Supporting Information

Details for great tit experimental supplementation

To ensure only experimental broods received extra food, and to avoid changes to nest defense associated with positioning the food near the nest box, we installed a small feeding tray inside each nest box (Verhulst 1994; Grieco 2003; Eeva et al. 2009). This was done during incubation at all nests. No broods were deserted after the introduction of the tray. Each day for the first week after hatching, we provided a *c.* 20g mixture of live meal worms (*Tenebrio molitor*) and rehydrated wax worm larvae (*Galleria mellonella*) cut into 0.25 cm pieces. This represents approximately 20% of the daily nutritional needs of the brood (van Balen 1973; Eeva et al. 2009). We checked whether great tits were using the food by placing cameras into 2 nests during the supplementation period. we observed parents taking food from the trays and directly feeding their offspring (Supplementary Movie 2). Parents also ate the food themselves. Either outcome serves to increase environmental conditions for the parents. Control nests were also visited each day so that all nests received comparable experimental disturbance, and an empty tray was placed in the nest box.

We alternated experimental treatments b assigning the first brood of the day that had hatchlings to the supplemented treatment, and then the next brood the unsupplemented (control) treatment. We reversed this order each day. We did not pre-randomize because we wanted to equalise hatch date within each treatment. Supplemented and unsupplemented nests varied slightly in clutch size (supplemented 9.81 +/- 0.33se, unsupplemented 8.82 +/- 0.32, p = 0.038*), but not in brood size (supplemented 9.18 +/- 0.36se, unsupplemented 8.59 +/- 0.36, p = 0.26) or hatch date (supplemented 25.29 +/- 0.58se, unsupplemented 25.18 +/- 0.57, p = 0.89). The difference in clutch size was driven by one unsupplemented nest with only 6 eggs; removing this nest or including clutch size as a control variable did not change the results of our parental response model.

Details of cross-fostering

All cross-fostering was done in the morning as soon as possible prior to filming, and all filming occurred between 7:00 and 15:00 (83% of feeding visits occurred between 9:00 and 13:00).

Hand-feeding protocol: We ranked chicks by weight in their filming nests. We assigned chicks to be handfed or not handfed in an alternating pattern by weight rank, which was reversed at each nest. For example, in filming brood A, the heaviest chick was handfed and the second heaviest was not, while in filming brood B the heaviest chick was not handfed. Immediately prior to filming, we hand-fed chicks in an artificial nest containing a cloth wrapped hand-warmer. We fed the selected chicks with Nutribird A 19 high energy bird food using a 5 mL syringe. We continued feeding until begging had ceased and could no longer be induced by whistling and tapping the sides of the bill with a syringe, indicating the chicks were probably satiated, as in (Kilner and Davies 1998).

Supplementary References:

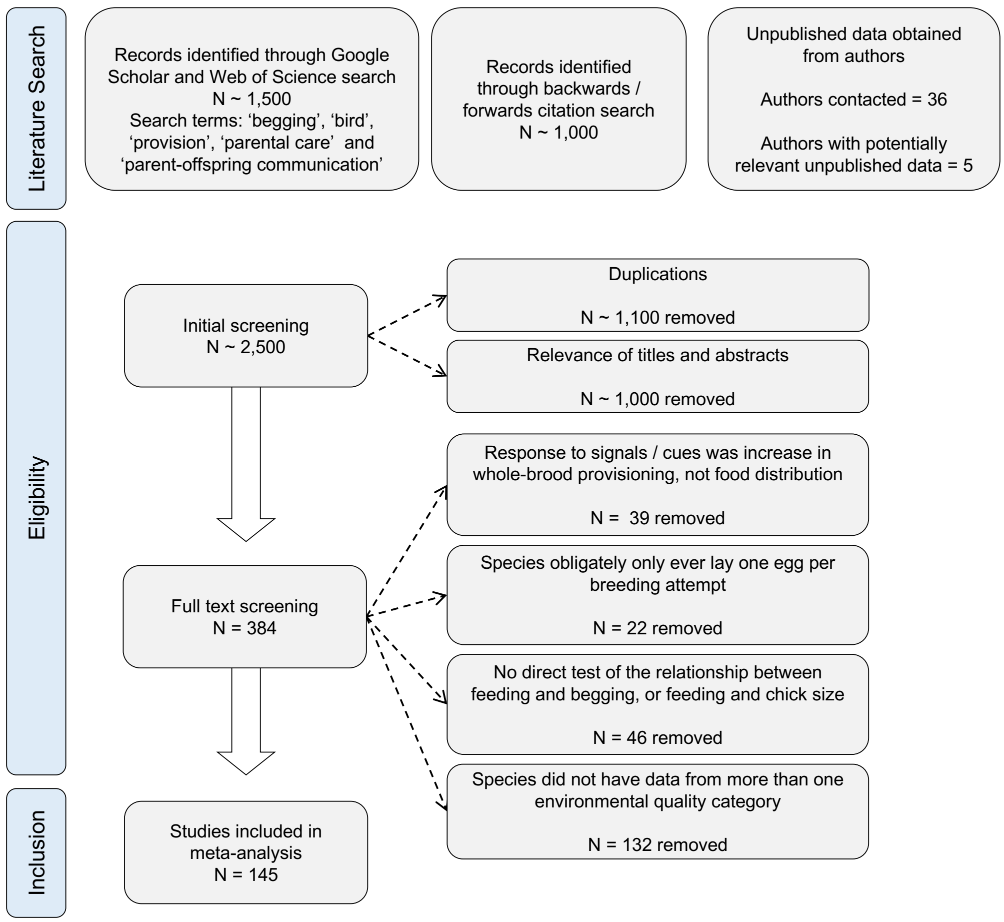
Eeva T, Sillanpää S, Salminen JP. The effects of diet quality and quantity on plumage colour and growth of great tit Parus major nestlings: a food manipulation experiment along a pollution gradient. Journal of Avian Biology **40**, 491–499 (2009).

