**South Devon Health Services**
Departments of Physiotherapy and Psychology
**PAIN MANAGEMENT**

# UNDERSTANDING PAIN 2

In the handout 'Understanding Pain' we said that there are 3 main reasons as to why people suffer from chronic pain:

1. The physical source for the pain
2. Changes in how we move.
3. Changes in the how the pain messages work

In this handout we are going to explain more about what happens in the pain messaging system:

## The Function of Pain

The main function of pain is to tell the body about injury and disease and to help us to make decisions about what to do. For example, if you put your hand on a hot oven, your brain quickly registers the pain and tells you to pull your hand away. So, pain is usually useful.

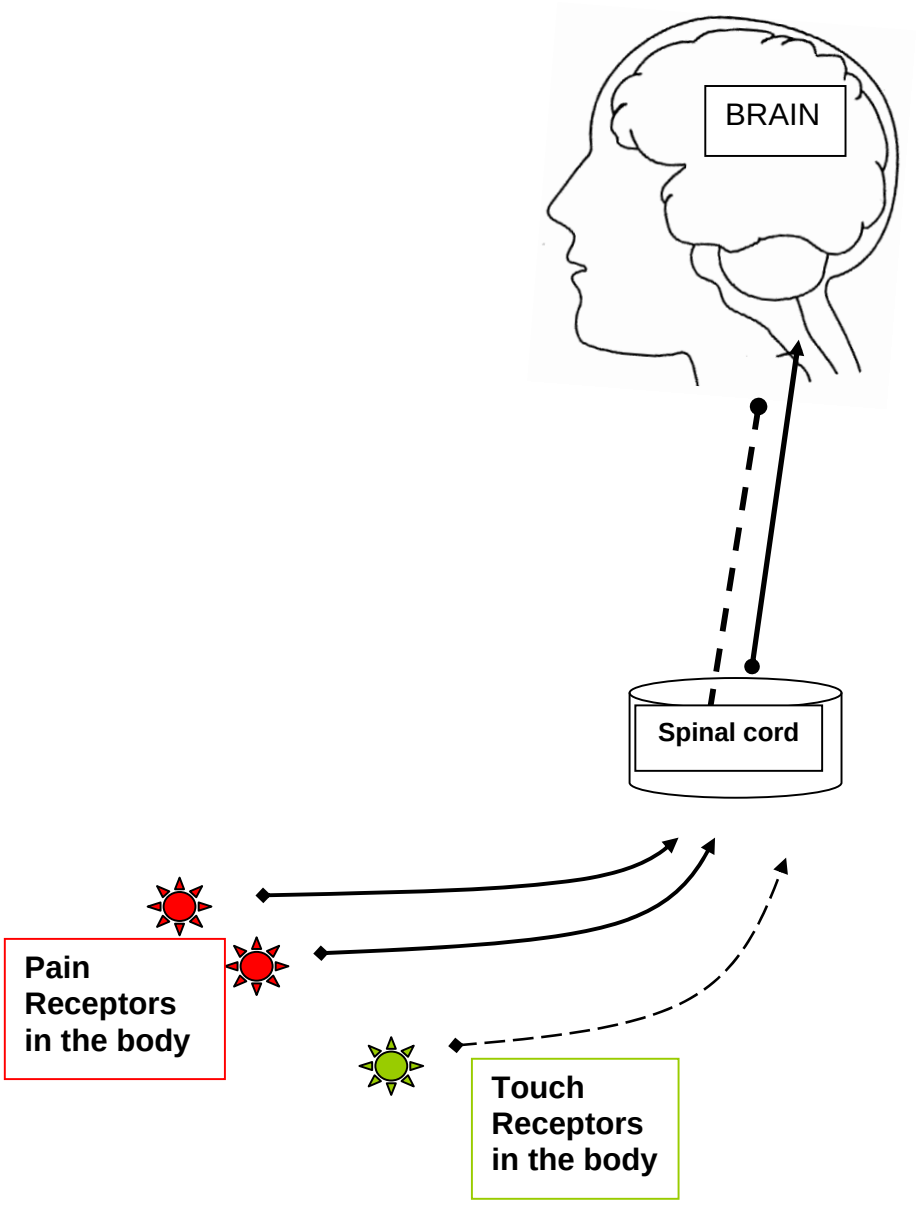
However, in *persistent* pain, our most up-to-date research tells us that something different is going on: the pain is **no longer serving a useful function**. It continues even when no further damage is occurring. It is a **real** sensation, but not an **useful** one.

