# MODULE 2 - The Nervous System

## How Does The Nervous System Work?

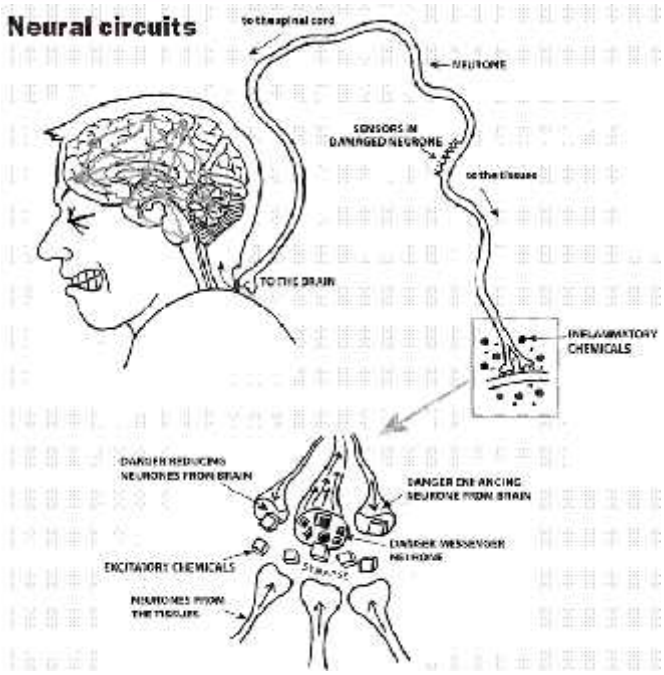
The nervous system carries electrical signals from the tissues (eg muscles/ligaments/discs) to the brain. This gives the brain information regarding what is happening to the tissues at any given time. The brain needs to continually know what is happening to the tissues. The brain then interprets the electrical signal and produces a response based on the information it receives.

Your nerves have millions of tiny receptors whose job it is to detect changes in the tissues. For example, in the nerves going to your muscles and joints, you have receptors which detect information such as

- Too hot/cold
- Stretching too much
- Too heavy
- Too much lactic acid

When a receptor detects a change in the tissues, an electrical signal is created that is carried by the nerves that go up to the brain. Your brain then decides what to do with this information, and then creates a response to counteract the change.

This is a normal process and is why you pull your hand away from a hot surface after you touch it.




(Butler and Moseley NOI Group Publications 2003)

## The Nervous System Is Highly Adaptable

The nervous system has a characteristic which is called “neuroplasticity”. This means that the nervous system is not set in stone but can adapt to changes and different situations.

Neuroplasticity is very helpful in some situations. It is what allows us to learn new skills or to improve our memory. When you learn something, new connections are made in the nervous system which helps you to remember this new information.

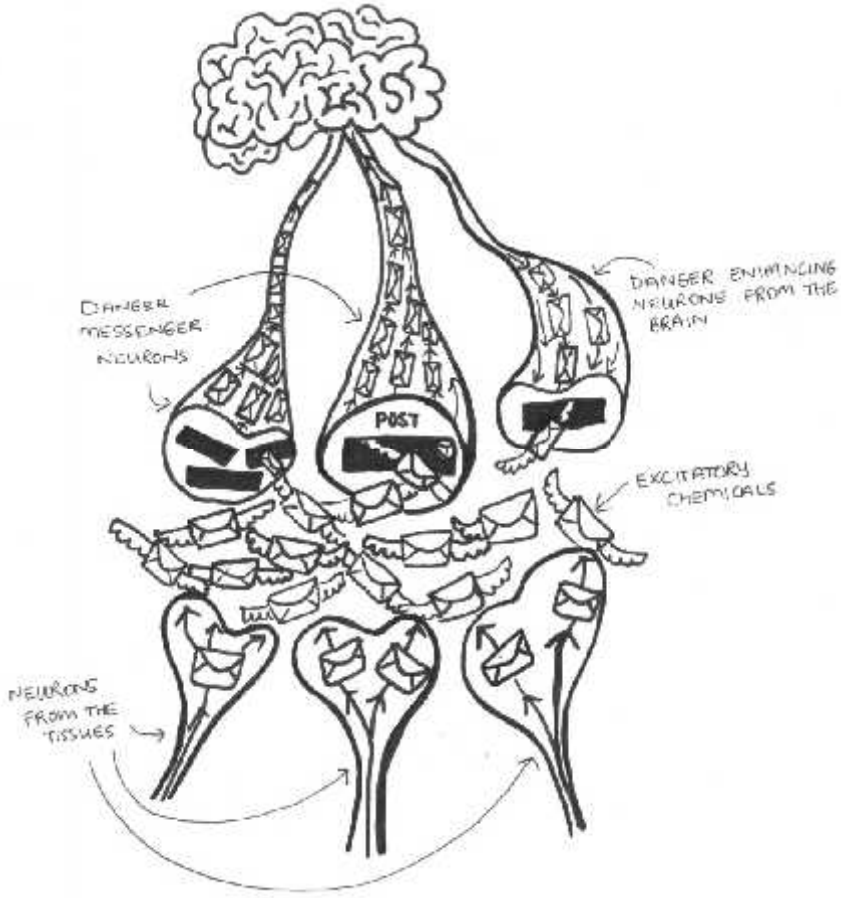
In chronic pain, neuroplasticity can be a problem. The way the nervous system operates actually changes in chronic pain situations. These changes can become part of the problem that we need to fix. We will now explain how the nervous system changes in chronic pain.

