Supplementary Information for "Parent-offspring conflict over mate choice"

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This supplement consists of three sections. First, we give a detailed explanation of how α determines the parental resource-allocation strategy. Second, we discuss how the model results are affected when the fecundity returns on investment are not diminishing (as assumed in the main text) but constant or increasing. Third, we present graphs for the case where mothers (instead of fathers) influence the mate choice of their daughters and allocate resources among them.

1.0 Description of the parental resource-allocation strategies

As illustrated in Fig. S1, we consider a continuum of possible parental resource-allocation strategies that are characterized by a parameter α. If $\alpha = 0$, parents use an equal allocation strategy, distributing their resources equally among their daughters, leading to the following equation for the amount of resources given to the *i*th daughter:

$$r_{z,i} = \frac{1}{N_D} R_z \tag{S1a}$$

where R_z is the total amount of resources the parent has to invest and N_D equals the number of daughters they have. If $\alpha < 0$, parents use a compensatory allocation strategy, allocating more resources to daughters that have received fewer resources from their mate (see Fig. S1a):

$$r_{z,i} \propto \left(1 - \frac{r_{m,i}}{\sum_{j=1}^{N_D} r_{m,j}} \right)^{-\alpha} \tag{S1b}$$

where $r_{m,i}$ is the amount of resources invested in daughter *i* by her chosen mate and the summation is over all daughters the parent has. If $\alpha > 0$, parents use an augmenting allocation strategy, allocating more resources to daughters that have received more resources from their mate (see Fig. S1b):

$$r_{z,i} \propto \left(\frac{r_{m,i}}{\sum_{j=1}^{N_D} r_{m,j}} \right)^{\alpha} \qquad \text{(S1c)}$$

The values for r_z are scaled so that their total (over all daughters of a parent) is equal to R_z, thus yielding the actual amounts of resources the daughters receive from their parent. The total amount of resources available to female *i* is $r_i = r_{z,i} + r_{m,i}$.

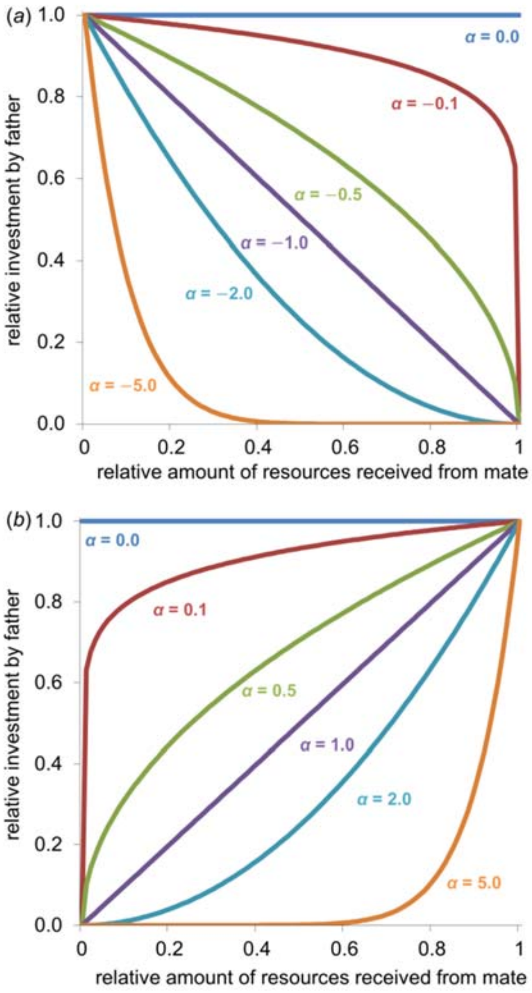

Figure S1. The relative investment of resources by the father in a focal female, as a function of the relative amount of resources that the female has already received from her mate. Separate graphs are shown for (*a*) negative values of α (equation S1b) and (*b*) positive values of α (equation S1c). In both graphs, the case of $\alpha = 0$ is also shown (equation S1a). Investment patterns for a number of possible values for α are given for illustration purposes. Investment is always relative to investment in sisters of the focal female.

2.0 Increasing versus diminishing fecundity returns on investment

In Step 4 of our model, we allowed the parental resource-allocation rule α to evolve. The simulations in the main text are based on the assumption that a daughter's fecundity f is a decelerating function of the total amount of resources r available to her, implying diminishing returns on investment. More specifically, we considered the relationship:

$$f(r) \propto \frac{r}{r+1} \qquad \text{(S2a)}$$

As discussed in the main text, this decelerating function promotes the evolution of a compensatory parental resource-allocation strategy (i.e. a negative value of α) and, as a consequence, to a conflict situation where the parents have a stronger preference than their daughters (i.e. a negative difference $p-q$).