## The Pain Messaging System

Let us start by explaining how the body and the brain get to know about and communicate pain:

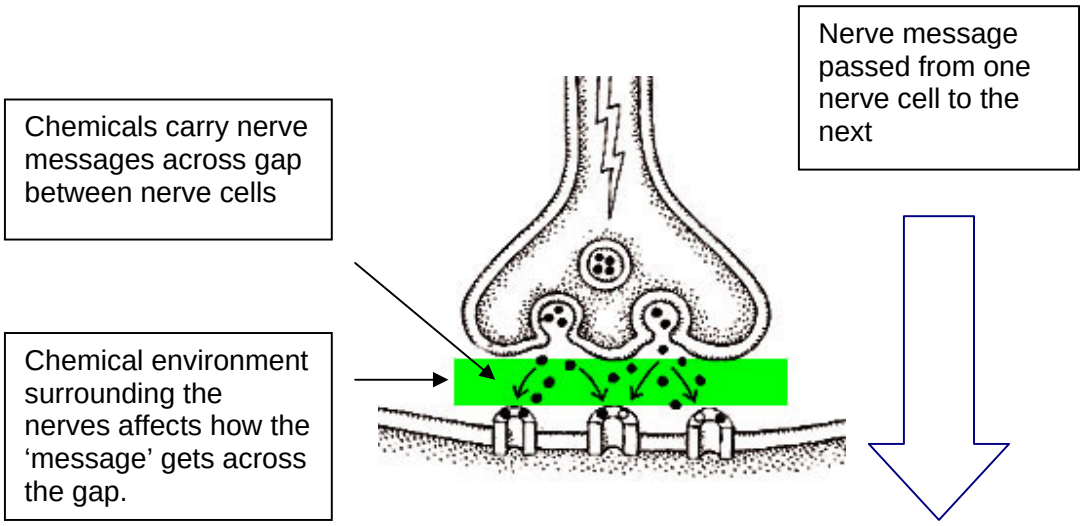
### Messages from the body to the brain:

**Receptor cells** are found in skin, muscles, joints, tendons and body organs. These respond to different types of input – for example, light touch, heavy touch, cold, chemicals etc. When these cells respond, they fire off electrical messages along the **nerves** in the body. Messages from any part of the body will first travel to the **spinal cord** and then on to the **brain**.



**What Happens To The Messages Between the Body and the Brain?**

When electrical messages arrive in the spinal cord (and at the brain), they go through a kind of relay station. There can be many messages arriving at the relay station at once. At the relay station, messages from one nerve get passed on to and influenced by messages from other nerves. The nerves communicate with each other by passing chemicals across the gaps between them at what is called a **synapse**:




The important thing to know is that messages can get **altered** when they cross the synapse. They can be **reduced**, **amplified**, **delayed** or '**fast tracked**'. It's a bit like the way that messages get altered at a radio transmitter. Or, we can think of the relay station a bit like a **gate** where more or less of the message gets through depending on how 'open' the gate is. This is part of the **PAIN GATE** process (see below)

## How does the brain make sense of messages when they arrive?

Surprisingly enough, we do not have one part of the brain that receives all of the messages to do with pain. When the messages reach the brain, they go to a number of **interpretation points** where the brain starts to make sense of them. At these points, the type and intensity of the message is analysed and compared to others: 'remembered' ones from the past and other messages that are happening now. The brain will make a 'decision' as to a) what is likely to be going on and b) how 'important' it is to listen to the message and tell you to take notice of it. The parts of the brain that are known to be involved in the experience of pain deal with:

