Introduction

Why do we, as humans, do what we do? This question has many answers and for years scientists and writers, philosophers and lovers, as well as many others have tried to answer this question from a number of different perspectives. Although many answers have been proposed, there has never been one definitive answer. That there is no one clear answer is frightening to many, including myself. If there is no reason for what we do, then is there a point? Is there a point to *any* of my actions? If not, then why am I here? Why are any of us here? A simple answer to this question is impossible. But, if one looks at it from a certain perspective, through a certain lens, maybe, just maybe, one can find some insight into why humans do what they do.

In my freshman year of high school, I hit a major roadblock of depression and anxiety. I began to have panic attacks trying to juggle all my schoolwork, sports and extracurricular activities. I would tell myself in my head "You can do it!" and "Be strong!" but inevitably I would end up in tears. My depression came from my anxiety, and I began to worry about who my real friends were. My mind would burn with questions, like why isn't anyone else feeling this way and, more importantly, why am *I* feeling this way? My curiosity led me to learn about depression and how common it is in teens, especially teenage girls. I thought about emotions and how certain aspects of life trigger them. These triggers, for me, were things such as the stress of school, pressures of social life, etc. I discovered that I was experiencing those feelings because I was not dealing with my emotions properly and that, more importantly, I was putting too much pressure on myself. Once I realized this, and stopped being so hard on myself, I found that I had learned a lot about myself and my emotions, but then another question arose in my mind. How are emotions produced within the human body?

My research started with the most basic question: what are emotions? Emotions are short-lived feelings, but they can develop into moods, which last longer. They are mainly generated in the limbic system and travel through a two-way traffic system which allows emotions to be felt and conscious thoughts to affect emotions (Carter 124). As the limbic system evolved, it "refined" into two very powerful tools: memory and learning. These two tools allow humans to be much smarter in making decisions for survival and to "fine-tune" their ability to adapt (Goleman 10-11) as they proceed through life. But *why* do we have emotions? I think that life would lack meaning without them (even though we wouldn't realize it), but why do we have them? Each emotion corresponds to a distinct reaction that prompts an action, because over time we have learned that that action best handles the situation at hand. The repetition of these situations is "our evolutionary history" (Goleman 4). This idea of evolutionary history deriving from habit was first put forward by Charles Darwin in his book The Expression of the Emotions in Man and Animals. Written in 1872, Darwin's book is an excellent example of early research on emotions that was later confirmed by others. Specifically, Darwin's ideas were supported by the research of Paul Ekman, who specializes in psychological research "and has contributed greatly to our understanding of human emotion" ("Research Resources"). Both Darwin and Ekman focus on how emotions are expressed, but neither discuss how emotions are produced and, although my experiences had led me to study how emotions are expressed and what aspects of the outside world trigger these emotions, I also wanted to know how emotions are produced. On a philosophical level, I thought a lot about

human nature and why humans behave the way they do. I became engrossed in figuring out why we do what we do, and how that traces back to our survival instincts and how this affects our emotions. But, what happens when one looks at emotions from a scientific perspective and, more specifically, a neurological perspective? What parts of our brains control the production of emotions? What connections are made in the brains that produce emotions? How much control do we have over the production of our emotions, in the present and in the past? How much control do humans have over the development of the emotional centers in our brain? Do we have no control, meaning that our brain development is solely based on genetics? Or is the environment we are brought up in also a factor in our brain development? There has been a lot of research done regarding how nature and nurture affect brain development. Extreme cases have been made for each being the main factor of our development as humans. My research leads me to believe that although each human's brain is composed of the same parts, successful brain development depends more on the environment in which the development takes place. This environment during the early stages of life and into adulthood and our self-awareness as we navigate throughout life determine the control that we have over our emotions.

