Why do people have phobias? - A neurobiological perspective

Contents:

1. Problem

Since many people don't understand the difference between fear and a phobia, they think that phobia is needed for survival and don't take any steps to overcome it. Even if they know the difference, they may not know how to overcome a phobia. So people with phobias don't enjoy their life to the full extent.

The first step in solving a problem is to understand why it is caused.

This project addresses all of the above by

- Creating awareness about how a phobia differs from fear
- Explaining why a phobia is caused and what happens in the brain and the body during fear and phobia
- Telling others how to overcome a phobia.

2. Research

What is Fear?

Fear is one of the basic human emotions and helps protect us. It alerts us when there is danger and helps deal with it using the flight, fight or freeze response. Feeling afraid is natural and helpful in many situations. It's programmed into our nervous system and acts like an instinct. One example is when someone is afraid of failing a test, they will most likely prepare for it and do well. Another example is if someone is afraid of becoming obese, they will probably have a healthy lifestyle to avoid it.

What is a Phobia?

A phobia is basically an exaggerated fear. Phobias are anxiety disorders and can interfere with day to day life in a negative way. People mainly have phobias based on a situation, living thing, object or place and they tend to avoid the thing that they are afraid of. If a person with a phobia comes in contact with the thing they are afraid of, they will have an intense reaction to it. For example, if someone has ophidiophobia (phobia of snakes), they might avoid going to the zoo altogether even though the snakes are contained in an enclosed habitat.

What is the Difference Between Fear and a Phobia?

Fear is a rational reaction to a dangerous event or object. Phobias, however, are irrational fears caused by an event or item. While fears help people respond appropriately to danger, phobias can interfere with a person's day to day life. For example, if someone is just afraid of dogs, they may back away from a stray dog. Whereas if someone has cynophobia (phobia of dogs), they may not go to a friend's house just because their friend has a dog.

Fear and other emotions are processed in the brain, specifically in the limbic system.

The Brain:

The brain is like a command center, telling other parts of the body what to do in specific situations. It consists of three sections:

- Forebrain
- Midbrain
- Hindbrain

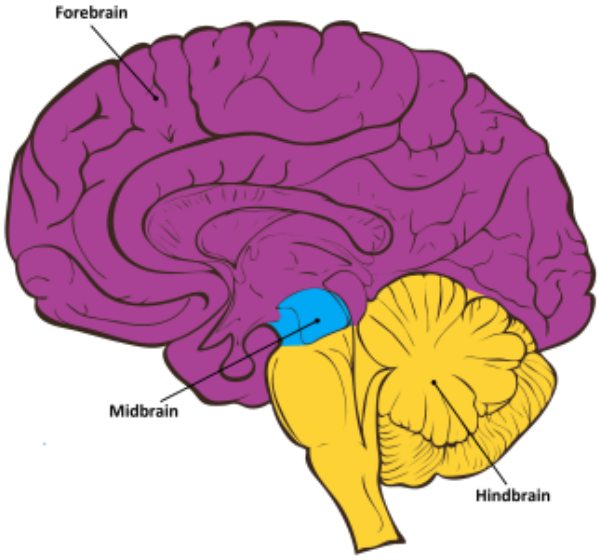


Figure 1 - Sections of a Brain

The forebrain is the largest and most highly developed part of the human brain. It consists primarily of the cerebrum and the structures hidden beneath it called "The Inner Brain". The limbic system is part of the inner brain. Covering the surface of the cerebrum is an important layer of tissue called the cerebral cortex. It is divided into four lobes: frontal, parietal, occipital and temporal.

