If our moral psychology is a Darwinian adaptation,what does that say about human nature? About social policy, which always presupposes something about human nature? About morality itself? *-Steven Pinker*

I have always been interested in what makes each person unique. I never understood how no two people are alike when everyone is made up of the same set of chromosomes. Through this research I set out to explore what makes each individual who they are, and whether individuality is affected by genes, environment, or a combination of the two. After doing some research, and learning more about genetics, I became interested in the different ways genes affect one's life. More specifically, I wanted to focus on the idea of morality, and the role genes have in influencing one's moral compass.

Biologists used to believe that you inherited your parents'[1] experiences. Giraffes are a common example. Biologists' believed that giraffes inherited their long necks over time. At one point their necks were no longer than any other animal, but when those short-necked giraffes stretched to reach high branches, their muscles stretched as well and their necks became a little longer. Then when those giraffes bred, their babies had slightly longer necks, but still stretched to reach the branches, but their babies had to reach less, and their babies even less. Eventually, the giraffe neck became long and able to reach high branches. People wanted to believe that they could deeply affect their genes[1]. Parents wanted, and still want, to be able to reverse some of the genes they may not have wanted their children to inherit. Sadly, genes are fixed; we do not yet know how to reverse gene mutations or any inherited trait. Genes work like blue-prints; they tell your body how to develop. Genes 'order' cells to make proteins made from amino acids, which become the building blocks to form DNA[2]. Although scientists have understood for a long time that your genes affect the way you look and even comprehend, it was not until recently that the question of morality has come into the question, as it relates to genes. Do genes affect one's moral compass, and if so, what does that say about free will?[3] Genes play a large role in shaping who we are; they affect our physical appearance, the way we perceive the world around us, and even how we distinguish between right and wrong. Although we are all made up of the same 46 chromosomes, it is our individual set of genes that makes us unique individuals. Gene mapping is an on-going process where specific genes are located in order to make research simpler and more organized. New information is constantly being discovered. Chromosomes are mapped by finding 'landmarks' in the human genome (genomenewsnetwork.org "DNA Mapping"). There are different levels of mapping, because a lot more information is known about some parts of the genome than others. That being said, nothing is 100% at this point; things turn out to be wrong all the time. When the genome is being mapped, it is one dimensional and linear, like the DNA molecules that make up the genome. DNA chains are made up of bases[4] and sugars.[5] There are four types of bases, referred to as 'A', 'G', 'C' and 'T'. Each base is composed of Carbon, Nitrogen,

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[1] A gene makes up a portion of a cell's DNA. Genes are basically the instructional manual for making everything your body needs, but proteins in particular. All genes are made up of different stretches of the four bases. They are all arranged in different ways and are different lengths.

[2] DNA stands for deoxyribonucleic acid. It carries the genetic information in every cell of one's body. DNA holds all of the hereditary material of the multi-cellular organisms. It is made up of four chemicals call bases that repeat over and over in pairs. Those chemicals form 'rungs' of double helix that make up the DNA shape.

[3] Free will being defined as the power to differentiate between right and wrong.

[4] Also known as nucleotides.

[5] 'Sugars' are rings of carbon.

and Oxygen. Those are the only four bases needed to write code describing the plan for one's entire body. As scientists continue researching, they are finding out more and more information about how the bases work together, and what that means for human life. Through the process of gene mapping, scientists are identifying more gene abnormalities. These abnormalities often have a strong influence on the lives of affected individuals as well as their families.

What happens when there is one abnormal gene?

