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## The Physiology of Love

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THE PHYSIOLOGY OF LOVE

by

Noelle Leon-Palmer

Completed in Partial Fulfillment  
of the Requirements for a Degree with Honors  
(Biology)

The Honors College

University of Maine

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## ABSTRACT

This thesis explores the physiology, endocrinology and neurobiology of love. The thesis is formatted as a creative writing piece that is laced with the science while remaining in the narrative voice. The story is divided into four loose categories; the growing, the loving, the hurting and the healing. The growing explores puberty, and the importance of puberty in terms of creating more mature relationships. The loving defines when the main character, Clara, falls in love with the antagonist. She eventually gets her heart broken and she has to learn how to heal from that. The hurting is her heartbreak; the story delves into the science of heartbreak and why it is so painful. Finally, the healing, is the part where Clara finds a way to heal through the help of her friends, family, and surprisingly music as well. Based on the research that is already available, this thesis explains the science behind all of the mysteries of love while at the same time creating a piece that is in a format that is accessible to people in the science field as well as people who are not.

This thesis gives readers a real-time breakdown of what is happening to their minds and their bodies when they are falling in love. It allows them a window into the unknown; giving them an explanation as to why they have been completely enraptured by love, or why they eventually will be.

I dedicate this piece to my first love.

## ACKNOWLEDGEMENTS

There has been a tremendous amount of people who have helped me throughout this process and I will be forever thankful for their support and encouragement. I have to give a thousand thank yous to my advisor for allowing me to take on such a huge project.

Your encouraging words were never lost, and your flexibility and imagination have helped make this creative piece special. To my committee, thank you for taking on such an abstract project and for having such an open mind the entire time, your input has been fruitful. To my editor, who told me to stop apologizing—those words meant a lot. Thank you for your skillful edits that allowed my voice to shine through in the best way possible.

To my roommates, friends, and family thank you for listening to me complain. And a special thank you to Addison Labonte—we did it!

## PREFACE: SCIENCE ANXIETY

My thesis explores the current research understanding of the physiology, endocrinology, and neurobiology of love. Love is known all over the world, and its importance in nature is paramount in reproduction and numerous types of social bonding. The romantic aspects of love have been represented ubiquitously through literature, media, and countless other mediums of expression. The biological aspects of love have only just started to be researched from a scientific perspective. My thesis reviews the scientific literature on this mysterious habit called love, with a focus on romantic love.

The way that I formatted my thesis was by combining a creative writing piece with a science-based piece, conveying in simple terms the findings from various relevant research studies. I wrote the narrative in Clara's voice, the main character, and laced the science into the piece so that the story was both educational and still in the voice of Clara.

The goal of this thesis was to make a science piece that was accessible to people who do not have a science background, while simultaneously making this piece accessible to people who have science anxiety. Anxiety is a feeling of worry, unease or trepidation towards an event that has uncertain outcomes. In terms of science, anxiety stems from various elements and makes science classes more difficult to conceptualize. In a lot of cases, science anxiety is associated with approaching something and feeling as if you are not going to succeed. Before the student has taken the class, they already sense failure. One of the reasons that people have these preconceived notions about science classes is because of the portrayal of science classes in the media. They are usually

portrayed as classes that can only be taken by a certain set of students, and completely inaccessible to any other students; this ignites fear in students.

Another source of science anxiety could be from the source of where the basics of science were first learned. In the case of University students, high school was where they developed their preliminary knowledge of the more complicated science classes. If that initial experience was a bad experience or taught by someone who did not know the material, then that initial experience could give the student an unhealthy representation of the classes or the topic. In a research study done by the American Institute of Physics, they found startling facts that only 47% of people teaching physics in high school had either a Minor or more in physics or physics education, and only 33% had a bachelor's degree with a physics or physics education Major. This brings up questions about who is teaching the classes, and what they are communicating to the students. Do the students sense any sort of anxiety from teachers that may not have a strong background in the science classes in the first place? Anxiety that is created initially in high school can then be carried onto University.

By formatting my thesis this way, I am trying to tackle science anxiety and help students learn harder science-based classes. Formatting my thesis in the form of a story makes it much more accessible and less frightening. Learning, and especially science-learning is special because there is an emotional aspect to it. That emotional aspect is soothed with the narrative aspect of my thesis, and the science education aspect is still ever present.

## AUTHOR'S NOTE:

I believe, with all of my heart, that love is a universal, international, cross-cultural, and cross species phenomenon. If you are a living being, you can love. Variations on love are as individual as a thumbprint. So, to focus on every aspect, from every angle would be unfeasible, and I wouldn't graduate on time. Therefore, I have focused on love from the social and biological point of view of the development of a girl through to her college years as a young woman. The main character in this story is a heterosexual female and I follow the science behind her story. However, the science of love is open and available to both heterosexual and homosexual relationships. There are no restrictions on love. She doesn't represent every young woman who loves, she is simply an example, a tiny sliver of the huge pie. And throughout the piece, I discuss other perspectives because there are so many realities of love.

-N.

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## THE PHYSIOLOGY OF LOVE

“Mom, have you ever been in love?”

“Yes, sweetie. I'm in love with your dad right now,” she replied without hesitation.

I wasn't very concerned with her answer. I had something big to tell her.

I tugged on her skirt to get her full attention. What I was about to tell her was epic...well as epic as anything can be for a 6-year-old.

“I'm in love right now. And Mom, it's the best feeling in the world!” I spun like a fairy in an attempt to display my happiness.

Jason Darty was my first love, and he loved me back. He had dated a lot of other girls in Mrs. Jordan's class but I was his favorite. That's what he told me. I never realized how fun love was until I started doing it. But it's quite fun. I guessed kissing was the next step. It goes love, then kissing, then six. I'm not sure what the number six has to do with love. But Mommy and Daddy do six and they love each other, so I wanted to do six too.

“Mommy, you know how you and daddy do six? Well, I want to do six, too.”

Mommy's eyes widened as she suddenly stopped cutting the zucchini for dinner so I assumed that this was a significant moment in my life and she was just as excited as I was.

“Where did you hear about sex, Clara?!”

She had a shrill tone in her voice as if I did something wrong. And I didn't understand. I did all of the steps right. I was in love, we kissed at recess and now it was time for six.

“I learned it from Zachary. He told me the steps. I'm following the steps”.

Zachary is my big cousin. He goes to middle school and does adult-like activities.

Her eyes were still rounded, and she had not started cutting up the zucchini again so I knew I was still in trouble. I didn't understand what this sex thing was that she was talking about. I said six. Maybe she didn't hear what I said. She seemed frozen. It looked as though she was “searching for her words.” That's something my mom and dad encourage me to do instead of saying ummmmmm.

I decided to help her out by repeating myself.

“Mommy, I want to do six with Jason because we love each other.”

And that's when she snapped.

“Sex is for grown-ups, Clara. I do not know what Zachary told you, and I will be sure to call Aunt Margaret, but sex is for when you are much, much older.”

There she went with the whole sex thing again.

“Six, Mom! Six!”

“Clara, NO!”

She was yelling by this point so I knew I was in very big trouble. I couldn't comprehend why this had to be so difficult. I was in love; why couldn't she understand?

Dad heard the yelling and came downstairs. Then mom and dad started whispering. They did this a lot. It was rude, in my personal opinion.

Then it was Dad's turn to have the wide eyes, but his were followed with a deep and hearty laughter. I loved when Daddy laughed. It made me happy. So I laughed, loud and hard right along with him.

“Clara, we need to talk.” He said this between laughs so I knew I wasn't in trouble anymore.

We went to the TV room, and we sat down, like grownups.

“I hear that you're in love and that you are ready for six?”

I knew he would understand.

“Yes, Daddy. I am ready! I am in love!” I got up and started twirling again.

“I'm very happy for you, kiddo. But you have to understand that this six that you're talking about, it's not for people your age. It's an activity that adults do. Cousin Zachary had it all wrong.”

He started laughing when he said the word six. So I started laughing, too.

“No, Clara. This is not a joke. Six is for adults.”

I was a bit confused because he kept giggling and also because a different big person told me that those were the three steps, and a rule is a rule.

“OK, Dad, but what am I supposed to do instead?” I asked.

“Hugs and art. We can make him a card right after dinner.”

Hugs, arts and kisses. But I didn’t tell Dad about the kisses, because I had a feeling that it would be another big thing. And I was over it.

“OK, Dad.”

I said this as I was walking upstairs to go play dolls. I couldn’t spend all day talking like a grownup with Dad. I had a life.

I woke up the next morning very excited in anticipation of seeing Jason. I jumped out of bed and twirled all the way to the bathroom to do my morning activities. I was going to see the love of my life today. I was going to kiss the love of my life!

After my morning activities, I dressed in my prettiest pink dress in hopes that he would love my favorite pink dress.

I ran downstairs just as Mommy was putting my pancakes on the table. Pancakes! Today was going to be nothing but amazing.

“Clara, please sit down and eat your breakfast.”

I was so excited that I decided not to listen to Mommy. TODAY IS THE BEST DAY EVER.

The bus ride and class were all a blur because all I could do was stare at Jason. I made sure to look at him all morning. I barely blinked, I just stared and looked and dreamed about the love of my life. Wow. Love is just something else.

I was buzzing and humming, waiting impatiently for lunch time so that I could talk to Jason. And as soon as the bell rang, I ran outside right behind him.

He did not react the way I expected him to. He saw me, his eyes opened wide and he took off running. At first I just stood there and stared at him, confused. I didn't even blink I just fixed my eyes on him really hard, trying to comprehend what he was doing. When he looked back, and saw me he started running faster.

So I made the assumption that I was supposed to chase after him. I guessed it was the appropriate next step. As I chased him I yelled "Jason, Jason. I love you!"

He replied, "Get away from me. You have cooties!"

He must have been confused.

"I love you!" We were rounding the corner near the parks and this was the longest that I had run in a very long time. I was more of a sedentary-activity child.

He looked back again and yelled, "Stop chasing me, Clara!"

"JASON! STOP RUNNING AWAY FROM ME!"

I was running and buzzing and making the weird humming noise. My eyes were watering from all of the staring and I could hardly see. I was winded so the humming came every few seconds. I sounded like a crazy animal, humming, panting, screaming and crying.

When I finally caught up to him, I was breathless but managed to get some words out.

“What are you doing? We are in love! Why are you running away from me?!”

“I don't love you. I love Cindy now. And you have to stop staring at me, Clara. I don't like it.” He had a cool attitude about him, and he wasn't even out of breath from all of the running that we just did.