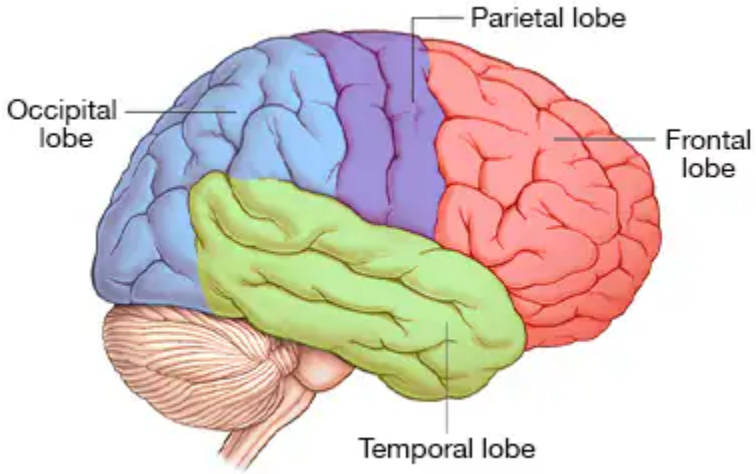


Figure 2 - Lobes of a Brain

- The frontal lobes, which are located in the front of the brain, help control thinking, planning, organizing, problem-solving, short-term memory and movement.
- The parietal lobes, which are in the middle part of the brain, help interpret feeling, taste, texture and temperature.
- The occipital lobes, which are located at the back of the brain, process images from your eyes and connect them to the images stored in your memory allowing you to recognize images.
- The temporal lobes, which are found at either side of the brain, help process information from your senses of smell, taste, sound and also play a role in memory storage.

The Limbic System:

The limbic system is a small group of structures in the brain which control emotions like fear, anger and anxiety. The limbic system is involved in essential survival behaviors including the flight, fight or freeze response.

It consists of four main parts:

- Hippocampus
- Hypothalamus
- Amygdala
- Thalamus

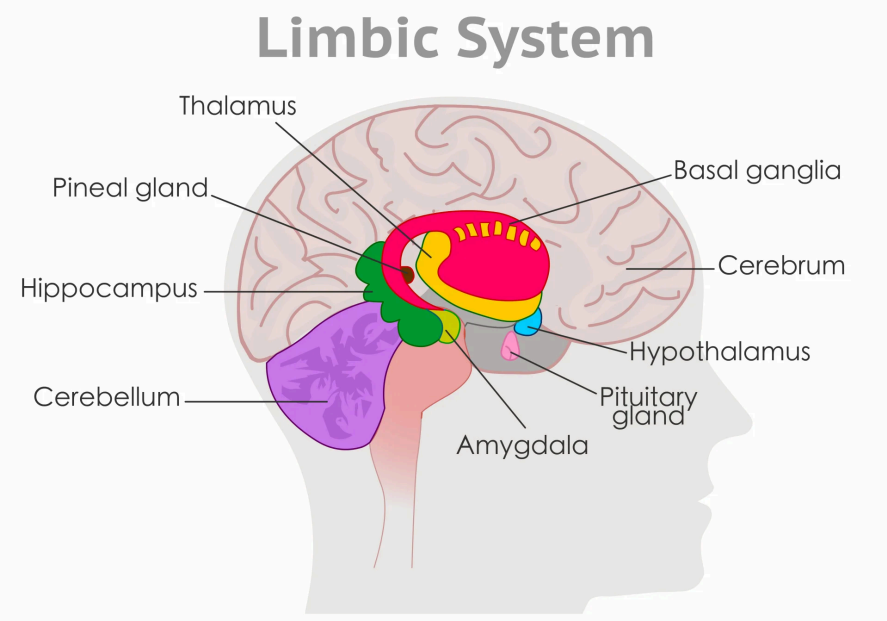


Figure 3 - The Limbic System

The hippocampus plays an important role in forming new memories. It converts your short term memories into long term memories.

The hypothalamus is quite a tiny structure. It regulates the autonomic nervous system, which basically is your flight, fight, freeze response. It also controls the endocrine system, which releases hormones into the bloodstream.

The amygdala plays a role in how you experience anger, violence, fear and anxiety.

The thalamus processes sensory information and "Tells" that information where to go.

What Happens in the Body During Fear?

The amygdala's major role is to detect and respond to a threat. Lets say your eyes see a spider on you. What would happen?