For thousands of years people believed that relatives look similar due to their environment (Jones 2). We now know that this is not true, and relatives look similar because they share many of the same genes. Genetics are all about differences, similarities, and abnormalities. An abnormality in just one gene can completely affect the whole system. One example is in the case of Ostenogenesis Imperfecta, which causes the bones to be more fragile than normal. It is a mutation in one of the two genes that produce type 1 collagen, an essential part of building connective tissue. At its most severe, babies with this disease are still-born, or die moments after birth. The act of being born often causes every bone in their body to fracture, or their very first breath causes their rib cage to shatter. At its least severe, a child could grow up only breaking one or two bones in total. Most inheritors fall somewhere in between. This disease can cause a lot of emotional problems in addition to the physical. It can be hard to pinpoint the disease, and the broken bones can seem to be without cause. There was one case where parents brought their 14 day old hysterical daughter into the hospital one night, only to find out she had an unexplained broken arm, and three unexplained broken ribs. The parents were confronted by social services that had been called in to investigate them for child abuse. The parents were mortified, but when no evidence was found, and the state told them they would not be getting their child back, her mom lied and confessed to the abuse. By confessing, she and her husband would get their child back, as long as she went to therapy. The situation got more complicated when the timeline did not make sense for her breaking the baby's ribs. When questioned, she gave in and again falsely admitted that her husband had also abused their daughter. Her husband, however, turned on her, and would not admit to being part of it. Since the parents' stories did not line up, their chances of getting their daughter back turned from slim to none. As an act of disparity, the mother started researching child abuse, and came across Ostenogenesis Imperfecta, or brittle bones. After talking to her pediatrician and a child geneticist, she got a court order to have tests done on her daughter. It was not until 11 months after that horrible night at the hospital that the parents ever got to see their daughter again, and even so the whole situation had caused them to part ways and file for divorce. The baby went through the rest of her childhood breaking one or two bones per year on average. The disease goes away after puberty, but often comes back after menopause when hormone levels change. Cases like this are proof of how powerful each individual gene really is. There is no useless gene, and even the most minor jobs are important in keeping the body healthy.

Another case of just two genes completely changing a family's life is in the case of spinal muscular atrophy. An infant when diagnosed, this little girl was still learning about the world around her. She would smile and become alert when her parents played or talked to her, but her body slowly seemed to be failing her. Milestones that she had overcome months before started to become impossible for her. First she stopped sitting up, then she could no longer move her head, until eventually she could no longer breathe. This condition comes from an abnormality in the 226 and 229 genes found on chromosome 5. It is a recessive trait, meaning that a recipient of this disease must get a non-working gene from both parents. The nerves that control voluntary

muscles start to disappear seemingly randomly; it is a degenerative condition that is a death sentence. Perhaps the worst part, is that intelligence remains; the recipient is trapped in an increasingly useless body. It is important to note, that every human has some mutations in their genes. Since humans have 46 chromosomes, half from each parent, making up 23 pairs of chromosomes, not every mutation causes a problem, but some do. It is, however, very problematic when a child inherits two of the same mutated genes, one from each parent. Parents often do not know they have a mutation in their genes, because it never causes problems for them, because they have one of the same genes that work fine.

Sanfilippo Syndrome[6] is basically the opposite disease. Sanfilippo Syndrome is a deficiency of a naturally occurring enzyme that causes your body to be unable to break down and dispose of a group of complex chemicals called glycoaminoglycans (GAGs). Storage of GAGs in the central nervous system causes a plateau of development and slow deterioration of neurologic functioning. In the case of one little girl it turned her from an empathetic toddler into basically a living zombie. By the end stage of this disease, the organs in the body still function, but the mind ceases to exist. Situations like this are especially difficult for families to deal with. Of course they love their children, but it is hard to stand by and watch their child lose connection to the world. Many families struggle with whether or not to put their children into special care facilities, or take care of them at home. While children in special care facilities can still visit with their families often, many parents feel like they are abandoning their child.

Marfan Syndrome affects the body's connective tissue, which is weak and has a hard time holding everything together, due to a lack of protein to make the tissue. Marfan Syndrome effects 1 in every 10,000 babies (excluding still-borns). A baby with a blind mom and an affected dad was found to have Marfan Syndrome after their many symptoms such as disproportionate elongation of the legs, loose joints, flat feet, chest is caved in or budges out, scoliosis, and trouble building muscle caused doctors to worry and run an abundance of tests. If the doctors had not noticed, and the baby was left untreated, her disease would likely have resulted in an early death. People with Marfan Syndrome are usually extremely near-sighted and over time they often lose their sight completely. Death usually comes between age 40 and 50, when the aorta finally bursts and floods the chest with blood. Luckily since both this girl and her father were closely monitored, they lived long and successful lives. New technology has greatly affected diseases like Marfan Syndrome. What before was seen as untreatable, can now be monitored, and controlled. This is all because of the rapid speed genetic research is now moving at because of the new technologies that allow scientists to look much more closely at genes, and see how they work.

How do genes affect the way we perceive the world?

