How Diversity in Nature Impacts Political Psychology

Joan S. Rabin

We are the human primate and our biological heritage is not irrelevant to our behavior, motivation and emotions. Most books and research on evolutionary heritage stress traits and not behaviors. If we want to understand how our evolutionary heritage influences our behavior we need to understand animal behavior (ethology). We have been called the political animal by everyone from Aristotle to Peter Hatemi and Rose McDermott (*Man is by nature a political animal: Evolution, biology, and politics*). Politics is based on social relationships and humans are profoundly social, as are our nearest relatives, the chimpanzees and bonobos. Politics is ultimately about power. Humans, chimpanzees, and bonobos create power dynamics within social structure.

It is also critical not to lose sight of the underlying developmental interaction of genetics and environment such that an examination of our evolutionary heritage and the relevant ethology does not mean that we have suddenly shifted toward a genetic determinism explanation of evolution and behavior. Sidanius & Kurzban, (2013) present an evolutionary approach to political psychology which rejects the nature/nurture dichotomy. “For any trait of any organism, it must be true that changes to its genes or its developmental environment could alter the trait—the construction of the phenotype is inherently an interaction” (p. 212). On the other hand, Hibbing, Smith, & Alford (2014), conclude that studies of the genetics of taste preference in fruit flies are relevant to the biopsychology of politics because “variation in tastes and preferences … is connected to political orientations” (2014, p. 90–91) and the underlying genetics explains some of our differences. Liberals and conservatives differ in taste, preferences, lifestyles, and just about everything else (Hetherington & Weiler, 2018).

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Perspectives

Evolution from a Feminist Perspective

The advent of the 21st century has brought a powerful new feminist view of biology. Books by eminent feminist biologists directly challenge sociobiology and biological determinism in science. Evolutionary biologist, Joan Roughgarden (2004), reconceptualizes the nature of sexual identity in the animal and human world. Behavioral ecologist, Marlene Zuk (2003) insists that we stop politicizing animal behavior and instead enjoy the diversity of animal life in nature for its own sake while still adhering to the scientific method. Brain development and animal behavior specialists Gisela Kaplan and Lesley Rogers (2003) offer a feminist perspective on the "gene hysteria" that is overtaking modern culture. The genetic determination explanations for gender differences that abound ignore the profound influences of culture and environment on behavior. Kaplan and Rogers reiterate the discouraging history within sociobiology of linking genetics and hormones to the fixed determination of women's roles in society, a long history of linking biological determination to human limitation.

These efforts were presaged by feminist evolutionary biologists such as primatologist Sarah Hrdy (The woman that never evolved, 1981) and avian behavioral ecologist Patricia Gowarty (Feminism and evolutionary biology, 1997). Geneticist Evelyn Fox Keller (1982, 2000) suggested that science could benefit from increased objectivity brought by feminist perspectives. All of these feminist scholars operate within an interactionist framework as opposed to a nature-nurture model that invites biological determinism of traits and behaviors. "Anyone who studies behavior quickly realizes that it is impossible to separate the environment from the organism experiencing it, so that all traits are necessarily the result of an interaction between the animal and its perceived world" (Zuk, 2003, p. 50). Keller (2010) titled her article in the New Scientist "Goodbye nature vs nurture debate," indicating that biological determinism was effectively demolished by epigenetics.

Ruth Hubbard, a Harvard biochemist, "wrote essays critiquing the assumptions of Charles Darwin, E. O. Wilson and Watson and Crick. Her work largely dismantled biological theories about gender inequality" (Corbett, 2016, para. 8). She recognized that the very questions in science came almost exclusively from white men who were limited by a gendered experience of life which placed men at the center of power and privilege. "Most of the difficulties derive from the fact that true objectivity is not possible for human beings rooted in cultural traditions" (Lowe & Hubbard, 1979, p. 144).

Biological Determinism Problem

The science of biology is of importance to many feminists because women's biology has been used to rationalize women's oppression (Bleier, 1984, 1986; Fehr, 2008; Hubbard, 1990; Tonn, 2018). This has far reaching implications for political psychology. Many of the positions common to conservatives are based on a sociobiological view of women's genetically pre-ordained roles.

> Feminists have pointed out that much of the political power of these sorts of biological arguments arises from problematic assumptions of determinism … assumptions of a close connection between women's biology, in terms of genes, hormones, and physiology, and women's psychological attributes and social positions. The general notion is that biology, as opposed to culture, is static and fixed. As a result, some contend that any political activity designed to change or improve women's condition is trying to create an 'unnatural' system that is doomed to fail (Fehr, 2011, 2018, p. 3).

Sociobiology

This view from the early nineteenth century science was revived and energized by Wilson (1975). Wilson's sociobiology has created a biological justification for the societal and institutional oppression of women with its framework of biological determinism of behavior. But evolution need not be interpreted in this way. Other evolutionary biologists see our biological heritage in much more enlightened terms (Gould, 1979; Cliquet, 1984; Gowaty, 1997; Hrdy, 1981, 2009; Roughgarden, 2004). Early on Cavalli-Sforza and Feldman (1981) countered Wilson's approach with a mathematical analysis that demonstrated how powerful cultural transmission of behavior can be. In modern times sociobiology has morphed into behavioral ecology and neurobiology which can range from deterministic to interactionist in outlook.

Robert Sapolsky (2017) points out that much of the vitriol around sociobiology has quieted as modern sociobiologists have toned down the extremes of the biological determinism perspective. At the same time the meteoric rise of epigenetic analysis in the last decade has reframed the whole notion of determinism such that a more interactionist approach has become common, especially in medical research (Moffitt, Caspi, & Rutter, 2006; Zhang, 2018). Yet, "epigenetics, which is just beginning to attract public attention and policy discussion, challenges conventional understanding of gene-environment interaction and intergenerational inheritance and perhaps much more besides" (Robison, 2016, p. 30). Because epigenetics is a process not a structure like a DNA molecular sequence, it is more likely that a flexible liberal brain, more used to dealing in gray areas, will accommodate to the reality of epigenetics more readily than a more fixed conservative brain. Process is far more challenging to conceptualize than structure. Whatever their cognitive style or brain function pattern, most people would rather deal with the fixed than the fluid.

Developmental Interactionism, Epigenetics and Diversity

Epigenetics activates and regulates genes in the DNA. Jerram Brown's (1975) formula is a helpful way to visualize epigenetics at work in a developmental interaction: $P_1 + G_1 + E_1 = P_2$. The phenotype represents both the physical appearance of the organism and the stage of development that the organism is in. The genotype represents the genes (DNA codes) that are available to be activated at a specific stage of development. The environment represents both the internal and external environment impinging on the organism at that stage of development (Phenotype #1 + Genotype #1 + Environment #1 = Phenotype #2). Many genes can only be activated at specific developmental stages, and never again. Epigenetics is the means by which the environment influences when and if the genetic code will be read-out. It is important to focus on the developmental aspect of epigenetics because the timing of epigenetic stimulation is critical to the outcome.

Paradigms provide ways of understanding how things work. The developmental interactionist paradigm provides an elegant framework for appreciating the impact of the diversity of behavior on living systems (Rabin, 2006, 2007). This paradigm of how genes and environment work intimately together to produce the nuances of traits and behaviors replaces the atavistic nature-nurture absurdity that has hounded the discipline of Psychology throughout the 20th century and even in to the 21st.

Epigenetics and Ethology

The study of animal behavior in the laboratory (Comparative Psychology)and in the wild (Ethology) contributes valuable insights into human proclivities and helps us to appreciate how evolution and genetics have shaped our heritage. Conservatives are wedded to tradition and are more comfortable with dualistic opposites, particularly male-female. They are more likely to feel threatened by ambiguity. The research on the diversity of biological sex has revealed a world filled with diversity where the concept of normal is severely challenged. Sexual diversity and sexual ambiguity in nature present a problem for the conservative mind. Yet, most people are unaware of this rich diversity and the term opposite sex is the most commonly used in our culture when speaking of women and men. The sexes are far from opposites and sexual diversity is the theme in nature. This is something we all need to become more familiar with so that we are more comfortable with the reality of nature rather than the prevailing myths in our culture.

Nurturance Versus Aggression: The Serotonin Factor

Rhesus monkeys are found in widely ranging climates and living conditions. There is a long tradition in Comparative Psychology of gathering principles of development relevant to humans from research on rhesus monkeys, *Macaca mulatta* (Harlow, 1971). Serotonin is a hormone critical to normal emotional functioning. A step in the manufacture of serotonin in the nervous system involves a biochemical called CSF 5-HIAA (cerebrospinal fluid 5-hydroxyindoleacetic acid). Low levels of CSF 5-HIAA are “associated with impaired impulse control, severe aggression, and social incompetence" in both humans and rhesus monkeys (Westergaard, Suomi, Higley, & Mehlman, 1999, p. 440). CSF 5-HIAA levels are genetically related.

Some people and some rhesus monkeys are born with low levels of CSF 5-HIAA due to their genetic heritage. However, the expression of these genes into behavior can be greatly influenced by the kind of nurturing experience the youngster receives. In the case of rhesus monkeys, Stephen Suomi (2003) has demonstrated that "good mothering can protect against poor genes" by affecting the expression of the genes into phenotypes.

Monkeys who were well nurtured showed higher serotonin levels than monkeys who received very little nurturance. The well nurtured monkeys demonstrated acceptable social behavior and aggression levels within their groups despite their genetic heritage that made it harder for them to produce appropriate serotonin levels.

Suomi (2004) specifically indicates that biobehavioral phenotypes are modifiable by the early environment. The strength of the attachment between infant and mother is a critical factor in offsetting the influence of genes that have the potential to produce inadequate levels of serotonin in the primate. If we put what Suomi is describing into the format of the epigenesis model of Jerram Brown (1975) then $\mathbf{G_{30} + E_{30} + P_{30} = P_{31}}$.

$\mathbf{G_{30}}$ = **serotonin level**
$\mathbf{E_{30}}$ = degree of maternal **nurturance**
$\mathbf{P_{30}}$ = **infancy**
$\mathbf{P_{31}}$ = **next stage of development in infancy**

Whether an individual generally behaves aggressively or peacefully is the consequence of a complex interaction between genes and environment, especially during the early stages of post-natal development. This is as true in rhesus monkeys as in the human primate. If we want to understand the roots of early aggression we must look beyond a simple biological determinism model (you have the gene, you have the behavior) to a developmental-interactionist model (Brown, 1975; Rabin, 1986) in which genes and environment are bound up in an intricate relationship that cannot be functionally separated.

