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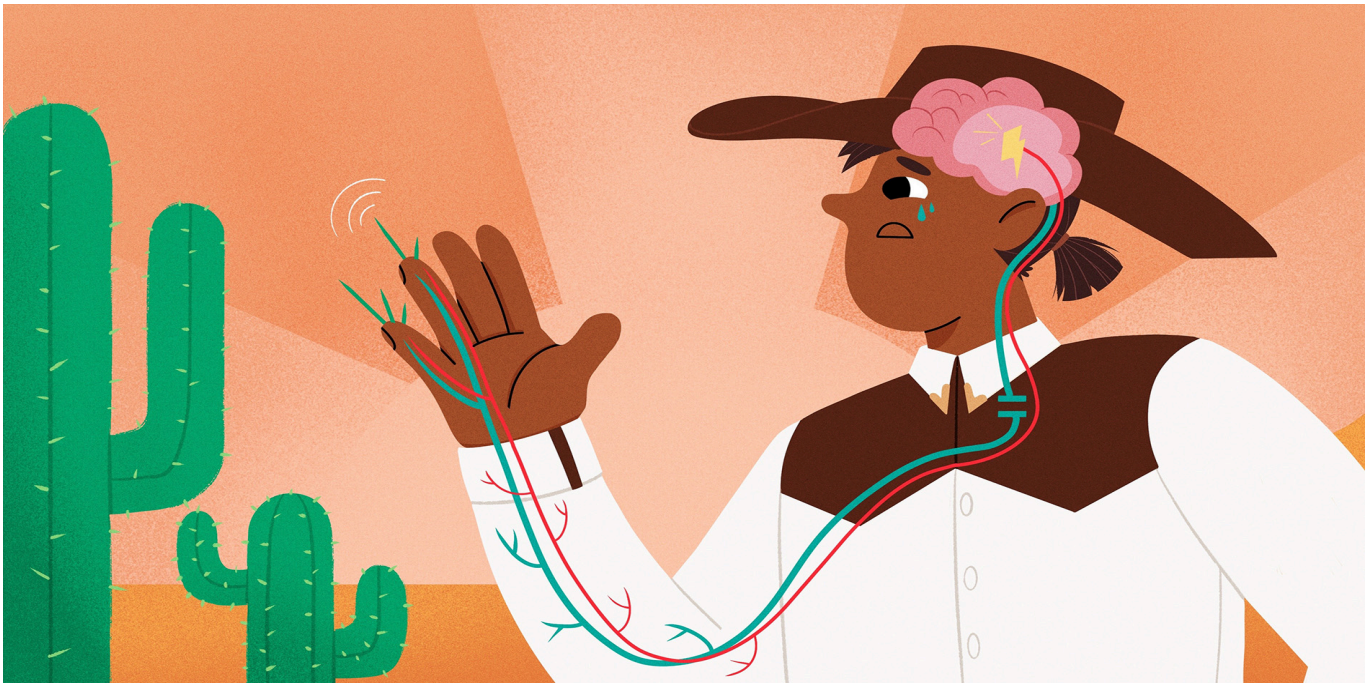

OUCH! WHAT IS PAIN AND WHY DO WE NEED IT?

Giovanna C. Del Sordo[1*] *and Megan H. Papesh*[2]

[1] *Department of Psychology, New Mexico State University, Las Cruces, NM, United States*
[2] *Department of Psychology, University of Massachusetts Lowell, Lowell, MA, United States*

YOUNG REVIEWERS:


AMBER
AGE: 15


JAKE
AGE: 15


SHERRY
AGE: 15

We experience pain almost every day. But what is pain exactly and how does it work? Physical pain is a sensation in the body that hurts or is unpleasant. The sensations of pain you feel work like an alarm, alerting you that something is wrong. Pain signals that a part of your body might have been harmed and that you should take action to prevent more aches. This alarm bell is located in the brain, and pain messages travel from the body to the brain. Some people are born without any sensations of pain. This is very dangerous, as there is no alarm bell telling them that something is not right. This article will explain what happens in the body and in the brain that causes us to feel pain and why it is important to feel pain.