I hated him.

I knew he was trouble. I should have never wasted my love on him. I should have never put on my favorite pink dress for him, and I should have definitely never, ever, ever thought of sining with him.

Jason is stupid. Boys are stupid. Love is stupid.

---

Fortunately, Jason Darty didn't ruin love for me. He simply gave me a realistic perspective of what love could be. But I didn't let that stop me. From ages 7 to fourteen, I had a slew of “boyfriends.” The summer of 2<sup>nd</sup> grade, I dated Lionnel. We were at Three Trees summer camp together. He carved my name in an oak tree and declared his love for me in front of all of his friends. Unfortunately, that union ended at the end of the week

when camp was over. There was Aaron, the boy who would never actually talk to me, but we dated for a whole month in 3<sup>rd</sup> grade. Dating consisted of him and I sending each other notes through our best friends. On Valentine's Day, he gave me a toy ring that he had won from a vending machine. It was pretty serious. And then in the 5<sup>th</sup> grade, there was Albert. He was the red-haired boy with the green eyes that every girl coveted. We dated for about three days, and then we broke up because he said I was too bossy.

After those pretty serious relationships, I took a break, and I practiced self-love. I had finally discovered masturbation. All of a sudden my body opened to the reality that sexuality exists. Before that day, in my all-pink Barbie themed room, sexuality was a mystical concept that I would never understand. As I got older desire and lust became available to me. It wasn't as if one day I woke up and said "I am going to masturbate!" It was a gradual process of self-exploration. It was as if my genitals became a big hot button. Where I got the idea to touch myself in the clitoral area in the first place is a mystery.

But it's not a biological mystery. The hot button phenomenon starts with puberty.

Puberty is heavily reliant on the changes that occur between the ears, in the brain. My "on" switch for puberty started with all of the stimulating hormonal changes in my body. A hormone acts by traveling through the blood and interacting with any and all of the parts of the body that are able to receive and respond to the specific hormone in question. When it was puberty time, around age 10 for me, the first hormone that was made in my hypothalamus and released was gonadotropin-releasing hormone. This hormone moseyed on through my blood vessels and made its way to my pituitary, a peanut sized gland

behind the hypothalamus, where it stimulated the release of follicle stimulating hormone and luteinizing hormone. Those two hormones then traveled through my blood and stimulated my first visit from Aunt Flow.

But before Aunt Flow came to visit there were a few years where my body was making other changes. I sprouted hair, my body grew, I developed breasts, and I smelled like onions for about two years. My mom said this was normal but I didn't find any part of it normal. The combination of hormones such as testosterone, estrogen and progesterone in my body at higher concentrations were changing me and were directing my curiosity towards my nether regions. There are two hormones that are said to specifically trigger libido in younger kids (and adults), but for every person the experience is different and libido may not be specific to those two hormones. For each girl or woman, the experience is unique but one fact that we can all agree on is that the desire to touch and explore our bodies is related to hormonal changes<sup>1</sup>. Either alone, or in combination, hormones act as a trigger. And I don't know which one it was for me but I do know I was a masturbating queen from 5<sup>th</sup> to 6<sup>th</sup> grade. Since I was brought up Catholic and masturbation was against the church, I was sure I was going to hell. It wasn't until my senior year of high school that I learned that masturbation was not unique to me. I wish I had known that earlier; it would have saved me many wearisome confessions with the priest.

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<sup>1</sup> \*Even though hormone levels play a role in regulating sexual desire and libido in the human body, there are other aspects that play a part, such as society, and one's own perspective on sex. Everyone is unique.

In the 6<sup>th</sup> grade, masturbation was at an all-time high however relationships were non-existent. In the 7<sup>th</sup> grade, my luck changed. The relationship between Jason Darty and I was rekindled, but with more finesse. I no longer chased him around the playground. Instead I resorted to my not-so-subtle winks and playful cheek kisses that left him desiring more. We dated for an impressively long time. He ended up being more than my first love. He became my vessel for the exploration of the opposite sex. Most of the questions that I had about sex were answered with our curious hands and mouths. We never had sex, and before we could the relationship ended. It all started when we parted ways to go to different high schools.

The long distance relationship model didn't work out for us. But we tried. The first week of high school, we Skyped every night until we fell asleep. Seven days into our long distance relationship I waited up for hours but there was no Skype call. I was irate. That next morning, I stormed over to his high school looking for blood. I yelled, pushed and interrogated him with the passion of a scorned woman and, finally, when I was done talking, he calmly explained to me that the Wi-Fi was shut down at his house as punishment; that's why he didn't Skype me. We broke up that day. I had very bad luck with Jason Darty.

Apparently women who are in long distance relationships have more testosterone circulating in their plasma than women who are in relationships and living in the same city as their partner. I believe it. I was much more aggressive than usual; borderline psychotic actually. I don't know if high schools that are five miles apart count as long

distance but I'll use that as my excuse for my very poor behavior. But all's well that ends well. Love isn't for everyone, I suppose.

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What is love? In the Merriam Webster online dictionary, it is defined as “an intense feeling of deep attraction.” In the Urban Dictionary, it is defined as “nature's way of tricking people into reproducing.” The Urban Dictionary may be more accurate.

Evolutionarily speaking, tricking humans and other animals into “falling in love” is a great way to ensure that pairs stay together long enough to reproduce and then take care of their offspring so that the babies can eventually make more babies. It's an unromantic concept, but from a purely scientific perspective, the reason for these strong bonds is so that we can propagate our existence. That's it. That's what it comes down to: Who can I make the best babies with?

How do you know when somebody loves you? This question has plagued humanity since the beginning of romance. It would all be so much easier if it was acceptable to have functional MRI machines at dinner dates. Or if we could take blood plasma samples upon first meeting someone. Unfortunately, these indicators are not considered proper decorum. So we have to rely on humans' subtle and inadequate hints and signals. Did he smile at me or was he just twitching? What did that extra emoji mean? Does he really love the way I look when I'm sleeping? Is that creepy? There are so many different mechanisms and chemical changes that we can look at to explore love and how the person of our affection makes us feel. If we could peel back the individual layers of who

we are as humans, go from the organism level, to the organ level, to the tissue and then the cellular level, we would discover so many hints, cues, and mind-blowing observations that occur when we are falling in love. And I wish I could say that it all makes sense when we look at it from a biological standpoint, but unfortunately love will always be somewhat of phenomenological mystery.

How do people fall in love? Ms. Lewis, my 8<sup>th</sup> grade gym teacher, told our health class that people fall in love aimlessly and without reason. She was always a bit dark though, so we'll take that one with a grain of salt. There is more to how we fall in love and who we fall in love with than we think. The calculations in our brains are meticulous and rapid.

And where does sex come into play in this whole love thing? Well, it feels great, when you are no longer in university, having immature college boys poke you with their thingamajig. But that overwhelming, bring-you-to-tears sex that eventually happens has a role in this thing that we call romantic love. Sex is so important. Think about how easy it is to become over taken by lust and desire. It's built like that for a reason.

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I rolled over and checked the digital clock on my oak night-table. It was just about 8 a.m. Meaning it was just about to be time for me to start my day. I peeled my duvet off and forced myself out of bed. My regular morning duties consisted of brushing my teeth, washing my face and applying just enough make-up so that I looked decent without actually seeming like I was trying. I had finally reached a point in my life where my dark

skin wasn't smeared with even darker blemishes, and my huge curly hair was not something that I frowned at – I embraced it. High school had been rough; not feeling pretty enough can be exhausting. But finally, when I looked in the mirror I saw a beautiful girl. By my third year of university I could say that I had finally reached that point.

That morning when I woke up, I had no idea how monumental my day would be. I had no idea that I would be so utterly blindsided by a person that I barely knew. I had been attending university for two years, and I had never seen him before. I have no idea how I could have missed his striking blue eyes, his full beard and his deep brown curly hair. Maybe I had mistaken him for a professor and completely skipped over him for two years, or maybe fate had made it so that I didn't meet him until that morning. But as soon as I walked into my neuro class, I saw him. His dark hair and his eyes caught my attention. I had never seen such blue eyes before; they were almost frightening. And from his face, my eyes traced down his neck to his arms. His right arm was completely covered in tattoos; they seemed frivolous individually, a bird, a cross, a lion, but together they made something worth looking at. He smiled; his teeth were immaculate. I had goosebumps.

The attraction that I had for this stranger went beyond the superficial. Yes, his eyes were majestic, and yes his teeth were basically a Colgate commercial, but I noticed other things, too. His presence was substantial. His walk was controlled. His face was symmetrically strong. He had it all. Upon first glance, he resembled a person who could sway me, influence me. He was power, and he was sex. He was someone I truly desired.

Beyond that there were parts of him that I knew were carefully calculated in my brain; his smell, his voice, the slightly protruding forehead. He was sound, genetically sound. On an even deeper layer, I knew that there was a flurry of characteristics that I was attracted to that were beyond the scope of my conscious. The processes that occur in my brain and in the sensory parts of my body are automatic and usually very rapid. Analogous to when I touch a hot stove, my reflexes make sure my hand gets the hell out of the way before I feel any pain from the heat. When I am attracted to someone, my senses are picking up on attributes that I might never pick up on. These subconscious assessments are not lost; they are simply added to the overall cocktail of emotions that I felt towards him.

One staple characteristic was his smell. Not his cologne, but the collection of chemical signals that he was releasing into the air. Similar to how hormones travel through the blood to signal within a body, pheromones are volatile airborne chemical signals that are released externally to help communication between individuals of the same species. The vomeronasal organ is the organ that receives the signal. It is found deep within the nasal cavity and acts to “smell” prospective mates to see how closely related they are to me. The pheromones that are released enable me to ensure he and I aren’t too genetically similar. One of the molecules within the group of pheromones released by humans is the major histocompatibility complex which is associated with immune response. Although the name seems long and drawn out, its job is simple. It ensures that two people with very similar genes do not mate. We are attracted to people with different major histocompatibility complexes than us, meaning we are attracted to the smell of people with different genes than us. By having a greater attraction to the smell of people with dissimilar genes, I was giving my future babies a chance at a more diverse immune

defense. The more diversity between a couple, the greater the diversity that the potential offspring will have. Regardless if the couple wants to or can have kids this screening process is still present. Evolutionarily, diversity is favored; and especially genetic diversity because it leads to a greater chance of survival. I wasn't kidding earlier when I said that it all came down to babies.