Gonadotropin-Releasing Hormone and the Epigenetics of Fertility

Mating and social rank are closely linked for many animals. Lower rank animals frequently fail to mate. In the cichlid fish Astatotilapia (Haplochromomis) burtoni Astatotilapia (Haplochromomis) burtoni males come in two phenotypes. The high-ranking males are a vibrant yellow color in addition to the blue color that characterizes all males. Low ranking males are not only dull colored but sterile. However, if the dominant male is removed from the group (usually thorough predation) the subordinate male will change color in minutes and his behavior will also change as he begins to court females for the first time first time. This rapid physical and behavioral change in response to a social environmental stimulus is remarkable. Even more extraordinary is the change in the fish's reproductive system that makes him fertile in one week after the removal of the dominant male from the group. Burmeister, Jarvis, and Fernald (2005) have demonstrated the link between the social environment (E) and the activation of a specific gene (G) during the adult stage of development (P). The change in the social environment signaled by the removal of the dominant male cichlid resulted in the activation of a gene known as immediate-early gene egr-1 in the brain (anterior preoptic area) of the subordinate fish. The expression of immediate-early gene egr-1 triggered a molecular cascade that resulted in physiological changes that made the fish fertile. Thus, the social environment was the trigger for genetic activity influencingcontrolling reproduction and dominance behavior.

Evolution: Theories and Modifications

It is critical that a complete and thorough understanding of biological reality is obtained before a discussion of biopsychology and politics can take place. Most people are unfamiliar with the specifics of evolutionary theory. Although conservatives are prone to believing that women's place in the world is ordained by "nature," they often do not believe that evolution is the process by which nature exists. The notion that nature is immutable and God-given leads to an expectation of strict biologically based gender limitations. Throughout the history of the nineteenth and twentieth centuries men have banned women from participating in everything from medical school to the Boston marathon based on theories of mental and physical limitation that bear no relation to the evolutionarily based adaptive capacity and flexibility of species *Homo sapiens*. The conservative perspective of fixity of biologically-based traits limits the nurturance capacity expected of men. Both genders are perceived as being fixed into certain sex roles by biology (Sinnott & Rabin, 2012). Evolution is the process by which we have obtained our genetic heritage. It is vital to appreciate how evolution operates and how it does not and just what that genetic heritage is.

Natural Selection

Charles Darwin (1859) explained much of what he observed of evolution in nature by the process of natural selection (traits that increase survival in a specific environment will be selected). Darwin realized that for the most part it is the environment itself that operates as the selection factor. Natural selection means environmental selection. Each genetic code that we possess worked well in a specific environment.

Darwinian Sexual Selection

Darwin was aware that natural selection does not account for the extreme traits observable in many species (such as the peacock's enormous and spectacularly adorned tail). Darwin explained traits such as bright colors in male birds and antlers in male deer as based on sexual selection rather than natural selection. He argued that it is not the environment that selects these traits but rather the female. According to Darwin males evolve dramatic colors, patterns, and appendages so that the female will be stimulated enough to mate with the most outstanding male. Darwin also believed that males struggle among themselves for "possession" of the female.

The Darwinian view of sexual selection has been absorbed into Western Culture with the notion of women as sexual teases and men needing extreme physical qualities to attract women. The notion of males competing with each other for the affections of women also derives from Darwin. This view is compatible with conservative thinking about women. Because alternative views of evolution are not widely known even liberals often adhere to the Darwinian view of sexual selection. This is why it is so important to learn of other perspectives on evolution.

Joan Roughgarden (2004) is an evolutionary biologist who is reasonably comfortable with Darwin's theory of natural selection, as well as his main point that all life on earth has descended from a single source. However, Roughgarden takes strong exception to Darwin's theory of sexual selection. She is not the only feminist to do so. Hrdy (1981) and Gowaty (1997) have argued for a thorough reevaluation of Darwin's theory of sexual selection based on modern research data.

Social Selection

Roughgarden (2004) goes on to propose an entirely different way of explaining the selection process which works to produce both ornamental and sexual traits. She views these traits as derived from a process of social selection in evolution. Physical traits that confer social acceptance within the group are selected for in the course of evolution. She argues persuasively that sexual selection does not account for the data as effectively as social selection. Darwin argued that male rivalry and female choice are the dynamics that account for the process of sexual selection and the sometimes bizarre traits that animals exhibit (such as the excessive antlers of elk or the peacock's tail). Roughgarden (2004, p. 175) maintains that rather than seeking each other's genes animals within a species are trying to "obtain access to resources that enable the production and survival of the young… they are seeking access to the resources that each controls." Emphasis then redounds to those physical traits that confer social acceptance within the group. Roughgarden calls these "social-inclusionary traits" that explain everything from the female spotted hyena's penis to the placement of female genitalia in bonobos that allows face to face same-sex sexual behavior. Social inclusionary traits are fundamental to the evolution of societies, both animal and human (Christakis, 2019).

Social Inclusion

Japanese macques are very social primates and live in mixed-sex groups of 50 to 200. Females form strong relationships with each other based on same-sex courtship and copulation. They do this despite the availability of males and will in fact repel males who try to come between them. Joan Roughgarden (2004) explains the frequency of female same-sex behavior in these monkeys quite simply. In terms of the dominance system among females there is a social necessity to make and keep allies. Female same-sex bonds offer not just pleasure but social inclusion, operating as "social-inclusionary traits" (p. 147).

Within this provocative feminist framework for understanding evolutionary survival animals are not seeking each other's genes but rather they are seeking access to resources that each has. By sharing these resources reproduction becomes possible. Social selection is evolutionary selection for those physical and behavioral traits that enhance social acceptance within the group. This replaces Darwin's theory of sexual selection with its emphasis on coy females and sperm-spreading males. The social selection paradigm completely undermines the claim that all males are biologically driven, rape-prone sperm spreaders and all women are teases, endlessly evaluating the genetic suitability of a male suitor.

Social and Environmental Influences on Baboon and Chimpanzee Aggression

Traditionally in an ethology course, baboons have been used as an example of male hierarchy and male power through aggression (DeVore & Washburn, 1964). It took female primatologists to discover the role of female baboons in the power structure of baboon society (Altmann, 1980: *Baboon mothers and infants*; Small, 1984: *Female primates: Studies by women primatologists*). Female baboons live longer and become the repositories of ecological knowledge. They guide the troop to water when there is drought, remembering those far off places that retain water under the dryist conditions. When a baboon troop travels, these older females are at the center of the troop where they are the most protected. The baboons at the periphery of the group are the adolescent males who are the most expendable and the most vulnerable to predation by leopards who prey on the outermost animals rather than face the combined power of the high-ranking males more centrally located.

It turns out that high levels of aggression in male baboons may not be a fixed part of their heritage. Robert Sapolsky and Lisa Share (2004) studied a troop of olive baboons in Kenya who switched from a high aggression culture to a low aggression culture after the most aggressive males died of bovine tuberculosis acquired from a garbage dump. The less aggressive males in the troop had avoided the dump because of the constant fighting over the concentrated food area. After the high-ranking males died the troop became much more peaceful and this new culture was maintained even when new males entered the troop from other troops. The new males adopted the culture of their new troop, shedding the culture of their birth troop. This research by Sapolsky and Share exemplifies the importance of considering environmental and social context when trying to explain behavior. What initially looked like biologically driven behavior of high aggression in males turned out to be culturally modifiable.

Male aggression in the common chimpanzee has been well documented (de Waal, 1982/2007; Goodall, 1990; Peterson & Wrangham, 1997). There are four subspecies of the common, or central chimpanzee. The western chimpanzee (Pan troglodytes verus) is much less violent than the more frequently studied central chimpanzee (Pan troglodytes troglodytes). The western chimpanzee is the only sub-species to live in a mixed savannah forest habitat, similar to that of our early human (hominin) ancestors. “For bonobos and western chimpanzees, ecological factors apparently allow relatively high gregariousness, which reduces the risk of experiencing a lethal attack” (Wilson, Boesch, Gilby, Hohmann, Itoh, Hashimoto . . . Wrangham, 2014, p.415). Once again, the environmental and social context exerts a moderating influence on aggression.

New Pathways in Evolution: Directed Evolution

Who would imagine that evolution could be harnessed in a process called “directed evolution” to create new enzymes and other biomolecules that can save the planet and life on earth. Frances Arnold recently received the Nobel Prize in Chemistry (2018) for doing just that. Existing proteins are chosen for some feature that seems useful. The gene that codes the protein is mutated through a polymerase chain reaction. The resulting microbes are able to do things never before imagined: carbon and silicone can be bonded together as can carbon and boron Arnold, 2018). Arnold, an ardent environmentalist, explained that “in the lab, we’re discovering that nature can do chemistry we never dreamed was possible” (Angier, 2019, p. D1). Directed evolution can produce unique enzymes that trigger chemical reactions that are cleaner and more efficient than current chemical protocols which rely on solvents, plastics and precious metals (Angier, 2019). Even the manufacture of biofuels can be made with far less damage to the environment (Krämer, 2018). The protein engineering of directed enzyme evolution copies how natural selection operates in the evolutionary process.

Domestication

Domestication of wild species indicates a clear pattern of reduced aggression (Belyaev, Ruvinsky, & Trut, 1981). Traits such as aggression tend to evolve in concert with a group of traits. The selection process which lowers aggression affects these ancillary traits as well. Domesticated animals "tend to exhibit correlations across traits that are not only behavioural but also morphological, physiological and cognitive, including variations in body coloration, cranial shape, dentition, brain size, activation of the hypothalamic pituitary adrenal (HPA) axis and problem-solving abilities" (Hare, Wobber, & Wrangham, 2012, p. 1). The skull of domesticated animals retains a juvenile structure making the cranium, jaw, and canine teeth smaller, and reducing bony ridges and other protrusions. The brain becomes smaller and frequently so does the body. Sexually dimorphic traits (non-reproductive physical traits that distinguish the sexes) are frequently significantly reduced. Serotonin levels are increased reducing reactive aggression. Social differences emerge such that domesticated animals show greater tolerance and more pro-social behaviors and play activity (Wrangham, 2019).

Silver foxes were selectively bred based on their behavior toward humans at 7 months of age (Trut, Oskina, & Kharlamova, 2009). Fox kits that approached humans and did not bite were bred together. After 20 generations these foxes were as tame as dogs. They exhibited tail wagging, and submissive posturing. The foxes uttered a high-pitched whine around humans, a sound usually made by kits toward their mother. The change in the physical features of the foxes was dramatic. Floppy ears, curly or shortened tails, and a piebald coloration were common. Sexual dimorphism was reduced in males such that they more closely resembled females. The domesticated foxes had markedly lower levels of stress related corticosteroid levels and lower levels of corticosteroid reactivity to stimuli. Conversely, these foxes had high levels of serotonin (Hare et al., 2012). This biochemical combination reduces aggression (Belyaev et al., 1981).