**Relay station**: this helps to prioritise messages that are coming in. This part of the brain is also involved in memory

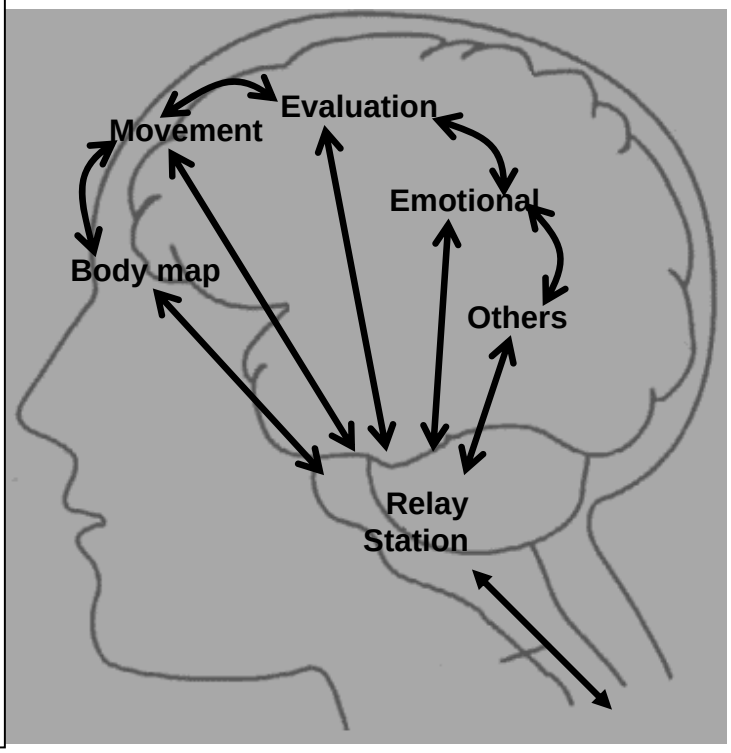
**Body map**: to tell you *where* you hurt

**Movement**: to tell you what is the best way to move in response to the pain

**Evaluation**: to help you make sense of what is going on

**Emotional**: it is important that our brains have a 'fear' response – it helps us to 'pay attention' to it

**Others**: our heart rate, blood pressure, temperature – and even immune system, are all affected by pain




All these areas working together make up what we experience as pain. They work **automatically**, i.e. without the person being consciously aware their activity. The conscious sensation is of having pain in one or more areas.

**Saying that your brain is essential for feeling pain**

**is not the same as saying that pain is 'all in your mind'.**

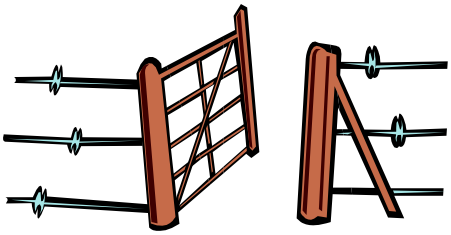
## So How Can We Understand What Is Happening With the Messages in Persistent Pain Conditions?

Over the years a number of theories have been developed to help us to understand pain. These help us to make sense of what is happening for people who have persistent pain conditions.

**Old Theories**

At first, the **intensity** of the pain was thought to be **directly** related to the amount of **damage** caused. It was assumed that there was a direct, non-stop pathway from the site of the pain to the brain.

**What we Now Know – The Pain Gate Theory**



As a result of observing pain experiences in different situations - two scientists, Melzack and Wall, realized that it was not as simple as this (remember the 'pain puzzles'). They developed a new explanation of how we experience pain – and called this the **Pain Gate Theory**

This theory says that different factors can affect the messages going through the relay stations in the spine (called '**Pain Gates'**) so that they become 'louder' or 'fainter'.

