



Fission-Fusion Dynamics: New Research Frameworks

Author(s): Filippo Aureli, Colleen M. Schaffner, Christophe Boesch, Simon K. Bearder, Josep Call, Colin A. Chapman, Richard Connor, Anthony Di Fiore, Robin I. M. Dunbar, S. Peter Henzi, Kay Holekamp, Amanda H. Korstjens, Robert Layton, Phyllis Lee, Julia Lehmann, Joseph H. Manson, Gabriel Ramos-Fernandez, Karen B. Strier and Carel P. van Schaik

Source: *Current Anthropology*, August 2008, Vol. 49, No. 4 (August 2008), pp. 627-654

Published by: The University of Chicago Press on behalf of Wenner-Gren Foundation for Anthropological Research

Stable URL: <http://www.jstor.com/stable/10.1086/586708>

JSTOR is a not-for-profit service that helps scholars, researchers, and students discover, use, and build upon a wide range of content in a trusted digital archive. We use information technology and tools to increase productivity and facilitate new forms of scholarship. For more information about JSTOR, please contact support@jstor.org.

Your use of the JSTOR archive indicates your acceptance of the Terms & Conditions of Use, available at <https://about.jstor.org/terms>



The University of Chicago Press and Wenner-Gren Foundation for Anthropological Research are collaborating with JSTOR to digitize, preserve and extend access to *Current Anthropology*

JSTOR

Supplement I from Aureli et al., ‘Fission-Fusion Dynamics’ (Current Anthropology, vol. 49, no. 4, p. 627)

What Does the Archeological Evidence Tell Us?

Because the major increase in brain size does not take place until relatively late in hominid evolution (the appearance of *Homo heidelbergensis*, ca. 0.5 million years ago; Aiello and Dunbar 1993), many of the steps outlined could not have taken place until quite late in human evolution. This conclusion is supported by the fact that a modern human life-history pattern (e.g., a greatly extended childhood) did not appear until very late in the sequence (probably not earlier than *H. heidelbergensis*; Thompson, Krovitz, and Nelson 2003) and that the shift from scavenging to large-scale hunting also did not occur much before the appearance of *H. heidelbergensis* (Klein 1999). The contribution of game to hunter-gatherer diets ranges from 25% to 100% (Marlowe 2001); among the Hadza, for example, meat provides 50% of calories consumed by active foragers (O’Connell et al. 2002). High meat intake is associated with a division of labor in which men specialize in hunting and women in gathering, greatly increasing the interdependence of the sexes (Kaplan et al. 2000). Modern humans bring meat back to camp and distribute it among family units. The earliest evidence for a base camp and for hunting technology are possible huts from the late *Homo erectus* site of Bilzingsleben (Mania, Toepfer, and Vlcek 1980) and definite hunting spears dating from ca. 400,000 years ago from Schoeningen (Thieme 1997), both in Germany.

In this scenario, the function of fission and fusion may have shifted from allowing individually foraging group members to reduce resource competition by distributing themselves over the area according to food distribution to optimizing the use of resources in the area by central-place foraging with information exchange. This latter system allows the community as a whole to benefit from the knowledge of individuals about temporally variable resources (e.g., fruiting trees or fresh kills) and their depletion rates. In a more complex society, assuming that food is shared at the central place, individuals can further enhance survival chances by spreading out according to the distribution of food in the area to increase the community’s food supply (Layton 2005; Smith 1991).

