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The Relationship Between the Rise in Monogamy and Brain Size in Humans

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ABSTRACT

There is a positive correlation between monogamy and the brain size in most animals. This is mostly due to monogamous relationships being much deeper in connection as well as the advent of monogamy stopping most sexual competition and fighting, allowing for deeper connections within the group and increased survival of the group as a whole. This paper examines the relationship between monogamy and brain size in humans, looking through the lens of two main theories: the ecological theory and the social intelligence hypothesis. Through our most common mating system, our research suggests that a major reason for the evolution of intelligence and the increase in brain size is due to monogamy as a whole. The paper discusses the evolutionary advantage of monogamy and its relationship with brain size.

Introduction

Monogamy is defined as "a mating system in which a single adult male and a single adult female mate.(Hoi & Griggio, 2010)." This mating system is quite rare to find in mammals and larger animals. It is even rarer in primates, with only a handful of primates having long-term, monogamous relationships. This paper will first establish why monogamy became a necessity in humans, and then move onto how monogamy has affected the human brain.

Monogamy has been shown to have a big impact and correlation on brain size in other animals that practice it. A huge part of human evolution is the evolution of the brain and the exponential increase in size over thousands of years. This rise in brain size is correlated with the rise in monogamy in humans. Monogamous relationships became a necessity due to a harsh environment. These relationships were much deeper and complex than polygamous relationships, so the human brain had to increase in size to handle these complicated relationships. Furthermore, due to lack of sexual competition and aggression, there was more energy that was used towards increasing brain size.

This paper explores this relationship between monogamy and brain size through the ecological theory, which caused monogamous relationships to become necessary, and the social intelligence theory, which posits that the increasingly complex nature of human relationships caused humans to evolve larger brains.

Methods

For this research paper, Google, Google Scholar, JSTOR, Journal of Mammalogy, NCIB, and Cambridge were primarily used. Twenty five articles were screened, and ten were included. Articles were included if they discussed "Monogamy", "Social Intelligence Hypothesis", "Chimpanzee Mating Systems", "Human Mating Systems", and "Gibbon Mating Systems." The key terms included: "Mating Systems", "Evolutionary advantage of monogamy", "Social Intelligence", "Self-Awareness", and "Monogamy." The search was done in English and research papers that established a causal link between monogamy and self-awareness were the ones primarily used. Literature included was published between the years of 2008 and 2023

The development and enhancement of the human brain is mainly due to a mix of environmental and social factors. An increase or decrease in resources and the difficulty of the environment determines how much energy is left for non-essential processes and features, like intelligence. Once sociality becomes energetically favorable, however, the complexity of those social relationships ends up necessitating a larger brain size.

These two factors – environmental and social – are described in two predominant hypotheses as to why the brain increased in size in humans. The first is the Ecological Theory which theorizes that due to a harder environment, humans had to evolve bigger brains to be able to survive. Rae states, "Broadly speaking, ecological pressures are hypothesised to have favoured increased cognition as primates exerted energy foraging for, and extracting, challenging or seasonal foods." (Rae, 2018) The second is the Social Intelligence Hypothesis which theorizes that due to increasingly complex social situations, humans had to evolve bigger brains. (Ulrich, 2018)

The Ecological Theory:

Instead of living in rainforests like chimpanzees, humans lived primarily in harsher and more barren savannas. With barren savannas and less food to eat, humans had to work together more often to survive. Furthermore, the advent of bipedalism caused a narrower birthing canal. This required humans to birth babies prematurely, producing babies who required a great amount of care (Tucker, 2014).

In our closest relatives, chimpanzees, females were highly competitive of male attention of babies which caused female on female aggression. (Trans, 2013) Males, in turn, committed infanticide due to paternal uncertainty. Female aggression and male infanticide were acceptable in a rainforest which had plentiful food and with babies that were not premature, but due to the various, dangerous environments and premature babies, it was evolutionarily favorable to develop a way to get rid of these factors (Tucker, 2014). Monogamy was one way to alleviate these issues, which needed brains that can handle more complex relationships.

The savanna was much harsher than the rainforest. There were bountiful predators with little amounts of camouflage. With the increased danger and the lack of physical strength of humans, humans had to become smarter and more social. Both of these traits required a larger brain.

The Social Intelligence Hypothesis:

Due to the unforgiving environment in which humans lived, monogamy became a necessity. Monogamy was the only way to decrease infanticide and to increase attention and care for the premature infants (Opie, 2013). As monogamy developed, society became much closer together and much bigger as well. As society became bigger, an increasing number of relationships became necessary for survival, people had to start developing larger brains as a response.

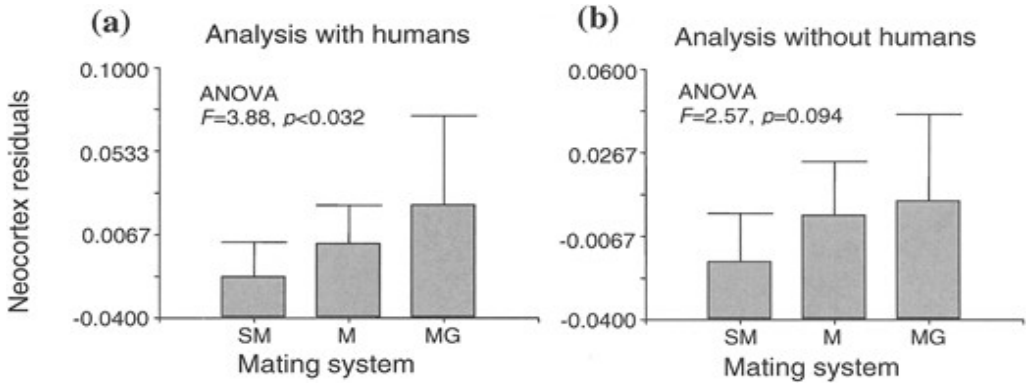

Figure 1. (Schillaci, 2008) This figure shows the size of the neocortex based on mating systems. Primates with monogamous mating systems consistently score higher than those of other mating systems with and without humans. (SM = Single Male; M = Multi-Male and Multi-Female; MG = Monogamous)

Furthermore, there was a drastic decrease in in-group fighting between males for females as well as between females for male attention. Energy could be redistributed from sexual competition to increased intelligence. This is evidenced by most monogamous animals having larger neocortex sizes, as can be seen in Figure 1.