Self-Domestication

The identical process of lower aggression, juvenilized physical appearance, and lessened sexual dimorphism that happens with the artificial selection process of domestication of wild animals also occurs when animals self-domesticate. Wolves changed into dogs on their own, not through human intervention (Hare, 2013). Those wolves whose temperaments allowed them to get closer to humans and their food resources benefitted greatly from the easily obtained calories. It was mostly the female wolves who had lower stress levels that were able to do this. Their offspring were more numerous and better nutritioned than that of completely wild wolves. This evolutionary benefit brought about the same self-domestication pattern that artificial selection produced in foxes.

The history of dogs is the "survival of the friendliest" (Hare, 2013). Brian Hare notes, "the physical changes that appeared in dogs over time, including splotchy coats, curly tails, and floppy ears, follow a pattern of a process known as self-domestication. It's what happens when the friendliest animals of a species somehow gain an advantage. Friendliness somehow drives these physical changes, which can begin to appear as visible byproducts of this selection in only a few generations" (Handwerk, 2018, para. 20).

Survival of the Fittest

Political conservatives go for "survival of the fittest" based on the competition and dominance scenario rather than the cooperation and egalitarianism scenario more enticing to liberals (Jost et al., 2003; Tuschman, 2013). For political conservatives the world is a dangerous place, therefore competition and self-interest are appropriate survival strategies. Liberals perceive the world as a much friendlier place where the essential goodness of people prevails. Which scenario you go with matters greatly. Sadly, most people have only heard of Darwin's survival of the fittest and not the more recent modifications of evolutionary theory that stress cooperation and fairness. Even worse, most people do not understand what fitness means. Fitness is measured by the number of off-spring produced who successfully make it to adulthood and go on to also reproduce. Fitness is about putting genes into the gene pool of a species long-term and is not a measure of strength or ferocity.

Fitness Value of Social Skills

"Caring, friendships, and the fitness value of social skills" have been demonstrated by Clay and de Waal (2013, p. 18121) in their research with bonobos in the Democratic Republic of the Congo. Bonobos are the other chimpanzee (Pan paniscus). Smaller and lighter weight than the better known, common chimpanzee (Pan troglodytes), bonobos are found only in the Congo (Diogo, Molnar, & Wood, 2017; de Waal, 1995; Kano, 1992). The development of socio-emotional competence in bonobos comes about through achieving a specific skill set regarding relationships. Bonobos have to learn how to form and maintain relationships and how to behave in an accepted way in social situations. Emotional learning is as important. Bonobos have to become sensitive to emotional cues from others and most important, they have to be able to control their own emotions in a social setting (Clay & de Waal, 2013). The end result is a remarkably peaceful society, although not entirely aggression free during mating (Hohmann & Fruth, 2003). Clearly, in bonobo society social skills have high fitness value.

Cognitive Rigidity Versus Cognitive Flexibility

Zero tolerance (absolute enforcement of regulations with no exceptions) is an example of the rule-bound more rigid conservative cognitive style reminiscent of the red-light green-light decision making of the blue-footed booby (Gould, 1983). Boobies nest in guano rings that they create to delineate their territory. If a nestling stays within the guano circle it is nurtured and fed, if the young booby ventures outside the circle the parent will attack it. The brain of the booby cannot process complexity.

Zero tolerance in nature is sad to watch and it can be just as damaging when humans apply it. The whole evolutionary point of species *Homo sapiens* is survival through problem solving capacity. We are the learning species. In that mode, flexibility is essential to dealing with complexity and ambiguity. Liberals tend toward flexibility, a high tolerance for ambiguity and uncertainty, and attraction to new experiences and sensations Mendez (2017). Staunch conservatives are more likely to go with the blue-footed booby approach and tend to approve of zero tolerance protocols, denying the very essence of species *Homo sapiens*.

Ecofeminism and Cooperation

Modern industrial and technological society has subjugated and devalued both nature and women (Merchant, 1980). Ecofeminism is based on the view that "life in nature (which includes human beings) is maintained by means of cooperation, and mutual care and love" (Mies & Shiva, 1993, p. 164). This feminist emphasis on cooperation is reflected in Roughgarden's (2004) concept of social inclusion. Cooperation is as important a force in evolution as competition (Dobzhansky, 1962). This powerful insight alters the original Darwinian conception of competition for resources being the driving force for evolutionary change. More recent theory and research has filled in the specifics of the ecofeminism vision of cooperation in evolution (Boyd & Richerson, 2009; Hammerstein, 2003; Sachs, Mueller, Wilcox, & Bull, 2004; Tomasello, Melis, Tennie, Wyman, & Herrmann, 2012). Hopefully, the new book by Nicholas Christakis, *Blueprint: The evolutionary origin of a good society* (2019), will help to mitigate the popular survival-of-the-fittest notion of dominance by the emphasis on "social suites". The nucleus of every society is the social suite consisting of individuality, love, friendship, social networks, cooperation, in-group preference, a degree of egalitarianism, and capacity for both learning and teaching in a social context. "These traits are evolutionarily rational, in other words, enhancing our Darwinian fitness and advancing our individual and collective interest" (Christakis, 2019, p. 15). Christakis notes that even human infants have a sense of fairness and reciprocity which form the basis of cooperation.

Cooperation, Fairness and Reciprocity

Cooperation is based on the premise of fairness and reciprocity. Our primate relatives are highly attuned to fairness. Capuchin monkeys demonstrate a finely honed sense of fairness and reciprocity. When two monkeys are housed side by side and each given a cucumber reward for presenting a token to the researcher all is well. But when one monkey is given a grape while the other still gets a less desirable cucumber slice for the same behavior, the injustice is obvious and the monkey gets very upset (Brosnan & de Waal, 2003).

Collaborative foraging in early humans represented a winning strategy for survival. The nature of foraging made cooperation mutually beneficial. Interdependence became an effective way for the group to survive. This mutualistic collaboration formed the basis of such interdependence. As a result of this evolutionary history, humans tend to share rather generously and fairly (Tomasello et al., 2012).

> Humans, as already evident in young children, have evolved a suite of cognitive and motivational mechanisms for sharing food cooperatively, coordinating and communicating toward joint goals with complementary roles, and engaging in various kinds of reputation-based social selection (including a concern for self-reputation as a cooperator)—what we have called skills and motivations for joint intentionality (Tomasello et al., 2012, p. 680).

Cultural Evolution

Cultural evolution of society-wide cooperation occurs especially fast in rapidly changing environments (Boyd & Richerson, 2009). The habitats occupied by early humans underwent rapid change due to climate instability (Potts & Sloan, 2010). The capacity for culture to respond much more quickly than genetic evolution allowed for rapid adaptation to new circumstances. Cooperation made these adaptations work.

"Humans have a constellation of psychological traits built for culture, including the tendency to conform to what others are doing …" (Christakis, 2019, p. 367). Conformity and cooperation go together. Unfortunately, conformity is also the basis of authoritarianism.

Status in social groups of animals is typically about dominance based on power. But status can also be accorded in relation to prestige based on the benefits an animal can offer. Lemurs who possess important survival information or skills are accorded prestige and play a central role in ring-tailed lemur (*Lemur catta*) society (Kulahci, Ghazanfar, & Rubenstein, 2018). We have evolved to value prestige even at a young age. "Insecure politicians exploit these types of cues, making ostentatious displays of fawning audiences in order to enhance their prestige in the eyes of others" (Christakis, 2019, p. 369). Trump's constant returning to his political base for rallies during his presidency speaks volumes about his need for prestige.

Evolution of the Human Primate

"Humans are culture-bearing and culture-dependent animals not only in myth, ritual, and art forms but also in social structure, technology, and use of the environment" (Tanner, 1981, p. 22). The major primate adaptation that made human culture possible is decelerated early growth allowing a greatly extended infancy and childhood (humans have the longest childhood of any animal). The more closely a primate is related to *Homo sapiens* the slower the growth pattern and the longer the period of maternal attachment in infancy and childhood. Emotion plays a large role in the infant learning environment thanks to the strong maternal-infant bond typical of primates. Social interactions with immediate and extended family members provide a rich learning environment for humans and our closest primate relatives.

Sapiens means wise in Latin. *Homo sapiens* would be better categorized as the "learning" being as our wisdom is very much in question given the human track record of environmental destruction, species extinction, and warfare starting very early in our history. Learning comes about through observation, imitation, practice and reinforcement. It is the ultimate social experience for the young of our species and our primary survival mechanism as a species.

Our chances of survival as individuals is remote. We aren't very fast compared to our predators, we don't have any armament such as claws or large sharp fangs, we don't possess any protective armored coverings or even a thick pelt. What we do have is our brains and an astounding capacity for endless learning. This allows us to create complex tools and technology for survival. But the most important survival tool we have is our social interconnectedness. "Essentially, the human condition is one of interdependence and this comprises a large part of our adaptation capacity" (Rabin, 1986, p. 26).

Close Relatives

Our nearest hominid relatives are the common chimpanzee and the bonobo, the two species of the genus *Pan*. The common chimpanzee (*Pan troglodytes*) is familiar to most people. The other chimpanzee, the bonobo (*Pan paniscus*) is similar in appearance, being somewhat slimmer and smaller than the taller and stockier common chimpanzee although bonobos in the wild are more muscular than captive bonobos. Two features that quickly distinguish the two species is that bonobos have pink lips compared to the brown of the common chimpanzee and bonobos have stylishly long head hair which often falls into a natural part down the middle. Finally, the deep pant hoot of the common chimpanzee made famous by Dr. Jane Goodall is missing in the bonobo which has a higher pitched voice (de Waal, 1995).

The common chimpanzee and the bonobo separated from their common ancestor somewhere between one million years ago (Prüfer, Munch, Hellmann, Akagi, Miller, Walenz, ... & Pääbo, 2012) and two million years ago (Diogo, Molnar, & Wood, 2017). "In fact, it is now becoming increasingly accepted that the bonobo-chimpanzee divergence was mainly due to the barrier to gene flow created by the formation of the Congo River *c*.1.5–2.5 Mya" (Diogo et al., 2017). All bonobos are found in the Democratic Republic of the Congo, below the Congo River. Chimpanzees are more widely distributed across Africa. They can be found north of the Congo River but also in western Tanzania (Gombe National Park), western Uganda, and southern Senegal. The common chimpanzee divides into four subspecies which differ from each other in local cultures: Western chimpanzee (*Pan troglodytes verus*), Central chimpanzee (*Pan troglodytes*), studied by Jane Goodall, Eastern chimpanzee (*Pan troglodytes schweinfurthii*), and Nigeria-Cameroon chimpanzee (*Pan troglodytes ellioti*). Chimpanzees have been extirpated from Gambia, Burkina Faso, Benin, and Togo. They occupy habitats ranging from savanna woodlands, to mixed grassland-forest and even tropical forests, from sea level to about 3000 m in elevation (Chimpanzees, WWF).