Remember, we said that at the relay stations in the spine ('synapses') the way that messages get passed from one nerve to the next can be affected by the chemistry in the body. This chemistry can be altered by many things relating to our physical and emotional wellbeing. The brain itself can also send messages back **down the spinal cord** to affect the 'pain gate'.

So, physical and psychological factors can ‘open’ or ‘close’ the pain gates, by altering the chemistry in the body – letting more or less of the pain message through:

| Opens Gates | Closes Gates |
|---|---|
| stress | sense of control |
| negative emotions | positive emotions |
| anger | relaxation |
| some drugs | some drugs |
| over-exertion | paced activity |
| fear | self-confidence |

**What else can be happening in persistent pain conditions?**

1. In persistent pain conditions, pain gates can get stuck open on ‘high alert’. This can be started, for example, by chemicals traveling up the nerve from the injured area. The setting of the pain gate remains changed **long after the initial damage has been repaired by the body’s normal healing processes.**

2**. As a result of this,** gentle movement, stretching, or even temperature changes can produce severe pain that **feels exactly like** some sort of injury or damage. In other words, the message is changed. One that starts out as ‘touch’ or ‘stretch’ is translated into another that is understood as ‘pain’: A bit like playing Chinese Whispers, the message can change.

3. Also, nerve cells which are normally inactive can **begin to produce** messages which are not switched off when they are supposed to. These messages get registered as pain.

4. Remember too that the brain receives messages from specific nerves but cannot always distinguish **which part** of the nerve is being irritated. An example of this is when you hit your 'funny bone' and feel pins and needles in your hand.

5 There are also important **changes in the way that the brain makes sense of messages**: In particular in the **pain 'memory':**

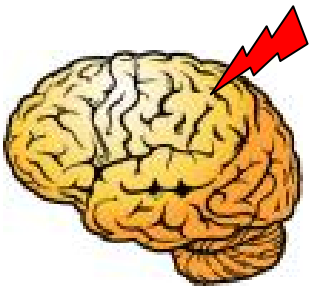
**Pain 'memories'** get laid down in the brain due to:

- repetition of pain
- a severe initial episode of pain
- regularly aggravating the pain
- 'pushing through' it
- 'winding it up' emotionally.

In pain research, these 'memories' are called '**neurotags**'. It is a bit like hearing a favourite song …the song gets 'stuck' on the brain and can become persistent and unpleasant! A similar process happens in people who suffer from phantom limb pain and other persistent pain problems. The experience (pain, remembering an annoying tune) can become so strongly linked with a thought, activity or memory that it can be switched on automatically.

Pain 'memory' is also important when it comes to movement. When we hurt, we will move differently to try and avoid the pain. The trouble is, pain is also processed in the 'movement' part of the brain: A message pathway is created and the 'pain memory' is felt whenever a certain movement happens – **despite there being no new damage.**

**Summary - So, how do we know we hurt?**



The brain's job is to make sense of all of the information that it receives through billions of electrical nerve messages. We experience pain when nerve cells in the brain become active and send a message to the conscious part of the brain to say 'You hurt'.  These nerve cells can become active for different reasons:

- Because of messages they receive from an injury or irritated tissue in another part of the body
- Because they have received messages from other parts of the brain.
- They can even just start producing messages without 'being told to' (as in the case of phantom limb pain).

