

Methods of Studying the Social Structure of Early Hominins: A Mini Review

Review Article

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Abstract

There has been numerous attempts by anthropologists and paleoanthropologist to study the social structure of early hominins, many of these were based on three main modalities of research; non-human primate models, behavioural ecology, and phylogenetic models. Non-human primate models are considered as the archetypal analytic approach of social structure. On the other hand, behavioural ecology emphasises on the shared behavioural patterns in between our specie, the early hominin species, and the species of African apes. The 3rd approach, the phylogenetic modelling, is considered to be the most novel method; It relies on the analysis of phylogenetic constraints in a particular ecosystem; which seems to enforce a specific type of social structure; it represents a responsive interaction between the; environment, evolutionary biology, and ultimately the social fabric.

Keywords: Social Sciences; Social Environment; Ecology; Primates; Hominidae; Hominins; Humans; Biological Evolution; Cultural Evolution.

Background

Hominidae includes the great apes; chimpanzees, bonobos, orangutans, gorillas, and humans. Formerly, humans, both extinct and extant, were placed in Hominidae, while great apes were put in a different family, Pongidae family [1, 2]. Despite the presence of landmark physiological differences in between humans and great apes, for example, the relative longer reproductive life span in chimpanzees females, both morphological and molecular studies confirmed that humans and chimpanzees are closely related and interlinked by a common ancestor at approximately six million years ago (Mya) [1-3].

Nevertheless, it is agreed that some traits are unique for human, these are; imitation, language and verbal skills, obligate bipedal locomotion, stable supine posture, and imagination [4-6]. The social structure of early hominin cannot be easily inferred as in the case of physical anthropology and archaeology. Hence, anthropologists use three main methods to infer data in relation to the social fabric of early hominins. Those methods include; nonhuman primate models, phylogenetic history, and behavioural ecology principles [7-10]. The landmark paper by Foley and Lee [11], discussed the presence of 32 core social systems in hominids (Figure 1); the classification is based on the status of male and

female distribution, and the strength of male-female association [11].

Non-human Primate Models

Modelling based on non-human primates is regarded as the archetypal approach for social structure studies. The social-marital structure in apes can be diverse, for example; monogamy (Gibbons), uni-male polygyny (Orangutan), uni-male polygyny (gorilla), and multi-male polygyny (chimpanzee). Although the savannah baboon monkeys are distantly related to hominins, they do have a profoundly similar social structure to early hominins due to the similar nature of their environments, which is represented by the open terrains of the Savannah [1]. The chimpanzee was also proposed as a model for studying the social structure in early hominins; chimpanzees share a common ancestry with early hominins; chimps may also use tools and hunt occasionally. However, chimpanzees are extant (living) models, and they differ anatomically from early hominins, for example, the different facial and dental anatomy when compared to the Australopithecines (afarensis, robustus, and africanus). Hence, the extinct hominins behavioural and social patterns would also be different from those of the chimpanzees [1, 12, 13]. In 1978, the pygmy chimpanzee known as bonobos (*Pan paniscus*) became an adopted model; it

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shares similar overall body proportions with an early hominin species known as *Australopithecus afarensis* (Lucy's specie); this hominin existed at around 3.2 Mya in east Africa. Furthermore, the bonobo's society is an egalitarian society promoting equality among its members, though it is more female-centered in which sex is a substitute for aggression and violence. Accordingly, *Pan paniscus* is considered as a more acceptable model (than *Pan troglodytes*) [1, 14].

Historical Non-human Primate Studies

Chimpanzees (common chimpanzee) and bonobos (pygmy chimpanzee) were used as non-human primate models to understand the behaviour and social structure of early hominins. Primatologists who pioneered the fields experiments include Tetsuro Matsuzawa, Jane Godall, and Dian Fossey. Each scientist has done intensive work on non-human primates to deduct the archaic behaviour of early hominins [1, 15,16].

According to Tetsuro Matsuzawa, Hominidae members are considered to have a protoculture. Culture and protoculture require three basic elements; emergence, transmission, and modification [17]. Protoculture emergence has been fictionally depicted in *Rise of the Planet of the Apes* in which a leader chimpanzee named Caesar begins a revolution against humans [18]. Several examples of intriguing protoculture have been observed in chimpanzees (*Pan troglodytes*) including; Sweet potato washing in snow (Japanese monkeys in Koshima (Japan), hot-bathing snow monkeys in shiga heights (Japan), and the extra-large cluster of Shodoshima snow monkeys in Saru Dango (Japan). Another interesting example is the *deer-riding* behaviour noticed in exclusively in a snow monkey sub-species (*Macaca fuscata yakui*) in Yakushima (Japan); the emergence of this commensalism-like behaviour (*deer-riding*) was first observed in a monkey nicknamed Rodeo [16, 19, 20]. Behavioural patterns have also been approached via the master-apprenticeship method, as studied by Matsuzawa with Ai and Ayumu (chimpanzees' nicknames) and by Tomonaga with Chloe and Cleo [16, 17].

