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PAIN EXPLAINED

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What is Persistent Pain?

To be able to understand persistent pain it is first helpful to look at pain in general.

Pain is the brain's way of telling you that it perceives danger. This is to **prompt you to take action** to stop causing damage or further damage by keeping you safe. For example, the pain you feel when you put your hand on something hot should make you move your hand to stop you burning yourself.

Pain is a normal response to protect you from potential danger / threat

Acute versus Persistent Pain

The example given above describes **acute** pain which is short term and is generally associated with damage or potential damage to the body. It lasts anything from a few seconds up to 3 months.

If you sprain your ankle you will feel pain from the injured ligaments which stops you from walking on it as much. This allows it time to heal. The pain will stop once your ankle has healed, as it no longer needs protecting.

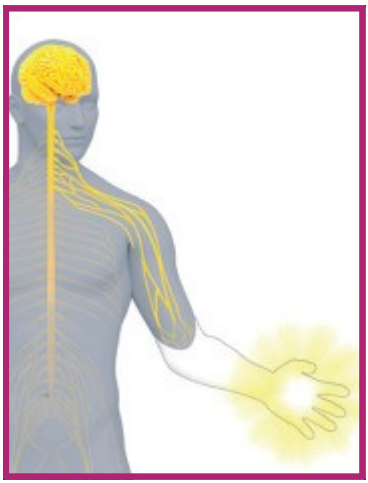
*The term 'chronic pain' was previously used by people to refer to the severity of the condition, but it really refers to how long you have had pain for. Because of the confusion we prefer to use the term **persistent pain.***

The term **persistent** pain describes pain that continues past the expected healing time of 3 months. Persistent pain, unlike acute pain, does not (for most people) indicate on-going damage. Rather, the pain is more to do with changes in the nervous system than with an on-going injury.

The reason why pain may continue after an injury has healed is complex and this leaflet aims to explain why.

People often assume that the more pain we feel, the more damage there must be. However we know that this is **not** the case because:

- Two people with the same type of injury report different pain intensities
- One person's pain intensity will vary over the course of an hour or day
- There are many instances when people with significant damage have reported no pain e.g. sporting or war injuries
- There are many instances when little damage can be seen on scans/ X-Rays but people report considerable levels of pain



You can probably think of some examples either personally or when others' pain does not necessarily reflect the amount of damage. A good example is phantom limb pain after an amputation, where pain is still experienced in the limb that no longer exists. In this example, the limb has been removed but pain is still felt where the limb used to be.

Pain does not necessarily mean damage or further damage

What Happens When We Experience Pain?

To explain the changes that occur in the nervous system when persistent pain is experienced, it is first helpful to understand what happens in **acute pain**. We will use the example of George who experiences acute pain after a brick falls on his foot.

The nervous system is the main part of our body which leads us to experience pain. The nervous system includes the brain, spinal cord and peripheral nerves which are the nerves in our arms, legs and trunk.

All over your body there are millions of detectors that sit in the walls at the end of the peripheral nerves. The role of the detectors is to report on what is going on in the body. They are specialised to detect changes in:

- **Mechanical** forces e.g. pinch or pressure

- **Temperature,** either hot or cold

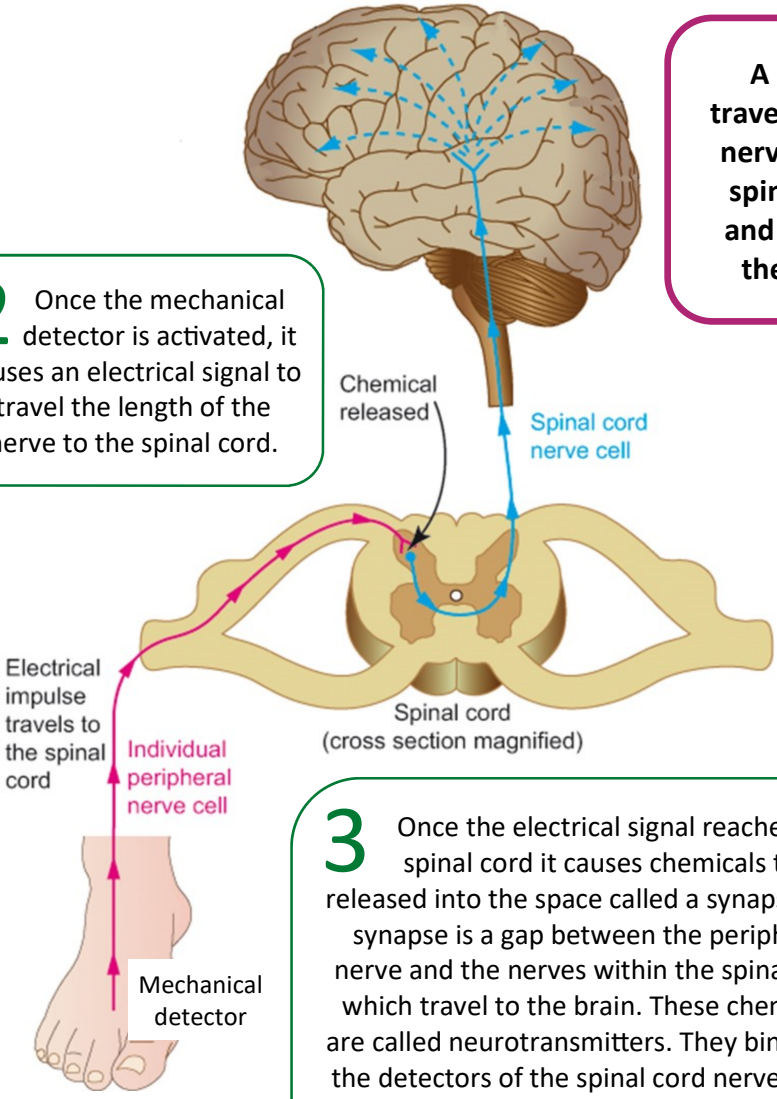
- **Chemicals,** that are either naturally produced by the body such as in inflammation or from external sources such as nettle stings

We have detectors at the ends of nerves that detect changes in the body

1 The mechanical detectors in George's foot will be activated by the pressure of the brick landing on his foot.

A signal travels up the nerve to the spinal cord and then to the brain

2 Once the mechanical detector is activated, it causes an electrical signal to travel the length of the nerve to the spinal cord.



3 Once the electrical signal reaches the spinal cord it causes chemicals to be released into the space called a synapse. The synapse is a gap between the peripheral nerve and the nerves within the spinal cord which travel to the brain. These chemicals are called neurotransmitters. They bind onto the detectors of the spinal cord nerves. This causes an electrical signal to travel up the spinal cord to the brain.

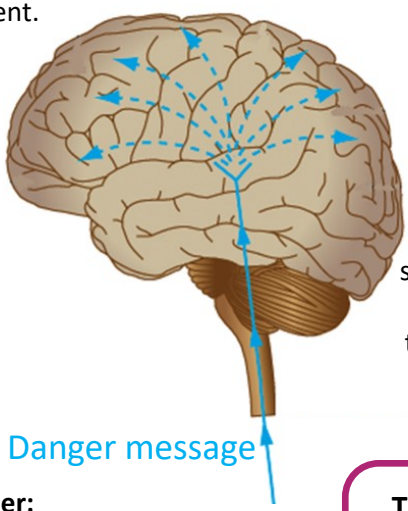
4 At this point, the brain receives information that the mechanical detectors in George's foot have been activated.

At this stage it is only a **danger message,** not a pain message. Before George can experience pain, the brain has to combine a lot of information to determine if there is any threat or danger.

The brain weighs up information to from George's:

Immediate environment:
Such as from his eyes and ears: If at that moment there is something occurring of greater threat or danger he is likely to feel less or no pain. For example if George sprained his ankle on crossing a busy road the chances are, that he would feel little pain until he got to the other side. This is because the brain concludes that there is potentially greater danger to life from being hit by a car than from any ankle damage. Therefore the brain is protecting him in that moment.

Memory:
What did this signal mean the last time the brain received it? Previously George had a brick fall on his foot which broke a bone. His brain is now more likely to conclude that there is potential damage based on past experience.