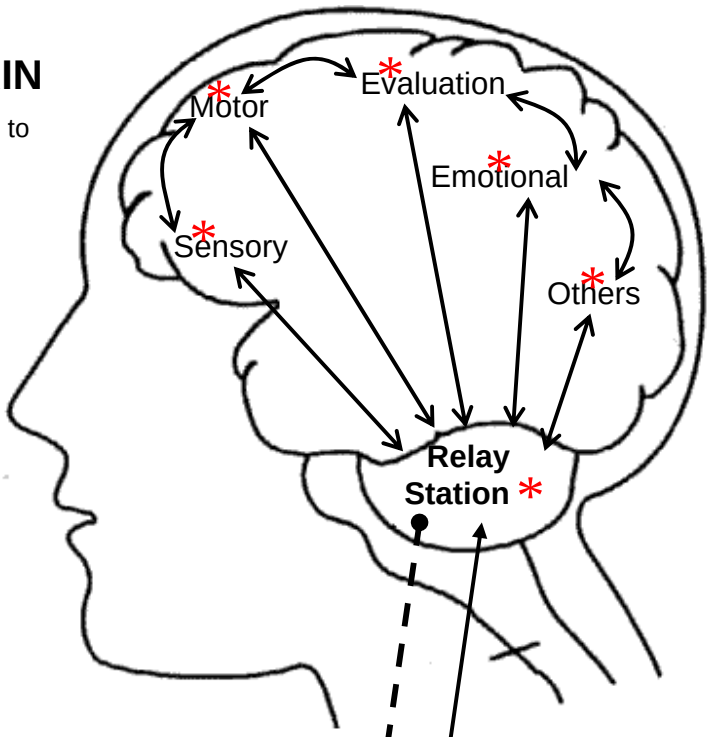
It is usually a combination of *all* of these processes: we can't measure or test it but in the end, it makes no difference…*you hurt.*

# PAIN MESSAGING SYSTEM - DIAGRAM

## BRAIN

The pain signal is relayed to various areas in the brain for processing.

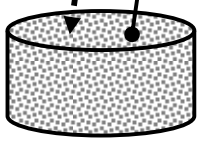
Sensory = where you hurt
Motor = movement in response to pain
Evaluation = making sense
Emotional = fear, shock, anxiety, etc.




Any signal (chemical or electrical) that arises in any one the * areas can result in the experience of pain. Pain is generated in the brain but this is not the same thing as saying that it is "all in your head."

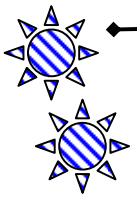
Signals from the brain can open or close the gates & affect the sensation *

Signals travel up through "open" gates to the relay station in the brain.

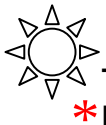


**Pain Gates**
**in Spinal Cord** *

**Receptors** *



Signals



**Touch**
* **Receptors**

* In a "well-functioning" system, touch signals dampen down the sensation of pain by closing the gates. However, due to the "gate" system and the messaging systems in the brain, light touch can be experienced as pain.

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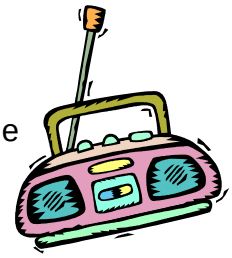
## Let's Try and Explain Pain 'in English'…



**In persistent pain the 'quality' of the signals can be altered**
Think of it like a radio where the volume can be made louder, quieter – or the channel changed or radio turned off.

- *Turning down the volume.* If a child falls over, we would rub their knee or apply warmth or ice: the 'damage' doesn't miraculously heal, but the 'message' received can be altered. This is the 'pain gate theory'

- *Turning up the volume.* Let's return to falling over. If you already have a bruised or grazed knee, falling over will be far more painful: the system is already 'sensitised'.

- *Switching off the radio.* If you twist your ankle when crossing a quiet road you take your time to limp to the pavement with the pain signal reasonably loud. However, if there was immediate danger then pain can be made quieter and you can run to safety. Thinking about it, it is important that our bodies are able to do this as it means the body can 'prioritise' things: you can 'deal' with the pain later (turn the radio on) – when it is safe.

- *Changing the channel.* Some people report completely altered sensations: they may be lightly touched in the skin, but it can trigger feelings of deep pain, burning, or a whole range of unpleasant sensations. Clearly, this is again, not associated with new or further damage, the messages are just being processed in an unhelpful way: one message goes in (touch), but another message is received (pain).

- In persistent pain it is as if the useful changes that happen to the messaging system after an injury don't 'switch off'. It is a bit like having a fire alarm that keeps ringing even when the fire is out.