Learn About ...

THE NOSE FINGER ILLUSION

Try this!

First, please wash or sanitize your hands. Then proceed with *Part 1* of the experiment.

Part 1: Take the index finger and middle finger of one hand, and touch your nose as shown in (A), with one fingertip on each side of your nose. Now, stroke your nose up and down, from its tip to its bridge, repeatedly with the two fingers. **How does your nose feel to your fingers?** Try the experiment again, but with your eyes closed, so that you can focus better on the sensation of touch. You might also try the experiment by running your fingers along the outside edges of a pencil, instead of your nose. Remember the sensations you just felt as you do *Part 2* of the experiment.

Part 2: Cross the same two fingers (you may have to use your other hand to help), and press the inside of these two fingertips against the tip of your nose (or pencil), as shown in (B). Close your eyes and stroke your nose again as you did before in *Part 1*. **What did you feel with your fingers this time? How many noses (or pencils) did you feel?**

Many people report feeling two noses with their crossed fingers! This feeling of two noses is called a **perceptual disjunction**, which means that you perceive something different than reality. Some people do not feel two noses, but still feel a distinct difference in *sensation* between the two parts of the experiment. In this experiment, the perceptual disjunction occurs because your brain does not account for your fingers being crossed. While looking at your hand without your fingers crossed, notice the opposite, exterior sides of your index and middle fingers. These two surfaces regularly only feel pressure simultaneously when they are in contact with two different objects. Therefore, your brain interprets your nose as two noses when your fingers are crossed, because it fills in information from

previous experiences. **But how are you able to feel your nose with your fingers, anyway? How does *touch* work?**

How do you feel? Literally, *how* do you feel? Touch, a type of **somatosensation** (*somato*, a prefix meaning "body"), is one of the senses we employ for exploring and collecting information about the world around us. This information tells us how to control our bodies, navigate our surroundings, and directly influence our environments. We also use touch to communicate important information and emotions with one another. Touch seems to play many useful roles in our lives! It is also very important from a clinical perspective and is still an active area of scientific research.

The sensation of touch starts through the triggering of receptors embedded in our skin. These receptors generate electrical signals, which are then sent to our brain. In our brain, these signals are processed and combined with additional information to result in a **perception** of the world around us. Keep on reading for details on how this amazing process works.

Your skin: Do you know what the biggest organ in the body is? If you said, "the skin," then you're correct! The skin is a remarkable organ, with specialized sensors for pressure, temperature, itch, and pain. Our skin protects our bodies from the environment by insulating us from temperature changes, shielding us from abrasion, and protecting us from harmful bacteria and fungi. Our skin also excretes waste, facilitates vitamin D_3 production, and allows for both everyday movements and changes in body structure over our lifetimes.

The skin is composed of three primary layers. The **epidermis** (*epi*, a prefix meaning "on top of," and *dermis*, meaning "skin") is the outermost layer, protecting us from the outside world by waterproofing us, providing protection against biological invaders, and shielding us from the sun's ultraviolet radiation. The middle layer of skin, the **dermis**, contains somatosensory receptors for pressure, temperature, itch, and pain. In addition, the dermis comprises the architectural elements for the skin's structural support and hair follicles. The dermis also contains blood vessels, which provide necessary nutrients for skin cells. The **hypodermis** (*hypo*, a prefix meaning "under"), our deepest layer of skin, uses fatty tissue to

pad our internal organs against shock and regulate our body temperature. In addition, the hypodermis connects our skin to our internal organs and the rest of our body.

In the touch experiment above, **pressure sensors** in the skin of your fingers are activated when you touch your nose (or the pencil). These sensors convert pressure into electrical signals to be processed by your brain. How do these signals get to your brain, and what happens to them once they've arrived?

Your nervous system: When the pressure sensors in your skin are activated, they generate **electrical potentials** (voltages). These potentials are then encoded into electrical signals that travel along your **neurons** (*neuro*, meaning "nerve"). When the signals reach the end of a neuron, they jump to the next neuron using chemicals called **neurotransmitters**. The signals, which originate from all over your body, travel through long chains of neurons from your skin to your spinal cord, and then on to your brain. They contain a wealth of information, including the type of sensation you are experiencing (such as pressure, pain, itch, or temperature), the location of the sensation on your body, the intensity of the sensation, and how long the sensation lasts. Various areas of the brain process all this information, resulting in a **perception** of the world around us. We then use this perception to aid our immediate decision making, and to make memories that might be useful in the future. How are these perceptions created, and how do we use them?

Your perception: Although our brain initially processes touch signals spatially according to where they were generated on the body, these signals do not remain separated, but are combined with our other senses (sight, smell, taste, and hearing) to provide a unified, multimodal perception of the world. Our brains also incorporate **memories** of past experiences to create these perceptions. This combining of multiple senses with our unique previous experiences means that we each may *perceive* the same experience differently.

Why does it matter? We use touch to manipulate our environments. Take throwing a baseball, for example. When you throw a baseball, your brain uses the sensory data from touch as **feedback** to inform your motor control to help you throw the baseball. Similarly, touch is integrated with visual information and sensory data from our vestibular system (the inner ear) to help with **balance** and **posture**, allowing us to stand, walk, run, and jump. Touch feedback may also be used for a variety of artistic purposes, such as playing piano, holding a paintbrush, or interpretive dancing!

Understanding touch is important for many other purposes, such as clinical treatments. For example, when eye injuries result in blindness, brain regions formerly used to perceive sight can adapt to support touch neurons from the fingers when reading braille. Such adaptation within the brain, which can occur for touch or any of the other senses, is known as **neural plasticity**. Neural plasticity plays a role in recovery from injuries to the brain such as strokes.

Touch also plays a key role in communication. When you meet someone new, do you hug them? Do you shake their hand? Does this differ from how you greet a close friend or family member? If you hug them, how long do you hug them? Is the hug duration the same for everyone? You can find a lot of meaning in communication through touch. This importance is evident in our language: have you ever called something that rouses your emotions "touching"? Or a tricky subject "touchy"? Or described something difficult as "hard," even though it is not actually a physically hard object? Because it is so fundamental to our understanding of and interaction with the world, touch impacts many facets of our lives, including the words we use.

Touch is an important sense that we use to keep ourselves safe from dangers, to control our body, to communicate with others, and to gather information about the world around us.

Further Exploration! For the next few days, consider the following questions:

- ✓ How are you using touch to **understand** the world around you?
- ✓ How are you using touch to **communicate** with other people around you?
- ✓ How is your brain integrating touch with your other senses to **perceive** your environment?

Please try our Home Experiment, The Size-Weight Illusion

References:

1. *Principles of neural science*. (2013). (E. R. Kandel, J. H. Schwartz, T. M. Jesell, S. A. Siegelbaum, & A. J. Hudspeth Eds. 5th ed.). New York: McGraw-Hill Medical.
2. Bear, M. F., Connors, B. W., & Paradiso, M. A. (2015). *Neuroscience: Exploring the Brain* (4th ed.). Philadelphia: Wolters Kluwer.