## **Supporting Information**

## Gavrilets 10.1073/pnas.1201718109

## SI Text

Fig. S1 illustrates the effects of contest intensity parameter  $\beta$  on the steepness of dominance hierarchies. Table S1 and Figs. S2–S7 illustrate the effects of various parameters on different es-

calation thresholds and on the Gini index of inequality. Figs. S2–S4 are for generation t = 2,000 (i.e., just before the evolution of helping was allowed) and Figs. S5–S7 are for generation t = 20,000 (when helping has already evolved).



**Fig. S1.** The effect of  $\beta$  on the average fertility at each rank after 2,000 generations of selection. The curves correspond to five different values of  $\beta = 0.5, 1, 2$ , 3, and 4 (from shallower to steeper). Other parameters: n = 10, c = 8,  $\alpha = 3$ ,  $\gamma = \sigma_e = \sigma_v = 0.2$ . The Gini index of inequality (defined as half the relative mean difference) was 0.22, 0.36, 0.52, 0.62, and 0.69, respectively. (*Inset*) The average number of times each individual of a particular rank lost the resource to a bully (increasing curves) and took the resource from an owner (decreasing curves). No apparent effect of  $\beta$  is shown.



**Fig. S2.** Effects of n,  $\beta$ , c, and  $\sigma_e$  on the average aggressiveness x at generation 2,000 (i.e., before helping behavior could evolve). Note that both negative and positive values of x are observed. Other parameters:  $\gamma = 0.2$ ,  $\sigma_v = 0.4$ .



Fig. S3. Effects of n,  $\beta$ , c, and  $\sigma_e$  on the ownership effect y at generation 2,000 (i.e., before helping behavior could evolve). Other parameters:  $\gamma = 0.2$ ,  $\sigma_v = 0.4$ .



Fig. S4. Effects of n,  $\beta$ , c, and  $\sigma_e$  on the Gini inequality index at generation 2,000 (i.e., before helping behavior could evolve). Other parameters:  $\gamma = 0.2$ ,  $\sigma_v = 0.4$ .

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**Fig. S5.** Effects of  $\alpha$ ,  $\beta$ , c, and  $\gamma$  on the average aggressiveness x at generation 20,000. Other parameters: n = 10,  $\sigma_e = 0.2$ ,  $\sigma_v = 0.4$ .



**Fig. S6.** Effects of  $\alpha$ ,  $\beta$ , n, and  $\sigma_e$  on the ownership effect y at generation 20,000. Other parameters: c = 4,  $\gamma = 0.2$ ,  $\sigma_v = 0.4$ .

Gavrilets www.pnas.org/cgi/content/short/1201718109



**Fig. S7.** Effects of  $\alpha$ ,  $\beta$ , n, and  $\sigma_e$  on the helping threshold z at generation 20,000. Other parameters: c = 4,  $\gamma = 0.2$ ,  $\sigma_v = 0.4$ .

Parameters	Variables						
	At generation 2,000			At generation 20,000			
	x	У	Gini	x	У	z	Gini
n	-0.11	-0.18	-0.00	-0.00	-0.08	-0.07	+0.05
β	+0.04	+0.01	+0.92	-0.01	+0.06	+0.21	+0.09
с	-0.33	-0.18	-0.01	-0.13	-0.02	-0.01	-0.00
γ	-0.00	0.00	-0.00	-0.01	+0.00	-0.00	-0.00
α	0.00	0.00	0.00	-0.09	+0.52	+0.02	+0.76
$\sigma_{e}$	-0.02	+0.05	+0.04	-0.00	-0.11	-0.27	-0.04
$\sigma_{v}$	+0.01	+0.03	0.00	+0.01	+0.00	-0.01	-0.00
Error	0.49	0.55	0.03	0.75	0.21	0.42	0.06

Table S1. Percentage of variation in different variables explained by different parameters (analysis of variance with linear effects only)

The absolute values shown give the percentage of the variation explained by a given parameter. The values smaller than 0.5% are shown as zeros (even if the corresponding effects are statistically significant). The sign shows whether increasing the corresponding parameter increases (+) or decreases (-) the corresponding variable statistically significantly. The absence of a sign means the corresponding effect (estimated using linear regression) is not significantly different from zero (at P = 0.05). x, y, and z are the average aggressiveness, the ownership effect, and the helping threshold, respectively; "Gini" is the Gini index of inequality.