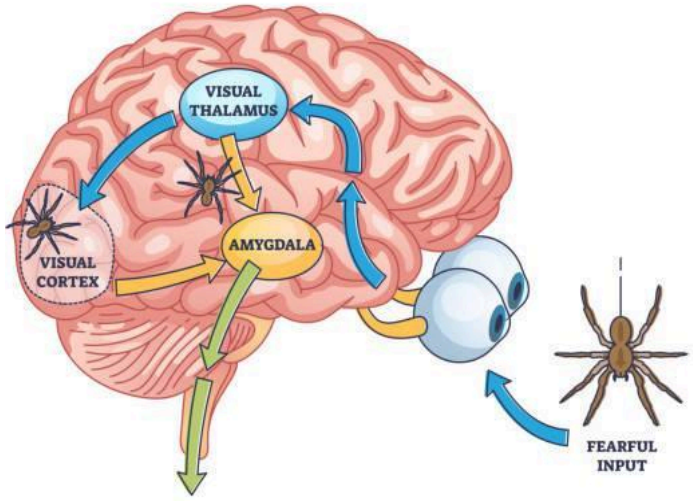


Figure 4a - Fear Circuit

The image goes to your eyes, "Gets a Ride" on the optic nerve and heads to the thalamus, which is located in the brain. From the thalamus, there is a direct pathway ("Low Road") and an indirect pathway ("High Road") to the amygdala.

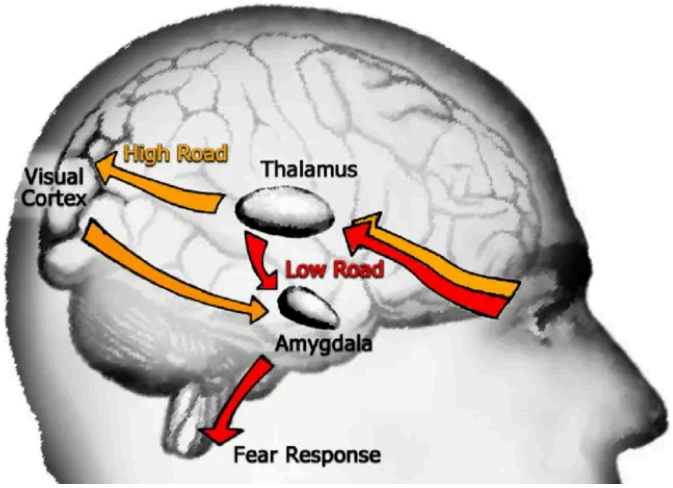


Figure 4b - Fear Circuit

The signal going directly to the amygdala is going on a "Fast Route". Whereas the signal going indirectly to the amygdala on a "Slow Route" takes a longer path via the cortex (Outer part of the brain). Since the signal directly reaches the amygdala first, your body reacts before you know what's happening. The amygdala triggers the hypothalamus, which in turn triggers the pituitary gland, the sympathetic nervous system and the adrenal glands to produce hormones. This response is your flight, fight or freeze response. You sweat, your heart, breathing and blood pressure rates go up, your pupils dilate etc.

In addition to triggering the release of hormones, the threat response also triggers the neurotransmitters, which are molecules that travel from one neuron to another. They can either be inhibitory (Inhibits specific brain signals and slows down the flow of information) or excitatory (Increases specific brain signals and speeds up the flow of information). The main inhibitory neurotransmitter is G.A.B.A (Gamma-aminobutyric acid), whereas glutamate is the main excitatory neurotransmitter. During fear, when G.A.B.A molecules are released, they reduce the activity of the neurons by inhibiting nerve transmissions. This ultimately produces a calming effect. Since glutamate increases fear and G.A.B.A reduces fear, the balance between them is essential for proper fear control.

Fear Conditioning

One of the main reasons for phobias is fear conditioning. We can understand fear conditioning through the concept of classical conditioning.