PAIN IS PAINFUL!

Have you ever gotten a paper cut? Or have you ever stubbed your toe on a piece of furniture? What you usually feel immediately after these situations is a pain sensation. Feelings of pain can be described in several ways depending on the type of injury you have. Pain can be

sharp, burning, shooting, or aching, for example. A paper cut can feel like the pain is nagging and throbbing, while a stubbed toe feels like the pain is shooting and aching.

Nobody likes to feel pain! It distracts us from what we are doing, like playing a game or doing homework. And on top of that, sometimes our injuries can take days to heal. However, as annoying and unpleasant as pain can be, it is really important. Pain is the alarm system of your body, which tells you that you have been hurt and that you should take care of your injury right away. Have you ever wondered why a paper cut is painful? Or what is happening inside your body that creates this sensation? Perhaps you have wondered why we need pain at all and what it would be like if you did not feel pain.

HOW DO WE FEEL PHYSICAL PAIN?

When you get a paper cut, the damage to your skin triggers your **nerves** (and more specifically your **sensory nerves**) to send a message to your brain, saying that you are injured. Sensory nerves that are triggered only by pain are called **nociceptors**. There are several kinds of nociceptors that react to different kinds of pain. Some nociceptors only detect pain from high temperature, like touching a hot stove. Others detect pain from damage like a sprained ankle. There are two groups of nociceptors that act differently from each other: A-fibers and C-fibers. A-fibers send pain messages to the brain very quickly, and you feel a very sudden and rapid burst of pain. C-fibers send pain messages much more slowly. For example, A-fibers react when you bump your elbow, and C-fibers react when you have sore muscles. So, separate types of nerves are responsible for the different pain sensations you can feel.

When you bump your elbow, A-fiber nerves send a pain message that travels up the **spinal cord** to several locations in the brain [1]. Each brain location has a specific role that creates how you feel pain: one part is responsible for recognizing the sensation itself, another is responsible for the emotion you might feel (maybe bringing tears to your eyes), while another will be responsible for your reaction to pain (such as rubbing your elbow).

A famous scientific theory, called **Gate Control Theory**, explains how pain messages travel from the elbow, through the spinal cord to the brain, and back to the elbow [2]. Imagine that there is a gate located in your spinal cord, which controls the pain messages that go to your brain. When the gate is open, all the pain messages carried by your A-fiber or C-fiber nerves can enter your brain, and you feel pain. When the gate is closed, most of the pain messages cannot pass and you feel no pain or less pain.

NERVES

Bundles of fibers that act like wires, carrying information between the body and the brain.

SENSORY NERVES

Nerves that are specialized in sending messages from the body to the brain. Other nerves, called motor nerves, send messages from the brain to the body.

NOCICEPTORS

Sensory nerves only responding to pain sensations. There are different types of nociceptors responding to different kinds of pain sensations (such as from a burn or from a sprained ankle).

SPINAL CORD

A pack of nerves that runs from the base of the brain down the center of the back. The spinal cord carries information between the body and the brain.

GATE CONTROL THEORY

Explain how the amount of pain we feel is adjusted through opening and closing of "gates" that are activated by stimulating different types of pain or non-pain nerves.

You might be wondering what controls the gate. When you bump your elbow, a lot of pain messages go from your elbow, open the gate, and rush to your brain, so you feel a lot of pain. But if you rub your elbow right away, you activate other types of nerves, called large-fiber nerves or L-fibers. These nerves are named because of their large size compared to A-fibers and C-fibers. They are activated by non-painful messages such as touch on the skin, vibrations, and movements. L-fibers send non-pain messages to your brain, and help close the gate, so you feel less pain (Figure 1). Other things can help you close the gate when you are feeling pain, like taking medicine or doing physical activity. By understanding how the Gate Control Theory of pain works, you can learn how to reduce your pain and feel better. If we usually want to decrease the pain we feel, does that mean that pain is always a bad thing?

