God's Omniscience

Lesson 3

Biology: Neuroscience and holiness

You shall be holy, for I the LORD your God am holy.
Leviticus 19:2 (NASB)

Introduction

Have you ever wondered how your brain works? Most of us have had the experience of forgetting someone's name just as we encounter him in a public setting. Later that same evening, or even a couple of days later, while engaged in some other activity we will spontaneously remember the person's name. How does that happen? How is it that our brain let us down in the first case and why did our brain give us the name in the second case? Or maybe you have had the experience of forgetting why you walked into a specific room, or remembering very specific details of experiences from your childhood. Our brains are not always this unpredictable though. Most of the time we remember and use an incredible amount of information stored in our brains. Just think about all of your capabilities, from sustaining a conversation to reading this essay, and from assembling a whole from pieces (cooking a meal, sewing a dress, rebuilding a motor, building a computer, etc.) to driving. God has created an astonishingly complex organ in our brain.

Brain research is a fascinating and growing field of study within neuroscience: n*euro* means nerve. The brain of a newborn baby contains around 100 billion neurons, (Williams and Herrup, 2001), which are what we call nerve cells, and we lose neurons after birth at a rate of about 200,000 per day (Best, n.d.). When you poke your finger with a needle you activate neurons in your finger that communicate with neurons in your spine that communicate with neurons in your brain – Ouch! Neuroscience has been around a long time. Thomas Willis, who lived from 1621 to 1675, is considered the founder of clinical neuroscience (Molná, 2004), but scientific studies of the brain had been published at least a century before Willis. In spite of this long history of study we still do not fully understand how the brain works, but we are making tremendous progress in our understanding.

> *Whatever is true, whatever is noble, whatever is right, whatever is pure, whatever is lovely, whatever is admirable—if anything is excellent or praiseworthy—think about such things.*
> Philippians 4:8 (NIV)

Have you ever wondered why in Philippians 4:8 God instructs us to think about good things? There are certainly many reasons we could list in answering that question. But is it possible that one of those reasons is the way God created our brains to function? Modern neuroscience is shedding some light on this idea.

Neuroscience

Neurons

Open your encyclopedia or any biology textbook, or visit any website on the nervous system and you are likely to see a drawing of a neuron (nerve cell) like the one in image 1.

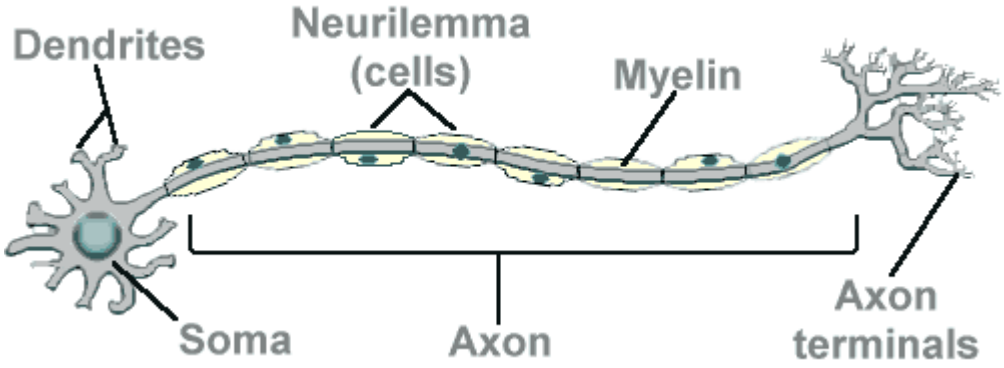

Image 1: Neuron (Sandhills, n.d.)

Remember that your brain has around 100 billion of these neurons. 100 billion is 100 times 10^9 or 100,000,000,000. If you had 100 billion crayons stacked end-to-end they would reach the moon and back 12 times or circle the equator 240 times or fill 1,730 Olympic sized swimming pools (NetScrap, n.d.). One-hundred billion is a lot of neurons. Now consider these two fascinating facts: neurons are stacked end-to-end in the brain but they do not touch one another (Biggs, et al., 2002); neurons begin to form about 42 days after conception and over the next 120 days 100 billion neurons form at a rate of 580,000 per minute (Bruer, 1999).

Neurons are communication devices. Every neuron forms connections with thousands of other neurons and cells (Best, n.d.). Remember that neurons do not touch other neurons. The connections that neurons make exist across the open space, called a synapse, between neurons. Within each neuron the dendrite receives signals and the axon terminals send out signals. The passing of signals among neurons includes both an electrochemical and a chemical process. The electrochemical process within a neuron produces a very small voltage that travels down the axon. When this voltage reaches the axon terminals they release chemicals called neurotransmitters that travel to neighboring neurons' dendrites. The neurotransmitters received by a neuron's dendrite will in turn initiate the electrochemical process and continue the communication process. But neurons do not pass on every signal they receive. Every neuron has a threshold level. If the neurotransmitters cause the neuron to generate a voltage above the threshold level then the neuron will pass the signal on to other neurons. If the voltage is below the threshold level then the neuron will not pass the signal on to other neurons. We call the connections between neurons synapses after the name of the gap between the neurons.