Part I:
Emotions in the Brain

Although emotions are mainly generated in the limbic system in the brain there are actually eleven parts within the brain that control the production of emotions (and which I will briefly describe below). These parts are: the hypothalamus, pituitary gland, mammillary body, frontal cortex, corpus callosum, hippocampus, amygdala, thalamus, stria terminalis, cingulate cortex, and olfactory complex. The hypothalamus, hippocampus, and amygdala are the parts that compose the limbic system and, therefore, are extremely important in the production of emotions. The hypothalamus and pituitary gland control hormones that produce physical reactions (Carter 124). The hypothalamus works as well with the mammillary body to produce hormonal signals and transmitters that affect the body's reactions to surrounding environment causing sensations and emotions. They also mediate fear and are connected by the fornix (Carter 124). In essence, they run an interface between memory and emotion. The frontal cortex receives information from the limbic system and then produces conscious feelings while information about the environment is sent from the cortex back to the limbic system in a continuous loop (Carter 124). The effect of emotion on thoughts is stronger than the effect of the latter on the former because there are more nerve tracts carrying signals from limbic to cortex than cortex to limbic. Basically, our emotions have a greater influence on our thoughts than our thoughts have on our emotions, illustrating how important emotional awareness and control is. The fifth part, the corpus callosum, plays the important role of transmitting emotions between the left and right hemispheres ("The Corpus Callosum"). The hippocampus retrieves and encodes memories and by retrieving personal memories it also recalls the emotions associated with that memory (Mandal). The amygdala is the most important part of the brain with respect to emotions. It is exclusively concerned with emotions and assesses both internal and external information. It assesses this information for the level of threat signified by the information as well as emotional significance. The thalamus is involved in the production of every emotion

because it serves as the distribution center for incoming information. Some thalamus nuclei have a strong influence on emotions because they push and pull emotionally important stimuli to the appropriate limbic areas (Carter 124). This illustrates a factor of our emotions that we do not have control over. The ninth part, the stria terminalis, is a network of pathways that link the amygdala to other parts of the brain, and is very important in anxiety and stress responses (Carter 124). The cingulate cortex is closest to the limbic system and performs difficult tasks, and experiences intense emotions such as love, anger, and lust. These intense emotions cause activity in the anterior cingulate cortex (ACC) which contains neurons that are sent to spindle cells and detect how others around them feel and then react to that (Carter 124). Lastly, the olfactory cortex carries messages about smell straight to the limbic system which is why smells can create such an intense emotional reaction ("Olfactory Pathways and Limbic"). These parts of the brain are what produce the emotions by taking in information, processing and decoding it, resulting in our emotions.

Although it is obvious that our emotions affect our actions, it is not as well known that this can happen even when we are not aware of our emotions. There are two different types of emotions that we experience--conscious and unconscious--depending on which parts of the brain are activated ("Conscious and Unconscious"). Emotions such as sadness and fear depend on signals from the right hemisphere to the left hemisphere to be processed. If these signals do not go through, a person may remain unconscious of their emotions but their behavior is still affected (Carter 126), so our emotions can greatly affect our actions beyond our conscious control. The process for conscious emotion is slow, but accurate, whereas the process for unconscious emotion is "fast and dirty" (Carter 125). Facial expressions are an extension of both types of emotion. This is because when we feel something the neural activation that corresponds to that emotion includes "the firing of neurons which, if not inhibited, cause the face and body muscles to contract in characteristic ways" (Carter 135). This phenomenon---that our emotions can affect our actions even when we are not aware of them---emphasizes the importance of awareness of ourselves and our emotions.

Part II:
The Developing Brain

Although there are aspects of brain development that are affected dramatically by the surrounding environment, there are some aspects that will develop in similar ways regardless of the environment. Brain development begins sixteen days after conception with the formation of the neural tube. At twenty-seven days the tube has begun to develop into the brain and spinal cord (Zero to Three). From conception to fifteen months, the brainstem develops. The brain stem encompasses the development of survival needs, sensory development, and motor development (Hannaford). Myelination is also not affected by the surrounding environment. Myelin is a "dense impermeable substance that covers the length of mature brain cells and is necessary for clear, efficient electrical transmission" (Zero to Three). Babies', toddlers', and young children's brains contain little myelin, which is why they process information much more slowly than adults. Myelination is a long process, but most parts of the brain begin adding "this critical insulation within the first two years of life'" (Zero to Three). These aspects of brain development are, for the most part, not affected by environmental factors (although

myelination can be negatively affected by malnutrition), but most aspects of development are affected by environmental factors, so a good environment is essential for all types of development, including emotional development, throughout childhood.