Another specific part of the brain that monogamy affects is the prefrontal cortex. Monogamy requires a degree of self-restraint which causes an even greater need for intelligence and self-awareness (Tucker, 2014). Monogamy is biologically regulated through a series of reward sites for maintaining those pair-bonds. The prefrontal cortex grew to include those reward sites to motivate individuals to stay in long term pairs (Ophir, 2012). Monogamous relationships were much more complicated and nuanced which necessitated a bigger prefrontal cortex.

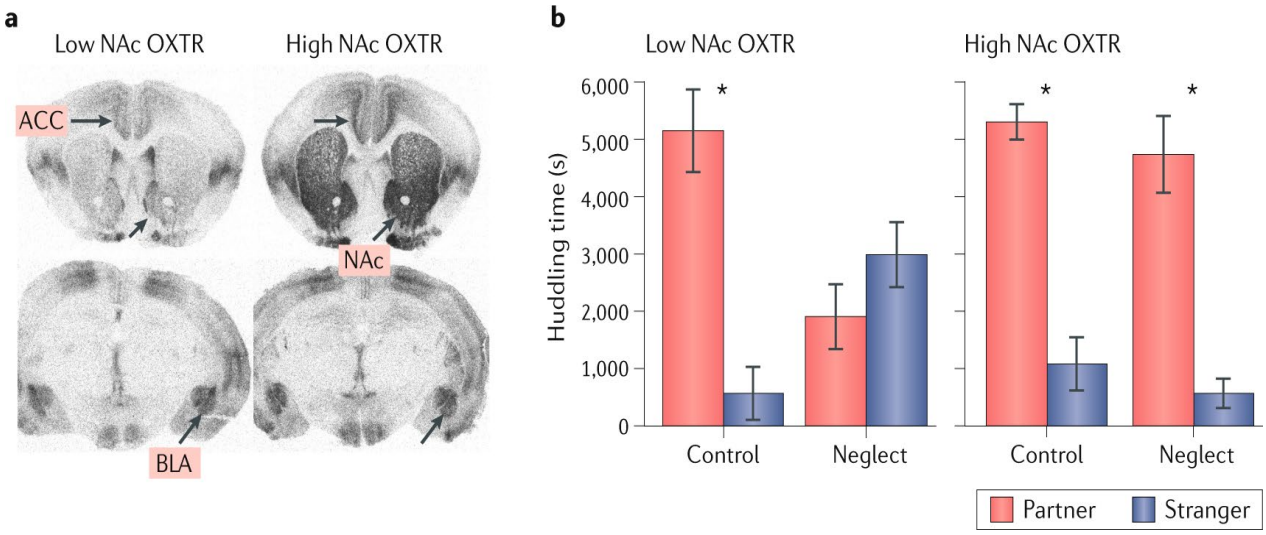

Figure 2. (Ophir, 2012) This figure shows the amount of oxytocin released in a vole's brain when with a partner in comparison to when with a stranger.

This relationship between monogamy and the prefrontal cortex has been seen extensively in voles (Ophir, 2012). Monogamy is perpetuated in voles through extensive neural circuits and adaptations in their prefrontal cortexes. Monogamy necessitates self-restraint and self-control which requires multiple adaptations in the prefrontal cortex in humans. (Tucker, 2014)

Discussion

Monogamy has deep roots in the evolution of the human brain. Due to new, harsher environments, group infighting for mates and uniparental care was evolutionarily unfavorable. It required more sociability and biparental care which caused the advent of monogamy. Due to monogamy and closer relationships between the group and between partners, brain size increased to allow humans to form these deeper bonds. This discussion of monogamy and brain size demonstrates how social factors and biological factors can influence each other through an evolutionary mechanism.

Self-restraint, an important quality for monogamous relationships, required an increase in the prefrontal cortex size (Trans, 2013). Furthermore, it has been seen that neocortex size is positively correlated with monogamous primates. It is obvious that monogamy touches multiple parts of the human brain and is heavily correlated with brain size and brain development in humans.

Furthermore, because monogamy resulted in biparental care, human infants had access to more resources and had more energy available to them (Trans, 2019). This led to them growing to be much smarter and capable of forming deeper relationships and bonds. Monogamy, in this way, led to bigger brain development not just over a span of

thousands of years, but also within the span of a few generations. Monogamous couples that spent much time with their children were able to grow children with a greater brain capacity than polygamous couples that spent less time and care on their children (Workman, 2016).

While there are a few exceptions among the extremely wealthy, most human relationships have been monogamous due to the need for a high amount of care in infants and due to the necessity of close bonds in the group that are not marred by competition for mates. (Edgar, 2016) It is clear that these relationships touch every part of the human species, from increasing societal bonds to our biological brain size. We can see through these pieces of evidence that both social and environmental factors influence the evolution of brain size and intelligence.

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