychologist at Bristol University, UK argued that Romanes had:

- Completely ignored previous opportunities for an animal to learn a behaviour;
- Confused testable and non-testable inferences from behaviour to mental events
- Used unnecessarily complicated terms to explain behaviour

In his book, *An Introduction. To Comparative Psychology* (1894) he articulated what we call, **Morgan's Cannon**: "In no case may we interpret an action as the outcome of the exercise of a higher psychological faculty, if it can be interpreted as the outcome of the exercise of one which stands lower in the psychological scale"

- Brief observation is not enough to understand the animal mind, systematic study is needed.
- Choose the simpler explanation compared to more complicated ones. if two explanations are equal something has gone wrong.

Trial and Error Learning

- He illustrated that by making one-off observations of an animal's behaviour can lead to wrong inference (e.g. insight)
- Repeated observations can reveal how the behaviour develops.
 - E.g. Imagine that you are walking along and you see a man with a dog. There is a gate. The dog goes up to the gate and inspects it, raises its paw and lowers the latch opening the gate. Romanes when told this fact by an observer, the dog had inspected the mechanical structure the gate and then used this mechanical insight to open the gate. Morgan said that this is wrong since it is based on anecdotal and one-off evidence.
 - Morgan recorded the history of how his dog learned to open a gate. At first, the dog scrambled multiple times, tried to jump over. As a consequence of repeated practice with this gate, it struck upon the fact that if it pressed the latch then the gate will open. In other words, the dog had learned through. A process of trial and error. It was nothing to do with the fact that the dog had gotten some insight into the mechanical structure of the gate.

- Romane's database consisted of mostly one-off observations.

Edward Thorndike (1874 – 1949) – Psychologist at Columbia University, US

- He intended on doing what Morgan had argued psychologists should do to study the human mind which was: to study the animal mind using systematic, quantitative experiments on *trial-and-error learning* in animals.

Thorndike's Puzzle Boxes for cats and dogs

- He designed puzzle boxes whereby if the cat in the box pulls the chain, the door opens and the cat can escape from the chamber. Thorndike arranged that there was food outside the chamber – acting as an incentive for the cat to learn how to escape.
- What Thorndike did was plot what the animal was doing from placement in the box to the animal making the effective response. Thorndike showed that across experiences of the animal being placed in the chamber, the time it took to making the appropriate response and escape gradually declined. There was improvement in the animals learned behaviour. This enabled him to produce the first learning curves.
- Thorndike also did cross-species comparisons and was unable to find a significant difference
- He also did learning by imitation and did not find any significant differences for that. He failed to realise that when you don't find evidence for something, it doesn't necessarily mean that something doesn't exist.
- He also found that he couldn't detect any type of forgetting. Once the animal learned the appropriate response, it was there forever. E.g. you learn to ride the bicycle – innately learnt.

Law of Effect

To explain his data, Thorndike postulated the Law of Effect, what he wanted to say was that: "Of several responses made to the same situation, those which are accompanied or closely followed by satisfaction to the animal will, other things being equal, be more firmly connected with the situation, so that, when it recurs, they will be more likely to recur."

- Pulling the chain caused the animal satisfaction as pulling the chain allowed the animal to escape and access the food.

He then wanted to say that Learning consists in the formation of connections between situations and responses – animals (and people) learn what to do in a situation – now termed ***procedural knowledge*** (e.g. habits, learning how to ride a bike). You are learning integrated motor patterns which constitute a kind of skill – learned behaviour.

The additional claim that Thorndike was making was that satisfaction (rewards) these connections while dissatisfaction (punishes) breaks them. This connection mediates your behaviour.

Metaphor for the Mind

- The metaphor for the mind was a telephone exchange where an operator connected and disconnected on line to another, thereby regulation communication from one line to the other.
 - Telephone operator is mediating the communication between the two telephones.

- Satisfaction connected the situation with the response and dissatisfaction broke this connection so that the situation would not subsequently provoke the response.

The Modern Metaphor of the Mind: The Computer – The brain is the computer and the mind is the software.

John Watson (1878-1958) – Psychologist at John Hopkins University

- He studied maze learning in rats and the innate behaviour of birds. This links back to Darwin who said that behaviour of any sort is innate and instinctive.
- In 1913, he published the Behaviourist Manifesto: *“Psychologist as the behaviourist views it.”*
 - This was very radical as until now we were talking about animal minds relating to the psychology of human minds.

Instead, Watson believed that Psychology should be studying behaviour rather than the mind.

- Watson argued that the traditional study of consciousness in people through introspection had failed because of its reliance on subjective data.
- Statements based upon such subjective data cannot be subjected to the public scrutiny required in science.
- He also argued that introspection was irrelevant to everyday problems and that the few areas where psychology had been effective (e.g. Mental Tests) was because it had been abandoned a concern with consciousness and the use of introspection.

Watson went onto studying infants and asked questions of the following sort:

- Do neonates display instinctive behaviours or just simple reflexes?
 - Instincts are coordinated patterns of movement whilst, reflexes are responses elicited by a stimulus.
 - What kind of stimuli elicit emotional reactions in infants?
 - How do stimuli come to elicit fear in “little Albert”?
 - His answer was: Pavlovian conditioning of emotional responses. He allowed little Albert to play with a furry rat. Whenever the rat was present he startled Albert. The consequence of this was that every time the rat became present Albert got scared as he had paired the rat to being scared/startled.
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