CA+ supplements for Gurven, M. 2006. Evolution of contingent cooperation. *Current Anthropology* 17(1):185-192.

CA+ Sidebar A

Several problems have plagued the measurement and interpretation of contingency as used in field studies. First, conditional acts of cooperation may be artifacts of symmetrical relationships, such as biological kinship or spatial proximity, among social actors rather than calculated reciprocity. A symmetrical relationship occurs when the relationship between A and B is identical to that between B and A. Thus, some sharing may occur only because some recipients are neighbors or close kin. We should be careful to distinguish such giving from calculated reciprocity. Classic cases of reciprocal altruism such as blood sharing in vampire bats (Wilkinson 1984) and allogrooming in impala (Hart and Hart 1992) have since been labeled as instances of symmetry-based, as opposed to calculated, reciprocity (Brosnan and de Waal 2002). Second, acts of defection and subsequent retaliation require actors to identify and distinguish acts of cooperation from noncooperation. However, acts of noncooperation may sometimes be unintended, attributable to mistakes, noise, or phenotypic constraints. When errors occur or limitations exist or when cooperation occurs in degrees rather than as all-or-nothing acts, greater levels of imbalance may be tolerated (Frean 1996; Wu and Axelrod 1995). Third, many measures of contingency are only statistical correlations and do not necessarily indicate a causal connection between acts performed in one time period and those performed after some subsequent delay. Fourth, not all studies distinguish between behaviors which are contingent within the context of dyadic interactions and those which are contingent at the larger level of the population. For example, Hawkes, O'Connell, and Blurton Jones (2001) test contingency by examining the quantities of food Y receives from all others based on how much Y has given to all others. This has been labeled "general" as opposed to "specific" contingency (Gurven et al. 2001). The focus on general contingency is problematic because only specific contingency can distinguish reciprocal altruism from other forms of giving (Hill and Kaplan 1993).

CA+ Sidebar B

The contingency variables may be operationalized as follows, where total amounts given by A to B (*left*) and by B to A (*right*) are expressed as double summations, with the inner summation describing the amounts given by a particular A (B) to a particular B (A) during a single distribution and the outer summation applying the inner one to all distributions in which a particular A (B) was a recipient:

Quantity:

$$\sum_{i_1}\sum_{j=B} amt_{iB} \qquad \sum_{i_2}\sum_{j=A} amt_{iA}$$

Standardized quantity:

$$\frac{\sum_{i_1}\sum_{j=B} amt_{iB}}{\sum_{i_1}\sum_{j} amt_{ij}} \quad \frac{\sum_{i_2}\sum_{j=A} amt_{iA}}{\sum_{i_2}\sum_{j} amt_{ij}}$$

Value 1:

$$\sum_{i_1}\sum_{j=B} \ln(amt_{iB}) \quad \sum_{i_2}\sum_{j=A} \ln(amt_{iA})$$

Value 2:

$$\sum_{i_1}\sum_{j=B} \sqrt{amt_{iB}} \sum_{i_2}\sum_{j=A} \sqrt{amt_{iA}}$$

CA+ Sidebar C

Ache food distributions were sampled using a combination of focal-household cluster observations (78% of all distributions), focal-resource sampling (10%), and interviews (12%). Focal-household cluster observations were 3-hour observation blocks of all food distributions, consumption, and production of all members of two or three households. Each household was sampled in this manner for an average of 56 hours, giving a total of 1,294 house-hours of observation for all 23 households in Arroyo Bandera. For each food distribution, we recorded the donor, the original acquirer (if different), all recipients, estimates of total resource package size, and amounts given to each recipient. Amounts were weighed using 10-kg and 25-kg Homs spring scales or counted (as in sticks of manioc) and then converted to kilograms or calories by using unit weight measurements of counted resources.

For the Hiwi, resource type, original package size, acquirer, weights of all pieces, and names of all recipients were recorded for every fifth resource brought back to camp amongst a group of families on sample days. This sample was biased toward acquirers who lived relatively close to the anthropologists. Weights were measured in the same fashion as among the Ache.

Additional Sources for CA+ Enhancements

- Frean, M. 1996. The evolution of degrees of cooperation. *Journal of Theoretical Biology* 182:549–59. First citation in article | CrossRef
- Hart, B. L., and L. A. Hart. 1992. Reciprocal allogrooming in impala, *Aepyceros melampus*. *Animal Behaviour* 44:1073–83. First citation in article
- Wilkinson, G. S. 1984. Reciprocal food sharing in the vampire bat. *Nature* 308:181–84. First citation in article | CrossRef

- Wu, J., and R. Axelrod. 1995. How to cope with noise in the iterated prisoner's dilemma. *Journal of Conflict Resolution* 39:183–89. First citation in article