Chimpanzee and Bonobo Differences

The most striking difference between bonobos and chimpanzees is their social structures. Rather than the male domination typical of the common chimpanzee, bonobos live in a female centered society that is both egalitarian and peaceful. Females that have achieved full adulthood are either the same social rank as males or outrank some males (Furuichi, 2011). Female bonobos create powerful alliances with other females that are constantly reinforced with sexual contact (specifically genital-genital rubbing). These female alliances prevent the aggression-based male dominance structure typical of the common chimpanzee (Strier, 2016). Effectively, it is the mothers who run bonobo society and even influence male rivalries thereby determining dominance rankings among males (de Waal, 1995; Legrain, Stevens, Alegria Iscoa, & Destrebecqz, 2011; Surbeck, Mundry, & Hohmann, 2010).

Another important feature separating chimpanzees from bonobos is that adult bonobos continue to engage in extensive play behavior. This is considered to be a tension diffusing mechanism that helps keep bonobo society relatively peaceful.

Bonobos use empathy to stay connected and coordinated in the social system (Clay, Palagi, & de Waal, 2018; de Waal, 2019a, 2019b). Chimpanzees do not display this high degree of empathy in their social interactions. Interestingly, there are differences in the neural circuitry of the brain between bonobos and chimpanzees. Bonobos have more gray matter in the right dorsal amygdala and the right anterior insula, areas associated with the perception of distress in others and in oneself (Rilling, Scholz, Preuss, Glasser, Errangi, & Behrens, 2011). Political conservatives have larger right side amygdalas and are highly sensitive to threat-induced fear (Kanai, Feilden, Firth, & Rees, 2011; Ressler, 2010). Another neurological difference distinguishing bonobos from chimpanzees is the larger connection between the ventral anterior cingulate cortex and the amygdala. This pathway is involved with mediating aggressive impulses (Rilling et al., 2011).

"Caring, friendships, and the fitness value of social skills" have been demonstrated by Clay and de Waal (2013, p. 18121) in their research with bonobos in the Democratic Republic of the Congo. The development of socio-emotional competence in bonobos comes about through achieving a specific skill set regarding relationships. Bonobos have to learn how to form and maintain relationships and how to behave in an accepted way in social situations. Emotional learning is as important. Bonobos have to become sensitive to emotional cues from others and most important, they have to be able to control their own emotions in a social setting (Clay & de Waal, 2013). The end result is a remarkably peaceful and egalitarian society, although not entirely aggression - free during mating (Hohmann & Fruth, 2003).

Bonobos offer a strong example of Joan Roughgarden's theory of social inclusion as well as laying the foundation for cooperation and a peaceful society. This is accomplished with friendship bonds supported by sex. Tension and stress are diffused with quick sexual pairings in every possible combination. Sex is used to reassure one another and to keep things calm. Make love not war is the bonobo anthem (de Waal, 2000).

Self-Domestication in Bonobos

Hare, Wobber & Wrangham (2012, p. 1) believe that the bonobos arrived at their current relatively peaceful and egalitarian social structure and culture by the process of self-domestication: "Evolution of bonobo psychology is due to selection against aggression". They attribute the smaller canine teeth, smaller jaw, juvenilized skull and more gracile body to self-domestication around reducing aggression.

Mating behavior is changed by self-domestication. Females have longer periods in which they are sexually receptive reducing the pressure on males to jockey with each other for access to fertile females. This has the effect of reducing overall aggression between males. In the common chimpanzee males attack females on a regular basis in an attempt to secure exclusive mating access through intimidation. Males vie with each other for social status as higher ranking males have better access to females. Since the window for fertile mating is short there is intense pressure on the males to mate successfully. None of this is true for bonobos. The extended fertility period reduces friction between males and males rarely attack a female. If a bonobo male does attack a female she rapidly assembles a coalition of other females who beat the male robustly (Hare et al., 2012; Wrangham, 2019). Humans extend this paradigm in that fertility is continuous for a significant portion of the lifespan.

Becoming an alpha male through hostile encounters with other males is linked with increased mating opportunities for chimpanzees. This is not so for bonobos. Male social rank in bonobos is determined by the social rank of the mother. Sons of high-ranking mothers have much easier access to females than sons of low ranking mothers. Sons remain closely attached to their mothers throughout their lives whereas adult females leave the natal group and move to a new group. Bonobos readily receive new members into their social groups. A unique feature of bonobos is that they form female-male friendships of equal power (Legrain et al., 2011; Surbeck et al., 2010; Wrangham, 2019).

Another important feature separating chimpanzees from bonobos is that adult bonobos continue to engage in extensive play behavior. This is considered to be a tension diffusing mechanism that helps keep bonobo society relatively peaceful. "Among bonobo females, characterized by social competence and affiliation, social play might enhance their behavioral flexibility and increase their socially symmetrical relationships which, after all, are the basis for their egalitarian society" (Palagi, 2006, abstract).

> Self-domestication has resulted in dramatic change in the biochemistry of the bonobo brain. "Higher levels of serotonin in the brain are associated with reduced reactive aggression. Strikingly, in bonobos, the amygdala contains twice as many serotonergic axons (nerves responding to serotonin) as it does in chimpanzees, suggesting one way in which bonobos have evolved a greater ability to regulate aggressive and fearful impulses." (Wrangham, 2019, p. 94).

Why and How Bonobos and Chimpanzees Diverged in Evolution

The answer to the divergence of chimpanzees and bonobos into such different social and physical structures is gorillas. There are no gorillas south of the Congo River where bonobos evolved. Gorillas compete with chimpanzees for the same food resources. This puts pressure on chimpanzees to find enough food and forces them to disperse in their quest to sustain themselves. The social structure of chimpanzees has been called a fission-fusion system that operates well under ecological constraints on food acquisition (Lehmann, Korstjens, & Dunbar, 2006).

Bonobos did not have to compete with gorillas for food so they were able to sustain a coherent group structure while feeding. This stability allowed strong social bonds to develop and function during social encounters. Female allies were always nearby if males became too aggressive. Bonobos also show a high level of tolerance for neighboring groups. Recently a case of food sharing of a valuable meat resource both within and between bonobo groups was documented (Fruth & Hohmann, 2018). The basis for this high level of tolerance is explained by the abundance of food resources and by female dominance in bonobo society (Furuichi, 2011).

Emotion in the Lives of Our Closest Relatives, the Chimpanzees and Bonobos

Emotion is the key to motivation whether it is the human primate or the non-human primate. Franz de Waal (2019a, b) documents the full range of emotions of our closest relatives the bonobos (*Pan paniscus*) and the chimpanzee (*Pan troglodytes*). The behavior and emotions of bonobos and chimpanzees gives us insight into our heritage as the human primate. It is all there. Everything from empathy to sorrow, joy to grief exists in the lives of our closest relatives (de Waal, 2019a, b; Goodall, 1986, 1990).

Jane Goodall set the standard for research on chimpanzees when she became the first person to live among chimpanzees and record their lives in the wild. She was accepted to Cambridge University for graduate study without ever having obtained an undergraduate degree. She spent 5 years with the wild chimpanzees in Gombe Stream National Park, Tanzania, starting in 1960. When she defended her PhD dissertation in 1965 (*Behaviour of free-living chimpanzees*) she was (and still is) the world's leading authority on chimpanzee society. She even raised her son, Hugo, better known as Grub, among the chimpanzees for a while (Goodall, 1986, 1990). During her 30 years with the Kasakela chimpanzee community in Gombe, Goodall documented all the emotions that we think of as human, especially compassion, altruism and love but also fear. Goodall changed the definition of human as the toolmaker by being the first to describe tool-making in the chimpanzee. Her knowledge of evolving chimpanzee culture is unmatched in the study of animal behavior.

Political Chimpanzees

Frans de Waal (1982, 2007) wrote extensively about political behavior in chimpanzees (*Pan troglodytes*). Comparisons with human situations border on the eerie: Forming alliances and coalitions, engaging in deception, status motivation, and the ability to reconcile. Reconciliation between warring males was accomplished by means of the intervention of female "mediators" (King, 2012). De Waal believes that human political activity has its basis in evolution and is visible in the lives of chimpanzees and bonobos.

Whereas de Waal (1982, 2007) studied chimpanzees mostly in captivity at the Burgher's Zoo in Arnhem, the Netherlands, for his book on *Chimpanzee politics*, Goodall and various colleagues have documented many political interactions between both male and female wild chimpanzees over 60 years at Gombe. The alpha male needs the support of a few other males with whom he makes strong alliances and forms operational coalitions to maintain power. Aggression is common in maintaining political power among males. The female alpha chimpanzee uses social relationships and strength of personality to maintain power (Cohen-Brown, 2018). High ranking females show large reserves of patience and confidence as well as strength (Wallauer, 2019). Recent observations at the Jane Goodall Institute's Gombe Stream Research Center have indicated that extended family groups can wield enormous power, engaging in aggressive encounters with other females and even banding "together to intimidate or retaliate against a high-ranking male in the community" (Wallauer, 2019).

It is vital to remember that Goodall's research legacy has given us the understanding that chimpanzee society is held together by altruism, strong friendships, and sharing of resources and knowledge. This insight is often lost in the overemphasis on chimpanzee aggression.

Funk et al. (2013) examined the relationship between political orientations and environmental and genetic influences. They emphasize that "though we refer to predispositions as having substantial heritable components, this does not mean that they are determined by genetic factors" (p. 809). They conclude that political dispositions have common genetic and environmental underpinnings and indeed that these political orientations may be yet another aspect of human personality. Perhaps these political orientations are part of chimpanzee personality as well.

Political Bonobos

Bonobo society is a matriarchy and power is divided between females and reinforced thorough sex between female partners. Females are the first to eat, they get groomed more than males, they will coerce males if needed, and are generally in charge. Amy Parish (1996) believes that the key to female power in bonobos is "lesbian sex". The deep emotional pleasure in evidence when females rub their genitalia up against each other creates a bond which becomes the basis for redoubtable social coalitions.

Political Dominance, Aggression and Gender

Sociobiologists and some primatologists, deduce that human nature as derivative of the evolutionary heritage from the common chimpanzee (*Pan troglodytes*) is hard wired for male dominance and male sexual coercion (Peterson & Wrangham, 1997). Richard Wrangham somewhat softens his stance on inborn aggression in his new book, *The goodness paradox* (2019). Nevertheless, chimpanzee societies are typically characterized as physically aggressive, male-bonded and male-dominated. If male power is seen to be biologically ordained because we carry chimpanzee genes then deterministic thinking is ascendant. Many political conservatives are comfortable with the notion that males are biologically ordained to govern. Political liberals will be much happier about the genes we carry from our bonobo heritage and the behavioral flexibility contained in that biological legacy. In either case, genes interact with the present day social, physical, and physiological environment in an epigenetic process that can alter what is produced. Deterministic thinking is inappropriate for either the chimpanzee or the bonobo scenario.