Thoughts and Feelings:
You may have experienced more pain at times of greater stress. If George was particularly anxious at the time about work or family life then the brain is more likely to conclude that he is in danger

Lifestyle and work:
George is a postman. Any damage to his foot would result in him being unable to work or go on his next holiday. Therefore to ensure that George looks after his foot the brain will protect him by sending pain to stop him from using it to allow it to heal.

Other:
Future plans, personal and cultural beliefs.

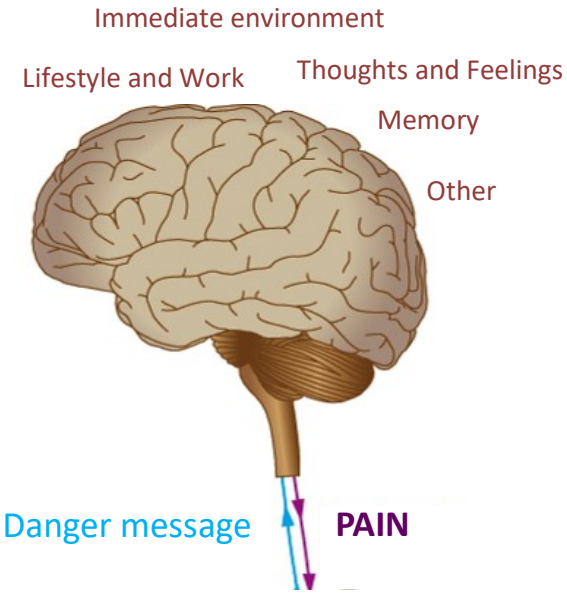
The brain has to make sense of the information it receives

5 The challenge for the brain is to construct as sensible a story as possible, based on all the information it is receiving. If the brain concludes that there is potential danger it will produce pain. Therefore pain is referred to as **an output from the brain.**

George feels pain because the brain has concluded that there is threat to his foot based on all the information, not just the pressure signals from the foot.

Pain is influenced by your environment, memory, thoughts, feelings, lifestyle and beliefs

If the brain concludes that there is a potential or actual threat you may experience pain



From brain imaging we know that there is not one centre in the brain that is responsible for the experience of pain, but that many areas are involved simultaneously. The parts of the brain that are active include areas responsible for sensation, movement, emotions and memory. Although there is some consistency, the exact parts of the brain and amount of activity at each brain area vary from person to person but also in the same individual depending on the context.

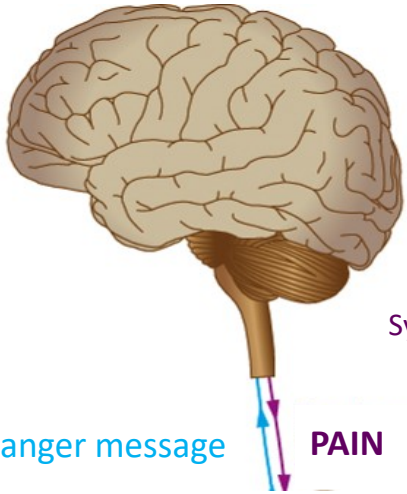
This is why every pain experience is unique.

6 When the brain concludes that George is in danger and produces a pain output it also calls upon other systems to protect George. The following systems may also be activated:

1. The sympathetic nervous system which can increase George's heart rate and make him sweat
2. The muscle system to protect his foot and keep it still
3. The endocrine system to reduce his gut activity so that energy is diverted to help the healing process
4. The immune system to produce chemicals which promote healing.

In acute pain, these systems are only activated for a short time. In persistent pain they are activated for longer periods of time, the consequences of which, will be described later.

Many systems are activated to promote healing



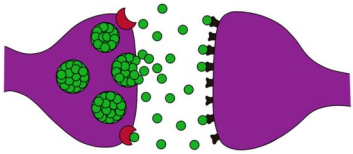
What Happens When Pain Persists?