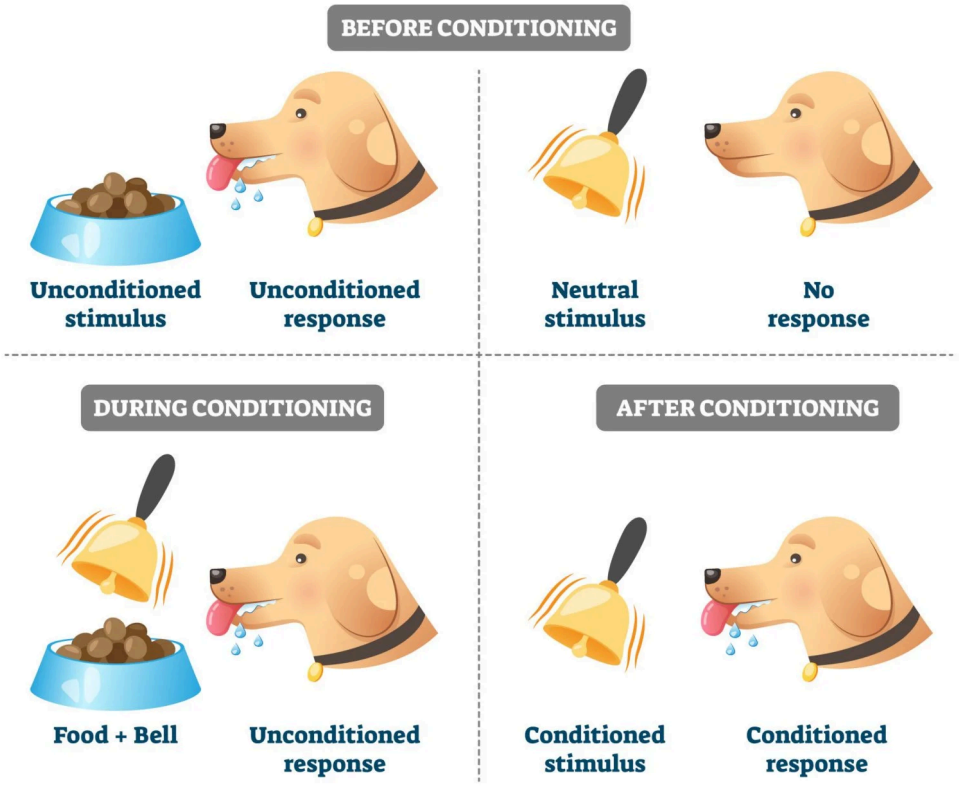


Figure 5 - Classical Conditioning

A dog will salivate if it sees food, but it won't do anything if it hears a bell. If the dog sees food and hears the bell ring at the same time, it will learn to associate the bell sound with food. Eventually, it will start salivating everytime it hears the bell.

Fear conditioning works the same way. If you change the positive aspect (eg. "Food") for a negative aspect (eg. "Electric Shock"), the dog will learn to associate the bell with an electric shock.

What Happens in the Body During a Phobia?

Phobias pop up when there are changes in the signaling of the limbic system as a result of extreme fear conditioning in certain situations. When analyzed through an fMRI (Functional magnetic resonance imaging) or a PET (Positron emission tomography) scan, the brains of the people with phobias have an hyperactive amygdala and/or show more activity than normal in the limbic system.

