THE BIOLOGICAL APPROACH TO PSYCHOLOGY

Biology is defined as the study of life (from the Greek ***bios*** meaning 'life' and ***logos*** meaning 'study'). A biological perspective is relevant to the study of Psychology in three ways:

1. **Comparative method:** different species of animal can be studied and compared. This can help in the search to understand human behaviour.
2. **Physiology:** how the nervous system and hormones work, how the brain functions, how changes in structure and/or function can affect behaviour. For example, we could ask how prescribed drugs to treat depression affect behaviour through their interaction with the nervous system.
3. **Investigation of inheritance:** what an animal inherits from its parents, mechanisms of inheritance (**genetics**). For example, we might want to know whether high intelligence is inherited from one generation to the next.

Each of these biological aspects, the comparative, the physiological and the genetic, can help illuminate human behaviour. If we want to understand all aspects of behaviour, perhaps we should start with one of the smallest units, the basic building block of the body, the cell.

The neuron

There are a number of different kinds of cells in the body, but the one Psychologists are most interested in is the nerve cell or, as it is more often called, the **neuron**. The human brain is made up of around 10,000,000,000 neurons. The total collection of nerve cells in the body is called the **nervous system** and the major part of the nervous system, consisting of the brain and the spinal cord, is called the **central nervous system (CNS)**. Neurons outside the CNS, which take information to and fro between the CNS and various regions of the body, are called **peripheral** neurons.

How do neurons function? If a neuron is probed with a piece of apparatus, a small electrical voltage can be detected. When this electrical voltage doesn't change, when it remains constant, the cell is said to be *resting*. However, when the voltage changes up and down, the cell is said to be *active*. Many neurons can rapidly change their electrical state, where the cell suddenly changes its voltage and then just as suddenly returns to its original condition. Changes of this kind are called **action potentials**. The more frequently the cell changes its voltage in this way (also termed **firing**), the more active it is said to be. Changes in electrical voltage constitute the signalling system, or language, of the nervous system.

A pathway consisting of neurons, over which information travels, is termed a **neural pathway**. Neurons that carry information ***to*** the CNS are called **afferent** neurons and neurons that carry information ***from*** the CNS to other parts of the body are called **efferent** neurons.

Neurons handle information in the body, taking messages from one part of the body to another. Another way of transmitting information in the body is via the **endocrine**

system. The vehicle used to transmit information through the endocrine system is provided by **hormones**. Hormones are chemicals that are carried by the blood from one location to another, more distant location. These chemical messengers take longer to transmit their information than the nervous system, but their effects are usually longer lasting.

It is obviously important to Psychology that the nervous system is understood: the information that reaches our CNS concerning events both in the outside world and in the internal environment of the body does so in the language of electrical changes in the neurons. Everything we feel, everything we do, everything we know has, as its physical basis, the neural structures of the central nervous system. BUT how do we come to possess our nervous systems? What factors determine the form of the nervous system? To answer these questions we need to go further into the structure and properties of cells to help us to understand the most important unit of information in the human body, the gene.

The gene

If a cell in examined under a microscope, one particular structure can be seen that is central to all cells: the **nucleus**. The nucleus of every cell in the human body (other than sperm or egg cells) contains 46 thread-shaped structures called **chromosomes**. These chromosomes are composed in part of a complex chemical called **DNA** (deoxyribonucleic acid). The DNA on each chromosome carries units of information called **genes**.

From the moment of conception to the time of death, our genes act together with environmental factors to influence *every* aspect of bodily structure and function. So, what determines our genes?

A human baby develops from a single cell. The process of development is possible because cells repeatedly divide. Each new cell contains an exact replica of the DNA in the original cell because each chromosome pair is copied exactly. BUT where did the original cell come from in the first place? From your parents. The egg from your Mother and the sperm cell from your Father each contain only half of each chromosome pair. At fertilisation, the two halves come together. Unlike replication, then, reproduction does not involve the production of an exact replica of either parent. The new cell that is formed through reproduction has a brand new set of chromosomes. After extensive cell division, a long period of development and interaction with the environment, accompanied by lots of wear and tear, the final product is uniquely ***you!***

So, in answer to the question "Where do the animal's genes come from?", you could reply "From its parents". However, another way of approaching this question is to look at it on a much longer time-scale, over many thousands of generations, and look at it through the process of evolution to find out why some genes survived and some did not.