In the following seconds, hours and days after an injury the nervous system adapts so that it becomes more efficient at sending signals to the brain. This process is called **sensitisation** and occurs in the **peripheral nerve, spinal cord and in the brain.**

Peripheral nerve

- Chemicals, in the case of inflammation, can linger in the tissues and more easily attach to detectors causing them to stay open for longer. Signals are therefore sent more frequently.
- Mechanical detectors are now activated more easily during movement.
- The brain becomes more interested in the painful area and allows more detectors to be formed.
- New nerve endings grow into the surrounding tissues. This is why pain can be felt in areas where there is no damage.
- Over a longer period of time nerves which do not carry 'danger signals' start doing so and sensations of touch are now experienced as pain.

Spinal Cord



As previously mentioned, the gap between the peripheral nerve and the second nerve travelling to the brain is called a synapse. Inside the synapse there are chemicals called neurotransmitters. These are released by nerves ending in the synapse. The second nerve also has detectors.

- In persistent pain the chemicals linger around the synapse for longer. They also attach a lot easier to the receptors in the second nerve.
- More detectors are laid down in the second nerve too. They also open up for longer, allowing more signals to be sent.

As a result **more danger messages make their way to the brain**. This can occur despite healing having taken place.

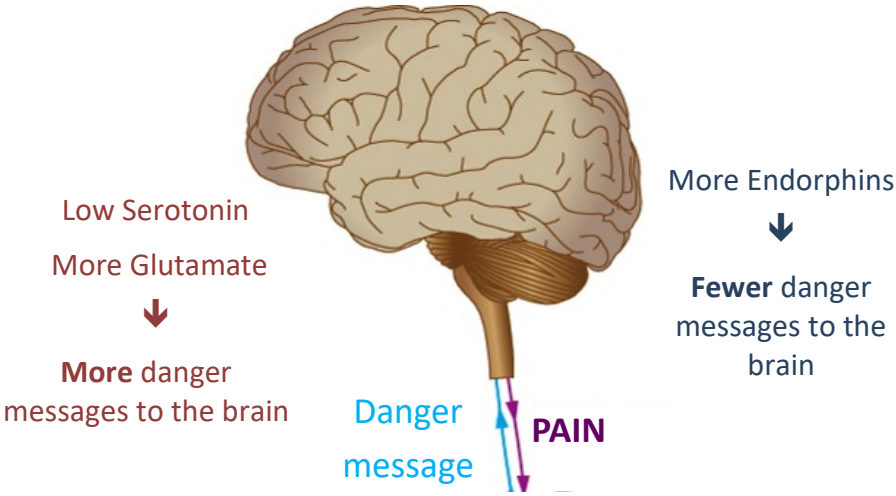
The Brain

Areas of the brain can send signals down to the synapse in the spinal cord. These areas can either increase or decrease the amount of signals being sent to the brain. The brain areas involved are the Periaqueductal grey (PAG) and the Rostral Ventromedial Medulla (RVM). They release chemicals into the synapse. Chemicals such as **serotonin and endorphins can reduce the messages.** Chemicals such as **glutamate can increase the messages**.

Under normal circumstances the brain inhibits signals being sent upwards. In persistent pain, the brain releases chemicals such as glutamate which increase the amount of signals travelling to the brain.

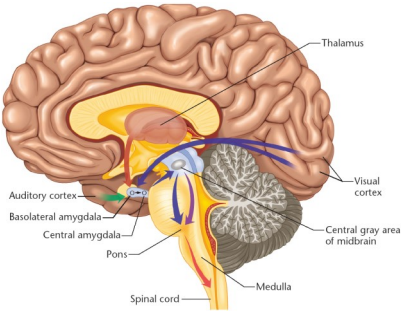
Pain and Mood:

There are certain conditions which can alter the amount of chemicals in the synapse. Depression can result in reduced serotonin. Being in pain is more likely to make you feel low. As a consequence less serotonin is produced and more signals travel to the brain. As a result you may experience more pain, which may cause you to withdraw from meaningful activities. This in turn makes your mood low. You can see how a vicious cycle develops.



The Endocrine System:

The Endocrine system includes the stress control area in the brain. The amygdala is part of this system and is the body's fight and flight centre. It is activated when the brain considers you to be in danger, as in when you are in pain or under stress.