Another trait that is being subconsciously evaluated is the pitch of someone's voice. I was listening for how deep his voice was. The deepness of a male's voice is associated with the amount of sex hormones that they have. Sex hormones are chemicals that affect sexual development and reproduction. The male larynx has many more sex hormone receptors than the female larynx. Upon binding of sex hormones to their respective receptors, the male larynx stretches and lengthens much more than the female's does. This is what creates deeper voices in males. Extremely deep voiced males are associated with higher levels of sex hormones like testosterone. This evolutionary trait is one that might not relate to reproduction necessarily. It may be more associated with protection. Males with lower voices usually have more testosterone. Testosterone sometimes signifies more aggressive behavior, which could be beneficial if that aggressive behavior is directed at that pesky saber toothed tiger that keeps trying to eat your babies. (I don't know if saber toothed tigers were actually baby eaters.)

Attraction, and whom we are attracted to, is not by chance. There is careful calculation that occurs in many different parts of our bodies that helps us find the person that we truly desire. Our eyes do a lot of the work; we are looking for little signals that give us evidence that the person that we are looking at has good survival fitness. Facial symmetry

is one thing that we look for, along with features such as a strong jaw. I was looking to see if at the very least we would be able to survive if it came down to us vs. a pack of hyenas. Us vs. them, mine vs. yours. At first glance, I was trying to make a family with him that would survive. Survival and reproduction are what fuel human beings. Love and lust are what help us accomplish those two goals.

Thankfully, saber toothed tigers are not a great concern to us anymore. But the evolutionary traits that had us looking for a mate who would offer the greatest protection still exist, like looking for a male with high testosterone levels. That doesn't mean that the lanky, doe-eyed gentleman that reads poetry at Starbucks every evening doesn't attract your attention, because he still does. It really depends on what you're attracted to. For me, my attraction was centered on the boy with the blue eyes.

I don't remember how long I was staring at him but it must have been for a while because he looked up from his book and caught my eyes. After vociferating heavily under my breath, I sat down. But it was too late. The damage was done. As soon as I saw that he was looking my way, my heart started racing. I was drowning in embarrassment. I was never a smooth person, but goodness, I didn't have to stare a hole into his forehead.

The rest of class passed by very quickly. I kept stealing glances in his direction, I really couldn't help it.

What's his name? Where is he from? How have I never met him before? These thoughts, and many others floated through my head while my professor lectured on about the REM cycle of premature rats in the Jackson lab. I didn't absorb any of it.

When class was finally dismissed, I gathered my notebooks as quickly as I could, hoping to get the chance to say hi, or at least get another look at the beautiful stranger. But by the time I packed up my bag, he was gone. My irrational emotions would have to wait until Wednesday's neuro class to see him again.

---

That night I got together with a few of my girlfriends for beers and grilled cheese sandwiches. It was something that we liked to do frequently.

The first thing we always talked about were the partners in our lives. Jasmine, and Natalie both had boyfriends and they were very happy. They both had been dating for a while and although I was very happy for them, I wish I could see them more. They were always with their boyfriends. I wasn't jealous. I don't think I was jealous. Well, maybe I was a little bit jealous. It was impossible not to be. Being alone, when everyone else around you has someone is difficult. But at the time I would have never told them that. It was embarrassing. I should have been happy that they were happy. I should have been, but that's not always how it works.

Skylar was dating a stunning girl named Christina, they're still dating today. They cooked together, cleaned together, studied together, they basically breathed together. I wanted what she had.

“Sooo, guys...I met a guy!” I could hardly contain my excitement any longer.

Natalie was the first to get excited with me. I could always count on her to be my personal cheerleader, even if she cheered me towards my demise.

“What's his name? Where did you meet? How was the date?” She shot these questions off with a smile on her lips. She ran her hand through her wavy black hair hesitantly and stopped smiling as soon as she saw me fidget uncomfortably in the leather couch.

“What, Clara?” She asked, “Does he actually exist?”

Yes, I had made up boyfriends before, but only as a joke and so that I wouldn't seem completely alone while all of my friends were out on dates or hanging out with their loved ones, but that doesn't mean that all of the boys that I talk about are non-existent. She did not need to look at me with pity. It pissed me off.

“He's real!” I replied indignantly.

“OK. what does he look like?” This time it was Jasmine talking.

Her green eyes were looking at me with concern as she threw her auburn hair up into a bun, preparing herself to be my personal counselor, just in case he was actually another imaginary boyfriend. She was the mother of the group. The one to hold your hair back as you threw up all the tequila that “you could handle” and the one to hold you while you cried over a breakup.

“He is tall and he has very dark curly hair, with blue eyes, and he has tattoos!”

“He sounds gorgeous!” said Natalie as her deep brown eyes lit up.

“Where did you meet this boy?” asked Jasmine, still not sold.

Before I could answer the question, Skylar interjected.

“He sounds like a big big big dick.” We all stopped and looked at Skylar. We knew she was the cynical one out of all of us in the group but, geez, buzz kill.

“You don't even know him, Skylar.” Natalie came to my defense as per usual.

“No one is that attractive, without being a dick.” Skylar explained nonchalantly as she flipped her long blonde hair.

“That's not true. My boyfriend is attractive and great.”

“Yeah he's perfect, Jasmine.” Skylar replied sarcastically. I was so glad she said what I was thinking.

Josh was one of the devil's minions. He was egotistical and selfish. He was basically the worst boyfriend that any girl could possibly have. It's odd because Jasmine just refused to see that. They had been dating for 6 months, and he had gotten progressively worse as the relationship advanced. We tried to delicately express our concern, and she blew up at us. She was in love.

Jasmine, like many other people in relationships, becomes enchanted when they are around their loved one. That's because the parts of the brain that are associated with pleasure and reward are active. If I were to put Jasmine under a functional MRI machine as she feasted her eyes upon her masochistic boyfriend the amount of oxygen would

increase in the parts of the brain that are associated with pleasure. This increase in oxygen is due to the increase in blood flow through the parts of the brain that are more active during that given moment. The brain has many different parts that work in conjunction with each other. It is rare that just one part of the brain is working at a single time solitarily. The parts that are at work when someone is with their loved one or even just sees a picture of a loved one are regions such as the ventral tegmental area, the nucleus accumbens and the paraventricular hypothalamic nucleus. These areas that are active when Jasmine is with Josh are heavily doused with dopamine receptors. Dopamine is a neurotransmitter that is associated with that cloud nine feeling. When dopamine binds to its receptor it causes a chemical reaction in the body, making people in love feel as if they are slightly high. A lot of street drugs like cocaine and ecstasy mimic the effects of dopamine. The term love drunk is not so farcical.

The chemicals at work in Jasmine's brain are not confined to just dopamine. Two other hormones, oxytocin and vasopressin are very much associated with love and the elation that we get when we are with our lovers. Oxytocin, which is a hormone that is pivotal in labor and childbirth, is also the hormone that is released from nipples that helps the newborn baby find the boob to drink the milk (Pheromone!). This hormone is very important in mother-child bonds. Oxytocin helps the baby identify the mother and vice versa. It also helps create the feel-good feelings that encourage mothers to continue to do things like hold their babies intimately and breast feed. Oxytocin is associated heavily with intimacy. It extends further from mother-baby bonds all the way to romantic love. When Jasmine sees the narcissistic Josh, the areas that have oxytocin receptors are activated. These areas are the same ones that are heavy with dopamine receptors.

Vasopressin is in that same group of hormones, but is more associated with commitment and fidelity. Oxytocin, vasopressin and dopamine receptors are all found in various areas in the brain. And oxytocin and vasopressin receptors are found in other places in the body. Meaning that love is truly a full-body experience. Jasmine's unfortunate bond with Josh was stimulated by the fact that every time she saw her venomous boyfriend oxytocin and vasopressin were released. This release activates regions of the brain that are dense in vasopressin and oxytocin receptors. The outcome of the binding is the release of chemicals that are used as incentive to get Jasmine to continue doing whatever she was doing to make her body feel that good. Unfortunately, what she was doing at the time was Josh, and so her body encouraged her to continue hanging out with him.

I was telling Jasmine about the oxytocin and vasopressin information and I – accidentally – told her about the correlation between the amount of receptors found in the brain and monogamy in animals. A lot of really cool experiments were done on prairie voles (which are monogamous mammals). They found out that the prairie voles that have a high amount of vasopressin and oxytocin receptors are able to create monogamous relationships. While it's more provocative cousin, the montane vole, which has a lower density of vasopressin and oxytocin receptors in the brain, are polygamous mammals. The lower density of receptors makes them more provocative. Jasmine was convinced that Josh's problem was biological, that he must have a lower density of oxytocin and vasopressin receptors in his brain. Personally, I thought he was just self-absorbed and unaware of the mental strain that he put on my best friend.

Looking back, I wish I were less judgmental of Jasmine and how she dealt with her relationship. When you're looking in from the side of memory, it's all black and white, but when you're in it, there are many shades of grey. Little did I know, I was going to be in the same position as Jasmine in a short amount of time. I never understood until it happened to me. But it was evident with Jasmine, and me as well, that love is in fact extremely blind. Blatant faults are seen as endearing, or they are not seen at all. Every person has faults. Realizing them doesn't mean that the person has to be less of your friend, or less of your lover. Love, unfortunately, casts a film of ignorance over loved ones, making it difficult to see any faults at all.

This ignorance is literal. Just as some parts of the brain become more active when Jasmine was around the abhorrent Josh, the parts of her brain that are associated with making judgments and with emotion are inactive. So the parts that are supposed to let her know whether or not it was a good idea to be with him are dark while the ones that make her feel ecstatic to see him are lit up like the sky on the fourth of July. We are set up to fall in love, and then to stay in love even if the person that we fall in love with isn't necessarily good for us. From an evolutionary stand-point it makes sense; the person we fall in love with offers protection from the harsh environments that our ancestors were enduring. It's really too bad that our brains are stuck in an outmoded era.

"He is good to me! Well, whatever, this is not about me. Clara, tell us about your boy."

"Well, actually, guys, I don't really know who he is. I just saw him in my neuro class, and I stared at him like a complete idiot and I haven't seen him since then. I don't even know his name."

They all stared at me with pathetic looks on their faces. They pitied me. I think I was overgrilled cheese and beer night.

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Have you ever met a complete stranger and wondered what their story was? Or wondered what their story could be with you?

I do this constantly. I've seen strangers on the subway, and then all of a sudden without them knowing, they are married to me with three kids and a house on the beach in the Hamptons.

I've met someone at the grocery store and then unbeknownst to this stranger, they are helping me pick out what color we are going to paint our kitchen while our Labradoodle runs in our backyard.