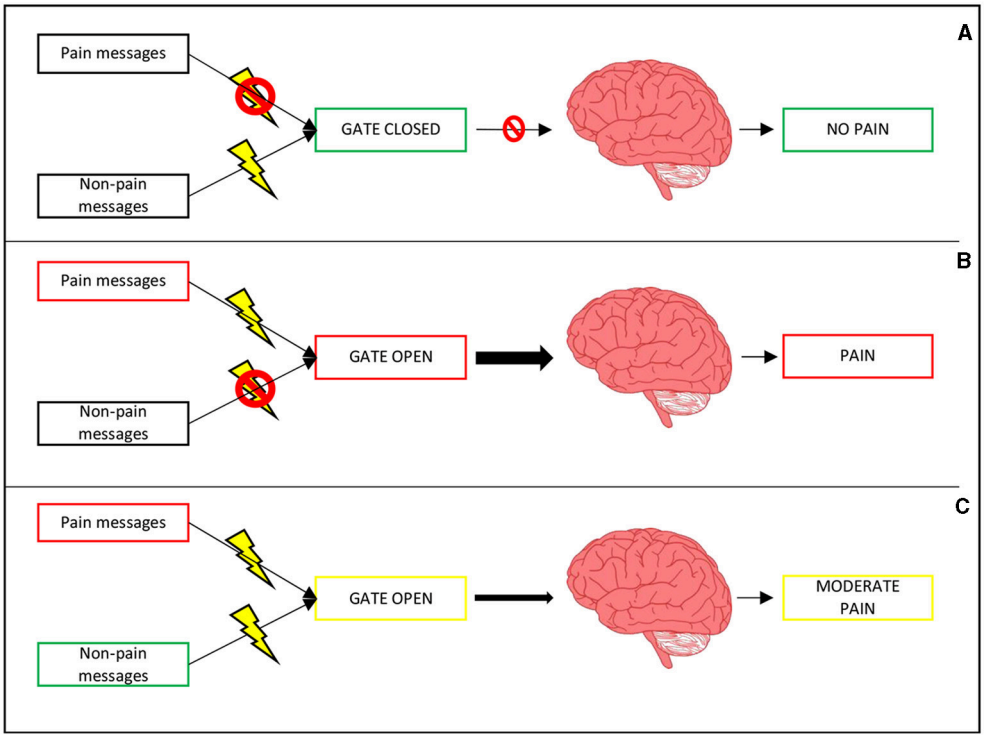

Figure 1

Figure 1

(A) When you are not feeling pain, non-pain (L-fiber) messages (like touch) are sent to the brain, while pain (A- and C-fibers) are not sending signals, so the gate stays closed. **(B)** If you bump your elbow, pain messages are sent to the brain. These pain messages will open the gate and travel to your brain, so you will feel pain. **(C)** If you bump your elbow and quickly rub it, both pain and non-pain messages are sent to the brain. Having both types of messages will partially close the gate, so you will only feel moderate pain sensations.

WHY IS PAIN NECESSARY?

You might remember, when you were little, being in the kitchen while an adult was cooking and being told not to touch the hot stove. At some point, most of us have touched a hot stove by curiosity or accident. Doing so usually feels extremely painful. Although it hurts, this pain sensation is very helpful in our everyday lives. Pain is necessary to quickly alert you that something you are doing is not good for you, so that you stop doing it. In other words, pain prevents you from getting an even worse injury. For example, when you touch the very

hot stove with your hand, you quickly remove it instead of keeping it on the hot stove.

If you have ever been burned by touching a hot stove, you probably never made that mistake again, right? This is another important role of pain: it helps you to learn what to avoid, so you do not get hurt again in the future. Remembering the sensation of your hand getting burned will help you avoid burning it again. Not only will you not touch the hot stove again, but you will probably be more careful around other objects that you know are hot.

