Stressed young birds stop learning from their parents and turn to wider flock

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Zebra finches in the "food puzzle" experiment are shown. The birds had to learn to flip the lids from the top of a grid of holes to reach the food reward of spinach underneath. Credit: Dr Neeltje Boogert

Highly-social zebra finches learn foraging skills from their parents. However, new research has found that when juvenile finches are exposed to elevated stress hormones just after hatching, they will later switch strategies and learn only from unrelated adult birds - ignoring

their parents' way of doing things and instead gaining foraging skills from the wider network of other adult finches.

Researchers say that spikes in stress during early development may act as a cue that their parents are doing something wrong, triggering the young birds to switch their social learning strategy and disregard parental approaches in favour of acquiring skills exclusively from other birds in the flock.

This stress cue and subsequent behavioural change would then allow the juveniles to bypass a "potentially maladaptive source of information" - possibly the result of low-quality parental investment or food scarcity at birth - and consequently avoid a "bad start in life", say the researchers.

The changes this stress could create in the patterns of individuals' social interactions may impact important population-wide processes, such as migration efficiency and the establishment of animal culture, they say. The new study is published today in the journal *Current Biology*.

"These results support the theory that developmental stress may be used as an informative cue about an individual's environment. If so, it may enable juveniles to avoid becoming trapped in a negative feedback loop provided by a bad start in life - by programming them to adopt alternative, and potentially more adaptive, behaviours that change their developmental trajectories," said Dr Neeltje Boogert, from Cambridge University's Department of Zoology, who authored the study with colleagues from the universities of Oxford and St Andrews.

For the study, the research team took 13 broods of zebra finch hatchlings and fed half of the chicks in each brood with physiologically relevant levels of the stress hormone corticosterone dissolved in peanut oil, and the other half - their control siblings - with just plain peanut oil. The chicks were treated each day for 16 days from the ages of 12 days

old.

Once the chicks reached nutritional independence, they were released with their families into one of two free-flying aviaries, where researchers tracked their social foraging networks using radio tags called PIT tags (Passive Integrated Transponder), about the size of a grain of rice. Each bird's unique PIT tag was scanned when a bird visited a feeder, allowing the researchers to track exactly who was foraging where, when and with whom.

Using these feeder visit data, the researchers were able to build finch social foraging networks, as the thirteen zebra finch families in the two aviaries foraged and interacted over the course of 40 days.

They found that the juveniles administered with the stress hormone were less likely to spend time with their parents, spent more time with other unrelated birds and were far less choosy about which birds they foraged with; whereas the control group stuck more closely to their parents, and foraged more consistently with the same flock mates.

To test whether these stress-hormone induced differences in social network positions affected who learned from whom, Boogert devised a food puzzle for the birds, and recorded exactly when each bird started solving it.

In the new test, the birds had to learn to flip the lids from the top of a grid of holes to reach the food reward of spinach underneath. All other feeders were removed from the aviaries, and the researchers filmed a series of nine one-hour trials over three days, monitoring and scoring how each bird learned to get to the bait.

They found that, while the control group of juvenile finches did also learn from some unrelated adults, they mostly copied their parents to

find out how to get the spinach. In sharp contrast, the developmentally-stressed chicks exclusively copied unrelated adults instead - not one looked to a parent to figure out the key to the spinach puzzle.

In fact, the stressed juveniles actually solved the task sooner than their control siblings, despite not using parents as role models to focus on. Boogert says this may be because they relied more on trial-and-error learning, or that they simply had access to the information sooner because they copied a large number of unrelated adult finches rather than just one of their two parents.

"If developmentally stressed birds occupy more central network positions and follow many others around, this might make them especially efficient spreaders of disease, as stressed individuals are also likely to have weakened immune systems," said Boogert.

"The next step is to explore the implications of our results for important population-level processes, such as the spread of avian pox or flu."

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