Behavioural studies can be either observational or experimental, in the laboratory or the natural habitat of a primate; these have been extensively studied by eminent primatologist including Jane

Godall and Dian Fosse, while the systematic field experiments are deemed to be pioneered by Tetsuro Matsuzawa [16]. Matsuzawa and colleagues have done numerous and remarkable behavioural, cognitive, and social studies in common chimpanzee, including the *Ai project* (1978), other studies in Skylab (2008) and Kumamoto Sanctuary (2011), field studies in Bossou-Africa, and in other regions of Central and West Africa [21-26]. Most of the studies were conducted either in the east or central Africa, while fewer ones were carried out in West Africa.

Phylogenetic Models

Phylogenetic models are based on common behavioural patterns in between the species of the African apes and humans. Wrangham and colleagues examined different behavioural traits (fourteen traits) including male-female interactions, social structure, and intergroup aggression [27, 28]. It was deducted that if a trait exists in all four species, it is likely to exist in the shared (common) ancestor. On the other hand, If the four species differ regarding specific trait, then nothing can be inferred about the common ancestor [27-29]. Wrangham also concluded that the common ancestor of African apes and hominins had closed social networks characterised by male-centered dominion, polygynous males, female exogamy, and no inter-females alliances. However, Lovejoy (1981) proposed that *Australopithecus afarensis* were non-hostile and monogamous [1].

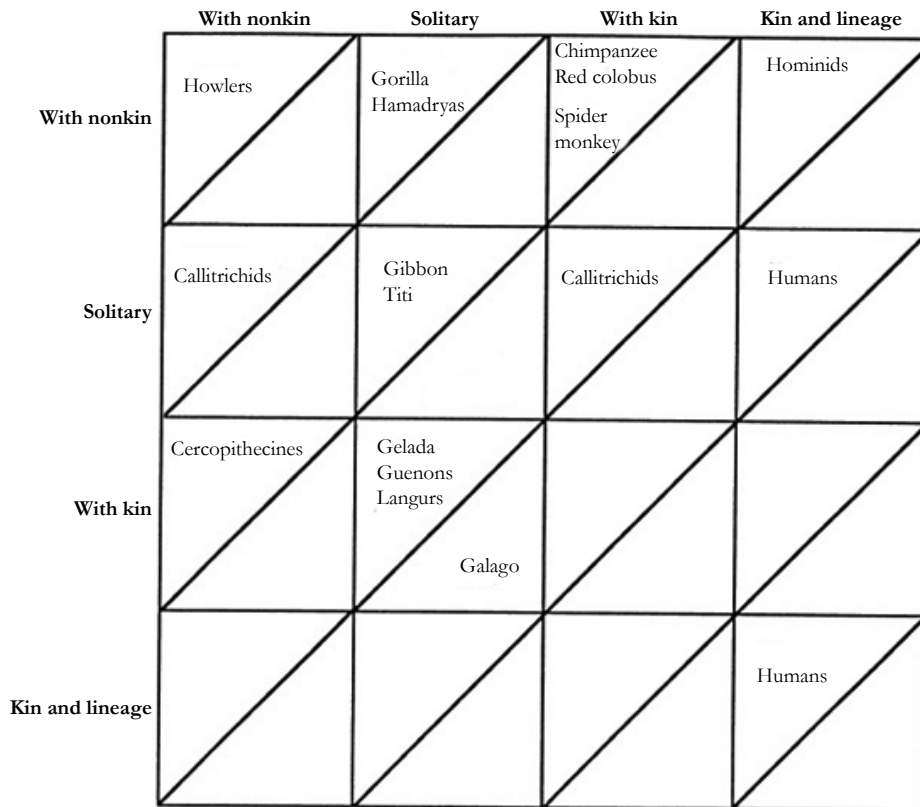
Behavioral Ecology

The third and the newest approach is based on the behavioural ecology principles (Table 1); it determines how the social structure can be modified in correspondence with the existing environment. It is an analysis of phylogenetic constraints in a particular ecosystem; it further implies that both ancestral anatomy and the social structure will restrain the potential social evolutionary pathway. In other words, there are limited and predicted pathways (Figure 2) for an ecosystem-driven modification in social structure [11, 30]. The social structure is highly variable among apes (Figure 1) including; solitary individuals (orangutans), monogamous pairs and family units (Gibbons), single male units with small numbers of non-kin females (gorillas), complex fission–fusion societies (chimpanzees), and some degree of male kin bonding (most

Table 1. Review of Models of Social Structures in Hominids.