I've met a boy at a party who comes home with me that night and falls in love, and then after university we get married and stay together forever. At our school reunion everyone admires the fact that we've been together since university.

My favorite fantasy is one where I'm waking up in the morning with someone's arm wrapped over me, holding me close. We are covered in a big white fluffy duvet, and we're so content, just lying in bed together all day. In that specific dream, we don't speak. We just lay there. The person loves me unconditionally and nothing needs to be said, or done for me to know that. I can feel it. I would kill to be able to feel that passion for real.

Dreaming is dangerous because eventually the dream will end. And then once it's over you're left with a hole where the dream once was. But at the same time I pray for those dreams because they keep me sane when I feel completely alone.

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Tuesday came and went. School, studying, eating and sleeping. But it wasn't a usual Tuesday. This Tuesday was special. It was electrically charged with anticipation for Wednesday. That night, I picked out my outfit, shaved my legs and did a facial. I was being ridiculous. I didn't even know his name, and I was preparing myself for him like Wednesday was our wedding day and I was his bride.

That morning I got up at 7:30 instead of 8 a.m. to make sure that I was ready, and so that I could be early to class.

I got to class at 8:45 a.m. and he wasn't there yet.

At 8:46 a.m. I started getting concerned that he wasn't going to show.

At 8:47 a.m. my anxiety was at an all-time high. What if he doesn't show?!

At 8:48 a.m. he walked into class.

As soon as he entered, my heart swelled and then started fluttering as fast as a hummingbird's wings. He sat down in the seat next to me, and my whole body started tingling. He's just so gorgeous. I looked up just as he looked up at me and smiled. My heart stopped for a second.

I was so knowledgeable on what was happening in my body and yet the helpless takeover of my nerves that he induced was unfaltering, regardless of my knowledge. As soon as I laid eyes on him, oxytocin and vasopressin flooded my system. The parts of my brain that advocate for desire and pleasure were lit up like a Christmas tree in Times Square.

Vasopressin and oxytocin bonded to their respective receptors, as did dopamine. The hormone flood began. This flood washed through my neural bodies and excited my sympathetic nervous system. My sympathetic system was the real culprit. When it is activated, epinephrine and norepinephrine are released. They are the hormones that cause the butterflies, the nausea, the sweating, dilation of my pupils and the increase in heart rate. I wish my nervous system knew how inappropriate those kinds of things are when one is trying to approach or at the very least seem normal around their crush. Pit stains are not cute. I understand that it is very important for survival. Back in the day, like way way back in the day it would have saved my butt. It's the mechanism that causes the classic fight or flight response. If I were being chased by a massive lion, my sympathetic system would be preeminent to my survival, but I wasn't being chased by anything so it needed to chill.

I did not talk to him at our Wednesday class, but I will tell you something: I remember being completely aware of his presence for the entire hour. It's a feeling that I got right under my lungs. A slight burning feeling. It was not necessarily a bad feeling but it definitely wasn't good. There was heat radiating in the pit of my gut. And every time he looked my way, that little ball of heat expanded a little bit more. If he looked away, the ball would shrink. I craved that little ball. I needed it to feel whole. Without it I felt like I was missing something. I should have known from that day that I was in trouble.

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September 21<sup>st</sup> was the day it happened. He came up to me after class and said hey.

“Hey.”

“Hey” was my response.

“I’m Ian, and I just wanted to introduce myself to you. Maybe we can study together or something. This class is pretty difficult”

I was sweating profusely. Not a cute glistening sweat, but a priest getting caught at a strip club kind of sweat.

“Yeah, it is really hard.”

That was my clever response.

“So what's your name?”

“Claire is my name. I mean Clara. Its Clara!”

Jesus Christ. I couldn't even verbalize my name correctly.

“I’m Ian. It’s a pleasure to meet you.”

The simplest of introductions caused a flood of warmth that washed through my brain and spread all the way down to my gut. The ball of heat in my stomach expanded just a

little bit more, and I felt a little more whole than I did a minute ago. Unaware that I had been missing anything before I met Ian, I was now fully aware. I needed the warmth that he, and only he, could supply. The hormone flood is addicting. The slow dopamine addiction was becoming stronger with every passing day. Those neuro classes quickly became my favorite.

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Each human is manufactured uniquely. Our bodies are sculpted based on many factors; ancestry, environment, society and also genetics. Genetics plays a huge role in who we are and how our bodies work. The ability of one person to feel and accept an emotion or a feeling may be a completely different experience for another person based on what our genes have predisposed us for. This discrepancy can be because of a number of reasons. These reasons can be social or physical, but they all have an impact. Think about our prairie vole friends. The amount of vasopressin and oxytocin receptors determined how monogamous they are.

Any one person will have a different amount and distribution of various receptors. Someone's literal capacity to receive love may be different from someone else's, just based on anatomy. Any one person can receive a whole bunch of love, but if they have very few receptors that are allowing love to be received and recognized, in the form of the hormone flood, then the love is lost. Wasted. Similarly, in a literal sense, if someone is not willing to accept your affection and appreciate you, no matter how much you pour out, it won't be enough. Josh is a perfect example of this. He may have a predisposition

to prefer a more provocative lifestyle but that doesn't mean that he necessarily has to. And that's the best part; biology is static. This ever-moving phenomenon called biology is not black and white, nor is it grey; it is plush with an infinite amount of colors. Genetics are our blue print, but we are still the architects, construction workers and painters of our lives.

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We exchanged phone numbers, and then I did not hear from him for a whole week. We would see each other in class, and it was fine but he just wouldn't text me. At first I thought that he was playing hard to get, but then I realized that nobody plays hard to get for a whole week. Then I thought that his phone must have been broken. But I saw him texting in class. Ian and I ended up going 9 days without texting each other. I'm pretty sure I was more aware of this countdown than he was.

I was waiting for a message from him as if it were a life or death situation, as if him texting me back determined whether or not I would be able to sleep that night, or survive until the next morning. I checked my phone every minute or so. These invasive thoughts consumed me. These overpowering thoughts were caused by the creation of emotional memories in my brain. Parts of the brain, such as the amygdala, which are associated with strong emotions interact with the hippocampus and create emotionally driven memories that tend to be remembered with much greater tenacity. Emotional memory compounded with the body's desire to receive more hormone floods caused by seeing the person of our affection were a great duo at making me feel like Ian was my new obsession. I kept

envisioning what it would be like when he finally messaged me and how wonderfully satisfying it would be. And yet days later I had not received a message. During those days, I found out that rejection through neglect is just as hurtful as regular old rejection.

On the 10<sup>th</sup> day, at 5:06 p.m. (I have a screenshot of the message), he messaged me.

“Hey you.”

Completely in denial to the fact that I had been ignored for a week and a half, I dove head first into his sweet words and kind messages. It’s incredible how I was able to go from melancholy to elation because of a message that was less than 7 characters long. I took the surge of epinephrine in my body as indication that Ian was a good idea. I assumed that if it felt good then it was good and that he must be good. Sometimes the human body can fool us.

We messaged back and forth for a week and then finally he asked me on a date.

Obviously, my answer was yes.

My school prep for Ian was extensive, and my date prep was a little bit crazy. I was getting ready for approximately three hours. Those three hours do not include me shopping for a brand new outfit nor does it include the one-and-a-half-hour nail salon appointment. I let my infatuation for Ian run my life that week. I did not think about anything other than that date for four days. On the night of the spectacle I was filled with nerves.

Although I was nervous, I was determined. Determined to make an impression, to show him that I was worth loving. In my mind this was an active exercise. I had this idea in my head that me, just being me, was not enough to make him want me. I had to actively impress him.

This happens in nature. Animals will put on a show to impress their potential mates. The difference between us and them is that their spectacles are not rooted from a lack of self-confidence, like mine were. Theirs stems from a need to stand out in the wild, to propagate their genes. Well, I suppose it is the same thing. Instead of fluffing my feathers, and leaving my urine trail, I put on a bunch of makeup and demanded that he love me. I too, after all, needed to propagate my genes. The weird thing about this is that in nature it's males that are usually the ones that have to work to woo the female. Today, in Western society, it seems that it is both the male and the female that have to put in a bunch of work. Not only did I feel obligated to put on makeup and wear my tightest dress, I'm sure he also felt obligated to look a little bit strong, and smell like an old spice commercial. Our desire to love and to lust comes from the idea that we need to make sure that our genetic information survives on to the next generation. The show that we put on is to ensure that we win the competition.

When I heard a knock on the door at 6 p.m., I threw up in my mouth (that darn epinephrine).

I yelled to my roommate to grab the door and brushed my teeth quickly. Looking at myself in the mirror, I saw a desperate girl. Desperate for lust, love and passion. I felt like I had been alone for far too long. A crazy thought. I was only, after all, 21. I had years to

find and keep love. But I didn't see it that way. I felt like I needed to make this, whatever it was, with Ian work. This date was my one chance.

A date in the 21<sup>st</sup> century for a 21-year-old woman is equivalent to being called onto a gameshow like Fear Factor or the Bachelorette. Excitement is inevitable, but there is also an overwhelming sense of doom. My date with Ian was no different and when we got to the little Italian restaurant at the corner of 21<sup>st</sup> and Bank, my nerves were super-active all over my body. Like little extensions routed from my spine and brain, I could feel each neural extension twitching; just waiting for action. My ancestral brain was interpreting this date with the same seriousness as a trip to the watering hole in the dangerous African wilderness and so along with my nerves, other parts of my sympathetic nervous system were in overdrive. I was bundled into such a tight ball that a phone ringing could completely transform me into a wild animal finally let out of its cage (epinephrine!).

So I ordered a glass of wine. And then another one. And then another one. Alcohol is a tricky drug. It acts as a depressant, meaning it slows everything down. It does this by targeting the neurotransmitters in our brain. There are two general types; excitatory and inhibitory neurotransmitters. Excitatory neurotransmitters create an action in the body, while inhibitory neurotransmitters will stop an activity and slow things down. Glutamate, which is an excitatory neurotransmitter, is suppressed by alcohol. And then GABA, which is an inhibitory neurotransmitter, is increased. Additionally, my good friend dopamine is increased as well. I was euphoric, while simultaneously sluggish. A perfect first date. The combination of those three chemical changes is what made me more than a little bit tipsy that night. My brain was all out of whack. My cerebellum which controls

movement was depressed which had me staggering and tripping over nothing. My cerebral cortex, involved in thought processing and consciousness was delayed which made me more uninhibited than usual. My medulla which functions in automatic functions like breathing and body temperature was slowed down making me sleepy. And my hypothalamus and pituitary, which controls automatic brain functions and hormone release was slowed down making me more sexually aroused (but because of the inhibition of the cerebellum, cerebral cortex and the medulla sex would be very difficult). I was a lethargic, stumbling, sleepy mess.

