ScienceWatch - Driving Them Cuckoo

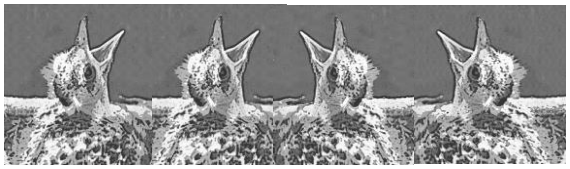
Nestling birds tell their parents they are hungry by energetically begging for food with wide-open mouths and frantic calls. How do the parents interpret these signals? Apparently, it is not simply a matter of "the squeaky wheel" gets the most food. A study done by R. M. Kilner, D. G. Noble and N.B. Davies at Cambridge University, and published in the February 25th 1999 issue of the journal *Nature*, reveals that parents of reed warblers (*Acrocephalus scirpaceus*), use both visual and vocal begging signals to adjust the feeding of their young. Nestling reed warblers beg for food by exhibiting a bright yellow gape and calling repeatedly. The researchers investigated whether total gape area in the nest (i.e., of all the nestlings) and calling rate convey distinct information to the parents on the state of deprivation of the chicks. They temporarily removed chicks from their nests in broods of four, fed them to satiety and then kept them warm but unfed. Every ten minutes for the next 110 minutes, the chicks were stimulated to beg and their responses were recorded on audio and videotape. They found that the longer chicks are deprived of food, the more frequently they call and the wider they open their mouths.

Next the research team investigated whether the parents regulate their feeding rate in response to both the rate at which the brood calls and the total gape area displayed at the nest. They augmented the calling rate by playing a recording of calls at the nest. Both the vocal and visual (total gape area) were equally altered by changing brood sizes so that they ranged from one to eight nestlings. By manipulating these signals the researchers found that the total gape area and the frequency of calls determined the rate at which the parents fed the nestlings. The researchers also found that older chicks called more frequently and presented a greater total gape area, which resulted in a higher parental feeding rate. These two signals so strongly influenced the feeding rate that once they were known it could be accurately predicted. Apparently the reed warbler parents have a mechanism for incorporating these two independent signals and determining the proper feeding rate based on a combination of the two signals.

Reed warbler chicks do not appear to lie to their parents by begging for more than they need, but the parents are deceived by an imposter. The reed warblers are parasitized by the common cuckoo (*Cuculus canorus*), a brood parasite that redirects the provisioning behavior of the songbird parents to the rearing of its own chick. Upon hatching, the cuckoo nestling evicts all the reed warbler nestlings and eggs from the nest. It then becomes the sole recipient of parental care. Apparently oblivious to the hoax, the pair of warblers feed the cuckoo chick until it becomes a behemoth fully eight times their own body weight. How is the ruse achieved? The answer lies in being able to dissect out exactly what visual and audio cues the parents use. Kilner *et al.* have shown that the cuckoo nestling can decipher the code that elicits provisioning and use it to its own advantage. They observed that a single cuckoo nestling at 6-8 days of age obtains a level of provisioning that matches the rate for four warbler chicks, a fairly normal brood size. Not coincidentally, the weight of a week-old cuckoo chick happens to match that of four reed warbler chicks. However, body size is not the answer, because a single blackbird (*Turdus merula*) or song thrush (*T. philomelos*) of the same body weight as a cuckoo nestling were fed at a significantly lower rate when placed in a reed warbler's nest. When accompanied by playback of four reed warblers calling, the feeding rate increased, but

still did not match that of a brood of four reed warblers. When the begging calls of a cuckoo nestling were used instead, the feeding rate actually rose above that seen for cuckoos of the same weight.

These results can best be explained by considering both the total gape area and calling rate presented to the parents in each of the above situations. Even though a *Turdus* chick has a wider gape than a cuckoo chick, it cannot get as much food because it calls at a much slower rate. Adding the calling of a brood of four reed warblers does not cause adequate provisioning because the gape area of a single *Turdus* does not match that of the brood. Combining the cuckoo calling with the *Turdus* chick elicits the highest provisioning response due to the rapid calling rate of the former and the wider gape of the latter. Despite its enormous size the cuckoo has a relatively small beak, so it can never match the visual stimulus of a brood of four gaping reed warblers. However, the parents base their feeding rate on the **combination** of two signals. So, the cuckoo's beak deficiency is compensated for by a vocal zest that not only matches the total calling rate of a brood of four reed warblers (at the age of one week), but rises so rapidly as the chick grows that it soon sounds like eight warbler nestlings. By combining the call of eight chicks with the gape area of two, the growing cuckoo motivates the parents to bring food for a normal brood of four. Thus reed warblers use exactly the same provisioning rules when feeding cuckoos and their own young.



The cuckoo has no stake in the long-term survival of the parents. So, why doesn't it simply exhaust them by demanding the provisioning rate of five or six chicks? Kilner *et al*. suggest two good reasons. First, the cuckoo needs the parents for ten days more than the warbler chicks, so it may not pay to exhaust them too soon. Second, the cuckoo may have "hit the wall", and may not be able to call more rapidly or gape more widely than it now does. Alternatively, the cuckoo may simply already get as much food as it needs. Whatever the reason for the upper limit, at present, the cuckoo definitely has the advantage in this evolutionary arms race.