Our genes not only determine our physical health, but they also affect they way we perceive the world. One example of genes affecting our perception is through color. The human eye does not see color, but only lightness and darkness (bbc.co.uk "Do You See What I See?"). Color is manufactured completely by our brains, which in turn are affected by our DNA. What happens is that there are sensors in the back of our eyes that send information about the light they are taking in through electrical signals called photoreceptors. Most people have three photoreceptors, and can see three colors: red, green, and blue. Some people have a hard time distinguishing between colors on the red / green scale; they are considered colorblind. Other

[6] One of the mucopolysaccharidoses.

people are extra sensitive to the red / green scale. They have four photoreceptors as opposed to three and are called tetrachromats. We don't see the exact colors as other people just like we don't feel the exact same pain. Just like we can determine that someone is in pain without literally feeling their pain, we can all agree on basic colors such as red, purple, and blue. The question is less about if my blue is your orange, and more a question of lightness and darkness or shade.

Color is also affected by vocabulary. The brain understands colors that it can name. The more colors in our vocabulary, the easier time we have distinguishing such colors. While there are seven accepted colors in the rainbow, about half the population only recognizes six because many people don't hold indigo in their vocabulary. Similarly, the Berinmo[7] language only has five colors in total, and they are all variations on white or tan. Colors that we would consider completely unrecognizable they can easily differentiate between, yet when given two berries, one blue and one purple, they cannot differentiate the color at all.

Our genes do not just affect the way the brain views color, but they control deep neurological functioning. Most psychological disorders are not directly linked on one gene, but relate back to many genes that cause risk of disorder. Schizophrenia is a good example. There are around ten genes known that contribute to the susceptibility and pathology of Schizophrenia, in addition to environment. The more of the 10 genes you have, the higher your chance of getting Schizophrenia is. There is one gene, found on chromosome 22 that nearly doubles your risk of developing the disorder. All of the genes that contribute to a high risk of Schizophrenia are in some way related to dopamine. When the bodies COMT[8] is abnormal it exhausts all the dopamine found in the brain, which in turn, causes hallucinations and impairs the brain's sense of reality. That is when one develops what we call Schizophrenia. This disorder is not limited to genes, however. There are a number of environmental factors that have been linked as well, such as: lead exposure during pregnancy, high stress situations at a young age, and drug use throughout the teenage years. While these environmental factors do not cause Schizophrenia, they, like the related genes, raise one's risk with each factor.

How do genes play a role in developing our identity?

"Plato, as usual, was there first. He liked to imagine the mind as a chariot pulled by two horses. If we follow the horses, we will be led like a 'fool into the world below'" (Lehrer 10). Plato thought it is up to the rational brain to guide the horses. If they get out of control it is the charioteer's job to take out the whip and regain authority. He thought that one of the two horses was well behaved, but all charioteers had trouble controlling the other horse and getting it to continue moving forward. Plato was not that far off, but to take his idea further; the rational brain works with a set of pretenses. It is predisposed to certain likes and dislikes and those pretenses help to dictate where the rational brain guides these horses, or the mind. Genes directly relate to the functioning of our minds. In one case, a man went to have surgery to have a tumor taken out of his brain. His surgery seemed to go smoothly, but after the whole process was over, he lost the ability to make decisions. One might argue that part of the brain had been cut out, and that was the cause of his inability to make choices. However, more and more studies are being done that connect DNA and genes to characteristics, behaviors, and even morals of individuals[9].

[7] The Berinmo people are a small tribe of hunter-gatherers that live in Papua New Guinea.
[8] Catechol-O-methyl transferase is an enzyme that degrades catecholamines, one of which is dopamine.
[9] It is important to note that all studies that are referred to in this paper are Western studies.

Studies have been conducted with identical twins, since they are the only humans with a perfectly identical genome[10]. The tests deal with "nature versus nurture"[11] by separating twins at birth, and watching how they develop in different situations. One of the most famous cases today is the study done on Amy and Beth. Amy and Beth were identical twins put up for adoption in New York. Once in the system, it was decided that they would be split up into two homes to test how that would affect their lives. Both were adopted by families in New York with working fathers, stay-at-home mothers, and both had an older brother. Amy's family however, grew to be unsatisfied with her, and made her feel like an outsider on their life. Whereas Beth's family did everything in their power to make her feel like she was just as much part of the family as anyone else, her mother even dyed her hair to match Beth's. Amy was a demanding infant. "She sucked her thumb; she bit her nails; she clung to her blanket; she cried when left alone" (Wright 49). She was taken over with fears. She was: "Shy, indifferent, suffering from a serious learning disorder, pathologically immature, she was the stereotypical picture of a rejected child" (Wright 49). The doctors thought she reacted this way to the environment that raised her. After looking at Beth's childhood however, the results were less clear. Although Beth was raised in a loving, caring, and nurturing home, she developed many of the same anxious qualities and fears that Amy did. For example, the only difference, was that while Beth's family loved her and supported her to help her work though her problems, Amy's family thought her as even more of an annoyance for them.