Our genetic closeness to bonobos can be used to study bonobo social behavior for clues as to possible survival strategies during our own evolution. Bonobos are welcoming to bonobo strangers and readily share food with them. This prosocial behavior establishes social bonds. "Bonobo networking has much to teach us about the origins of the human network we all rely upon" (Tan, Ariely, & Hare, 2017).

Close Genetic Relationship Between Humans, Bonobos, and Chimpanzees

We share 99% of our DNA with chimpanzees and bonobos, sort of. Humans share about 1.6% DNA only with bonobos not common chimpanzees. In the same vein humans and common chimpanzees share about 1.6% DNA that we do not share with bonobos. "The bonobo genome shows that more than 3% of the human genome is more closely related to either bonobos or chimpanzees than these are related to each other.… About 25% of human genes contain parts that are more closely related to one of the two apes than the other." (Prüfer et al., 2012, p. 530).

It is not possible to determine which of the two great apes we are more closely related to as we share different genes with each of them that they do not share with each other. This complicated evolutionary history comes about because the ancestral population that gave rise to all of us, humans, chimpanzees, and bonobos, was large (approximately 27,000 breeding adults) and quite genetically diverse. The ancestral line leading to humans split off from the line leading to modern chimpanzees and bonobos over four million years ago. The common chimpanzee (*Pan troglodytes*) and the bonobo (*Pan paniscus*) separated from their common ancestor either one million years ago (Prüfer et al., 2012) or two million years ago (Diogo et al., 2017). What we are left with is the fact that modern humans, bonobos, and chimpanzees retain somewhat different subsets of the diverse gene pool of that shared ancestral group four million year ago (Prüfer et al.; Gibbons, 2012). "Chimpanzees and bonobos each possess certain characteristics that are more similar to human traits than they are to one another's" (Prüfer et al., 2012, p. 528).

In addition to the data from genetics we now have the first study of bonobo anatomy. An intriguing finding has emerged. The muscles of bonobos which are indicators of physical function, are closer to human anatomy than to chimpanzee anatomy (Diogo et al., 2017). Perhaps we evolved more along the lines of bonobos than chimpanzees.

Savanna Hypothesis

The key to understanding what made humans diverge from the evolutionary pathways of bonobos and chimpanzees is adaptation to a newly created environment. When the African savannah was formed from a prolonged drought that reduced Africa's forests, ancestral humans (hominins) ventured out of the forest, leaving behind both bonobos and chimpanzees. The adaptations suited for forest dwelling began to be overtaken by traits more suited for survival in the open savanna: walking completely upright, complex tool making, enlargement of the brain (especially the cerebral cortex), complex language, complex mental activity (problem solving, learning), extended childhood learning time, reduced sexual dimorphism, complex social behavior, and development of technology for rapid adaptation to changing needs. This is known as the savanna hypothesis which explains human evolution as a series of adaptations to the dry, open grasslands dotted with acacia trees of the African savanna (Bender, Tobias, & Bender, 2012).

Based on extensive anthropological research Nancy Tanner (1981) hypothesized that a critical evolutionary pathway came about because of women and children. A key technological innovation which allowed our earliest hominin ancestors to make the transition to the environment of the African savanna was successful gathering of plants and small animals such as insects.

> It is, therefore, highly probable that it was women with offspring who developed the new gathering technology and that this was the innovation critical to the ape-human divergence. It is further reasonable to suppose that the technological innovations associated with gathering had a powerful impact on subsequent biological evolution. Mothers who were the best gatherers—that is, who were most intelligent, who used tools most effectively, who walked and carried most efficiently, and who shared gathered food—had children who were the most likely to survive. (Tanner, 1981, p. 268)

Variability Selection Hypothesis

A new theory of human evolution has been put forward by Rick Potts of the Smithsonian's Human Origins Program (Potts & Sloan, 2010). Potts expands the notion of our special human traits coming from adaptation to the single stable environment of the African savanna to the idea that we evolved because we were able to adapt to changing environments. It was the very instability of the environment that drove human adaptations (Potts, 1996, 2013; Potts & Faith, 2015).

Given the fluctuations of climate in human evolution, natural selection may be more about "survival of the versatile" than survival of the fittest (Potts & Sloan, 2010). Potts sees flexibility as the key to survival and gives the name 'variability selection' to his theory. In an interview for NOAA Potts describes his theory:

> Variability selection is a form of natural selection that explains adaptation as a response to dramatically increased variability in the environment. When climate and other aspects of the environment vary dramatically, it can really affect the survival and success of an organism and its offspring over time. The effects can be evident in the gene pool and adaptations of an organism over time. Ultimately, organisms that can cope with widely varying conditions have a better chance of surviving novel and unpredictable environments…. Over time and in different places where our ancestors lived, environments varied widely. Variability selection proposes that major features of human evolution were actually ways that our ancestors became more adaptable. It's a process of selection and adaptation to environmental variability, and it accounts for traits that cannot be explained by adaptation to any one environment or trend. For example, our large brains are useful for processing a wide range of information, our teeth and ability to make tools are useful for consuming a wide variety of foods, our sociability helps us team up with others when our survival is threatened (Scott, 2016, para. 2).

The research on long-term climate patterns indicates that the special adaptations characteristic of the genus *Homo* (hominins) and species *Homo sapiens* occurred during the greatest changes in global climate. This environmental instability was the factor driving hominin adaptation and evolution, according to Richard Potts and Chris Sloan (2010). Foraging hominins had to be flexible in their genetic possibilities to be able to respond to rapid climate changes with modified phenotypes. Rather than evolving in relation to one specific habitat, human ancestors became more and more able to cope with changing environments. ". . . important changes in stone technology, sociality, and other aspects of hominin behavior can now be understood as adaptive responses to heightened habitat instability" (Potts, Behrensmeyer, Faith, Tryon, Brooks, Yellen, ... Renaut, 2018, abstract).

A large research undertaking on subdivided populations of hominins across Africa (Scerri, Thomas, Manica, Gunz, Stock, Stringer, & . . . Chikhi, 2018) gives powerful support to Potts' theory. Hominin fossils have been found in widely dispersed locations in Africa that had very different ecosystems, climates, and habitat diversity. Different tool cultures emerged in different parts of Africa. These groups also differed in population size. The conclusion drawn by the authors is that human evolution occurred in different populations across Africa.

How humans evolved matters very much in understanding the exact nature of our biological heritage. Evolving in relation to a specific habitat is very different from evolving to be capable of adapting to changing environments. One implies a fixity of traits whereas the other extols flexibility of response. Most likely, our human capacity for survival is based on our ability to adapt to change. Many species have gone extinct because they were perfectly adapted to a highly specific environment. When that environment was modified by climate or other events the over specialized species went extinct (Raia, Carotenuto, Mondanaro, Castiglione, Passaro, Saggese, … Fortelius, 2016).

Self-Domestication in Humans

Humans most likely self-domesticated by selecting for lower aggression, similar to bonobo adaptation. The genomic signs of self-domestication have been elucidated in recent research (Theofanopoulou, Gastaldon, O'Rourke, Samuels, Martins, Delogu, … Boeckx, 2017). In comparing modern humans with Neanderthals, clear indicators of self-domestication are evident: reduction of sexual dimorphism, reduction in tooth and jaw size, more gracile body structure, smaller brow ridges and noses, and even a smaller cranial capacity commensurate with shorter stature. When the DNA of Neanderthals and Denisovans is compared to that of modern humans, differences in the genetics of the neural crest emerge. The point of the study was "to identify domestication-related pathways that could be suggestive of a self-domestication process in anatomically modern humans (AMH). The fact that we find neural crest-related changes in AMH compared to Neanderthals/Denisovans, and that such changes are also found in another species hypothesized to have undergone a self-domestication process (bonobos), reinforces our hypothesis that self-domestication took place in our species" (Theofanopoulou et al., 2017). A physiological change vital to the self-domestication process is the lowering of activity in the hypothalamus-pituitary-adrenal axis (the stress response system in the brain).

The key to the underlying genetic changes accompanying self-domestication is the neural crest. The embryo separates into three layers, the endoderm, mesoderm, and ectoderm. But a fourth embryological development factor exists, the neural crest. Neural crest cells move to every part of the developing body affecting a wide variety of traits. In this manner selection for low aggression brought along a string of unrelated traits, the ones we associate with self-domestication (Wrangham, 2019).

Selection for low aggression is a process that can involve killing. Lower ranking males could band together to take on a bully or tyrant Alpha male. With a coordinated effort based on cooperation the group of males could succeed in killing the Alpha male and therefore eliminating his genes from the gene pool (Wrangham, 2019). This pattern reflects evolution from a chimpanzee ancestor as bonobos lowered aggression simply because it did not pay, and in fact, was counterproductive in achieving sexual access to females.

Human evolution produced a more egalitarian society during the early forager-hunter period (Kaplan, Hooper, & Gurven, 2009). Once agriculture and food storage came into being, inequalities arose both with regard to gender and to individual power and resources.

Preadaptations for the Journey to Human

Many traits developed during the evolutionary journey of the precursor primate of modern bonobos, chimpanzees, and humans are critical to the ultimate success of the human species. Preadaptations for the human primate most commonly cited refer to physical features such as a relatively large body size with a relatively large brain and grasping hands with opposable thumbs. The ultimate human adaptation for evolutionary survival is culture (Boyd & Richerson, 2009; Gould, 2002; Laland, Odling-Smee, & Myles, 2010; Tanner, 1981). Preadaptations for culture can be seen in gorilla, orangutan, chimpanzee and bonobo society and even in capuchin monkeys and Japanese macaque societies (McGrew, 1998). Chimpanzees and Japanese monkeys "show innovation, dissemination, standardization, durability, diffusion, and tradition in both subsistence and nonsubsistence activities …." (McGrew, 1998, p. 301). The key to culture and human survival is social cooperation (Boyd & Richerson, 2009. Humans show greater social cooperation than any other species.

Culture and Social Learning

Culture existed almost as soon as the genus *Homo* came into being (Alperson-Afil et al., 2009). Culture makes rapid adaptation to local circumstances possible. While the high level of human intelligence is clearly vital to the ascendency of *Homo sapiens*, Robert Boyd and Peter Richerson (2009) argue that only culture could have made possible the human ecological success that allowed us to survive in greatly diverse habitats, from the desert to the arctic. They go on to describe a model of evolution that explains why humans were able to develop such a high degree of cooperation. Human psychology concurrently evolved a core of pro-social motivation.

