Lessons on Love from Biology

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Introduction

For many of us, the arc of our life's narrative is guided by certain common checkpoints. Instinct and expectation funnel us down the path from education to employment to marriage to parenthood to retirement with little hesitation. Almost all of us are driven by this shared schema, spending our lives' simply coloring within its lines. While there are certainly exceptions and cultural considerations, this template remains consistent and compelling in most of the world.

Why do so many people stay on course? Have millenia of experimentation determined that this pattern is the recipe to a happy life or are we arbitrarily carving a narrow path into a world "where the rules are made up, and the points don't matter"? These are complex questions and I cannot imagine tackling them in their entirety here, however, I may begin by addressing a single step along the familiar path.

The expectations surrounding marriage, seen throughout different countries and customs, speaks not only to how we view societal structures and families, but also the romantic relationships we engage in. Most of humankind lives under the norm that they will not only marry one individual but will remain monogamous throughout their life, regardless of marital status. Those who deviate are often looked down upon as promiscuous or adulterers. Studies indicate that a median of 96-98% of children in the world are the product of sex while the parents were in a monogamous relationship (Bellis et al., 2005; Simmons et al., 2004). While it is certainly true that many of these parents will not stay together and that depending on the region the number could go as low as 50%, it is still an insightful statistic to demonstrate the prevalence of at least serial monogamy among people.

The commonality of monogamy being acknowledged, I think it is worth asking *why* this is the case. More specifically I want to ask what part of our nature conditions us to be monogamous. I will steer clear from the legal and cultural conundrum that is the institution of marriage and instead peer into the underpinning biology of monogamy. Monogamy is a critical foundation upon which most people construct their entire perception of relationships and love, but what insights can neuroscience and evolution provide to better our understanding of why that is the case.

What is monogamy?

In order to discuss the topic properly, it is important that we define monogamy well. Especially if we are interested in taking a biological approach and would like to make cross species

comparisons, it is key that we do not let our human biases seep into our definition. For example, in early research into monogamy, it was often just assumed that opposite-sex animals living in the same territory only mated with one another. However, it is possible to be socially monogamous without being genetically monogamous, meaning that two animals might live together as a pair, but have kids outside of that partnership. It is also possible that two parents are a pair, but don't equally share the responsibility of rearing the offspring. Here we can see how the lines begin to blur and how important precise language is. For our purposes, unless otherwise stated, I will define monogamy in this article as both social and genetic monogamy without placing any emphasis on how parental responsibilities are distributed.

Where does monogamy come from?

To investigate this question we must dive into the world of evolutionary biology and think critically about how animals pair up. Monogamy has been particularly fascinating to evolutionary biologists because it seems counterintuitive on its face. Evolution favors behaviors that allow animals to spread their genes, so why would it be advantageous for an animal to shack up with a single mate? Would it not be more beneficial to try and mate with as many partners as possible?

It turns out that most of the time it is, as the vast majority of animals are not monogamous. Even in populations of animals that are mostly monogamous, there are some individuals that deviate, creating a careful balance between the benefits of promiscuity versus those of fidelity. For that balance to occur, certain conditions must be met, but scientists are still arguing over what these conditions are and to what degree each one might influence evolution (Solomon and Ophir, 2020).

One theory is that sexually transmitted infections (STI) could be a major driving force for monogamy (Bauch and McElreath, 2016). Mating with multiple partners can increase the number of offspring who can pass on your genes, but it also increases your risk of contracting a serious STI. Under these conditions it may be in your interest to stick with one partner and be the best parent you can to the limited offspring you make. Then, as the prevalence of STIs decreases in the population, it may become worth the risk again to breed with multiple partners. However, if too many individuals become promiscuous, the rate of STIs might rise. Here you can see how a delicate and fascinating balance is being strung.

Other researchers argue that the availability of mates is a highly influential factor in the evolution of monogamy. They claim that in times of mate scarcity, males who guarded their females would outperform those who abandoned their females in search of additional partners only to find guarded females (Schacht, 2016). This, then, opened the door for variation in the amount of involvement fathers took in the raising of the offspring. The authors suggest that human fathers who took a greater parental role had more kids and successfully propagated their genes throughout the population.

There are numerous other theories out there and with so many plausible sounding ideas, there remains significant debate in the scientific community. It is still being discussed what factors are

really at play, to what degree they influenced the evolution of monogamy, and if they differ drastically in different species. It is possible that all the above listed scenarios contributed together to develop the behavior we see in humans today. What is certain is that a balance must be struck between the default advantage of promiscuity and the special conditions that promote monogamy.

How does monogamy happen?