Evolution

Until the 19th Century, the dominant view used to explain the diversity of life on the planet was in terms of God's creation. Today, however, the dominant explanatory mechanism to account for the diversity of animal forms is **Darwin's theory of Evolution by Natural Selection**[1] . The estimate is that life on Earth began, in its simplest form, around 4000 million years ago. Today there are over one million different species in existence. How can we begin to explain the changes in form of animals and the change in their numbers? Darwin developed his theory to explain this.

The starting point of the theory is that the physical characteristics of an organism are important for its survival and for its success in reproducing itself. For example, within a given species, the characteristics of the individual animal will vary: some rats have stronger legs than others, some dogs have a better sense of smell than others, some seagulls have stronger wings than others etc. The stronger the rat's legs, the faster it can run; the better the dog's sense of smell, the more food it can find; the stronger the seagull's wings, the further it can fly in search of food. All these attributes mean that the animal is more likely to survive in order to reproduce and pass on these characteristics to its offspring.

The environment is such that only some of the offspring of an animal will flourish. Those animals possessing characteristics that help it survive will flourish at the expense of those without that characteristic. That way the population of the animal will change .... or **evolve**[2]. A successful organism is one that is well adapted to its environment, so it can pass on it characteristics to its offspring. The term **natural selection** refers to the process whereby characteristics (such as strong legs) are maintained and continued in the animal according to their survival value in a particular environment, according to their **adaptation** value. The term **fitness**[3] refers to the animal's ability to survive and produce offspring.

We have mentioned various characteristics of animals that might improve their fitness, but how do these characteristics arise in the first place? How did the first ever giraffe to have an extra long neck come about? It is only by passing on genes that inherited

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[1] Of course, there remains some controversy over this and the Biblical account of creation and opinions do still vary.

[2] A reasonable question at this point would be "Why don't animals continue evolving?, so that you end up with, for example, a 'super-rat' with super strong legs that can run as fast as lightning! The answer is that the advantages given by super strong legs would also bring along with it disadvantages. The rat would be likely to get heavier, need more food to survive, have less places to hide (because it was too big and be ***less*** likely to survive. The process of evolution, therefore, has to find compromises, trading off advantages and disadvantages.

[3] There are two factors that contribute to the fitness of an animal: **fecundity** and **viability**. Fecundity refers to the number of fertilised eggs that the animal produces and viability refers to the chances of survival of the fertilised eggs. For example, fish produce large numbers of fertilised eggs, so their fecundity is high; however, the chances of survival of those eggs is very slim, so their viability is low. In contrast, primates produce very few fertilised eggs, so their fecundity is low; however the chances of survival of the individual is very high, so their viability is high.

characteristics can be given to a new organism. So where did the gene for the giraffe's extra long neck (or any other animal's particular characteristics) come from? To answer that, we need to go back to the discussion of reproduction. Firstly, recall that the combination of chromosomes at fertilisation, half from each parent, yields a completely novel set of chromosomes. This means that this unique individual can inherit a combination of characteristics that give it an advantage over either of its parents. Secondly, occasionally in the process of inheritance a **mutation** appears by chance in a gene carried by one (or both) of the parents. As a result of this, the offspring is different from either of its parents in a way that could not be predicted. Sometimes this mutation is advantageous to the animal (e.g. a giraffe's long neck) and sometimes it is not (e.g. if the animal is born without lungs and lives on land). If the mutation is advantageous then the animal will survive and pass on the mutated characteristic to its offspring, if it is disadvantageous it will not survive to pass the characteristic on. **Selective pressure** refers to any property of environment which tends to favour one form of species over another.

What does all this have to do with Psychology? The genes we have today, that, through interactions with the environment, make us behave in the way that we do, have evolved via the process of natural selection. Recall that we said that the nervous system is the physical basis for the processes that make us behave in the way that we do? Our brains are made up of thousands of millions of neurons and the processes that make us what we are (e.g. consciousness, memory, learning, emotion, intelligence, thought, language) take place somewhere in these neurons in the brain: it is through these neurons that genes exert their influence on behaviour.

This should give you some idea of the influence and importance of the biological perspective.