Additional References Cited in Supplements A–I

- Aldrich-Blake, F. P. G., T. K. Bunn, R. I. M. Dunbar, and P. M. Headley. 1971. Observations on baboons, *Papio anubis*, in an arid region in Ethiopia. *Folia Primatologica* 15:1–35.
- Anderson, C. M. 1981. Subgrouping in a chacma baboon (*Papio ursinus*) population. *Primates* 22:445–58.
- Bearder, S. K. 1987. Lorises, bushbabies, and tarsiers: Diverse societies in solitary foragers. In *Primate societies*, ed. B. B. Smuts, D. L. Cheney, R. M. Seyfarth, R. W. Wrangham, and T. T. Struhsaker, 11–24. Chicago: University of Chicago Press.
- Chapman, C. A. 1990. Ecological constraints on group size in three species of Neotropical primates. *Folia Primatologica* 55:1–9.
- Chapman, C. A., F. J. White, and R. W. Wrangham. 1993. Defining subgroup size in fission-fusion societies. *Folia Primatologica* 61:31–34.
- Connor, R. C., and M. Krützen. 2003. Levels and patterns in dolphin alliance formation. In *Animal social complexity: Intelligence, culture, and individualized societies*, ed. F. B. M. de Waal and P. L. Tyack, 115–20. Cambridge: Harvard University Press.
- Connor, R. C., R. A. Smolker, and A. F. Richards. 1992. Dolphin alliances and coalitions. In *Coalitions and alliances in human and nonhuman animals*, ed. A. H. Harcourt and F. B. M. de Waal, 415–43. New York: Oxford University Press.
- Conradt, L. 1998. Could asynchrony in activity between the sexes cause inter-sexual social segregation in ruminants? *Philosophical Transactions of the Royal Society, London*, B 265:1359–63.
- Cross, P. C., J. O. Lloyd-Smith, and W. M. Getz. 2005. Disentangling association patterns in fission-fusion societies using African buffalo as an example. *Animal Behaviour* 69:499–506.