> Social learning allows human populations to accumulate adaptive information over many generations, leading to the cultural evolution of highly adaptive behaviors and technology. Because this process is much faster than genetic evolution, human populations can evolve cultural adaptations to local environments, an especially valuable adaptation to the chaotic, rapidly changing world of the Pleistocene. However, the same psychological mechanisms that create this benefit necessarily come with a built-in cost. To get the benefits of social learning, humans have to be credulous, for the most part accepting the ways that they observe in their society as sensible and proper, and such credulity opens up human minds to the spread of maladaptive beliefs. (Boyd & Richerson, 2009, p. 3286)

This built-in propensity for maladaptive beliefs underlies the ease with which humans fall prey to conspiracy theories, blood libels, partisan extremism, authoritarianism, or just plain silly gossip. Our reliance on the group for survival is our strength but also contains a potential psychological weakness. We are born believers, but not discriminating ones (Levitin, 2014, 2016; Shermer, 2011). This has unfortunate consequences in politics, particularly with regard to populism and authoritarianism.

Culture, Social Environment, Epigenetics, and Evolution

"Humans have especially sophisticated perceptual capacities, enabling them to respond to a wide range of complex visual, auditory, linguistic and behavioural/emotional signals in their extended environment. Research has recently begun to show that responses to such signals can extend all the way down to the level of gene expression" (Keller, 2016, abstract). The mechanism by which the social environment can influence epigenetic development in evolution is close upon us. The consequences for human evolution of our intense social embeddedness may extend to altering the read-out of our genes by epigenetic responsiveness to human perception. Culture may indeed be part of the process affecting how our genes work to produce traits.

Diversity in Nature

The wonder of diversity bequeathed to us by the processes of natural selection, sexual selection, and social selection in the evolution of species allows us to move beyond the narrow confines of our traditional cultural conceptualizations of sex roles and gender stereotypes. As part of biodiversity in nature we find remarkable variety in patterns of reproduction, sexual development, and sexual orientation. The diversity of patterns of reproduction and sexuality that abound in nature demonstrates the flexibility of both animal and human behavior. New models of relationships between living things provide a different perspective from which to interpret the vast array of behavioral plasticity and creativity characterizing animal behavior in the wild. Paradigms such as ecofeminism and social selection focus on cooperation being the equal of competition as the driving force in the evolution of species. Same-sex intimate behaviors and pair bonds in animals are widespread across species and common in primates. This diversity is an example of behavioral plasticity in nature.

How we understand our place in the biological world informs our identity. Those who rely on the fixed genetic determination of behavior paradigm are likely to be both conservative and fundamentalist. The more people understand the vast diversity of our biological heritage the more it can strengthen cognitive flexibility and a more pliant and comfortable identity.

Single-Sex Patterns of Reproduction

Most people assume that sexual reproduction (female ova + male sperm) is universal among animals. It is enjoyable to expand upon the story of the whiptail lizard (*Cnemidophorus neomexicanus*), a species consisting entirely of females who reproduce by cloning (Crews, 1987). A single female in isolation can produce genetically identical daughters. If two females encounter each other they may engage in mutual sexual stimulation in which the hormone estrogen brings on “female” copulatory behavior patterns and progesterone brings on “male” copulatory behavior patterns in each lizard alternatively (they take turns). Under this stimulation pattern each female produces more daughters than if she reproduces in isolation.

More than eight species of female-only whiptail lizards are found in steambeds in Mexico, New Mexico and Texas. Hawaiian geckoes are also all females and can be found thorough out the islands of the South Pacific. There are entire species of fish that are all female. Among vertebrates in general all female species can be found in most groups (Roughgarden, 2004).

Epigenetics of Temperature-Based Sexual Development

Ambient temperature is a powerful epigenetic influence on cellular development in the embryo. Alligators lay a large number of eggs in a huge mass of decaying swamp vegetation. These eggs are incubated by the heat given off by the decaying vegetation in warm climates. The eggs are layered at different levels of the vegetation mass such that those nearer to the top experience warmer ambient temperatures than those nearer the bottom. If the temperature is 91 degrees and above, all the eggs hatched will be males. If the ambient temperature is 88 degrees and below all the hatchlings will be female (Ferguson & Joanen, 1982). Turtles are the opposite, with warmer temperatures producing females and cooler ones producing males. Sea turtles dig huge holes in the beach sand and lay hundreds of eggs. Because of global warming, greater heat is reaching lower into the holes and resulting in sex ratios that can be skewed by as much as 116 females for every male (Jensen, Allen, Eguchi, Bell, LaCasella, Hilton, . . . & Dutton, 2018). The underlying genetic and epigenetic mechanisms for temperature-determined sex have recently been determined (Radhakrishnan, Literman, Neuwald, & Valenzuela, 2018). DNA methylation and histone acetylation genes were the most responsive to epigenetic ambient temperature stimulation.

Sexual Development

The basic pattern of sexual development is female in all mammals (Lips, 2019). This is not entirely a default situation since certain genes (Wnt-4 and DAX-1) are necessary for female devlopment to progress (Sinisi, Pasquali, Notaro, Bellastella 2003). However, male development can only happen by changing the direction of development. Information on the Y chromosome may switch the developmental pathway from female to male if the genetic codes are successfully read-out epigenetically. The developmental environment can be influenced by many factors, especially hormones. Possession of a Y chromosome does not ensure that a male organism will develop. Biological sex is an outcome of epigenetic process not genetic determinism.

Sex Changers

Most people assume that if you are born one sex you stay that way. This brings us to the world of sex-changing fishes (Todd, Liu, Muncaster, & Gemmell, 2016). At least one-third of all tropical fish changes sex (Warner, 1984) and also "2% of all extant teleost species scattered across more than 20 taxonomic families in 9 orders" (Avise & Mank, 2009, p. 152). There are three major sex change paradigms: Female to male (protogynous hermaphrodite), male to female (protandrous hermaphrodite), and serial bi-directional sex changers (serial hermaphrodites), including simultaneous hermaphrodites (Todd, Liu, Muncaster, & Gemmell, 2016). Hart, Kratter, Crowley (2016). In some families of tropical coral reef fishes, sex changing is so common that biologists needed to create the word "gonochoristic" to describe those species with two distinct sexes in which males always stayed males and females always stayed females. Imagine a world in which it is necessary to designate which individuals remain the same sex throughout their lives!

Sex Changers: Female to Male (Protogynous Hermaphrodites)

Sex changers are protogynous hermaphrodites, in which all members of the species are born female and some of them change into males in late adulthood, as needed for reproduction. Examples of protogynous hermaphrodites are groupers, wrasses, porgies, parrotfishes, and angelfishes (Todd et Al., 2016). Species such as *Malacanthus plumieri*, the sand tilefish (Clark, Rabin, & Holderman, 1988), *Malacanthus brevirostris*, the short-nosed tilefish, and *Parapercis hexoptalma*, the spotted sand perch (Clark, Pohle, & Rabin, 1991) live in small groups consisting of one male and one to seven females, each with its own dwelling made of coral rubble tunneled into and on top of the sand. Most members of these species spend their entire lives as females but retain the potential to change into males if the resident male is lost to predation.

Sexism and Androcentrism in Science

In 1987 I presented a paper on the sand tilefish at the Sixth Biennial Conference on the Ecological and Evolutionary Ethology of Fishes (Clark et al., 1988; Clark, Rabin, Bunyan, Murdock, Shen, & Petzold, 1989). At the conference one of the presenters, Yvonne Sadovy, reflecting on the morning symposium devoted to sex change in fishes, indicated that no one had questioned the basic premise that changing from female to male was desirable and sought after by the fish. She pointed out that it was perfectly possible that females benefitted from remaining female and that the sex-changer was forced to switch by pressure from more dominant females. This is a perfect example of how the world view of many male researchers precludes certain possibilities because in their minds being male is the superior status.

I raised another androcentric-thinking concern at the conference, that of the word "harem" to describe the social structure of a single male, multiple female mating system. This is not a neutral word, and indeed the historical reality of the harem situation is associated with slavery for women. To take such a loaded word from human culture to describe behavior in fishes is far from the neutrality and objectivity that is the heart of scientific endeavor. Even so, the word harem is almost universally used in ethology.

"The term 'harem' implies a dominant male (Rosser, 1986) and may obscure the possibilities of a less agentic (individualistic, hierarchically oriented), more communal (cooperative) power structure within the group" (Clark et al., 1988, p. 283). Interestingly, it is the female who decides if mating will occur on any given night. Each fish has its own elaborate burrow piled high and round with coral rubble. Each evening the male swims to each burrow where the resident female is waiting. The male does a dramatic dance to entice the female to mate but if she is not interested she merely turns away and dives into her burrow. The rejected male moves on to the next burrow. This pattern of behavior does not appear to reflect the male power structure that sociologists and historians describe for human harems. The sand tilefish, *Malacanthis plumieri*, exhibits a social structure in which females have their own elaborate private residences which they build and maintain. Males do not have more imposing burrows (Rabin, Benveniste, & Clark, 1988; Rabin & Clark, 1989). In human society this would amount to autonomy, freedom, and power and not the virtual slavery of the harem. The way animal behavior is described in science has enormous ramifications for society and for politcs.

Sex Changers: Male to Female (Protandrous Hermaphrodites)

Whereas the protogynous pattern of sex change is the most common, nature also provides protandrous hermaphrodites such as the anemonefish or clown fish (Warner, 1984), and the barramundi, a giant perch from Australia (Domingos, Budd, Banh, Goldsbury, Zenger, & Jerry, 2018). In this relatively rare pattern all the young are born male and they all change in to females when they reach later adulthood. All large clown fish are females, all small clown fish are males. The female is dominant over the males and keeps a group of males within her territory, only one of which is a breeding male (Fricke, 1979). The sex change in protandrous hermaphrodites is epigenetically controlled. One epigenetic trigger for the barramundi is the change from the freshwater of its early years to the saltwater of adulthood. "Epigenetics is involved in sex differentiation of gonochoristic and hermaphroditic fish species, whereby two genes dmrt1 (pro-male) and cyp19a1 (pro-female) are known to play major roles" (Domingos et al., 2018, abstract). It is enlightening to learn that epigenetics is part of sexual development in fishes that do not change sex (gonochoristic species).

Two-Way Sex Changers (Serial Hermaphrodites)

Things get even more interesting with the fish that are two-way sex changers. Coral gobies (*Paragobiodon echinocephalus*) can change sex and sometime later change back again to their original sex (Kuwamura, Nakshima, & Yogo, 1994). Multiple sequential sex changes back and forth can also occur in coral gobies (Nakshima, Kuwamura, & Yogo, 1995). The protogynous angelfish (*Centropyge ferrugata*) can change from a male back to a female if it encounters a rival dominant male (Sakai, Karino, Kuwamura, Nakashima, & Maruo, 2003). The chalk bass (*Serranus tortugarum*) is so sexually flexible that it can change sex rapidly back and forth as it exchanges eggs with its partner who does the same. This strategy allows the caloric burden of egg production to be shared between mating pairs (Hart, Kratter, Crowley, 2016).