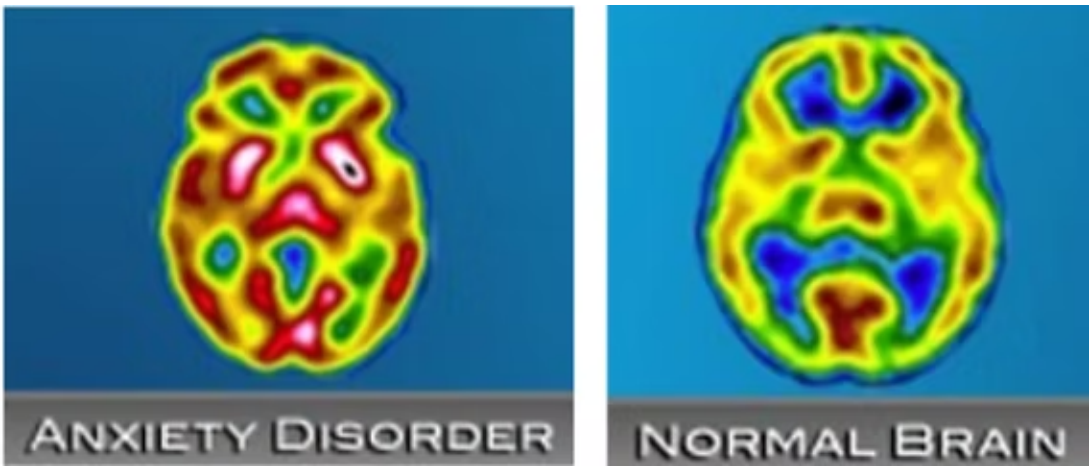


Figure 6 - Brain Scans

This can be due to less G.A.B.A (Inhibitory signaling) or more glutamate (Excitatory signaling) in the brain. In short, it is basically the imbalance of glutamate and G.A.B.A that makes the body have an intense reaction to fear resulting in a phobia.

How to Overcome a Phobia?

Overcoming a phobia seems challenging, but it's actually really simple. The best way to overcome a phobia is by repeatedly exposing yourself to what you fear in a safe way. This is called exposure therapy. Systematic desensitization is a type of exposure therapy. It involves gradually exposing the person to the feared object or situation in a relaxed and controlled way. It consists of three phases:

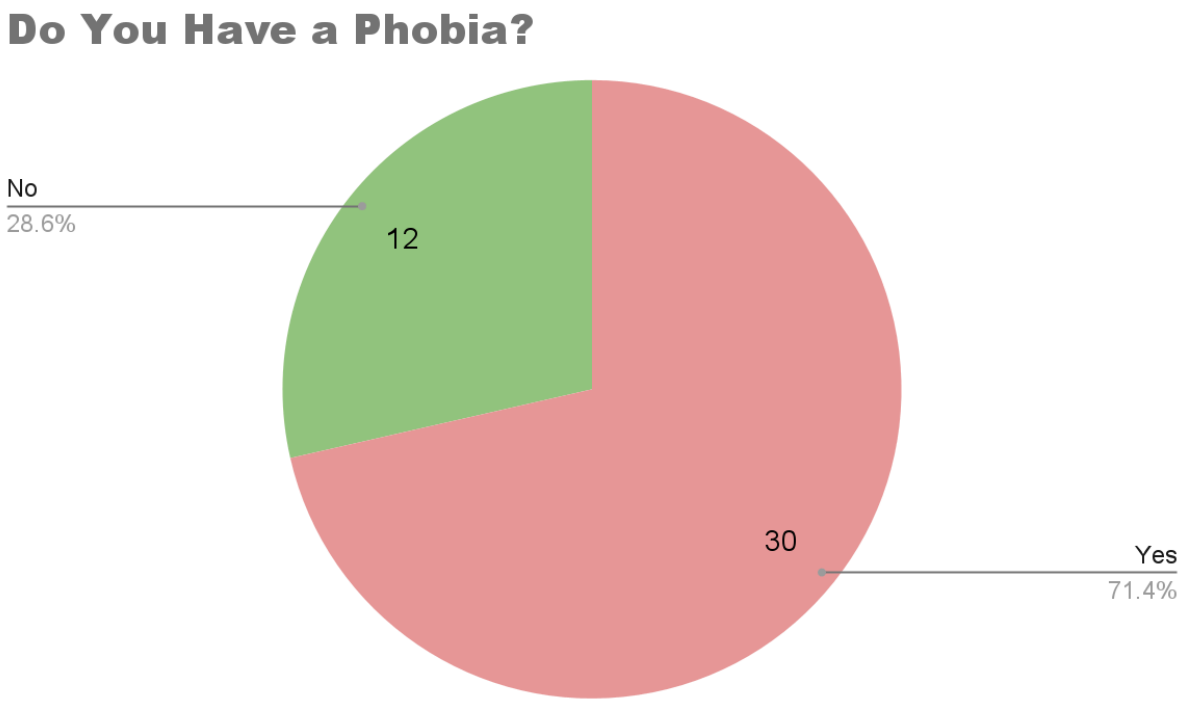
- ★ Relaxation Training: The person learns deep muscle relaxation techniques and breathing exercises to control anxiety and physical reactions to stress.
- ★ Establishment of Anxiety List: The person and their therapist work together to create a list of fear-inducing situations related to the person's phobia, ranking them from least anxiety-provoking to most. For example, if the person is trying to get rid of cynophobia, the list may look like:
    - Step One - Think about a dog.
    - Step Two - Look at dog pictures.
    - Step Three - Watch movies/videos with dogs in them.
    - Step Four - Hold a dog toy or stuffed animal
    - Step Five - Stand near a dog on a leash.
    - Step Six - Stand directly beside a dog on a leash.
    - Step Seven - Pet a dog on a leash.
    - Step Eight - Pet a dog off the leash.
- ★ Gradual Exposure: Starting with the least anxiety-inducing situation, the person is exposed to each item while using relaxation techniques. They move up the list only when they can remain relaxed at the current step. Over time, this exposure in a relaxed state removes the anxiety response to the feared stimulus.