We started talking and the conversation flowed just as easily as my wine flowed from the bottle to my glass.

He seemed smart and funny; I felt that I had really hit the jackpot with him. Every time I looked up from my plate, I would meet his blue eyes gazing at me. It made me feel special. I felt an overwhelming sense of euphoria or drunkenness, they're hard to decipher. Each compliment was complemented with a rush of heat. And any time he touched my hand with his, my heart rate would increase. With every compliment and every touch, with every gaze he supplied me with a flood of epinephrine and dopamine. I was elated. Throughout that date and throughout our relationship he became my furnace. He gave me heat and warmth, in the form of all of the chemical reactions in my body, that I felt like I couldn't find anywhere else.

Our first kiss was when I was in a drunken stupor, but I remember it. The momentousness of the kiss was so grand that my brain registered it as important enough to transfer to long-term memory. I knew that this memory, along with all emotional memories, is

triggered by specific emotions and that they last longer than other memories. It would never be forgotten. He drove me back to my apartment and walked me to the front porch. He said something that for the life of me I cannot remember. What I do recollect is the moment he leaned in to lock lips. As he slowly leaned his body towards mine and touched his hands to my waist my body was releasing oxytocin, dopamine and epinephrine. The combination of those hormones and neurotransmitters caused my cheeks to flush, my heart rate to increase, my pupils to dilate and caused my breathing to become a bit more staggered than usual. As we kissed and the hormones increased, there was also a decrease of stress hormones circulating through my body, like cortisol. As I closed my eyes and waited for his lips to finally touch mine, I was walking on air. When our lips touched all I felt was bliss. As we delved deeper into the kiss, the saliva that we exchanged contained testosterone which helped increase my libido and made me want to kiss him even more. My conscious brain was focused on the bliss of the kiss, but my subconscious brain was tasting, and smelling him. My subconscious brain was making sure that he passed all of the tests. And he did. The kiss felt good and I felt good doing it. That overall sensation meant more than the fact that he was a good kisser. It meant we were a good chemical match.

After that first date we started spending all of our time together. It was an overwhelming, time-consuming addiction. I needed to see him, smell him, hear him at all points of the day. I was the addict; he was my vice. At no point during the first couple months did I think that maybe I was spending too much time with him, and at no point did I even consider spending less. I remembered the old me, the one that hadn't been in love, and I remember being so judgmental and harsh to my friends that abandoned me when they

were falling in love. Apologies were in order. I understood that this feeling was so satiating. To walk away from it, would be painful and the thought of him possibly leaving me was terrifying.

The addiction that I had for Ian was much more than a figment of my imagination; there was a shift in my chemistry as soon as I fell for him; the hormone serotonin decreased and cortisol increased. Serotonin makes us feel good, and cortisol makes us stressed. The combination of low serotonin and high cortisol levels is characteristic for people who have obsessive compulsive disorders, depression and anxiety disorders. Those hormone levels are also characteristic for people who are falling in love.

The ultimate difference between love and infatuation is that infatuation gives you room to make choices. You want the other person but you do not need them. Love, on the other hand, becomes a need. It grabs you and throws you into an inescapable hold that threatens to take your life. At no point do you struggle to get free and at every moment you are more than willing to offer up more of yourself. This was how I felt and this is how I knew that I was in love with Ian.

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“How is the boy?” Skylar asked

I had come up for air. The girls and I had finally found time to get together again.

“He’s great. I don’t think I’ve ever been happier.”

“And he’s nice to you?” asked Natalie. “There’s no funny business, eh?”

“Not at all, I feel as if I’ve figured it out. All the stars align, the cow finally got over the moon, the fat lady has sung, they’ve all happened. I’m complete, I’m whole.”

The look on their faces should have warned me. Speculation, concern, and hesitation were compounded on the faces of my three best friends. Jasmine was the one to speak up.

“Just make sure you don’t put all of your eggs in one basket Clara.”

I had never been one to take good advice.

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Time passed. Our relationship grew. With each day there was another dimension added to who we were. Our lust was turning into compassion, and our love was morphing into something more concrete. I was at the point where I needed him. Emotionally, mentally, physically: I needed him.

The physical need was satisfied sexually. Our sex was the epitome of any sex that I had ever had, and in my egotistical world, it was the best sex that anybody in the whole world had ever had. Physically, it felt good but emotionally, the connection that I felt was breathtaking. When we made love, we were like two pieces of a puzzle that were finally put together after hours of work.

Rocking and swaying in our sea of love, the same heat that came from my brain when we first met was present all over my body. From my toes to the tip of my head I was flooded.

And when I reached the top of the wave ready for the break I was leaping head first with reckless abandon into a sea of heat and passion. Any amount of heat that I thought had existed in my body before was multiplied by ten and the power of it all was overwhelming. My whole body would go numb in these moments.

Sex is much more powerful than people think it is. To say that it causes pleasure wouldn't do it justice. The sex that Ian and I had was clear-cut in its purpose; to allow him and I to be as close together as possible without actually becoming one person. He touched me in the most sensual ways and in the most sensual places. My wrists, my fingers, my nipples: with every touch a little bit of oxytocin was released. Accompanied with the release of oxytocin was the activation of dopamine in my brain. That started the sympathetic nervous system cascade that made everything feel good. The release of all of these hormones and neurotransmitters occurred slowly until at the very end the biggest release of oxytocin of all: orgasm. And with that grand release was the feelings associated with it: pleasure, comfort and a desire to feel it all again.

In prairie voles, it takes one orgasm for them to mate and for them to pair bond for life. I felt very similar to the rodent family in that moment; when Ian and I first had sex, I immediately felt a deeper attraction, and a deeper connection with him. It added an entirely new dimension to our relationship. I felt more comfortable around him, and the more sex that we had, the happier I was. This was just another way that I was dependent on Ian. I craved the rush of pleasure that I felt when he touched me and kissed me.

There are so many layers and dimensions to sex. From the moment you think about the idea of sex, especially with someone that you are lusting for, your body chemistry

changes. It starts with just the thought of a kiss and then from there it's just a beautiful exponentially charged emotional cascade that can unhinge any person.

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Saturday night for a college student is like watching a dog in heat hump a human leg. Uncomfortable.

My girlfriends and I always get ready together on Saturday nights. Tonight we were going to a random house party not too far from Natalie's apartment so we were going to get ready and pre-game there.

After we each got ready in Nat's bedroom we all got together with her two roommates in the kitchen and started drinking. Nat and I were sharing a fifth of tequila. Christy and Skylar were sharing a bottle of Captain's together and Jasmine wasn't present because Josh broke up with her for the millionth time and she "couldn't bear the thought of having fun when she knew that he didn't love her anymore".

"I have never dated anybody, and I don't plan on doing it for a while" said Teresa, one of Nat's roommates.

She was gorgeous: mocha skin, green eyes and long deep brown hair. She could have been a model.

“That’s kind of lonely, don’t you think,” asked Nat as she poured herself another shot, “don’t you miss having some sort of companionship? Someone to rub your back, or say cute things to you?”

“I can say cute things to myself. And any Tom, Dick, or Harry can rub my back. I hate to break it to you guys, but boys are sluts. They might never actually get the title but they are definitely sluts.”

Christy started laughing, “I have never heard anyone call a boy a slut before. But I guess it’s true.”

“I mean all we have to do is tell them we want sex and they pull out their thingy.” Says Nat as she starts cracking up. At that point Nat leaned in really close to all of us she whispered, “the key is, ladies, to spray yourself with the stuff that makes them go nuts!”

She stared at us for a while, waiting for our reaction.

“What’s that Nat?” I finally urged as it seemed that she wasn’t going to tell us what it actually was.

“I bought this little spray bottle filled with pheromones from this website and apparently it attracts all the boys’ attention. I swear my boyfriend goes nuts.”<sup>2</sup>

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<sup>2</sup> There is no proof that “pheromone perfumes” will attract mates. They also have not been approved by the FDA.

She had this child-like excitement plastered all over her face, and I wasn't going to be the one to crush her dreams and apparently no one else was going to crush them either so we changed the subject.

“Well anyway... boys are gross. They're all just gross.” Shouts Teresa.

We continued drinking and talking, but mostly we continued drinking and all of a sudden (or it seemed like it), everyone was quite drunk. Jasmine usually had us count our shots, but she wasn't there so we got a little out of hand.

I remember going to the bathroom, looking in the mirror and not being able to re-apply my lipstick. (This is never a good sign. Never.)

We walked over to the party and stepped inside. It was hot, muggy and smelled like stale beer. It was crowded and loud, and the music was blasting loud enough so that no one could have a meaningful conversation. There were girls running around in the bare minimum. There was a scarily high amount of groping and inappropriate make-out sessions. There was sexual grinding and dancing. If there had been poles present, I would have been concerned that this would turn into a strip club.

If I could describe a college party in one word it would be icky. The best, or I guess the worst part is the fact that when you are wasted you do not realize the absurdity of the events that are unfolding around you. The groping is good attention, the make-out sessions are cute and the nudity is attractive.

We walked into the party, and we were excited. We headed straight to the kitchen to make ourselves another mixed drink, as if we really needed another mixed drink.

As we were shoving our way to the opening in the kitchen someone grabbed my arm and pulled me away. This aggressive behavior didn't faze me. I was drunk at a party after all. And when I finally looked up and saw who it was, nothing else mattered. All I could feel was Ian's fingers wrapped tightly around my wrist, and all I could see were his eyes. They were staring right into mine. That was all it took, and I knew that whatever he wanted in that moment he could have. It didn't matter if he never texted me back, or that he barely spoke to me in class. In my head, all that mattered was the fact that he was with me, talking to me at that party.

The ball in my gut was swelling and expanding with every word that he spoke to me. I was euphoric. I don't know if it was the tequila or if it was Ian. But I was the happiest girl in the world.

We spent the majority of the night together. Every so often he would disappear for a minute or two to go and talk to one of his guy friends or to go talk to another girl. But he always came back and put his hand on my lower back and whispered something cute in my ear. As the party started dying down and people started leaving, Nat and her roommates told me they were leaving and asked if I wanted to go with them. I turned them down, having intentions to go home with Ian. When Christy and Skylar said they were taking a cab home, I turned down their offer to split a cab as well. Ian was waiting for me.