- Dias, P. A., and E. Rodriguez-Luna. 2006. Seasonal changes in male associative behavior and subgrouping of *Alouatta palliata* on an island. *International Journal of Primatology* 27:1635–51.
- Fokuda, F. 1989. Habitual fission-fusion and social organization of the Hakone troop T of Japanese macaques in Kanagawa prefecture, Japan. *International Journal of Primatology* 10:419–39.
- Goodall, J. 1986. *The chimpanzees of Gombe: Patterns of behavior*. Cambridge: Harvard University Press.
- Grüter, C. C., and D. Zinner. 2004. Nested societies: Convergent adaptations of baboons and snub-nosed monkeys. *Primate Report* 70:1–98.
- Johnson, C. 2001. Distributed primate cognition: A review. *Animal Cognition* 4:167–83.
- Kaplan, H. S., K. R. Hill, J. B. Lancaster, and A. M. Hurtado. 2000. A theory of human life history evolution: Diet, intelligence, and longevity. *Evolutionary Anthropology* 9:156–85.
- Layton, R. 2005. Are hunter-gatherer immediate return strategies adaptive? In *Property and equality: Ritualization, sharing, egalitarianism*, vol. 1, ed. T. Widlok and W. Tadesse, 130–50. New York: Berghahn Books.
- Lehmann, J., and C. Boesch. 2008. Sex differences in chimpanzee sociality. *International Journal of Primatology* 29:65–81.
- Levin, S. A. 1992. The problem of pattern and scale in ecology. *Ecology* 73:1943–67.
- Lottker, P., M. Huck, and E. W. Heymann. 2004. Demographic parameters and events in wild moustached tamarins (*Saguinus mystax*). *American Journal of Primatology* 64:425–49.
- Lusseau, D., and M. E. J. Newman. 2004. Identifying the role that animals play in their social networks. *Proceedings of the Royal Society, London, B* 271:S477–81.
- Mania, D., V. Toepfer, and E. Vlcek. 1980. *Bilzingsleben: Homo erectus, seine Kultur und seine Umwelt*. Berlin: Deutscher Verlag der Wissenschaften.
- Manson, J. H., and S. Perry. 2004. Reunions following separation: Negotiating uncertain relationships? *Folia Primatologica* 75:146–47.
- Marlowe, F. W. 2001. Male contribution to diet and female reproductive success among foragers. *Current Anthropology* 42:755–60.
- Morland, H. S. 1991. Preliminary report on the social organization of ruffed lemurs (*Varecia varecia variegata*) in a northeast Madagascar rain forest. *Folia Primatologica* 56:157–61.
- Noë, R., and P. Hammerstein. 1995. Biological markets: Supply and demand determine the effect of partner choice in cooperation, mutualism and mating. *Behavioral Ecology Sociobiology* 35:1–11.
- Noë, R., C. P. van Schaik, and J. A. R. A. M. van Hooff. 1991. The market effect: An explanation for pay-off asymmetries among collaborating animals. *Ethology* 87:97–118.
- Nowak, M. A., and K. Sigmund. 1998. Evolution of indirect reciprocity by image-scoring. *Nature* 393:573–77.
- O’Connell, J. F., K. Hawkes, K. D. Lupo, and N. G. Blurton Jones. 2002. Male strategies and Plio-Pleistocene archaeology. *Journal of Human Evolution* 43:831–72.
- Poole, J. H., P. C. Lee, and C. J. Moss. n.d. Male social dynamics: From independence to beyond. In *The Amboseli elephant: A long-term perspective on a long-lived species*, ed. C. J. Moss and H. Croze. Chicago: University of Chicago Press. In press.
- Ruckstuhl, K. E. 1998. Foraging behaviour and sexual segregation in bighorn sheep. *Animal Behaviour* 56:99–106.
- Schaffner, C. M., and F. Aureli. 2005. Grooming and embracing in spider monkeys. *International Journal of Primatology* 26:1093–1106.
- Smith, E. A. 1991. *Inujjamiut foraging strategies: Evolutionary ecology of an arctic hunting economy*. New York: Aldine.
- Sparrow, A. D. 1999. A heterogeneity of heterogeneities. *Trends in Ecology and Evolution* 14:422–23.
- Sugiyama, Y., and J. Koman. 1979. Social structure and dynamics of wild chimpanzees at Bossou, Guinea. *Primates* 20:323–39.
- Thieme, H. 1997. Lower Palaeolithic hunting spears from Germany. *Nature* 385:807–10.
- Thompson, J. L., G. E. Krovitz, and A. J. Nelson, eds. 2003. *Patterns of growth and development in the genus Homo*. Cambridge: Cambridge University Press.
- van Schaik, C. P. 1999. The socioecology of fission-fusion sociality in orangutans. *Primates* 40:69–86.
- van Schaik, C. P., and M. A. van Noordwijk. 1988. Scramble and contest feeding competition among female long-tailed macaques (*Macaca fascicularis*). *Behaviour* 105:77–98.

- Vasey, N. 1997. Community ecology and behavior of *Varecia varecia rubra* and *Lemur fulvus albifrons* on the Masoala Peninsula, Madagascar. PhD diss., Washington University.
- Wanker, R. 2002. Social system and acoustic communication of spectacled parrotlets (*Forpus conspicillatus*): Research in captivity and in the wild. In *Bird research and breeding*, ed. C. Mettke-Hofmann and U. Ganzlosser, 83–108. Fürth: Filander Verlag.
- Whitehead, H., L. Bejder, and C. A. Ottensmeyer. 2005. Testing association patterns: Issues arising and extensions. *Animal Behaviour* 69:e1–e6.
- Whitehead, H., and S. Dufault. 1999. Techniques for analysing vertebrate social structure using identified individuals: Review and recommendations. *Advances in the Study of Behavior* 28:33–74.
- Willis, C. K. R., and R. M. Brigham. 2004. Roost switching, roost sharing and social cohesion: Forest-dwelling big brown bats, *Eptesicus fuscus*, conform to the fission-fusion model. *Animal Behaviour* 68:495–505.
- Wilson, W. G., and S. A. Richards. 2000. Consuming and grouping: Resource-mediated animal aggregation. *Ecology Letters* 3:175–80.