As simple as that may sound, understanding how neurons work and translating that knowledge into an understanding of how you and I think and learn are two very different problems.

Thinking and Learning

To understand thinking and learning we must have a way of evaluating the brain as a whole unit rather than just looking at the function of one neuron. Considering the brain as a single organ leads to a number of difficult questions. How do 100 billion neurons work together to give me someone's name? Where was the name to begin with? How did it get there? Why could I not access the name when I encountered the person? What was going on inside my brain, among all those neurons, that resulted in me spontaneously remembering the name several hours after I needed it? As you can see, these are very difficult questions: questions for which science is not yet fully prepared to answer. But we are making progress in our search for answers to these questions.

Much of our progress in understanding how the brain works comes from neuroimaging. Neuroimaging involves making images of the brain as it performs different tasks. The imaging tools used for neuroimaging make an alphabet soup, but you have probably heard of several of the tools by their abbreviation: electro-encephalography (EEG), magnetoencephalography (MEG), positron emission tomography (PET), single photon emission computed tomography (SPECT), computerized tomography (CAT), magnetic resonance imaging (MRI) (LONI, 2006).

Neuro imaging has revealed to us that there are two major areas of the brain; "There is a part for receiving, remembering, and integrating information that comes from the outside. And there is a second part for acting, modifying, creating, and controlling" (Zull, 2002, p.34). In general the receiving portion corresponds with the back of the brain and the acting portion with the front of the brain. The front and back portions of our brain are wired together with a super-highway of nerve bundles, called fasiculi, that permit our brain to function as a single organ.

When you or I learn something we engage both parts of our brain, first by using the back part of our brain to receive an input such as an idea or image through some concrete experience and then by using the front part of our brain to create our own ideas and actions that are based on the input (Zull, 2002). This operating of the brain as a whole unit is directly linked with the neurons because both systems are required for learning. As the brain's back and front sections are communicating, individual neurons in each section are growing new synapses (connections with other neurons) and forming new networks of neurons.

"It seems that every fact we know, every idea we understand, and every action we take has the form of a network of neurons in our brain. We know of no other form" (Zull, 2002, p.99). "If [our] knowledge is to grow, the neuronal networks must physically change" (Zull, p. 112). Thus learning, regardless of whatever else it may involve, is physical because learning involves neurons growing new synapses. When you learn something your brain changes, you change.

The growth of synapses and networks of neurons are guided by two criteria (Zull, 2002).

1. How much the synapses are used
2. How important the signals are

Growth of synapses based on use is much like the growth of muscles. Our muscles are strengthened and grow based on their use. Think of the weight lifter with

large biceps or the runner with muscular legs. Your neurons with their synapses work in the same way. Experiments have shown that our experiences—what we see, hear and participate in—change the activity of our neurons causing synapses to grow. "Neurons that are repeatedly used grow stronger synapses and more effective neuronal networks" (Zull, 2002, p.117).

To understand growth of synapses based on the importance of the signal consider your ability to carry on a conversation at a potluck. There is a lot of communication going on all around you, but you are focused on your conversation with one or two other people. Your conversation can be interrupted if you recognize that new input is as important or more important than your current conversation such as when someone starts talking on the public address system, your child screams in pain, or a passerby greets you. All of these examples will cause you to pause, even if only temporarily, your current conversation and engage the new input. Thus, these examples illustrate important signals. On the other hand some signals are not as important, the best example being the other conversations going on all around you. Neurons function in a similar fashion. Just like your ability to select which input or conversation to pay attention to, neurons will only fire (send out signals) if their incoming signal generates a voltage that reaches their threshold level.

Another facet to the growth of synapses based on the importance of the signal is emotions, such as fear, joy, and surprise. Emotions aid our neurons in picking up on signals that might be below their threshold level because emotions release a chemical into our brains that "increase[s] the responsiveness of existing synapses…so that neurons produce stronger, more numerous synapses" (Zull, 2002, p. 225).