3. Method

To understand how common a phobia is, I conducted an online survey for grades four, five, six students and teachers. My survey included the following questions:

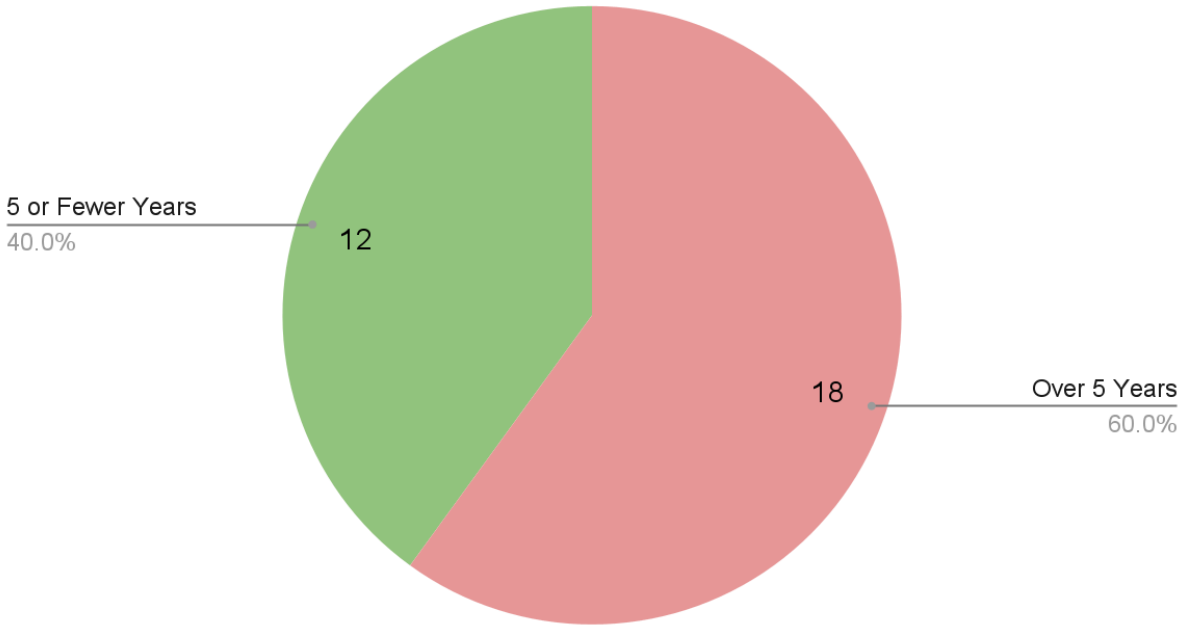
- Do you have a phobia? If yes, what is it?
- If you have a phobia, how long have you had it?
- If you have a phobia, what caused you to start having it?
- Are you willing to get over your phobia?