Female and Male Together in One

Gynandromorphs are those rare animals that have a combination of male and female tissues which in certain cases results in the animal appearing half male and half female bilaterally. Gynandromorphs can also appear in a mosaic pattern of female and male patches across the body (Butler, 2017). A cardinal which showed bright red male colors on the left and dull buff female colors on the right was studied in the field for months (Peer & Motz, 2014). Another cardinal drew media fame frequenting a bird feeder in a suburban back yard (Weintraub, 2019). This one had male coloration on the right side and female on the left, making it possible that it might mate since birds' ovaries are only functional on the left side. In addition to birds, gynandromorphs can be found in crustaceans and other arthropods, spiders, and insects (Butler, 2017).

Sexual Orientation in Nature

Socially conservative people believe that being gay goes against "nature" and is therefore unnatural (Whitehead, 2014; Bienkov, 2017; Wood & Bartkowski, 2004). Socially liberal people believe that diversity in sexual orientation needs to be supported and people who are different from the norm need to be protected (Jost, 2009; Hetherington & Weilrer, 2018). Very few on either side understand that diversity is normative in nature (Bagemihl, 1999).

At the heart of disruption to the traditional social order is the defiance of the male-female bond. Same-sex intimate relationships are perceived as being a direct threat to the stability of the social architecture that provides order and continuity (Tuschman, 2013). Conservative are more likely to be deeply challenged by non-traditional partnering because of this destabilization threat. Same-sex relationships have traditionally been called "unnatural". Nothing could be farther from the reality of the natural world.

Same-Sex Intimacy Is "Natural"

In a much-cited book published in 1951, Ford and Beach indicated the variability and range of sexual partner behavior across species. Since then we have many more examples of same-sex intimate behaviors in a variety of primates and other mammals from rhesus monkeys to dolphins to giraffes (Bagemihl, 1999; Bailey & Zuk, 2009; Lane, Haughan, Evans, Tregenza, & House, 2016; Sommer & Vasey, 2006; Vasey & Forrester, 2015). Sex in nature is a riot of diversity rather than the simple male-female duality most people expect).

Bruce Bagemihl (1999) provided an encyclopedic examination of the existence of same-sex intimate behavior in nature. "Homosexual behavior occurs in more than 450 different kinds of animals worldwide, and is found in every major geographic region and every major animal group" (p. 12). In 2006, the Natural History Museum of the University of Oslo created an animal homosexuality exhibit. The museum researchers found over 1000 examples of species of animals engaging in same-sex intimate behavior (Homosexuality in the Animal kingdom—Naturhistorisk museum, https://www.nhm.uio.no/besok-oss/utstillinger/…/againstnature/gayanimals.html).

Same-Sex Attraction and Evolution

The core issue of natural selection in evolution is reproduction. Bagemihl answered the question of how same-sex behaviors could be selected for in evolution by pointing out that “reproduction is not necessarily a required component of ‘survival’—in some instances, it may be beneficial for a species or an ecosystem as a whole if some of its members do not procreate.” (1999, p. 249). This allows some animals to be helpers in raising the young or foraging for food and puts less population stress on the environment.

Inclusive Fitness Hypothesis

In Darwin’s theory of evolution fitness is a measure of reproductive success. If same-sex couples do not reproduce how can they be fit and pass their genes on? The answer is inclusive fitness which operates through the reproductive success of closely related kin. If a non-breeding animal increases the survival rate of offspring of closely related kin then the non-reproducing animal still has a measure of fitness since it shares many genes with close relatives and these will be passed on (Strier, 2016).

Social Glue Hypothesis

Another adaptive explanation of same-sex relationships is that they represent a kind of social glue that maintains alliances between pairs. This can be seen in male dolphin pairs who spend lifetimes together (Mann, 2005) and female bonobos who retain power through sexually based alliances (de Waal, 2000).

Evolutionary Origins

Because same-sex intimacy is so widespread in the animal and human world it likely has evolutionary origins. Nathan Bailey and Marlene Zuk (2009) examined this premise:

> The evolutionary origins of same-sex sexual behaviors can be decoupled from their present function. It does not matter whether they arise as a byproduct of selection on other traits, genetic drift or millions of years of carefully honed adaptation driven by selection. They can have the same evolutionary consequences regardless of their independent causes. This highlights a key feature of same-sex sexual behaviors: they are flexibly deployed in a variety of

> circumstances, for example, as alternative reproductive tactics, as cooperative breeding strategies, as facilitators of social bonding or as mediators of intrasexual conflict. Once this flexibility is established, it becomes in and of itself a selective force that can shape selection on other aspects of physiology, life history, social behavior and even morphology (p. 6).

Flexibility is a critical factor in evolutionary success. Both physical and social environments can change quickly. Behaviors that work in a variety of contexts have significant survival value.

Aesthetic Evolution

Recently, Richard Prum (2017) has offered a whole new way and very old way to look at sexual selection (mate choice). Charles Darwin was the first to propose a theory of aesthetic evolution which is driven by the preferences of mostly females, but sometimes males, when choosing a mate. In *Descent of man* Darwin used the phrase “a taste for the beautiful” to describe why one animal is attracted to another. Darwin had to abandon his theory because of pressure from a contemporary rival evolutionary theorist, A. R. Wallace (Prum, 2012). What Prum (2012, 2017) adds to Darwin’s idea is that perception is the key to beauty and depends on the nervous system and especially the sensory system of the individual. He gives numerous examples of the co-evolution of plants and their pollinators as the groundwork to understanding how physical traits can co-evolve in relation to perceived attraction of the choosing mate.

Aesthetic Evolution of Same-Sex Attraction

Prum (2017) has a theory of how human same-sex intimacy might have evolved. He believes that female and male same-sex attraction evolved separately. Because primate and human females have to leave their birth group (female-dispersal based societies) they are in need of allies in their new social group. Female alliances are of great value and can be strengthened by sexual ties, as in bonobo society. These alliances increase the autonomy of females by offering protection from unwanted male sexual coercion. (This dynamic also operates in societies where females do not have to leave the natal group).

Male same-sex orientations evolved as a by-product of female choice in heterosexual mating. According to Prum, females were attracted to more aesthetically pleasing, and more pro-social personality traits in male suitors. This selection pressure operated to expand male sexual desires including same-sex attractions.

Same-Sex Intimate Relationships in Primates

All the Great Apes (orangutans, gorillas, and chimpanzees) engage in same-sex intimate behavior. This includes both female-female and male-male bonds. Many primates including our closest relatives the common chimpanzee (*Pan troglodytes*) and the bonobo (*Pan paniscus*) engage in both heterosexual and same-sex behavior as part of their normal pattern (Vasey & Forrester, 2015). Bruce Bagemihl defines "normal" as "a routine aspect of the social and sexual organization of the species" (1999, p. 211).

Among monkeys, same-sex intimacy has been studied in the field for spider monkeys (Busia, Denice, Aureli, & Schaffner, 2018), Japanese macaques (Vasey, 1998, 2002), and capuchin monkeys (Manson, Perry, & Parish, 1997). Although same-sex intimacy is rare in New World monkeys it is found in 13 out of 20 genera of Old World monkeys (Dixson, 2010).

Gorilla Sex

Gorillas live in fairly small clusters consisting of a dominant silverback male and anywhere from three to six female adults with five to seven youngsters as well as a few juvenile males. Gorillas are polygynous with all heterosexual mating limited to the silverback male and the adult females. It is common for adult males to form all-male groups. Within these groups considerable homosexual activity takes place on a regular basis. "Each male has preferred partners whom he courts and has sex with; some interact with only one other male in the group, while others have multiple partners (Up to five have been recorded for one individual)." (Bagemihl, 1999, p. 281).

Female mountain gorillas were studied at the Karisoke Research Center (KRC) of the Dian Fossey Gorilla Fund International (DFGFI) in Volcanoes National Park, Rwanda. "Our report demonstrates that same-sex sexual contacts among females are clearly a component of the behavioral repertoire of mountain gorillas, albeit a relatively infrequent one" (Grueter & Stoinski, 2016).

Bonobo society is a matriarchy supported by multiple sexual bonds. Female bonobos engage in same-sex intimacy regularly and over their lifetimes (de Waal, 1995; Parish, 1996).

Female Alliances in Monkeys

Japanese macaques are very social primates and live in mixed-sex groups of 50 to 200. Females outnumber males in a group by about four to one. Females form strong relationships with each other based on same-sex courtship and copulation. They are attracted to those females that they are not genetically related to. Females will engage in sexual activities despite the availability of males and they will reject males that try to come between them (Vasey, 1998, 2002). Joan Roughgarden (2004) offers an interesting perspective regarding female same-sex bonding in Japanese macaques which she interprets as operating as social inclusionary traits. In terms of the hierarchical dominance system governing their lives it is crucial to make and to keep allies. Female same-sex bonds offer not just pleasure but social inclusion. According to Roughgarden their very lives depend on sexually-based female relationships.

Transgender in Nature

Joan Roughgarden refers to a certain black-hooded warbler found in Maryland as being transgender. "In all aspects of its anatomy, the bird was a male. Contradictory to Y's status as a male, all his behavior observed during 1988 and 1989 was categorically female; e.g., nest building, incubating and brooding young, but not singing or engaging in territorial defense" (Niven, 1993, p. 192) which are male behaviors in warblers. The eggs in the nest were laid by an unknown female. "Gender identity in this individual hooded warbler evidently crossed over from that typical of the sexed body" (Roughgarden, 2004, p. 104).

Nurturance

The instinct concept is so powerful it rules the thinking of many people, especially where motherhood is concerned. Maternal instinct is one of the most widely believed myths. The culturally-ordained role of caregiver is mistaken for a biologically-ordained behavioral trait or even a God given one. In nature, however, nurturance is not restricted to mothers or even females and learning has a critical role in successful nurturing.

Fundamentalist groups worldwide believe that women's and men's roles are preordained and immutable. Feminism is derided as a violation of the stability and order these roles provide. Feminism is also viewed as a threat to social stability and order. A key belief is that women are natural nurturers and that nurturing itself is "mothering". The mother role is seen as the keystone to family structure and that of the society as a whole. If female nurturance is the natural order of life on earth then the notion of male nurturance presents an imbalance to that natural order. Ethological research has clearly demonstrated that male nurturance is widespread and natural to many species, including our own.

Male Nurturance

How often have we heard the term “mothering” being used to denote “nurturing” behaviors? Many people assume that only females are natural nurturers. This certainly is not the case in the animal world where we have everything from the “pregnant” male seahorse (Jones, 2004) to the long-suffering emperor penguin father, protecting the egg in his pouch from the Antarctic storms (Bryce, 2019), to the gentle gibbon or siamang father, cuddling his youngster (Lappan & Whittaker, 2008).