Holiness

> *Whatever is true, whatever is noble, whatever is right, whatever is pure, whatever is lovely, whatever is admirable—if anything is excellent or praiseworthy—think about such things.*
>
> Philippians 4:8 (NIV)

So why did God give us this instruction? Based on neuroscience we know that our brain changes when we think and learn. If you think on true, noble, right, pure, lovely, admirable, excellent, and praiseworthy things our networks of neurons associated with these things will change. You will grow and strengthen the appropriate synapses. You will change. *Following God's command will physically change you.* Strong synapses and networks of neurons related to true, noble, right, pure, lovely, admirable, excellent and praiseworthy things will allow you to act in these ways as well because we know the brain formulates action as well as receives input via the coordinated efforts of the front and back half of the brain.

Unfortunately, the opposite is true as well. If you focus on hatred, impurity, jealousy, selfish ambition, dissension, etc. (Galatians 5:19-21) you will grow more synapses and strengthen the networks of neurons associated with these sinful things and you will increase your ability to respond and act in these ways. This is a recipe for disaster because "those who practice such things will not inherit the kingdom of God"

(Galatians 5:21, NASB). Fortunately, God provides a way of escape through salvation and the indwelling Holy Spirit. And neuroscience informs us that you can strengthen the good networks of neurons by beginning to use them today and over time your good networks of neurons, your good thoughts and your good actions will outperform your bad ones.

- We are to love God with all of our mind (Matthew 22:37)
- Sin has resulted in futile thinking and a depraved mind (Romans 1: 18-32)
- Paul used his mind to fight against sinful desires (Romans 7:21-24)
- Spirit living requires setting our minds on things of the Spirit (Romans 8:5-8)
- We are transformed by the renewing of our minds (Romans 12:2)
- Think with sober judgment when evaluating yourself (Romans 12:3)
- Do not think about how to gratify the desires of the sinful nature (Romans 13:14)
- Prayer and worship are not only spiritual, they are also mental (1 Corinthians 14:15)
- Satan has blinded the minds of unbelievers (2 Corinthians 4:4)
- We are to guard our belief with our minds (2 Corinthians 11:3)
- Our thinking and acting should reflect our relationship with God (Ephesians 4:17-32)
- The focus of our mind can make us an enemy of the cross of Christ (Philippians 3:17-21)
- God's peace guards our minds (Philippians 4:7)
- We are to think on good things (Philippians 4:8)
- An unspiritual mind can make us narcissistic (Colossians 2:18)
- We are to set our minds on things above, not on earthly things (Colossians 3:2)
- Truth and a corrupt mind do not coincide together (1 Timothy 6:5; 2 Timothy 3:8)
- Purity and a corrupt mind do not coincide together (Titus 1:15)
- In the new covenant God puts his laws in our minds (Hebrews 8:7-13; 10:16)
- We are to prepare our minds for action (1 Peter 1:13)
- We are to be holy because God is holy (1 Peter 1:16)
- Peter wrote both letters (1st and 2nd Peter) to stimulate the reader to wholesome thinking (2 Peter 3:1)
- Christ searches our minds (Revelation 2:23)

References

Best, B. (n.d.). *The anatomical basis of mind*. Retrieved August 3, 2006, from http://www.benbest.com/science/anatmind/anatmind.html.

Biggs, A., Gregg, K., Hagins, W.C., Kapicka, C., Lundgren, L., & Rillero, P. (2002). *Biology: The dynamics of life.* Glencoe/McGraw-Hill.

Bruer, J.T. (1999). Neural connections: Some you use, some you lose. *Phi Delta Kappan, 81*(4), 264-277.

LONI (2006). History of Neuro Imaging. Laboratory of Neuro Imaging, University of Southern California. Retrieved August 3, 2006, from http://www.loni.ucla.edu/Research/Timeline.shtml

Molnár, Z. (2004). Thomas Willis (1621-1675), the founder of clinical neuroscience. *Nature Reviews Neuroscience, 5*(4), 239-335. Retrieved August 3, 2006, from http://www.nature.com/cgi-taf/DynaPage.taf?file=/nrn/journal/v5/n4/full/nrn1369_fs.html

NASB (1977). *New American Standard Bible*. The Lockman Foundation, La Habra, California.

NetScrap (n.d.) Crayola…100 billion served. Retrieved August 3, 2006, from http://www.netscrap.com/netscrap_detail.cfm?scrap_id=70

NIV (1984). *The Holy Bible, New International Version.* International Bible Society.

Sandhills Community College (n.d.). Neuron structure and function. Retrieved August 3, 2006, from http://normandy.sandhills.cc.nc.us/psy150/neuron.html.

Williams, R.W. & Herrup, K. (2001). The control of neuron number. Originally published in *The Annual Review of Neuroscience 11*, 423-453 (1998). Retrieved August 3, 2006, from http://www.nervenet.org/papers/NUMBER_REV_1988.html

Zull, J.E. (2002). *The art of changing the brain: Enriching the practice of teaching by exploring the biology of learning.* Sterling, Virginia: Stylus.