All my friends were gone, and there were just a few guys and a few girls left at the party. Ian was talking to this blonde girl but I really thought nothing of it. I was his girl tonight. He finally pulled away from her and came up to me. Finally, we were leaving. But instead of heading to the front door he pulled me into the bathroom and locked the door. He kissed me. It was a sloppy, wet kiss, with a lot of tongue.

They should change the saying to: A kiss is worth a thousand words. The way someone kisses you can tell you so much about a person. It goes beyond whether or not they use too much or too little tongue, or if their lips are too big or too small. It's their smell, the way they touch you, the way they hold you, their breath. Pay attention to how they kiss you but more importantly, pay attention to the way you feel when they're kissing you. That night at the party when he kissed me, I didn't like the way any of it felt. And when he touched me, I was uncomfortable. That night I learned that just because sex feels right one time does not mean that in another situation it will feel good at all.

"Let's get out of here, Ian," I slurred

"How about we just stay in here for a little bit?" he replied as he nuzzled my neck.

"Wh---?"

But he covered my mouth with another kiss before I could get the question out. He started pulling up my skirt and pulling down my underwear. And then that was it.

"Alright, Clara. I've got to go."

He kissed me on my cheek as he pulled up his pants and left me in the bathroom.

After he left my tequila came up in heaves. I found what little dignity I had left, and I peeled myself off of the bathroom floor.

I could have sworn that as I was leaving the bathroom I saw him leaving through the front door with the blonde girl from the party. But that couldn't be true. My heart wouldn't allow it, nor would it allow the fact that I had been raped. These two things were hard for me to accept, and so I didn't.

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“Mom, what was your first kiss with Daddy like?”

“It was beautiful, Clara. We had been dating for a while, and finally after this romantic dinner at Luigi's he walked me home. When we got to my front door, he gave me a hug and then pulled in for a soft kiss on the lips. I'll never forget it.”

“That sounds really nice, Mom.”

“Why, Clara? Are you planning on kissing a boy anytime soon?”

She asked the question, but I could tell that her mind was somewhere else, thinking about her love and her first kiss.

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For all of my readers who do not drink belligerently on the weekends, do ridiculous things and then regret them heavily in the morning, I am going to do my best to tell you how it goes.

Usually, you wake up, super early even though you went to sleep at about 4 a.m. Upon initial opening of your eyes, you are confused and dazed. You think it's just a normal morning. And then after a few seconds, you come to reality. Your limbs are sore from running in heels. Your throat hurts from all of the yelling and all of the vodka. Your head is pounding as if a little construction man were using a jackhammer on your frontal cortex. Your mouth is as dry as a swab of cotton, and you're pretty sure that if you don't consume some sort of liquid, you will die of dehydration.

And as bad as the physical aspects are and as uncomfortable as you are with the physical state of your body, your brain is the part that really brings you to your knees. Your brain, and the memory of the night.

It only took three Snapchat stories for me to figure it out. Ian's, Nat's and Jaqueline's (the blonde girl from the party).

Nat's Snapchat story showed me how drunk I was.

Ian's Snapchat story showed me that he was talking to me for a lot of the night.

Jacqueline's story showed me that Ian went home with her that night.

The ball of heat under my lungs was almost non-existent. I could feel a sharp pain in my chest and my whole body felt numb.

I never realized how accurate the term heartbreak was until it actually happened to me. It felt as if my heart was literally ripping into pieces. That ball of heat that once made me feel whole shrunk away and took a piece of me as it left. I was missing part of my core, he took that with him. My stomach hurt, my legs were weak. How was I supposed to walk? I couldn't breathe. I remember laying in the fetal position just listening to myself cry. Trying to comfort myself and keep myself together. Hoping, praying that if I held myself tight enough I could try and make the hole a little bit smaller, make my heart beat again, be able to inhale. But I couldn't. I was in pain. I wish I could breathe. Have you ever heard yourself cry? It's a terrible sound. That gut wrenching cry that lets you know that you have been completely and utterly mangled. That you are irreparable. You just wish you could breathe. I wished I could breathe.

Every morning I would wake up and go back to sleep. The first few days were like this. I lay in bed and cried. When I looked at social media, I could see that he was having a blast: at the movies, sushi dinners, video games. He had no idea of the agony that he was putting me through. Of course, I hadn't told him, but wasn't it obvious? We went from spending every single night together to nothing in a matter of minutes. He was inside of me 5 days ago. Inside of me! Doesn't that count for anything? We had talked about our futures as he held me, kissed me, rubbed my back. Did it mean anything to him? Because to me it meant the world. He meant the world to me. He was my world and I was nothing but another girl to him. The pain lasted for such a long time. Crying, crying and crying. I rocked myself to sleep by holding my insides together. I held on to myself as tightly as possible. I was scared that if I didn't, it would all spill out. There would be nothing left of me but a shell. So I held on as tightly as I could. The pain lasted for such a long time.

The physical pain that I was feeling was very real. All the pleasure that I felt when Ian and I were at our best had evaded me. Oxytocin, vasopressin and dopamine were no longer present, what my brain amplified instead was the release of stress hormones like cortisol and epinephrine. In a short surge, these hormones are very helpful to help deal with stressful situations. Over a long time, however, they cause undesired effects. Cortisol over a long period will send blood to the muscles causing them to contract, causing the pains and aches. And blood is moved away from the gastrointestinal area, which can cause cramps and diarrhea. My brain was registering my heartbreak as literal pain. My body was breaking down because of the heartbreak\*. Acute stress over a short period of time is okay, and also necessary for survival. But over long periods of time, when stress becomes chronic; the effects on the body are magnanimous. In some people, like myself, stress is a chronic phenomenon that lasted for what felt like an eternity.

Heartbreak is a very physical thing. Love is a very physical thing. You develop a dependence to the person that you are spending all of your time with. This dependence runs deep. It satiates you, makes you happy. Love is a bit like a trap in the sense that you don't know when it will up and leave. It takes so much courage to love, and to be loved. In this world that is so inconsistent and so unpredictable, leaping into the arms of another faulty human is terrifying. And the repercussions are magnanimous. Imagine, loving someone with everything that you have, with all of you. Then by some terrible misfortune your lover dies; a little part of you will die too. It is demoralizing to lose the person who has become part of you, someone that you have a life with, someone whose presence has become an extended part of you. Your thoughts become their thoughts and your memories become theirs. I wonder to myself everyday why I did this to myself. Why

humans do it to themselves. And then I remember that romantic love is very much involuntary. But at the same time, even if it were voluntary I'm sure humans would participate still. Like a drug or alcohol, consumption of it makes you feel good. Regardless of the health risks, the pleasure outweighs the sacrifice. And plus when it's good the feeling is satisfying and irreplaceable. When it's bad, we seek the potential and the hope that one day it will be good.

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“Hey beautiful.”

“Hey Ian, what's up?”

I was trying to remain cool and distant, but I could feel that ball of heat slowly coming out of hiding. As soon as I looked at him, into his deep blue eyes, that ball expanded and swelled. I remembered all of the good times. In that instance I forgot that he had abused me, embarrassed me and left me on the bathroom floor. I forgot that he slept with someone else, on the same night that he had slept with me. I forgot that he had hurt me physically and emotionally. It didn't matter, right? I was in love.

It still startles me and scares me how quickly I forgot. Any doubts and uncertainties disappeared completely and I fell into him. I flew deep into the eye of the tornado. It was calm, but I knew that at any moment it was going to pull me into the winds and spit me out again.

We want to feel good and we seek the things that make us feel good. The bad memories, the ones that make me cringe and cry those ones are substituted for the ones that make my heart swell and make me gush. The moments where I felt vulnerable and embarrassed were replaced by those moments where I felt like I was in complete control of my heart and myself. I confused and contorted solid memories. Memories are so misleading; they are a collection of perceptions that are changed every time a memory is retrieved.

Through loving Ian I learned how malleable memories really are. I pushed the bad memories deep into my subconscious and on the surface all I left was the good. I saved myself from the pain and I went straight for the pleasure. I allowed myself to be soothed with the malleability of my memory.

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Telling my friends that I was going over to Ian's to hang out was more difficult than anything that I've ever done. They disapproved of him so heavily that even me texting him pissed them off. I got to the point where I changed his name in my phone and refused to let them know when I was with him.

We went back to doing all the things that we were doing before the incident. I didn't ever bring it up, and he definitely didn't. In many ways I was encouraging the fact that he cheated on me by pretending it didn't happen. There was no discussion, no remorse and not even a whisper of hope for an apology. I kept telling myself that he was sorry. But I could have probably judged based on the fact that he didn't apologize that he wasn't sorry.

One of the greatest lessons that I learned from this experience is that when someone shows you who they really are, that's usually who they really are.

I had chosen to forgive Ian. Unfortunately, upon the decision of forgiveness, all of the memories of the incident were still fresh in my brain. The incident was un-changeable in my memory. Or at least, the important parts were. There were many triggers that initiated the feelings of anger that I had towards Ian because of that night. And it felt like, the longer I “forgave” him the more acute those memories became and the more blood red my rage became. Things that triggered memories of the incident were pictures of Jacqueline. As unhealthy as it was, and unfair as it was, I associated Ian’s treatment towards me with her. Anytime I saw a picture of her, or heard her name my body would tighten up, my heart rate would increase and my stomach would choke itself into huge knots. Another trigger was anytime Ian leaned in to kiss me when he was drunk. Whenever he did, my brain would immediately go to his sloppy kiss that night. There were many moments where I would find myself in tears because of a memory. These triggers elicited the feelings that I felt during the incident. Emotional memory was what made sure I never forgot that night. My brain was telling me that the experience that I had with Ian that night was a moment that my body interpreted as important enough to never forget.

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“Do you guys do anything but lie in that nasty room, watch movies and have sex?”

The girls figured out that I was with Ian the other night.

“Yeah, we do stuff.”

That was my meager response. They were about to eat me alive.

“He is basically the definition of Netflix and Chill, but he’s too cheap to buy Netflix so he just puts a whole bunch of viruses on your laptop from random streaming sites.” Said Skylar

“Great job, Ian,” added Jasmine as she does a slow clap. The slow clap was very sarcastic and super unnecessary.

“Do you guys even watch good movies? I bet he makes you watch nonsense. God, I hate him.”

I finished the rest of my beer and shoved a grilled cheese sandwich into my mouth.

Has he even taken you on a date yet?” asked Jasmine incredulously. “It’s been months!

I cracked another beer open. He hadn’t.

“Have you checked him for STDs? Do you use condoms?”

Jesus Christ.