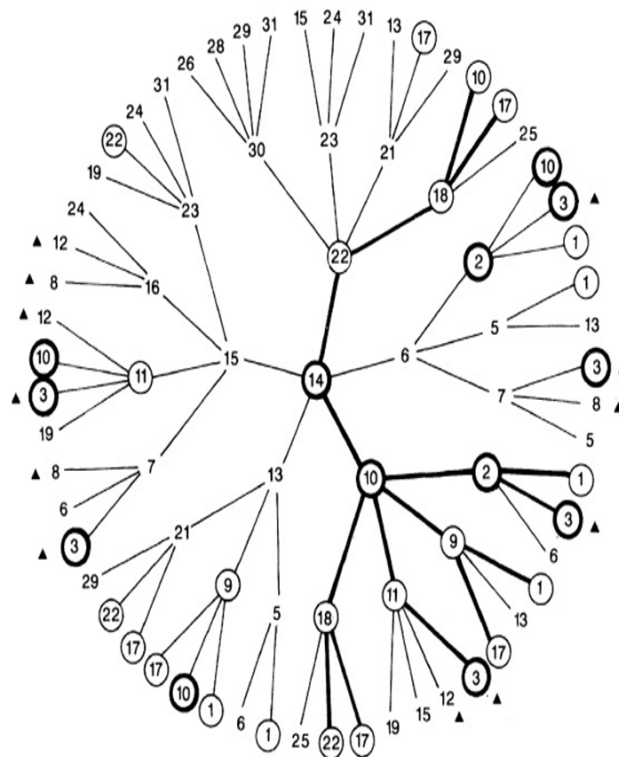
Study	Hominid taxon	Behavioural Features	Social Structure
DeVore and Washburn, 1963	Early Australopithecus	Large group, male competition and dominance	Large multimale group
Isaac, 1978	<i>Homo habilis</i>	Food sharing and division of labour	Monogamous pair, family unit
Tanner, 1981	Prothominid	Female role augmentation; foraging, offspring bond, and mate choice	Females-offspring group
Lovejoy, 1981	Prothominid, early hominid	Provisioning of females and young members	Monogamous pair, family unit
McGrew, 1981	Non-specified	Use and manufacturing of tools	Chimpanzee-like social structure
Hill, 1982	Non-specified	Hunting, male provisioning	Polygynous harems
Wrangham, 1983	African apes and hominids common ancestor	Hostile and closed social structure, female exogamy, and polygyny	Restricted grouping of males and exogamous females
Gigliheri, 1987	Earliest hominid	Male alliances, female exogamy	Territorial male kin structure
Parker, 1987	Spectrum from earliest hominids to <i>Homo sapiens</i>	Female mate and sexual selection	Monogamy and pair-bonding

Figure 1. Core social systems (32 in total) in hominids, a classification based on the status of male and female distribution (x-y axes), and the strength of male-female association.



Ω Reproduced with Permission (Foley and Lee, 1989)

Figure 2. Potential Evolutionary Pathways of Social Structure in Non-human Primates.



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African apes) [1, 11, 30].

Approximately 10 Mya (end of Miocene) the steadily cooling climate was responsible for reducing the dense forests, which eventually led to a drier habitat with sparse food distribution in East Africa, particularly in the region of the great rift valley [1, 9]. This ecological modification favoured the evolution of a chimpanzee-like social structure of dispersed females with their offspring and kin-related males for defensive-offensive warfare against other competing groups. The earliest Hominin social fabric occurred in parallel with enhanced male kinship alliances within the geography of an open terrain (the Savannah). The persistent cooling trend promoted these open terrains and increased predatory threats from other species. As a result, the social structure demanded an increment in group size (more members) to enhance survival; those large groups required strong male alliances with other related males (based on kinship). Hence, early hominins are most likely to live in big groups of men and women, up to 200 individuals altogether with their offsprings, with the males being closely related to each other. The females would be given the task to forage for food resources in the open terrains, where they would enhance their defence from predators by associating with other females, and one or more strong males within their group [1, 9-11].

Approximately 3 to 1 Mya, hominin species developed a degree of anatomic diversities as a form of adaptive subsistence, for instance, *Australopithecus robustus* fed on hard plant-based low-quality diet found in the dispersed patches of the savannah. Bonds between males became weaker due to more intense competition for food resources; this was also accompanied by sexual dimorphism (gender-based body size discrepancies). On the other hand, the later *Homo erectus* evolved an augmented (endo)-cranial capacity and a reduced dental apparatus. Moreover, the *erectines* who also lived in a similar tropical environment and the open savannah, adopted an entirely different subsistence strategy from the *robusts*, they increased the caloric meat consumption to feed their hungry brains, this was promoted and accompanied by the emergence of tool-making abilities which are basically a manifestation of an advanced brain power and a superior cognitive skills. However, they also had to roam for meaty food resources to considerable distances, which led to the compromise of male ability to defend the females. As a result, those males had to rely on solid alliances by strengthening their kinship bonding for an effective territorial defence against external threats [27-30].

Conclusion

The social structure for early hominins is complex, and cannot be easily inferred; The complexity of the social fabric of early hominins is paralleled only by the complex nature of its analytic models and tools. Several models exist; each of these is based on a specific analytic method or a combination of methods including; non-human primate models, behavioural ecology, and phylogenetic models. Several attempts were carried out by anthropologist and paleoanthropologist in this field. However, these models are neither fully accurate nor foolproof. Hence, an integrative approach to all three models might be mandatory. Behavioural ecology appears to be special; its uniqueness arises from the Integrative observation and analysis of the ecosystem, the anatomic and evolutionary adaptations, and the available

possibilities of social structure. Behavioural ecology is responsive to the interaction of the environment versus the evolutionary adaptations and social organisation of the early hominins.

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