We addressed some questions about *why*, evolutionarily speaking, monogamy arises, but we must also ask *how*. What mechanisms are actually causing us to be monogamous? In other words, while it might be easy to just say that evolution makes us more monogamous, that tells us little about what is really happening in our bodies on a biological level to elicit behavioral change. The field of neuroscience is a critical avenue through which we can study the exact mechanics being manipulated and dialed in by selective processes.

One of the key animals for monogamy neuroscience research is the prairie vole. This small rodent has served as a model subject for studying monogamy in some of the leading experiments of the field. Scientists have done everything from evaluating viral gene manipulation on pair-bonding behavior to simply getting the voles drunk to see what they do (Potretzke and Ryabinin, 2019).

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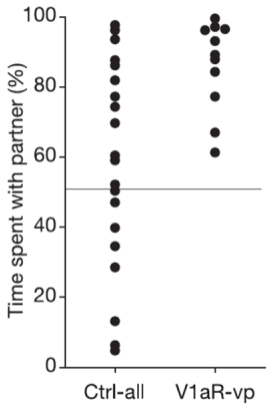
An adorable prairie vole couple

Vole populations will have monogamous and “roaming” promiscuous individuals. The ratio of these two groups is dynamic and depends on many conditions. One of the big ways scientists have investigated questions related to monogamy is by trying to better understand the

physiological differences between voles who use one of these distinct reproductive strategies versus the other.

Researchers have recognized that there is a lot of diversity in the brains of prairie voles. Specifically, they noted that the receptor for an important social behavior modulating hormone called vasopressin varied greatly between voles. They soon began to hypothesize that the more receptors an individual had in a particular part of their brain, the more likely they were to be monogamous (Phelps and Young, 2003; Ferris et al., 1994).

To test this hypothesis, the scientists performed an incredible experiment with a much more promiscuous close cousin to the prairie vole, the meadow vole. They created a virus that would enter specific brain cells of the meadow vole and cause them to create more vasopressin receptors. After this treatment, the meadow voles quickly began to perform monogamous behaviors, such as spending more time with a partner (Young et al., 2004).



The control voles, who didn't have their number of receptors changed, spent random amounts of time with a partner, those with the change in receptors (V1aR-vp) spent more time paired up

This experiment exposed some of the neurobiology underpinning monogamy and related social behaviors. Further research has gone on to demonstrate that other hormones such as oxytocin are also likely involved (Ophir, 2017). Other work has even drawn a direct connection between the presence of evolutionary pressures, similar to what we discussed earlier, and the activity of genes that control how much vasopressin receptor is being produced in the brain (Phelps et al. 2015). Such a strong line of evidence provides a way for us to ground the conceptual arguments we posit about the evolution of monogamy with tangible biological findings in the brain.

While the methods and findings of these neuroscience studies are nothing short of amazing, they are also seemingly terrifying. The precise alteration of a single gene completely changed the mating behavior of voles and it would be foolish to think there is not a comparable underlying neurobiology in humans. But how comparable? Could our behavior be manipulated so drastically with such ease? What would that even mean, and would we still call the urge love? Perhaps, all this time, the love potion depicted in so many fairy tales was nothing more than a viral injection to the brain capable of modifying ventral pallidum expression of vasopressin 1 receptors.

Conclusion

A complex, biological understanding of monogamy takes shape amongst the social constructs that have long remained unchallenged determinants of our perspective on the topic of monogamy. A fundamental comprehension of the delicate, evolutionary balance generating monogamy tells us that we would never expect a population with 100% monogamous instinct. Moreover, we can see that our "traditional" concepts of what a relationship should be are not based on logical absolutes, but rather historical accident and circumstance. In fact, evidence suggests that our recent evolutionary ancestors were not even monogamous (Shultz, 2011). To

be clear, I am not calling for the downfall of monogamy in human society, I am simply pointing out that we shouldn't be so quick to believe that just because something *is* a certain way, that it *should or must* be that way.

So, if the idea of one true love is nothing more than a reproductive strategy driven into us by selective pressures and, at its core, love is nothing more than an easily manipulated neurobiological phenomenon, how do we move forward? I would argue that this realization is not a dreadful step toward nihilism, but rather it is freeing. Understanding what we feel doesn't make it any less real to us, we just know ourselves a little better. Now, perhaps, we can relax some of the expectations we put on ourselves and others to fit the relationship mold people have long been crammed into. We could decide how we want to experience love, free from the overarching restraint of arbitrary norms. I am not afraid to embrace the chaotic, biological perspective because sometimes the games "where the rules are made up, and the points don't matter" can be the most fun.

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