The Amygdala connects to the Rostral Ventromedial Medulla (RVM) and can increase the amount of chemicals in the synapse which increase messages sent to the brain

The stress control area of the brain can also alter cortisol levels in the body.

Systems which are **not needed** for stressful situations are **turned off**. As a result you may experience:

- digestion problems
- sleep disturbance
- poor memory
- Poor healing.

Systems which are **necessary** to cope with danger are **switched on.**

- your heart may beat faster
- you may breathe quicker
- your muscles may become tenser
- over a period time this may cause you to feel exhausted.

The Autonomic Nervous System:

This system releases Adrenalin into the body when you are under stress and/or in pain. When this system is being continually activated the adrenalin starts to sensitise the nerves.

The Muscle System:

When you have had long term pain and stress the big long muscles in the body may become tenser and this can cause you to move and/or hold yourself differently.

The Immune system:

Long term stress and pain leads to more chemicals called cytokines to be released which increases nerve sensitivity. The immune system is also responsible for pain spreading.

The Immune, Endocrine, Autonomic and Neural systems all interact with each other and can increase each other's activity in long term pain conditions

The Sensitised Nervous System

The nervous system has become sensitised and something that might not have hurt starts to hurt and something that may have hurt a bit, starts to hurt a whole lot more. These are signs that the nervous system have changed from responding to a physical injury to a sensitised one.

Other signs that you have a sensitised nervous system are:

1) Pain which spreads and worsens,
2) Movement, even small ones, may now hurt,
3) Pain which becomes less predictable
4) Pain which can be influenced by your mood, being worse on the days where one is more stressed or low.

In a sensitised nervous system, pain can be experienced in the absence of damage

Sensitisation helps to explain why **pain can be present in the absence of damage**. It can also help explain why, even when there is evidence of damage; continued pain does not mean that more damage is occurring.

Persistent pain can best be likened to a burglar alarm system. The alarm is triggered when there is a burglar in the house as in acute pain, but continues to sound even once the burglar has left.

The Myth of Persistent Pain

As we have described persistent pain is less do with on-going or recurrent damage in the body but more to do with unhelpful changes in the nervous system.

Key Messages

1. **Pain is always real**
2. **Pain does not necessarily mean damage or further damage**
3. **Pain is an protective output of the nervous system to perceived danger / threat**
4. **The nervous system becomes sensitised – goes into overdrive and does not switch off after an injury**
5. **There are many things which will influence your experience of pain**
6. **Persistent pain results from real physiological processes**

Understanding Pain Resources

Solent Pain Teams recommend the following resources to help understand persistent pain and its impact. The information in these supports the understanding pain talk given in our introductory Sessions.

YouTube Resources and Websites

- **Brainman, Understanding Pain in Five Minutes**
  https://www.youtube.com/watch?v=5KrUL8tOaQs
- **Understanding the Complexity of Pain:**
  https://www.youtube.com/watch?v=Zv6RPoVZx9M
- **Tame The Beast — It's time to rethink persistent pain:** 5min
  https://www.youtube.com/watch?v=ikUzvSph7Z4
- **Jack with Peter O'Sullivan**:
  https://www.youtube.com/watch?v=j4gmtpdwmrs
- **The mysterious science of pain:**
  https://www.youtube.com/watch?v=eakyDiXX6Uc&feature=youtu.be
- **Lorimer Moseley 'Body in mind - the role of the brain in chronic pain' at Mind & Its Potential 2011:** https://www.youtube.com/watch?v=RYoGXv22G3k
- **The Retrain Pain Foundation:** https://www.retrainpain.org/
- https://www.paintoolkit.org/resources/for-patients
- **10 Facts Every Person should know about back pain. Presented by Patients:** https://www.youtube.com/watch?v=Hif5Cxikdmo&feature=youtu.be&app=desktop
- **Please also see our website:** https://www.solent.nhs.uk/msk/self-help/persistent-pain-management/

Books: Painful Yarns: Metaphors and Stories to Help Understand the Biology of Pain Paperback – Lorimer Moseley
Explain Pain 2nd Edition – 2013 by Lorimer Moseley David Butler

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