SOCIAL STRUCTURE: THE KEY TO AN INTELLIGENT LINEAGE. M.R.S. António[1] and D. Schulze-Makuch[1], [1]School of Earth and Environmental Sciences, Washington State University, Pullman, WA 99164, USA (quimarina@wsu.edu; dirksm@wsu.edu)

Introduction: Up until recently, the prevailing theory about our origins lay on a chimp-like ancestor [1]. It has now become clear, that is not the case [2]. The discovery of *Ardipithecus ramidus* (Ardi) has proved to be a turning point in the understanding of what human origins consisted of. Among many unexpected features is the negligible difference in the size of male and female canine teeth, which is a distinct feature between humanoids and the great apes. In the great apes, the size of the canines in males is much larger than in females. In the mammal lineage this is indicative of a social structure dominated by male competition for access to females [3]. This in turn generally leads to polygamous arrangements, characterized by continuous or seasonal violence and instability caused by challenges to the dominant males [4]. This violence is rarely restricted to males themselves in the primate lineage, spreading to females and their infants, with infanticide being a common result of shifts in male dominance [5]. Surprisingly, *Ardipithecus* does not show these features. The size of the canines of males and females is identical [2]. This can be interpreted as indicative of a social structure less based on male-male competition and more on female-choice, which were likely to lead to primarily monogamous arrangements [6]. These systems tend to provide more stability, less violence and therefore more opportunities for cooperation instead of competition. All evidence combined, suggests that our ancestors might have been widely different from what we have assumed. The discovery of Ardi is a reminder of just how little we understand our own origins.

Stability: Change is known to be an evolutionary trigger. When conditions change new phenotypes are selected in order to improve the species adaptation to the new environment. Constantly changing environments host on average higher life diversity (and biomass, indicative of productivity) than constant environments. Although, when animals adopt a social lifestyle, by living in communities in which there is interdependence, change becomes an obstacle to progress. Stability in the present and foreseeable future is necessary in order to justify efforts towards the transmission of acquired behaviors. Investment in teaching and learning will not be productive unless this stability is achieved. Failure to achieve it is most likely to result in a stasis, if not regression to a nonsocial state.

The distant cousin: Chimpanzees are undoubtedly close to humans, not only at the genetic level but equally in their phenotypes and behavior at large. Although, chimpanzees are also distinct from us in very important features that are not easily quantifiable and for that reason have been given less importance. The differences commonly pointed to account for the different fate of humans and chimpanzees are bipedalism, dexterity and vocal ability, among others. And although these are significant differences, something more fundamental is likely to have impaired their progress.

Chimpanzees do have a complex social structure where communal learning is costly and extensive. But they are plagued by an inherent instability. The constant threat of infanticide by a change in male dominance forces male energy to be invested in status maintenance, mainly achieved by force, intimidation, the installment of a fear atmosphere and constant aggressive displays. Juveniles will learn these behaviors by imitation and replicate them, perpetuating the instability. This includes females which are often aggressive towards each other. It is important to clearly recognize that chimpanzees do develop lifelong bounds with particular individuals, but the cohesion of the group as a whole is weak when compared to other social arrangements as the ones manifested by most *Canidae* groups. Chimpanzees in fact score much less than meerkats (for example) in several fronts of group cohesion: chimps have more episodes of intra-violence, a higher severity of violence, demonstrate less sacrifice for their peers, have less demonstrations of group bounding and invest much less if at all on others offspring (dependent on the individual's relationship with the mother). Chimpanzees' social arrangement may have crippled their further investment in transmission of acquired information. In general, the outcome simply will not pay off the investment because fear diverts the concentration of efforts on maintaining security and assuring individual survival, leading in turn to an emphasis on genetic transmission, instead of social. It is a vicious circle, only breakable if communal stability can be achieved and maintained as the norm, instead of the exception. This is a reality that *Ardipithecus* does not seem to have experienced.