The surrounding environment is important in the early stages of development, but becomes even more important in the later stages. At three years of age, the basic structure of the brain is complete but "parts of the brain [in the prefrontal cortex] still remain 'offline'" (Carter 203). It is only as the amygdala and the hippocampus come online that the brain can begin to retain information and memories. As these parts of the brain come "online" they create four major abilities: the ability to detect patterns and make approximations, the capacity for different types of memory, the ability to self-correct and learn from experience, and an "inexhaustible capacity to create" (Wilson 11). Within these four abilities are eight forms of intelligence that develop in childhood which are mathematical/logical, verbal/linguistic, interpersonal (understanding other people), intrapersonal (understanding yourself), musical/rhythm, spatial, bodily/kinesthetic, and naturalistic (Wilson 25-26). All of these forms of intelligence are connected with the AEIOU learning cycle which stands for: Awareness, Exploration, Inquiry, Order, and Understanding or Use (Wilson 13). The different parts of this cycle make sense because they compose most of what we learn in the early years of the developmental process. In these early years we learn "how to be *a human being*--learning to move, to communicate, and to master basic social skills" (Sylwester 60). As we build on these skills, we transition into the second half of cognitive development when the accumulation of the previous developments begins to show, through "gestalt elaboration." Gestalt elaboration includes "whole picture processing" as well as "image movement, rhythm, emotion, [and] intuition" (Hannaford). This development takes place between four and a half and seven years of age. During the period of seven to nine years of age the brain focuses on specific skills and refines skills already learned. These skills include cognition, social behavior, language, technique development in music and sports, motor skills, reading, and writing (Hannaford). Thus, even after the foundation of development has been laid, the surrounding environment is still very important, because it is in the later stages of development that we begin to develop the skills that form our personality, intelligence, and behavior.

Part III:
Nature Versus Nurture

It is a long debated topic whether nature or nurture plays a bigger role in childhood development, especially in emotional development. The general consensus seems to be that what we are born with does not determine the person we will become, but it does determine the variety of possible developmental outcomes (Wilson 5). As Dr. Samuel Putnam states (in a personal interview), "You can't separate the two, there are so many relationships between them" (Putnam). The debate of nature versus nurture, when regarding brain development is, in essence, a question of genes versus environment. Genes are "the basic wiring plan for forming all of the cells (neurons)" (Zero to Three) and "often convey a vulnerability, not an absolute outcome" (Putnam). For example if depression is common in a child's family they have greater vulnerability to become depressed than a child whose family does not have a history of depression, but this vulnerability will only become apparent if exposed to a certain environment. The

environment or the experience is “responsible for fine-tuning those connections, helping each child adapt to the particular environment” (Zero to Three). In other words, the aspects of genes and environment are intertwined in complex ways, both contributing to emotional and brain development.

Although most brains develop in similar ways physically, the surrounding environment can impact this physical growth significantly. The Goldilocks Principle consists of four concepts, each of which is essential to the proper brain development of a fetus. These concepts are weight gain, nutrition, stress, and exercise (Medina 29). Each of these are essential for development during pregnancy and throughout childhood. Studies have been done that show that sleep is a crucial factor in all types of development, which is one example of how nurture (not nature) affects development. One of the major environmental factors that affects brain development is nutrition. The brains of children who are malnourished do not grow properly, which can cause behavioral and cognitive defects. Good nutrition is essential for proper brain development for “although the brain accounts for only 2% of the body's weight, it uses 20% of the nutrient energy” (Wilson 35-36) and in infants it uses 60% of their energy. From these examples, we can see how nurture (not nature) can dramatically affect the physical development of the brain.

The biggest impact that the surrounding environment has on emotional development is that it determines how a baby forms relationships with the world around it. Even as early as birth, babies are aware of shapes, colors, and sounds. Exploration of the world is critical for development because it provides stimuli that intrigue and challenge a baby’s mind (Morris 130). Many people view young children playing with toys and dolls as just that, playing, but what they do not realize is that these behaviors are the “outward evidence of the amazing changes taking place inside their[the children's] brains in response to input from their environments and their own actions, thoughts, and feelings” (Wilson 1). Every baby is born with “neophilia” or love of the new, a craving that is stronger in humans than any other animal. A baby must be provided with a safe environment to explore the novelty of the world around them (Morris 130). Neophilia is the opposite of neophobia, which is the fear of the new. This fear can result from a traumatic experience when exploring something new, which then translates in a baby's brain that exploring the new is bad because of this one experience (Morris 130). Although I do not remember being a baby, I must not have had this kind of traumatic experience, because I love the new. I have a need for adventure and a desire to explore. It has created my drive and ambition to learn. It is why I wrote this paper.