“Do you?! This isn’t a joke.”

Jasmine was able to replicate the same shrill tone as my mother. It was impressive.

“Of course, I use condoms,” I replied.

“Thank God.” quipped Nat

“He should really take you on a date, Clara,” repeated Jasmine

I finished my third beer, and we were still talking about Ian. It was a long night.

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I want to say that I was completely happy and that my friends were completely left field but I wasn't. Every so often I would remember. I would remember that I wasn't his first choice. And that at any point I could become his second choice again. These thoughts left me feeling breathless. I would do anything to be his first choice. I was desperate for it. I had the choice to walk away but I was stuck. As each day passed I was sucked deeper and deeper. Without him, I'm breathless, and at the same time the longer I am with him the more breathless I become.

The hardest part, I think, was realizing that it was a choice. The pain I was feeling was something that I was choosing to inflict upon myself. I could be free of pain. I could feel good again, but for the life of me I couldn't find the courage to say goodbye. I think that that was the hardest thing to accept. The fact that I was willing to continuously hurt myself.

“Kiss me.”

We were lying in bed. Ian was playing video games, and I was reading

“Give me a second Clara bear. I just want to finish this level.”

“God forbid, you kiss me on the cheek for a second and then go back to your game” was my quick retort.

It was getting harder. The fact that I was second even just for a minute was getting harder and harder to accept. As time passed that pathogenic seed germinated and dug its roots into my memory. I was his second choice. I could be his second choice again. I couldn't shake these thoughts, and he did nothing to try and remove them. If I brought up the girl from the party he would shut down the conversation before it even began. So many times, my death seemed inevitable when I was with Ian. He was metaphorically killing me. I was letting him kill me. Just walk away Clara. I couldn't. You don't walk away from something you love, you either get kicked out or you drag yourself away while your internal soul kicks, screams, scratches and cries. You tear yourself into millions of tiny little pieces to escape.

Paranoia and anxiety were becoming who I was. The thought that whenever he wasn't with me meant that he was with someone else. The conflict of whether I should just end it and be alone or stay with him and constantly doubt. Plus the fact that I had no idea what staying with him meant. We had never officially started dating. He didn't see the need in ruining anything with labels. I saw it as a cowardly way of refuting commitment. With tattoos laced into his whole entire left arm, I knew that commitment wasn't the issue. So then the only solution was that I was the issue. The burden of being an issue, of being second, of knowing that I had the choice to walk away and I wasn't was causing my soul harm and on top of that my body was more stressed than ever. Moments that used to cause the hormone flood were no longer igniting any sort of happiness within me. I was

surging with cortisol and other stress hormones; and with that came the knots in my shoulders, the insomnia, and the constant colds. I was deteriorating.

“Just kiss me, Ian.”

Desperation washed through my voice. He paid no mind.

“Come on, Ian. Just kiss me.”

I needed him to love me back.

“Clara, I’m busy right now. Give me a second.”

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My evenings went like this.

At 11 p.m., he would text me.

By 11:15 p.m. he would show up.

At 11:30 p.m. we had sex, no foreplay.

He left the next morning at 6:45am or 7am,

And I pitied myself.

I don’t remember when our relationship became all about sex, but once it did I completely lost interest in it. The sex became dry and pokey. It was borderline painful, and I felt like his breath smelt weird. All of these physical changes started after he cheated on me. My brain no longer saw him for the knight in shining armor and he started

becoming the boy who cheated. But yet even still, those emotional memories kept me holding on. I still sought for his companionship. I was still bonded to him even though he had rejected me.

That night when I went over to Nat's for grilled cheese and beer night, I went over on a mission. I got my girls with me, and I composed the message. It was probably the most wonderful message that I had ever written. Filled with fantastic metaphors, beautiful analogies, and raw emotion. I had never written down exactly how I had felt about Ian, or how I felt during the relationship. That message was the key that unlocked all of the emotions that I had ever felt for this boy. I was liberated.

I sent the message.

His reply was angry, aggressive and acidic. I cried. I apologized, and I took him back.

I can hardly keep track of how many times this happened.

The shame of taking him back was starting to take a toll on me. Apparently after he found out that I could break up with him, he was ready to change. But did that mean that everything that had happened in the past no longer meant anything. How far does forgiveness go?

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“How's school going, love?”

It was Christmas Break, the longest break that Ian and I had to go without seeing each other. And I was home. It was so nice to be home.

My dad and I were sitting in the living room. The Christmas tree was lit up magnificently, squeezed into the corner, and presents were scarce, but an appropriate number for an only child with no younger kids in the family. There were stockings above the fireplace and the fire was crackling and jumping, demanding our attention. The fire, and being home made me feel warm.

Unable to answer his question, I changed the subject. My parents didn't receive my report cards anymore, but I still felt ashamed of the semester that I had been having. For school and also for life.

"It's OK. How's work going? Mom was telling me that you guys added another contractor to the business. That's great!"

I couldn't tell my parents that I had been completely neglecting school. I was failing 4 out of 6 of my classes and I would probably have to retake them. That's not something easy to tell your parents when you had been a 4.0 student up until your third year of college.

"Yeah, we've really expanded, kiddo. Your mom and I might just be able to have an early retirement! Hey, how's that boy of yours?" He did a fake boxing swing. "Do I need to rough him up a bit?"

If only he knew.

"He's good. We're good."

"And what about the girls? I talked to Nat's mom the other day. They're thinking of buying her a new car."

“Lucky girl.”

My voice was dead. Flat. Emotionless. Any emotion that I had was drained as soon as my dad brought up Ian. That’s what Ian did, he drained all of my emotions. At first his name ignited anger, but rage was hard to contain and one day it became too much and I decided that it would be easier to just not feel. At first he had heightened them, everything was euphoria and bliss. But how quickly that had all changed to an empty void.

“What’s wrong, kid?”

I have this habit: When someone asks me what’s wrong, sympathy is all it takes to tip me over the edge and I start balling. When my dad said, “What’s wrong, kid?” I realized that everything was wrong. I was in a relationship with a person that didn’t care about me on the same level that I cared about them. It was exhausting. I was exhausted.

“I can’t do it anymore, Dad,” I sputtered between scattered breathes and hiccups.

“Do what?”

My dad was baffled. He had no clue of what to do or how to react. He called for my Mom

“Cristina! Something’s happening to Clara!”

I couldn’t help but start laughing. I must have looked like a maniac. He seemed scared that I had turned into some sort of crazy monster. He was looking at me as if I had a horn right in the middle of my head.

My mom showed up in the doorway carrying a dish towel, and wearing a dirty apron. I looked at her, and then I looked back at my dad. My anchors. My support. At the very least, if I couldn’t be alone, I would have them.

“Oh no, what’s wrong love?” my mom asked.

And the tears started again.

“Ian.”

“OK, sweetie, let’s go upstairs. There’s nothing a nice shower can’t fix”

I followed my mom upstairs and into the bathroom. The water cooled me down and healed me a little. It gave me some of my heat and some of my color back. I stayed in the shower and I cried for an hour. I don’t know if it was the comfort of being home or the grand blessing of being away from Ian but I felt a different kind of wholeness.

The feel good hormones, oxytocin, vasopressin and dopamine are not only released upon company with romantic loves, they’re also activated by being surrounded by parental love, friends and family. My source of happiness was not limited to Ian. That fact saved me.

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It was time.

Ian walked into the restaurant. He saw me and smiled.

God his eyes are magnificent.

“Hey, Clara.” He kissed me on my cheek

My heart stopped for a second.

“Hey, Ian.”

“What’s up? What’s all of this about?”

I paused and took in the scene. Couples, and families were over packed in the busiest restaurant in town, the little Italian shop on 21<sup>st</sup> and Bank Street, where we had our first date. I thought it would be poetic to make it all come full circle. In that moment, I regretted it. Nostalgia was taking over, and that first date; with that first touch, first kiss, the firsts of it all, they were bringing me to my knees.

I realized that he was waiting for me to say something.

“Ian, we have to stop this.”

“Stop what?”

“Whatever we are, us.”

It took a moment for him to register my words. When he did, his face changed. His eyes clouded over. No longer were they sparkling, they seemed dark.

“You want to stop seeing me?”

“I mean I wouldn’t really consider it seeing each other. We just have sex” was my reply.

“I thought it was more than that. Clara, you know I’m going through a lot of things right now. It seems a bit selfish of you to do this right now. It seems like you’re just doing this because it’s convenient for you.”

Me? Selfish?

“I don’t know if that’s it Ian. I think that I’ve been more than accommodating for you, these past months. I’m going to try and take care of myself now.”

Ian stared at me for what seemed like an eternity without saying a word. And then without so much as a goodbye, he stormed out of the restaurant.

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I got home that night, and I lay in bed. I was distraught still, and still in the healing process. I was about to go fall asleep and then Beyoncé came on. It was the song To the Left. I remember singing it for the first time on the playground in like 2<sup>nd</sup> grade. I remember singing it with such confidence and such sass. I knew, at the age of 6, that there would never be a boy who would walk all over me. And if they had the audacity to, I would shove them into a corner just like Beyoncé did.

Sitting in my apartment, by myself, listening to Beyoncé was all I needed. I got up, and I started singing, at the top of my lungs. I was basically yelling. I was laughing, and yelling and singing and I realized that I hadn't felt this happy in a really long time. Before I knew it, I was crying. Not sad tears. My tears symbolized something so much greater than Ian. My tears were tears of relief. I loved myself and I was happy. I was having a really good time all by myself.

Music and the power of music are very much underrated. It has the capacity to change moods, to lift spirits and to help heal. Similarly, to most things that feel good to the human body, when we hear music that we like there is an increase in activity in the parts of our brains that are associated with reward. The release of feel-good hormones like dopamine, oxytocin and vasopressin start a cascade in our bodies that allows rejuvenation. I needed that space and time with music; to start my healing process.

I put on Pandora radio and I danced for what felt like eternity. Dancing, laughing and singing. Eventually I got hot, and I shed all of my clothes, except for my underwear and bra. I was booty popping, and twirling, I was acting like a fool, and pretending I was a ballerina. I was having fun. I was happy. I could breathe. And in that moment I took one more step forward; I learned that me, all by myself, that was enough. In many ways though this lesson was not first learned in that moment. I had learned that I was enough 21 years ago. Twirling like a ballerina, dancing, having fun all by myself were things that I had been doing for years. When I was younger there was nothing that could have stopped me, especially not a boy like Ian. The transition from girl to woman had done something to my self-confidence but in that moment I was choosing to reclaim it. As a child the love that I needed was within me and was fueled and kept alive by the love that my family afforded me. My support system was strong then, and it was enough to get me through anything. My support system now was just as big, if not bigger because I had added even more people to my family, friends like Jasmine, Skylar and Natalie who would protect me no matter what. So that night as I danced in my underwear I allowed myself the space and time to regress to a person who was untainted by people like Ian and Jason Darty. I danced knowing that I was loved and was someone who could be loved. I, in that instance, allowed myself to forget about romantic love, and I focused on self-love. I let myself become a kid again and it felt so good.

