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Personality in the wild

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Abstract

Behavioural traits can influence an individual animal's fitness, and trait combinations can change over its lifetime, according to a study of wild trout during a key period in their development.

Life is hard for a young brown trout in a cold Swedish stream. There are so many dangers to watch out for, such as a hungry mink lurking around the bend, and so many things to do, such as competing for food. Indeed, a young brown trout has only around a 10% chance of surviving to adulthood[1]. If a fish can beat the odds and survive this dangerous period, it emerges different from before — not just bigger, but also behaviourally changed. A recent paper by Adriaenssens and Johnsson in *Ecology Letters*[2] reports that the individuals that make it through this bottle neck behave more predictably across contexts than they did before. Is this because of those harrowing early experiences? Or are these fish the ones that were better adapted in the first place? Adriaenssens and Johnsson's findings suggest that the answer is an intriguing combination of both factors.

Animal personalities are interesting to researchers because behaviour is notoriously flexible — unlike most morphological traits, behaviour can change almost instantaneously. Within seconds, a fish might go from aggressively attacking an intruder to foraging alone in the middle of the stream. But there is growing evidence that behaviour does not always change at a moment's notice, and that animals have distinctive personalities that they retain over time. One view[3] is that animal personalities may result from constraints: limiting mechanisms that prevent an individual from being able to change, such as a genetic propensity. An alternative interpretation[4] is that consistent differences in behaviour between individuals might be the result of adaptation through natural selection. There is evidence for both the constraint[5] and the adaptive[6] models, and strong support for the latter comes from research showing that behavioural consistency arises from both behavioural plasticity (when individuals change their behaviour in response to environmental conditions) and non-random survival of individuals[7]. However, that study was carried out in the lab, where life is relatively simple. The significance of Adriaenssens and Johnsson's work is that it starts to show us how adaptive personalities can emerge in the wild.

The authors captured young (around two and half months old) brown trout (*Salmo trutta*; Fig. 1) in a stream in western Sweden and gave each individual a unique colour mark. The trout were then put through a series of behavioural assays in the lab. One of these was an `open-field test', in which trout were individually placed in an open arena and observed to determine whether they were the kind of fish that explores everything, or the type that moves little and hunkers down in one spot. Another assay involved a confrontation with an opponent — in this case, the trout's own reflection in a mirror. Here, the researchers were looking to see whether the individual attacked the intruder or if it was relatively non-aggressive. After assessing each fish in all of the assays, the researchers released them back into the stream.

Two months later, Adriaenssens and Johnsson returned to the stream. Of the 81 individuals that were tested, they recaptured 28. On the basis of the assumption that those fish that were not recaptured had died, the authors' analyses showed that an individual's behaviour predicted its survival: trout that had been very active in the open-field test were more likely to survive to 4.5 months of age than those that had moved around less. An alternative explanation would be that the inactive individuals did not die, but rather were harder to recapture or more likely to disperse out of the study area. However, Adriaenssens and Johnsson provide evidence against both of these possibilities, showing that inactive fish were in fact easier to catch and did not move as far in the stream. So the first notable result from this study is that it shows natural selection acting on differences in behaviour among individuals in a wild population.

The authors then put the recaptured fish through the same assays and found that their behaviour had changed during their time back in the stream — the trout were more active at 4.5 months of age than they had been at 2.5 months. However, despite this overall behavioural change and the vagaries of life in the wild, the survivors retained their relative personality traits: the fish that had been the most active in the first round of testing, for example, were still the most active.

Finally, and perhaps most intriguingly, Adriaenssens and Johnsson report that the individuals' behaviour became more distinctive. Whereas the young trout did not behave consistently across the different behavioural assays, the older trout did, such that highly exploratory individuals were now also more aggressive. In other words, the individuals were now more predictable, and a `behavioural syndrome'[3] linking exploratory behaviour to aggressive behaviour had emerged.

There are two ways in which this could have occurred. First, it may be that only those individuals that were relatively exploratory and aggressive, or relatively non-exploratory and non-aggressive, in the first place survived. Alternatively, it is possible that individuals changed their behaviour over time and this caused different behaviours to become coupled together. Adriaenssens and Johnsson present evidence in support of both mechanisms, but they were unable to thoroughly disentangle the two; designing experiments that can tease these two processes apart is a pressing goal for future work. Further studies are also needed to determine whether there are consequences of such non-random survival in the next generation — in other words, if behavioural variation is heritable.

The biggest question, though, is why did individual fish become predictable? That is, why did behaviours become coupled together, and what are the fitness advantages to being a trout that behaves consistently? Several hypotheses exist to explain why behaviours should come packaged together[8] — for example, that there might be social benefits of being predictable[9]. But so far there have been few empirical tests of these ideas, and this represents another exciting challenge for future work.

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Figure 1. Fishy activity

Adriaenssens and Johnsson's study[2] of the behaviour of wild brown trout (*Salmo trutta*) shows that individuals with consistently high activity levels are more likely to survive the early months of life.