## How Do The Nerves Change In Chronic Pain?

We need to explain a number of changes that happen to your nerves with persisting pain. If you understand these changes, you will understand some of the reasons why your pain persists.

First, more receptors grow in your nerves near your injury. These receptors become more sensitive to particular changes, such as movement, temperature and chemicals. Basically a smaller change in temperature or movement can set off the receptor, so more electrical signals travel up the nerves to the brain. The receptors become very good at detecting changes in the tissues.

Secondly, the nerves get better at transmitting information in the spinal cord and up to your brain. The connections between the nerves are strengthened. Also, the ability of your nerves to inhibit or




stop the nerve transmission is reduced. Lots of chemical and structural changes happen to the nerves in your spinal cord to increase their ability to carry nerve impulses from your injured tissues up to your brain.

Your brain ends up receiving too much information about what is happening in your tissues. The more nerve signals coming from the old injury, the more pain will be produced in the brain by those signals.

Overall, the nervous system which controls the area that you injured becomes sensitised. Therefore, your nervous system and brain receive an amplified version of what is happening to your muscles/joints.

## What Is The Outcome Of These Nerve Changes?

The response that your brain makes to these incoming messages from the nerves is based on this amplified version of events. The information that your brain receives may not accurately represent what is actually happening down where you originally hurt yourself. Basically as the signals travel further up the nerve pathway to the brain, the intensity of the signal is increased.

A signal that starts at a 3/10 level at the muscles or the discs is turned up to a 7/10 level by the time it reaches the brain. This turning up of the signal is done by the changes that occur in the nervous system that we discussed.

The brains response to this amplified message may be to make you behave in a similar way to how you respond to acute pain, when it makes you do something to protect the area.

This seems sensible, but in actual fact, the old injury has healed and doesn't need more protecting. It actually needs to move and stretch so it can get back to its original strength and flexibility.

You should be able to see that the nerve dysfunction results in an overprotective response. This can lead to the chronic pain cycle that we explained earlier.

There are many examples of neuroplasticity—that is how the nervous system changes. Most examples of neuroplasticity involve a type of learning.

## Example: Beagle

One example is dogs, such as a beagle, who have a terrific sense of smell. Beagles are used in customs to detect forbidden food products from entering the country.

A normal beagle has a good sense of smell, but a customs beagle has a brilliant sense of smell. The training of the customs beagle uses neuroplasticity to make their sense of smell become more sensitive to certain foods which need to be detected in customs. Their receptors which detect the smell of food become so sensitive that they can detect a tiny piece of food amongst mountains of luggage. Their receptors detect the information, and make their brain take action – that being to run over to the piece of luggage and sit next to it to alert the customs officer of the food.

A normal or untrained beagle has the same "hardware" - being their nose, nerves and brain, but their nervous system has not been trained to be so sensitive.

Your receptor system has become like the customs beagle. Because your nerves have become sensitised, the receptors only need a small amount of information to detect a change in the tissues. Once this change is detected, your brain will create a response. That response might be to stop doing the activity. The problem is that because the brain receives an amplified message, the response that the brain makes may not be the best thing for your muscles and joints.

The increased sensitivity means that things that used to hurt a bit now hurt more. This is called hyperalgesia.

Also, some things that did not hurt before become painful, such as light touch. This is called allodynia.

This can occur regardless of how tough you are, or what your pain tolerance used to be like. Neuroplasticity is a powerful process and can cause persisting pain even if an injury has healed.

## Example: A Walk Through The Forest

The first time someone walks through the forest, they need to make a track. They may need a map, compass and good navigation skills to find their way. They may need to clear obstacles which are blocking the path. If hundreds of people then follow this track, the track gets trampled down, wider and easier to follow, even without a map and a compass.

In chronic pain, the nerves become like a well-worn track. Because of sensitisation, the electrical signals have an easy uninterrupted path from the old injury to the brain.

## Sensitive Nerves Can Cause Ongoing Pain

So even though your injury may be healing, because of the changes that happen in the nerves, the pain can become persistent. The ongoing pain is therefore not due to your initial injury from not physically healing, but is due to these changes in the nerves.

The changes we described are just a few changes which actually happen. More complicated changes also occur including, such as:

The nerves make new connections in the spinal cord.

The nerves make more chemicals (called neurotransmitters) which improves the efficiency of the nerves to send messages from one nerve to another

Nerves which normally carry information about light touch sensations end up carrying information about pain.

Nerves start sending off electrical signals even without being exposed to stretch, heat or acid

The natural chemicals which can interrupt the electrical signals and stop their passage to the brain stop working.

The parts of the brain which receive all these signals gets better at interpreting the electrical signals as pain.

The main point to remember is that it is the sensitivity of the nerves that create the ongoing pain. This does not mean that the pain is imaginary, or all in your head, or you are going crazy - but can be explained by understanding how the nerves work, and how they change when you have pain.

In module 4, we will tell you how to get these nerves to go back to normal. Just as they can become more sensitive, they can also be trained to become less sensitive.

## Key Points - Module 2

Nerves carry electrical signals from the tissues to the brain. Pain is produced in the brain as a result of these electrical signals.

Neuroplasticity makes the nerves more sensitive. This creates more electrical signals which reach the brain, ending up with more pain.

The brain gets an amplified version of what is happening at the old injury. It incorrectly concludes that because of the pain, there is still a danger to the tissues or that the injury has not healed. The brain makes you become too protective of the old injury.

The overprotective response can lead to the chronic pain cycle.

The brain, nerves and spinal cord are all adaptable.

That means they can be trained to become more sensitive but they can also be trained to be less sensitive. Great news!