An even more bizarre case, is the story of Jim Springs and Jim Lewis. Both men were adopted into different families that choose separately to name them James, and both boys went by "Jim." They lived apart for 39 years before reconnecting, and finding that their lives were eerily similar. Both of them were six feet tall and weighted 180 pounds. As children, they both vacationed with their families to St. Pete Beach, Florida, and they both had childhood dogs named Toy. Both men married, got divorced, and remarried, and both Jim's first wives were named Linda, and their second wives were named Betty. When they had children, one named their son James Allan, the other named their son James Alan. Both Jims were part-time sheriffs, and in their free time enjoyed carpentry. They both suffered from severe headaches. They even enjoyed the same brands of beer and cigarettes (Miller Light, and Salem). While in most cases, the twins don't lead lives that are as similar, it has been shown that behaviors such as "smoking, insomnia, marriage, divorce, choice of career, hobbies, use of contraceptives, consumption of coffee (but not tea), menstrual symptoms, and suicide," have much higher rates of concordance in identical twins as opposed to fraternal.

Even more recently, scientists have been discussing the possibility of a moral gene. The idea started with an interesting pattern with the train problem. The train problem is where you are the train driver and you are driving an empty train down the tracks. Up ahead you see that an evil villain has tied five people to the track you are headed down. You cannot get off the track, but you do have the option to switch directions. Going the other direction the villain has tied one person to the tracks. You do not know any of these people, or anything about them. You have to make the decision to switch the gears or not. Most people choose to kill the one person, since they have to make a choice either way, they opt for killing less people. However, a group of

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[10] The genome refers to an entire set of genes. Scientists believe that around 20,500 genes make up the human genome. The human genome is basically deciphered in three ways: determining the order or sequence of the genes, making maps to show the locations of the genes in all the major sections of the chromosomes, and producing 'linkage maps' which track inherited traits (such as genetic diseases) over generations.

[11] Nature being one's genetic make-up, and nurture their family life and environment.

people taking selective SSRIs[12] polled opposite, and most people did not want to change the tracks. The chemical, serotonin, that they are taking, is released at links between nerves as a part of signaling in the brain. Serotonin exists naturally in the human body, but because of alterations in the promoter, some people have long forms which is a normal amount of serotonin, and some people have short forms which are reduced levels like the levels of people taking SSRI. Scientists tested the levels of serotonin in the genes of 65 healthy people and found that 22 had the long form, 13 had the short form, and 30 had one of each gene. They then proceeded to do a morality test, asking the participants a series of questions that related to morals. They found that in terms of morally neutral situations as well as in intentional harm situations, there was no measurable difference in the participants. However, in foreseen harm situations, such as the train problem, there was a huge difference. People with two long strand genes were much more likely to hurt one to save five, whereas the people with two short strand genes as well as those with one long one short, were much more likely to see the situation as morally neutral and not interfere (scientificamerican.org "A Moral Gene?"). Genes play a role in developing the morals that shape one's life, but situation plays a role as well. An example is height. In places where a lot of people are malnourished, the population tends to have a closer range of heights. This doesn't happen because they all have the same genes for height, but because the people who have genes to make them taller, do not have the nourishment to enable that gene. Another example is in cultures that don't drink. Some people have the gene that predisposes them to alcoholism, yet it rarely becomes an issue because it just isn't part of their culture. Genes can only play their role, if the circumstances allow them to.

Genes work as an instructional manual for life. They can determine the way you look, think, and act. Genes provide a rough outline of who you are, but although genes are set in stone, your life is not. Genes predispose you to certain likes and dislikes. It is important to understand that unlike in appearances or brain functioning, there is not yet reason to believe there are specific genes for behavior. So while genes do affect preferences, humans also have free will. That being said, there is reason to believe that genes influence overall human behaviors. One is born with the ability to feel a certain amount of empathy, but as it stands right now, it seems that the amount of empathy they feel is subject to change based on their environment, and how they are raised. How much of your identity is shaped by genes as opposed to environment?

[12] Serotonin reuptake inhibitors

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