Francis, Anthony, Brunton, and Kunz (1994) have studied the nurturing behavior of male fruit bats. These flying mammal males are actually capable of lactating. This provides us with the image of a male bat feeding his progeny with milk from his nipples.

The male stickleback fish builds a nest for the young, entices a female to lay her eggs in the nest, covers the eggs with sperm and chases the female away. Then the male cares for the young when they are hatched (Li & Owings, 1978).

The female ostrich is grayish-brown which blends in with the African savannah habitat, providing excellent camouflage during the day when she is on the nest. The black male ostrich takes over the nest at night while it is the female’s turn to forage for food. They are equally caring for the safety of the nest and for the young (Kimwele & Graves, 2003).

Jacanas are small to medium size shorebirds found in the tropics and subtropics worldwide. Widely splayed toes allow them to walk on top of water plants on lakes allowing them to spend most of their lives on floating vegetation. The female is polyandrous and territorial. She mates with several males in her territory and then leaves the care of the young to each male while she defends the territory (Sibley, 2001). Evolution is the process of successful adaptation to specific environments. Whatever behaviors work to bring about successful reproduction of the species are selected by the evolutionary process. Apparently, the female territorial defender and male nurturer works just fine for Jacanas.

Paternal Care in Primates

Paternal care of the young in our primate relatives sheds much needed light on the naturalness of male nurturance in *Homo sapiens*, the human primate. Monkeys exhibit a few examples of paternal care. Some lemurs, “the New World marmosets, tamarins, titi monkeys, and owl monkeys show direct care of their offspring” (Storey & Zeigler, 2016, p. 260). In titi monkeys it is the fathers who carry the infants and it is the fathers who are the primary parent that the infant attaches to (Hoffman, Mendoza, Hennessy, & Mason, 1995). In the lesser apes it is the siamangs not the gibbons who demonstrate paternal care. Fathers carry their offspring after the first year of life until they are fully independent (Fernandez-Duque, Valeggia, & Mendoza, 2009).

Jane Goodall (1986) tells of her observations of an orphaned chimpanzee raised by its brother and sister. Goodall describes how inept both brother and sister were in their clumsy efforts to care for their orphaned sibling. She indicates that the female was no more knowledgeable than the male, but they were both equally motivated to try meeting the youngster's needs and ultimately they both succeeded. The notion of maternal instinct in anthropoid apes, including humans, is not borne out by the research data.

Dian Fossey spent 17 years studying the mountain gorilla in Rwanda's Volcanoes National Park. Her early work on gorilla vocalizations and home range (Fossey, 1972, 1974) were achieved in close proximity to the gorillas, an unimagined feat for a novice researcher. Gorillas live in groups with a dominant silver backed male, females and young, and sometimes subordinate males as well. Fossey noted that the silver backed male in one group raised a young orphaned gorilla. The motherless gorilla was a hell-raiser since any transgressions were covered by the indulgent father. Fossey named the youngster Tiger. Everyone at Fossey's Karisoke Research Center in the Virunga Mountains considered the rambunctious Tiger to be a male. Many years later a researcher at the center was following a trail of gorilla scat and came across Tiger, now an adult and nursing her infant (personal communication, Wayne McGuire, National Geographic memorial for Dian Fossey, Washington, DC, 1985). This remarkable story illustrates three critical points. The dominant silver back male was both nurturing and indulgent toward his daughter. Because Tiger was rambunctious everyone assumed she was male. Tiger was a good nurturer to her infant because her father had taught her how to nurture.

Love Is Learned and Hormonal But Not Instinctive

Another of Goodall's revealing observations indicates that care of the young is a learned skill in chimpanzees and that female nurturance is by no means biologically assured. Goodall (1986) tells of a young mother who came as a stranger into the chimpanzee group under study. She was dragging a newborn infant by its umbilical cord and appeared terrified of the infant. The older females in the group came toward the stranger. One took the baby away, bit off the umbilical cord and cleaned up the bloody, debris-covered infant. Another comforted the frightened stranger. The young mother watched alertly as the infant was soothed and comforted by an older female, many times a mother. Eventually, the young mother reached for the infant and the older female placed the infant gently in the mother's arms and showed the mother how to nurse the infant. This sequence illustrates what Harry Harlow points out in the title of his 1971 book on rhesus monkeys: *Learning to love*. We nurture because we were nurtured not because of some genetic encoding spuriously called maternal instinct. "The maternal instinct, as a behavior that arises absolute and predetermined from its primordial genetic roots, is a myth" (Zuk, 2003, p. 51).

Sarah Hrdy (1999) notes that primates in general (and most certainly the human primate) have plenty of time to connect with each other. Unlike precocial species who must imprint on the mother shortly after birth or hatching, primates can learn the key features of mutual identification, bonding slowly and most often with help from members of their highly social species. We now have considerable evidence of the relationship between biology and social experience in male primate nurturance. Hormonal influences and social experience interact to produce nurturing fathers and mothers.

Social Touch

Nurturing behavior is centered around touch. The "good mothering" so vital in diminishing aggression depends upon touch. The role of touch and physical comfort in infants on later cognitive, exploratory, and social behaviors (Simpson, Sclafani, Paukner, Kaburu, Suomi, & Ferrari, 2019) is critical in both monkeys and humans. These findings on rhesus monkeys were consistent with those found in human adults "suggesting that social touch can have wide-ranging positive effects on social behavior" (2019, p. 17). How wonderful to find that Harry Harlow's (1971) *Learning to love* was so on target with the concept of contact comfort.

Work with human children has shown that social attention is increased by experiencing more touching by their mothers (Reece, Ebstein, Cheng, Ng, & Schirmer, 2016). Touching also affects resting activity in the brain and forging connections in regions of the brain involved with mental activity (Brauer, Xiao, Poulain, Friederici, & Schirmer, 2016). Gently touching the skin in a sweeping motion activates oxytocin release producing physiological arousal of a pleasant nature and increasing the likelihood of prosocial interactions (Cascio, Moore, & McGlone, 2019).

"The marginalization of women and the destruction of biodiversity go hand in hand. Loss of diversity is the price paid in the patriarchal model of progress that pushes inexorably toward monocultures, uniformity and homogeneity" (Mies & Shiva, 1993, p. 6). The political consequences of this trend may not seem obvious but Fritsche and Hoppe (2019) have written extensively on the relationship between people, nature and terror management. The view of conservatives toward nature is far more exploitative than engaging whereas the view of liberals involves direct connection in terms of enhancing personal identity (Fritsche & Hafner, 2012). For liberals, nature needs to be protected and cared for. A recent example comes from the attitude of conservatives and liberals to the return of the wolf in an area of Germany bordering on Poland (where the wolves came from). A right-wing Alternative for Germany lawmaker describes wolves and immigrants with similar hostility. Supporters of the wolves are viewed "as urban elites by rural left-behinds" (Bennhold, 2019, p. A8). Whether the wolf is viewed as a dangerous invasive predator or an endangered species requiring protection and respect depends on the conservative vs. liberal worldview of the beholder.

Human Politics: Differing Views of Evolution

Politics and Evolution

Conservatives tend to operate on the principle that evolutionarily-based competition for limited resources underlies human motivation. Altruism is possible if the recipient of the good deed is a relative. Altruism toward non-relatives is considered to be a losing strategy in the competition for survival. “If as conservatives tend to believe, human nature is fundamentally competitive and self-interest prevails, then people live in a dangerous world” (Tuschman, 2013, p. 308). The dangerous world concept has now been transmogrified into what Avi Tuschman refers to as “folk-Darwinism” derived from the extreme Social Darwinist view that survival of the fittest requires a ruthless approach to what is imagined as a life-or-death struggle for existence. Extreme right-wing political groups exemplify this worldview.

Liberals tend to operate on the principle that evolutionarily-based cooperation in attaining survival resources underlies human motivation. Altruism toward non-relatives is considered to be important in the creation of the social networks necessary for success (Tuschman, 2013). In both cases, humans display their heritage as a social species. The difference is in whether resources are shared with kin or more widely shared. This also translates to sharing only within the identity group or extending beyond the identity group to other humans.

Politics and Gender

Politics is power. Masculinity is defined as power in many cultures including American and European culture. In Western culture women have traditionally held power in the private sphere whereas men held all the public power. The origins of sexual inequality have been attributed to women’s biological limitations (Wilson, 1975). Peggy Sanday (1981) examined the origins of sexual inequality from an anthropological perspective and discovered that definitions of masculinity and femininity vary greatly among cultures as do expectations for power sharing. “Sex role plans are cultural and not biological… they do not derive from human genetics but from the historical and political circumstances in which people find themselves when they are forced to come to terms with the environment and themselves as a social unit” (Sanday, 1981, p. 15–16). The key element is who has the power to make decisions.

Creation Stories, Environment, and Gender Equality

The environmental surround is a vital element influencing both origin stories and sex roles (Sanday, 1981). Gentle environments with steady food supplies, readily acquired, produce origin stories with either gender neutral creation figures or female creation figures. There is less likelihood of masculinity being defined as power and a greater likelihood of shared power. In harsh environments with seasonal famines creation figures are universally male and sex roles empower men not women. Three major world religions (Judaism, Islam, and Christianity) have come out of the harsh environment of the desert and are profoundly patriarchal. The point here is please don't blame our power differentials on biology. There is nothing natural about male dominance and female subjugation as many societies studied by anthropologists can attest to (Sanday, 1981; Benedict 1934/2003; Mead, 1935/2003; Brown, 1970; Dyble, Salali, Chaudhary, Page, Smith, Thompson, . . .Migliano, 2015).

We Started Out Egalitarian

Our heritage from the forager-hunter period of human history is that of an egalitarian society (Dyble et al., 2015). Sexual equality with shared childcare was likely an evolutionary advantage for early human societies. Gatherer-hunter societies in which women are equal have many more non-related members than do less egalitarian groups. Women's choices of mates and companions create larger social networks and foster closer cooperation between people who are not kin, diversifying the gene pool. An added benefit to an enlarged social network is the opportunity to share information, especially innovations. Gender equality is likely to be a survival advantage in this regard. "Sex equality and the resulting low within-camp relatedness had many important consequences. Co-residence with unrelated individuals set the selective environment for the evolution of hyper-cooperation and prosociality" (Dyble et al., 2015, p. 797).

Reconceptualize Masculinity

It's time to get back to our egalitarian roots and recognize that power needs to be shared and no longer used as a definer of masculinity. The difficulty in electing a woman as president of the United States reflects this discomfort with women and power and the sense of threat to masculinity that female power represents. Gender equality will never happen unless the definition of masculinity is dramatically changed in a humanistic direction to allow men to enjoy their masculinity without having to constantly prove it to other men (Pleck, 1995). “Male dominance in myth and everyday life is associated with fear, conflict, and strife” (Sanday, 1981, p. 35). Shared power can make life better for everyone. We can all do with less fear, conflict, and strife.

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