We have now enough evidence to believe that the nature of our ancestors was qualitatively different from what we currently observe in the great apes. We can further infer that the social arrangements manifested by the social dogs and rodents resembles the social world

experienced by Ardi in a greater extent that the chimpanzees reality.

Social Structure: Many animals display individual personalities, more so if they are social animals. Just as in humans, the personality of a social animal is the product of very complex interactions between their genotype, rearing, and youth and adult life experiences that are heavily influenced by their social status, age, sex and particular circumstances that merge to result in the formation of a relatively stable personality (the same circumstances that determine the personality outcome can also determine its rigidity or flexibility to further changes). Here are outlined 3 major personality traits that can heavily impact the evolution of a community: indoctrinability, consistency and sociality. Indoctrinability is the receptivity level to indoctrination. This trait can be further divided into 3 different categories: the followers (tend to adopt observed behaviors), the outlaws (tend to reject observed behaviors), and the reinforcers (tend to adopt and propagate observed behaviors). The second personality trait is consistency. The consistency parameter is related to the indoctrinability trait. Individuals may be more or less prone to shift from being a follower, reinforcer or outlaw. Consistency can therefore be high (rigid social role), low (will shift social roles) or drifting (simultaneously adopts different social roles). The third trait, sociality is perhaps the one with the greatest potential evolutionary impact. This trait refers to the interest and ability to communicate individual behaviors. In terms of sociality an individual can be a broadcaster (will broadly share acquired behavior), individualistic (will not share acquired behavior) or selective (will only share with a restricted number of individuals). This results in 27 possible combinations among these 3 traits. Particular combinations of these traits as well as ratios in a particular population can be a key to the fate of that community.

For the purposes of propagation of information, the broadcasters are clearly a beneficial trait, regardless of their indoctrinability (reinforcer, follower or outlaw). Selective personalities also have a very significant impact potential, since they may lead to fractures in the community and eventually splits. So it is safe to assume that the more broadcasters and selectives a population has the more likely it is that behaviors will be transmitted inter- and intra-generations. But it is less obvious what ratio of indoctrinability is more beneficial for a community to progress. The presence of the 3 variants is needed: reinforcers, followers and outlaws. Reinforcers are needed in order to guarantee stability and continuity, conserving 'traditions' in the community, followers represent the masses, and they are needed in order to propel changes. They are in effect the bulk of the changing force. Outlaws are the innovators, the ones that venture on trying a different angle, and their presence is obviously needed if any change is to occur. But is there an optimal ratio? It is well documented that different species (and different populations within the same species) have different natural tendencies. These natural tendencies are a product of their own life histories. Counter intuitively, most social animals show no shortage of outlaws (innovators). What they seem to lack is a pacific source of reinforcers. Reinforcers do exist in most social species, but they exert their influence by the power of intimidation and installment of fear. This is clearly evident in primates. Reinforcers which show truly widespread empathic relationships are rare. Positive reinforcers are rare and even rarer will they be in communities where instability prevails, as the power of strength will inevitably gain the upper hand. So in communities where social status is determined by strength, as in male competition dominated structures, the occurrence and maintenance of positive reinforcers is condemned to failure. This is the case for primates. Despite their outstanding inventive and communicative abilities, the fear and punishment inculcated by the dominants oppresses the expression of submissive individuals, which are the most likely to search for new social and ecological alternatives. This is probably why primates have not developed into a more complex lineage. They are doomed by their social structure. Social New World monkeys, dogs, rodents and birds where social structure is not necessarily determined by force but instead transmitted from parents to the older offsprings and relatively respected by all members of the community (mostly disputed at the time of transmission of dominance and afterwards rarely contested), proportionate a much better stability and odds of continuity. The dominants do not constantly feel threatened by lower class individuals and therefore can assume a relaxed dominance, allowing for the expression of individuals at large, therefore creating a good level of general satisfaction that feeds back into the continuity of the hierarchy. Positive reinforcers are therefore much more common in these systems. All these factors promote the cohesion of the community and trust instead of fear of each other. Have we been looking for the root of social complexity in the wrong place?

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