We also ran corresponding simulations using two other functions for the relationship between resources and female fecundity: an accelerating function, implying increasing returns per unit of investment:

$$f(r) \propto \exp(0.25r) \qquad \text{(S2b)}$$

and a linear function, implying constant returns per unit of investment:

$$f(r) \propto \mathrm{r} \qquad \text{(S2c)}$$

Figures S2 and S3 (respectively for paternal and maternal involvement; note the different scales on the y-axis in both graphs) summarize the outcome of these simulations. As with the results presented in the main text, the results for maternal and paternal involvement are qualitatively in close agreement with each other. When returns on investment are increasing (i.e. f is given by S2b), the parental resource-allocation rule evolves to a positive value and female preference p^* is significantly stronger than parental preference q^*. Again these results are in line with our expectations; if returns on investment are increasing, parents achieve the highest total fecundity of their daughters by using an augmenting allocation strategy. Daughters evolve to exploit this allocation rule by expressing a stronger preference than their parents, resulting in conflict over mate choice.

The simulations for a linear function (equation S2c) had a similar outcome to those with diminishing returns on investment: both α and $p-q$ evolved to negative values. This outcome is somewhat unexpected, because now the fecundity returns per unit of investment are constant, implying that any resource-allocation pattern of the parent should have the same effect on the total fecundity of their daughters. However, upon closer inspection, this results appears to be contingent on the assumption that parents have a limited (and, in our case, fixed) amount of resources to invest in their daughters. If any daughter fails to produce daughters of her own, those resources are effectively lost. This means that it is in the interest of parents to maximize the chance that all of their daughters produce at least some granddaughters. This is achieved by the evolution of a negative value of α, which ensures that the minimum fecundity among daughters is maximized.

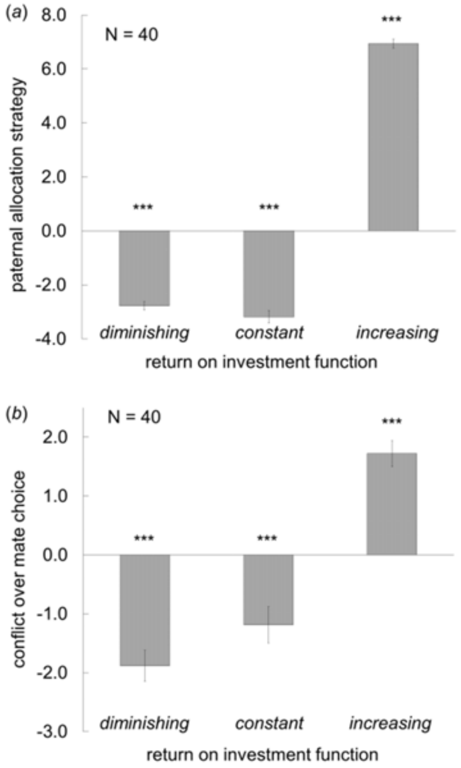

Figure S2. Evolved values of (*a*) the paternal resource-allocation parameter α and (*b*) the degree of conflict over mate choice (difference between female and paternal preferences, $p - q$) in Step 4, where fathers distribute resources among their daughters according to an evolving allocation rule. Results are shown for three different assumptions about fecundity returns per unit investment: diminishing, constant, and increasing. The graphs show mean and standard errors across 40 replicate simulations at generation 500,000. Significant differences from zero are indicated by *** ($P < 0.001$).