## GLOSSARY

**Blood Plasma:** When I refer to plasma in this piece, I am referring to all of the parts of blood except for the actual red blood cells. The plasma contains water, salts and proteins, while the blood part consists of the red blood cells, white blood cells and platelets. The plasma is what is looked at when researchers measure hormone levels in the blood.

**Dopamine:** a neurotransmitter that is released in the brain that binds to dopamine receptors. Dopamine is both an excitatory and inhibitory neurotransmitter. Dopamine is associated with the cloud nine feeling that people get when they do drugs or when they drink alcohol. It is also found in very high concentrations when people are in love and with their loved ones.

Through research with the prairie vole, a monogamous mammal, researchers found that there are two dopamine receptors D1 and D2. Upon binding of dopamine with D2 receptors, the prairie voles form their pair bonds (fall in love with their mate). After pair-bonding, the D1 receptors are upregulated (increased) and the dopamine binds to the D1 receptor. The D1 receptor is what stops the vole from forming any bonds with other voles. It causes the vole to be more aggressive towards voles that are not its partners.

**Embarrassment:** a biological mechanism to help smooth out our social skills. Humans have been social animals for a long time and the capacity to interact well in a group without committing social faux-pas helps with those relationships. Embarrassment is a way of discouraging social bloopers by activating the sympathetic nervous system.

**Epinephrine:** a hormone that binds to the adrenergic receptors in the body that cause effects like pupil dilation, butterflies, and sweating.

**Functional MRI machines (fMRI):** a machine that measures the amount of oxygen that is present in a certain region of the brain by tracking the amount of blood flow in a certain area. For reasons not fully understood, neural activity increases blood flow much more than oxygen metabolism. Oxygen rich blood has very different magnetic properties than oxygen poor blood meaning that the MRI machines are able to pick up when a certain part of the brain is high in blood, and in activity. The fMRI machines have been used to study which parts of the brain are active depending on what someone is doing.

**Hormone:** a regulatory substance made in the body that circulates through the blood to reach its target tissues or organ.

**Hypothalamus:** the part of the brain that functions in hormone production. The hormones from the hypothalamus control many necessary function such as temperature regulation, mood, thirst, hunger and sex. The hypothalamus also houses glands like the pituitary gland.

**Major histocompatibility complex:** a type of cell surface receptor that are essential for immune response. They let the cell know when there are foreign substances in the body.

**Oxytocin:** a hormone that is released during child-birth and labor. This hormone is also released upon orgasm or nipple stimulation. It is sometimes referred as the love hormone as it helps with bonding.

**Pituitary Gland:** a major endocrine gland that has a role in growth and the regulation of other hormones in the body.

**Pheromones:** chemicals that are released from the body to the outside environment and that are received and sensed from another organism of the same species. The usage of pheromones in humans is still under debate but there have been a few very intriguing experiments that help demonstrate the possible use for pheromones.

- Experiment 1: Wedekind et al. did an experiment to test how pheromones may help in sexual selection. They typed 49 women and 44 men for their MHC class. The males wore a t-shirt for two nights without showering or wearing any sort of perfumes or colognes. The following day, the females were asked to smell the t-shirts and judge the odors of the shirt as more pleasant or less pleasant on a scale. The shirts that were worn by men who had dissimilar MHC and genotypes as the woman were preferred. The shirts that were worn by men with similar MHC classes and similar genotypes as the woman were judged as less pleasant by the females.
- Experiment 2: Singh et al did a similar experiment as Wedekind, except they reversed the roles. They asked females who were not using contraceptives (because that changes the way that we smell) to wear t-shirts for three nights. Half of the females were in the late follicular phase of their menstrual cycle (ovulatory phase) and the other half of the females were in the luteal phase of their menstrual cycle (non-ovulatory phase). They then asked the men to judge the smell of the shirts. They found that the t-shirts that were worn during the follicular phase of the women's cycles were judged as smelling more pleasant and sexy.

**Puberty:** The Meriam Webster online dictionary defines it as “the period of life when a person's sexual organs mature and he or she becomes able to have children”.

But that's a general definition. Puberty is a time when chemical changes occur in the brain. Certain hormone levels increase. Some of those hormones are gonadotropin releasing hormone, estrogen, progesterone, testosterone, follicle stimulating hormone and luteinizing hormone. These hormones act in concert to cause the primary and secondary sex changes such as hair growth, muscle development, vocal changes and development of the sex organs.

**Prairie Vole:** one of the first monogamous mammals that research was conducted on. They are able to form pair bonds after one sexual interaction with each other. The prairie voles are known for their monogamy because of the high level of vasopressin and oxytocin receptors found in their brain. What's really interesting is their cousin, the montane vole, is very promiscuous. One significant difference between the two voles is the density of vasopressin and oxytocin receptors that they have in their brains. The montane voles have much less than the prairie voles, which helps explain their more polygamous lifestyle. Vasopressin and oxytocin are what allow them to make their pair bonds.

**Vasopressin:** a hormone that is important in pair bonding. It is more prevalent in males and is found in high concentrations after a father has had a child. It is referred to as the fidelity hormone. It reinforces monogamy and pair bonding.

**Volatile chemicals:** chemicals that evaporate easily at room temperature. Most sex pheromones are volatile allowing them to diffuse easily and reach their target receptor.

**Vomer nasal Organ (VNO):** a peripheral sensory organ of the olfactory system. It is found at the base of the nasal septum or in the roof of the mouth in most mammals. The

role that it has in human sensory is controversial but in other mammals the VNO is involved in sexual responses and endocrine production.

**Reflex:** an involuntary or automatic action that occurs through a simple reflex arc as a result of a stimulus.

**Sympathetic Nervous System:** one of the two parts of the autonomic nervous system. The sympathetic nervous system is responsible for the effects of the fight or flight response.

**Takotsubo Cardiomyopathy, or broken heart disease:** characterized by an increase in stress hormones within the body. The sudden increase in hormones enlarge the left ventricle causing the left ventricle to pump incorrectly and the rest of the heart to have to pump more forcefully. This disorder is treatable but in some cases it may be fatal.

## REFERENCES

- Akaike et al. (1987) Excitatory and inhibitory effects of dopamine on neuronal activity of the caudate nucleus neurons in vitro. *Brain Res.* 1987 Aug 25;418(2):262-72. <http://www.ncbi.nlm.nih.gov/pubmed/2890403>
- de Boer A., Van Buel E. M., Ter Horst G. J. (2012). Love is more than just a kiss: a neurobiological perspective on love and affection. *Neuroscience* 201 114–124. 10.1016/j.neuroscience.2011.11.017
- Brennan PA. Pheromones and Mammalian Behavior. In: Menini A, editor. *The Neurobiology of Olfaction*. Boca Raton (FL): CRC Press/Taylor & Francis; 2010. Chapter 6. Available from: <http://www.ncbi.nlm.nih.gov/books/NBK55973/>
- Buchanan, Tony W. “Retrieval of Emotional Memories.” *Psychological bulletin* 133.5 (2007): 761–779. PMC. Web. 9 Mar. 2016.
- Feinberg M., Willer R., Keltner D. (2012). Flustered and faithful: embarrassment as a signal of prosociality. *J. Pers. Soc. Psychol.* 102, 81–97 10.1037/a0025403
- Life Sciences Learning Center. (2013). Hand on a Hot Stove. <https://www.urmc.rochester.edu/medialibraries/urmcmedia/life-sciences-learning-center/documents/2013-14neuroscience/handonhotstove-092513-teacher.pdf>
- Meredith M (1994) Chronic recording of vomeronasal pump activation in awake behaving hamsters. *Physiol Behav* 56:345–354
- Meredith M (2001) Human vomeronasal organ function: a critical review of best and worst cases. *Chem Senses* 26:433–445.
- Palmer, L (2013) *Bonding Matters, The Chemistry of Attachment*. <http://babyreference.com/bonding-matters-the-chemistry-of-attachment/>
- Re, Daniel E. et al. “Preferences for Very Low and Very High Voice Pitch in Humans.” Ed. David Reby. *PLoS ONE* 7.3 (2012): e32719. PMC. Web. 9 Mar. 2016.
- Scheib, J E, S W Gangestad, and R Thornhill. “Facial Attractiveness, Symmetry and Cues of Good Genes.” *Proceedings of the Royal Society B: Biological Sciences* 266.1431 (1999): 1913–1917. Print.
- Singh D., Bronstad P. M. (2001). Female body odour is a potential cue to ovulation. *Proc. R. Soc. Lond. B Biol. Sci.* 268 797–801. 10.1098/rspb.2001.1589
- Terasawa, Ei et al. “Recent Discoveries on the Control of GnRH Neurons in Nonhuman Primates.” *Journal of neuroendocrinology* 22.7 (2010): 630–638. PMC. Web. 9 Mar. 2016.

USC School of Medecine. (n.d). What is fMRI?

<http://fmri.ucsd.edu/Research/whatisfmri.html>

Vidavalur, Ramesh et al. "Significance of Wine and Resveratrol in Cardiovascular Disease: French Paradox Revisited." *Experimental & Clinical Cardiology* 11.3 (2006): 217–225. Print.

Wedekind, C, and S Furi. "Body Odour Preferences in Men and Women: Do They Aim for Specific MHC Combinations or Simply Heterozygosity?" *Proceedings of the Royal Society B: Biological Sciences* 264.1387 (1997): 1471–1479. Print.

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Noelle Elizabeth-Anne Leon-Palmer was born in Scarborough, Ontario on December 16<sup>th</sup> 1994. She attended Pickering High School in Ajax, Ontario where she first discovered her passion for science. After High School she went to the University of Maine on a full soccer scholarship. She majored in Biology, minored in chemistry and completed the requirements for the pre-med concentration. On top of that she joined the Honors College at UMaine her freshman year. Her expected graduation date is May 2016.

The summer following graduation she is planning on writing her MCAT's and applying to medical school. During her gap year she would like to travel, and gain real life experience in the medical field. Noelle hopes to one day be a doctor.