Grieco F. Greater food availability reduces tarsus asymmetry in nestling blue tits. The Condor **105**, 599–603 (2003).

Kilner R, Davies NB. Nestling mouth colour: Ecological correlates of a begging signal. *Animal Behaviour* **56**, 705–712 (1998).

van Balen JH. A Comparative Study of the Breeding Ecology of the Great Tit *Parus major* in Different Habitats. *The Condor* **61**, 1–93 (1973).

Verhulst S. Supplementary Food in the Nestling Phase Affects Reproductive Success in Pied Flycatchers (*Ficedula hypoleuca*). *The Auk* **11,** 714–716 (1994).



Supplementary Fig. 1. PRISMA flow chart of search results and the study selection process.

Supplementary Results

Supplementary Table 1. The impact of parental food supplementation on offspring survival and mass

A. Likelihood of brood reduction (yes/no)

	Z score	P value
Supplementation	2.94	0.0033**
Clutch size	1.94	0.053
Brood size	-0.96	0.34
Hatch date	-1.02	0.31

B. Extent of brood reduction (number of dead chicks)

	Z score	P value
Supplementation	2.10	0.045*
Clutch size	1.76	0.09
Brood size	1.20	0.23
Hatch date	-0.42	0.68

C. Chick mass on day 7 (surviving chicks only)

	Z score	P value
Supplementation	1.58	0.12
Clutch size	-0.99	0.33
Hatch date	-0.67	0.51

We tested the impact of supplementation on (**A**) the likelihood of brood reduction using a binomial linear model; (**B**) the extent of brood reduction using a quasi-poisson linear model; and (**C**) chick mass using a linear mixed model with nest ID as a random effect. N = 34 nests (17 supplemented, 17 unsupplemented); 302 chicks (154 supplemented; 148 unsupplemented).

Supplementary Table 2. The effect of supplementation treatment, begging and size on chick feeding.

	Estimate	**95% CI**	**pMCMC**
Supplementation	-0.07	-3.74 to -2.74	<0.001***
Weight rank	-0.24	-0.62 to 0.14	0.84
Weight rank^2	-0.47	-0.88 to -0.07	0.021*
Relative begging posture	2.38	1.91 to 2.87	<0.001***
Supplementation: weight rank	0.22	-0.22 to 0.69	0.35
Supplementation: weight rank^2	0.50	0.01 to 0.99	0.045*
Supplementation: begging posture	-0.04	-0.71 to 0.58	0.91
Relative begging posture : Weight rank	0.12	-0.28 to 0.54	0.58
Relative begging posture : Weight rank^2	0.40	-0.04 to 0.85	0.07
Supplementation: Begging posture : Weight rank	-0.36	-0.86 to 0.12	0.14
Supplementation: Begging posture : Weight rank^2	-0.56	-1.09 to -0.03	0.041*

MCMCglmm logistic regression on the likelihood of being fed (yes/no). Supplementation treatment was either control or supplemented. Relative begging posture is the posture of the focal chick divided by the mean posture of all begging chicks on that feeding visit. The non-linear effect of weight rank was analysed using the quadratic term. Nest, parent ID, chick ID, and feeding visit were included as random effects. N = 29 nests, 54 adults, 199 chicks, 1121 feeding visits.

Supplementary Video Legends

Supplementary Video 1: Example of a great tit feeding visit during experiment

Supplemetary Video 2: Example of great tit parents using the supplementary food