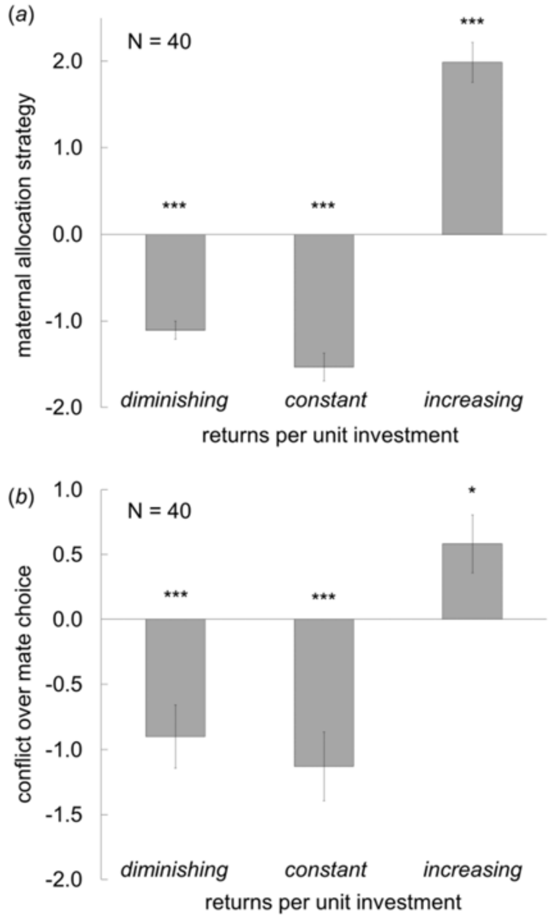

Figure S3. Evolved values of (*a*) the maternal resource-allocation parameter α and (*b*) the degree of conflict over mate choice (difference between female and maternal preferences, $p - q$) in Step 4, where mothers distribute resources among their daughters according to an evolving allocation rule. Results are shown for three different assumptions about fecundity returns per unit investment: diminishing, constant, and increasing. The graphs show mean and standard errors across 40 replicate simulations at generation 500,000. Significant differences from zero are indicated by * ($P < 0.05$) and *** ($P < 0.001$).

3.0 Graphs for maternal influence on mate choice

We considered two versions of the model: one where fathers exert control over their daughters' mate choice and distribute resources among them, and one where mothers play this role. The only difference between these two versions is in whose values of α and q, the father's or the mother's, are used in equations 3, 4, and S1a–c; all other details of the model are identical. In the main text we presented the results for paternal involvement. The corresponding graphs for maternal involvement are shown in Figs S4 and S5. The observed parent-offspring conflict is qualitatively the same under both paternal and maternal involvement, but quantitatively stronger in the case of paternal involvement.

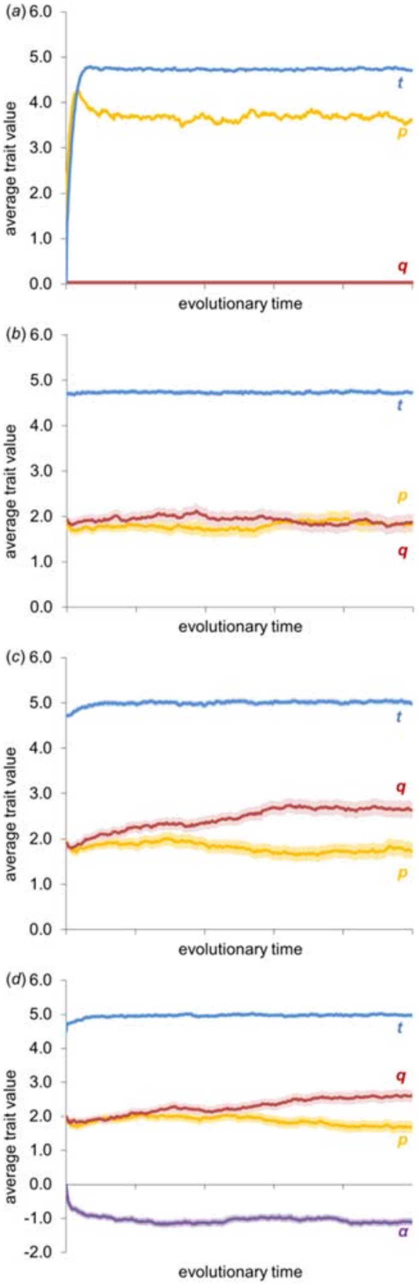

Figure S4. The coevolution of female preference p, maternal preference q, male indicator trait t and maternal resource-allocation strategy α in Steps 1-4 of the modified version of the model in which mothers can influence the mate choice of their daughters, as well as allocate resources among them. As in Fig. 1 in the main text, (*a*), (*b*) and (*c*) show results for Steps 1-3 of the model (in step 3, α is fixed at -2). Panel (*d*) shows results for Step 4 of the model, and corresponds to Fig. 3 in the main text. The graphs show averages and standard errors of the mean across 40 replicates.

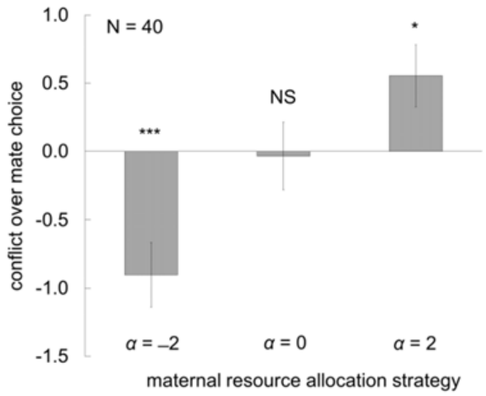

Figure S5. The evolved difference between female and maternal preferences in Step 3, where mothers distribute resources among their daughters according to a fixed allocation rule. This figure is the counterpart of Fig. 2 in the main text, where fathers allocate resources according to a fixed allocation rule. The graph shows the degree of conflict over mate choice, represented as means and standard errors (across 40 replicate simulations) of $p^* - q^*$, for three different fixed values of α. Significant differences from zero are indicated with * ($P < 0.05$) and *** ($P < 0.001$), non-significant differences from zero are indicated with NS ($P > 0.05$).