Although the majority of developments in the brain take place in the early years, brain plasticity allows for changes and other developments to take place later in life. “Brain plasticity” is a term used to describe the recent discovery that although the brain develops the most in the early years of life, it continues to develop throughout one's life. This is due to the “changeability of neurons and the structures (synapses) that connect these brain cells” (Morris 2). It starts with experience-expectant plasticity, which “refers to experiences that are common to all humans and are important for typical development” (Wilson 2). Common examples of such experiences are learning how to talk and walk. Babies are “amassing the nuances of how words are pronounced” (Wilson 2) before they begin to speak. This is how accents are developed and is the basis of how babies will speak and communicate through language. As I discovered more information about this I began to wonder: what if a child were brought up, at least in its very early years of life, in

a silent household, never hearing anyone speak? They would have to develop other ways of communication such as reading body language, or possibly sign language. This could potentially lead to a more aware and observant person, for they would be more adept at reading other people's body language, instead of only listening to the words they speak. This connects in an important way to the nature versus nurture debate, for in nature our brains are built to have a language center and we are built to be verbal creatures, but if young children are not exposed to voices, will they learn how to speak on their own? This illustrates a type of development that our parents have control over but that we do not have control over as individuals because we are so young. The opposite of this is experience-dependent synaptogenesis, which has to do with activities such as vocabulary growth, playing musical instruments and sports (Wilson 3). Growth in any of these skills has to do with practice or experience in these areas. This demonstrates the opposite of experience-expectant plasticity because, as we get older, we have control over things, such as how much we practice sports or study for school. Brains are very malleable so it is extremely important that they be exposed to a good environment throughout one's life.

The best environment for a developing brain is one that is loving and responsive, and encouraging of healthy exploration. This is mainly dependent on the parents and their own emotional well-being. A healthy, responsive relationship is one in which the parents and child are "emotionally tuned into each other" (MDCH). It is also important to balance warmth and discipline. Both in moderation are important; in particular, with respect to discipline, one must "deemphasize power as a parent" (Putnam). This kind of relationship is very important because it supports healthy development of cognition, communication, moral knowledge, and social-emotional competence. Healthy relationships support good experiences that help the brain develop in healthy ways whereas negative experiences can actually cause "genetically normal" children to "develop serious emotional difficulties" (Hawley 2). A fair, loving, and supportive environment is best for development and lays a foundation for later developments and behavior.

Part IV:
Emotional Control

Many people think that they cannot control their emotions in the moment and the actions that result from those emotions. They are wrong. As humans, we have a natural drive to be in control; this drive extends to our emotions and they can be controlled, but never as much as we would hope. All people are affected by what are referred to as "neural hijackings," which are, in essence, when the impulse of survival takes control over your mind, and actions "recruiting the rest of the brain to its urgent agenda" regardless of other circumstances (Goleman 14). This happens to all people and is usually followed by the feeling of not knowing what came over them. A fascinating study done by Richard Davidson examined the brain activity in Tibetan monks who have been practicing meditation and, in effect, training their mental state for 2500 years. They train their mental state "away from destructive emotions and toward a more compassionate, happier frame of being" (Sheeves). Activity in the right prefrontal cortex of the brain indicates negative emotions whereas the left indicates happy emotions. When Davidson studied a senior monk, skilled in meditation, he found that the activity in his prefrontal cortex was far to the left, indicating that he was a very happy person (Sheeves). So,

although neural hijackings are inevitable, we can potentially control our emotions on some level. In another meditation study, half of the volunteers received eight weeks of meditation training while the other half received none. At the end of the study it was observed that people who had received meditation training had more brain activity in the frontal cortex indicating that they were happier than those who had not received meditation training (Sheeves). Through practices such as these, humans can obtain some control over their emotions and overall well-being.

Conclusion

My research leads me to the conclusion that the surrounding environment is the most important factor in brain development. It is the development of our self and emotional awareness, during the early stages of life (and throughout adulthood) that determines the control we have over our emotions. This is important because many people feel lost and hopeless when battling mental illness. Their emotions seem to be out of their control. That was how I felt during my freshman year, and I felt that way because I was not aware of my choices and, more importantly, my emotions. Once I became more aware of my choices and my emotions, my life improved a great deal. People need to be aware of the concept of emotional control because it can affect not only them but also their children. Parents need to be aware of the environment that they raise their children in because it will greatly impact their children's development and emotional control.

The goal of this paper was to find some answers. I didn't find one clear answer, but I feel that I have a better understanding of what that answer might be. Strangely, this understanding does not come from the information I gathered, but rather in opposition to the idea that I could answer this question merely by gaining more information. We strive to gain knowledge and information about the world around us, but why? I believe that we are searching for a path that will lead us to happiness, but I do not think we will find it just by gathering more information about the world outside of ourselves. We also need to look inside ourselves--at our emotions, our choices, and our actions--and ask, why?