

## My Secret Role in True Happiness: A Story of a Neuron

### Mallory Burney

Department of Biology  
Lake Forest College  
Lake Forest, Illinois 60045

I have the power to control every single thing you will ever do. You may think you maneuver your thoughts, actions, and emotions, but in reality my neighbors and I are behind all the aspects that make you who you are. I am one of the most exceptional cells found in the human body. Unlike other cells, I have some unusual features that allow me to communicate with my neighbors. I have dendrites that extend like branches from my body and allow me to receive important messages. I decipher these messages in my cell body and send it down my axon. My axon is like a wire, allowing me to send signals over long distances to my terminal buttons, where I release chemicals called neurotransmitters to my next neighbor through a process called action potential. I am a neuron.

My creation began from an original stem cell, which was produced from a collection of cells called an embryonic disk. The stem cell eventually developed into precursor cells for neurons. My precursor cell then produced what is called a neuroblast, or a neuron with an unknown fate. It was at this point in my life that I had to figure out what my role inside of Lucy, my human's, brain was supposed to be. To begin this process, I migrated to Lucy's frontal cortex by following a road that was laid out for me called a radial glial cell. I would reside here for the rest of my life. My journey to Lucy's cortex was incredibly difficult and dangerous. I was forced to watch the majority of the neurons traveling around me die. When I finally reached my destination, I was incredibly relieved as I knew only one in every three neurons survives this treacherous journey.

I immediately knew that my fate was to be a glutamate neuron, one that receives the neurotransmitter dopamine, once I arrived in the cortex. Using this knowledge, I connected with a dopamine neuron that lived all the way in Lucy's midbrain. I was astounded by the length of his axon, and maybe even a little jealous. However, we eventually became close friends as we found a perfect balance between sending and receiving dopamine. I soon collected a vast network with my neighboring neurons. But, just when I began to feel comfortable in my new home, I noticed that my connections with some of my neighbors were becoming weaker. It soon became clear that Lucy wasn't using these neurons, and as a result they began to die off. Watching my neighbors die was a difficult and sometimes terrifying experience. Nevertheless, I was constantly assured that Lucy needed me by the fact that my connections with other neurons continued to strengthen.

As Lucy entered adolescence, her emotional circuits went haywire. But I tried my best to keep everything as regulated and stable as possible. I suppose it was difficult for Lucy to deal with all of the changes in her brain because one day something incredible happened. Out of nowhere, the dopamine neuron that I was connected to released a tremendous amount of neurotransmitters. I was further shocked when the dopamine cell did not take back some of the dopamine released in process known as reuptake. Then the realization hit me: Lucy had used the drug cocaine. When my neighbor didn't take back some of the dopamine he released, it caused an increase of dopamine in our synapse, or the space between his terminal button and my

dendrite. I felt my behavior become erratic, and before I knew it, I didn't have any control over my actions.

The dopamine bursts continued time after time, and after a while, I began to feel overwhelmed. The amount of dopamine released was so intense I searched for any way I could make the surges of dopamine stop. Finally, I figured it out! As the dopamine continued coming, I sucked in several of my dopamine receptors so the amount of dopamine I took in would be reduced. Oh the relief! Finally the constant bombardment quieted.

This solution worked for a little while, and I was able to function almost normally. But then, something happened that I couldn't believe. The neuron I was connected to released an even more exuberant amount of dopamine! I knew immediately that Lucy must have upped her dosage of cocaine. I felt a sinking feeling, as I knew her behavior from this point would only worsen. Again, constant noise of the dopamine became deafening and when I couldn't stand the noise any longer, I had no choice but to close even more receptors.

Over time, this became a terrible cycle of destruction throughout Lucy's entire brain and body. Every time she abused cocaine other parts of her body such as her heart would react as well. One day, when Lucy was at an incredibly high dosage, my neighbors and I could tell that her heart rate had increased to a point where she nearly died. I was terrified for her. Despite the challenges Lucy had put me through, I was still committed to doing the best I could to make her happy and keep in balance.

To my delight, this near death experience seemed to trigger a desire within Lucy to stop using drugs. Soon after the incident, Lucy stopped ingesting cocaine and the release of dopamine from my neighbor stopped. At first, I was elated that the constant overstimulation I had been feeling for years ceased. However, I soon began to feel an ache for the neurotransmitter. What small amount of dopamine I did receive was nearly impossible for me to take in because I had already closed so many of my dopamine receptors. Soon, I was starving. My desire to end the constant berate of dopamine turned into an intense and painful need for the neurotransmitter. Lucy was going through withdrawal and the only way I could think to save her and myself was to re-extend the dopamine transmitters I had pulled into myself earlier. This was an incredibly slow and difficult process, but after time had passed, I found myself feeling better as I was able to take in slightly larger amounts of dopamine. Soon, my neighbor, the dopamine neuron, began to adapt to the changes in Lucy's brain as well and release more and more dopamine. Together, we began to recover. Slowly I returned to homeostasis, or the natural state I was in before Lucy began her drug use.

Lucy is now in her late twenties and she is beginning to do all the things she always dreamed she could do. The realization of her dreams is what causes my neighbor to release dopamine and I am able to absorb just the right amount. Although the road to recovery was challenging for Lucy and her brain, it is now more rewarding than ever to play what small role I have in making Lucy truly happy.

*Note: Eukaryon is published by students at Lake Forest College, who are solely responsible for its content. The views expressed in Eukaryon do not necessarily reflect those of the College. Articles published within Eukaryon should not be cited in bibliographies. Material contained herein should be treated as personal communication and should be cited as such only with the consent of the author.*

\*This author wrote the paper as a part of BIOL 130 under the direction of Dr. DebBurman