Sometimes pain can come from the inside of your body, like when you have a headache or a stomachache. Pain also signals illnesses. A headache or a stomachache is also your body's way of alerting you that something is wrong. For example, when you have the flu, you might have chills and a fever, and your whole body can feel painful. These are the signs that you are sick, and they help you to take action and treat what is wrong in your body. So, when you have the flu, an adult takes you to the doctor, who might give you some medications to fight the flu. If you did not go to the doctor, your illness could become worse, making you even sicker.

Overall, you can imagine pain sensations as the alarm in your body that works hard for your survival, helping you to stay as healthy as possible. But what happens if the alarm is broken?

WHAT WOULD HAPPEN IF WE DID NOT FEEL PAIN?

Have your ever wondered what it would be like if you did not feel any pain? You could touch a hot stove and not feel a burn or get a papercut without experiencing the nagging pain. Not feeling pain might seem like having a superpower, but it is actually very dangerous!

CONGENITAL INSENSITIVITY TO PAIN

A disorder in which people are born without the ability to feel any pain sensations.

Some people are born with the inability to feel any pain sensations. They have a disorder called **congenital insensitivity to pain** (CIP) [3]. People with CIP can put their hands on a hot stove and not feel the burning sensation. The problem is that they would most likely *keep* their hand on the hot stove, and the burn could get really bad. Their bodies do not send pain messages to the brain letting them know that something is wrong and that they should take care of their injuries or illnesses. They lack the alarm bell signaling that they are hurt, sick, or that they should avoid certain situations to stay healthy.

People with CIP do not feel pain sensations because their nociceptors do not function properly. Their nociceptors are underdeveloped which means that they cannot send the pain messages from the body, through the spinal cord, and to the brain. If the pain messages never reach the specific parts of the brain that make sense of pain sensations, it is impossible to feel pain. People with CIP must be extra careful with

their bodies. They must take extra precautions and go to the doctor more often, to make sure that they are in good health.

THINK POSITIVE!

Physical pain is not a pleasant sensation. However, it is something that we all absolutely need to stay healthy, prevent injuries, and get treated when necessary. This alarm system is made up of nerves that constantly relay messages between the body and the brain, to make sure that we know when something is wrong with us. While not feeling pain might seem like a superpower, it can be very dangerous, as we might not even realize that we are hurt. The next time you bump your elbow or get a paper cut, make sure to remember all the positive aspects of pain and how it helps you to protect your body!

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YOUNG REVIEWERS

AMBER, AGE: 15

Hi! My name is Amber, from Hangzhou, China. I am 15 years old now. My greatest interest goes to reading books about psychology and nature. These books open a brand-new world for my mind. I am also a music lover, especially lyrical songs. In my spare time, I love to bake with my family, as these are all romantic things in my life.

JAKE, AGE: 15

Hello! I am an aspiring neuroscientist with an interest in how we perceive the world around us. I am currently a freshmen in high school and love to read and write so Frontiers for Young Minds was the perfect opportunity for me! My hobbies include playing piano, playing tennis, swimming, playing video games with my friends, and running. My ultimate goal is to one day make the world a better place through the work of sciences!

SHERRY, AGE: 15

Hi! I am Sherry and I am going to enter 11th grade. I am into photography, traveling and documentaries. I also love playing badminton and listening to music. I am interested in fun facts related to human body, particularly how it works and its malfunctions. I always like to learn more things about neuroscience and explore more about mental disorders. I hope one day I could help those who suffer from these illnesses.

AUTHORS

GIOVANNA C. DEL SORDO

I am a Ph.D. student at New Mexico State University. I enjoy studying attention, memory, and metacognitive processes (thinking about your own thinking). In my free time, I like to read, go on hikes, and spend time with my friends. *delsordo@nmsu.edu

MEGAN H. PAPESH

Megan H. Papesh is an associate professor at the University of Massachusetts, Lowell. Her laboratory investigates the brain and behavior in many domains, including human memory, face perception, visual search, and attention. She has won several teaching and research awards, including the Rising Star award from the Association for Psychological Science. In her free time, she enjoys spoiling her dogs, spoiling other people's dogs, and hiking.