4. Data



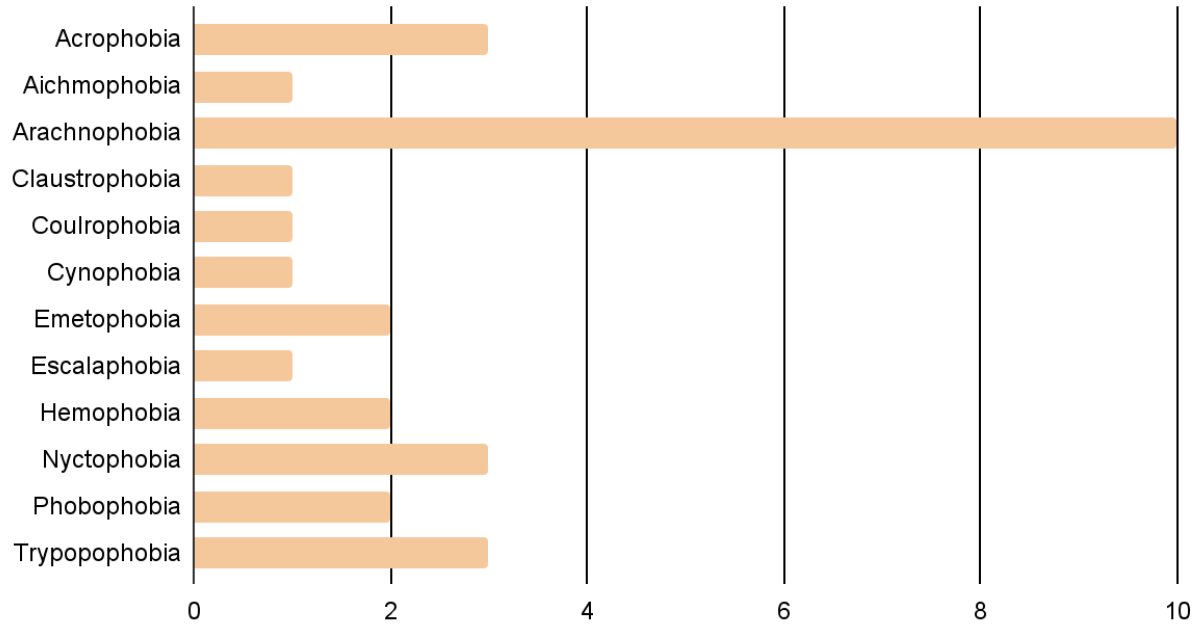
For my survey, I got a total of forty - two responses, out of which thirty have phobias.

How Long Have You Had Your Phobia?



Eighteen people have had their phobia for over five years and the remaining for less than five years.

What Phobia do You Have?



Arachnophobia is the most common phobia with ten responses.

5. Conclusion

In conclusion, extreme fear conditioning (learning to associate something harmless to a frightening event or thing) is the main reason behind many phobias.

First of all, a phobia is quite different from fear. While fear is a rational reaction to something that is actually harmful, a phobia is an irrational fear that can interfere with a person's day to day life in a negative way. The limbic system, which is located in the inner brain, plays a major role in processing fear and other emotions.

Normally, during frightful situations, the excitatory neurotransmitter (glutamate) and the inhibitory neurotransmitter (G.A.B.A.) balance each other out and lead to proper fear control. However, sometimes there may be an imbalance of G.A.B.A. and glutamate due to fear conditioning, resulting in a phobia.

People with phobias constantly feel at danger when they are near or think about what they fear the most, which means they can't live their lives to the fullest. This is where exposure therapy comes in. Gradually exposing people to their feared object or situation is the best way to get rid of their phobia. Taking small baby steps and removing their fear response from the least anxiety-inducing thing to the most, means people can overcome their phobia and enjoy their life and everything it has to offer without too much anxiety.

6. Acknowledgements

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