Risky attraction to the familiar smell of disease

Many animals remember smells, sights, and sounds (‘cues’) they encounter as juveniles, like the smell of nearby individuals, or their environment. These memorised (or ‘imprinted’) cues can help identify important individuals, such as members of the same species or family. Animals often rely on these cues as adults when deciding with whom to spend time and with whom to mate. For example, imprinted smells help salmon and trout identify their kin – being near kin is beneficial because they are more likely to share food and shelter than unrelated individuals. Imprinted cues are even what some fish use to identify to which species they belong. When juvenile swordtail fish are experimentally raised with adults of a different species, they prefer to shoal and mate with members of that species (even though this won’t result in offspring), rather than members of their own species.

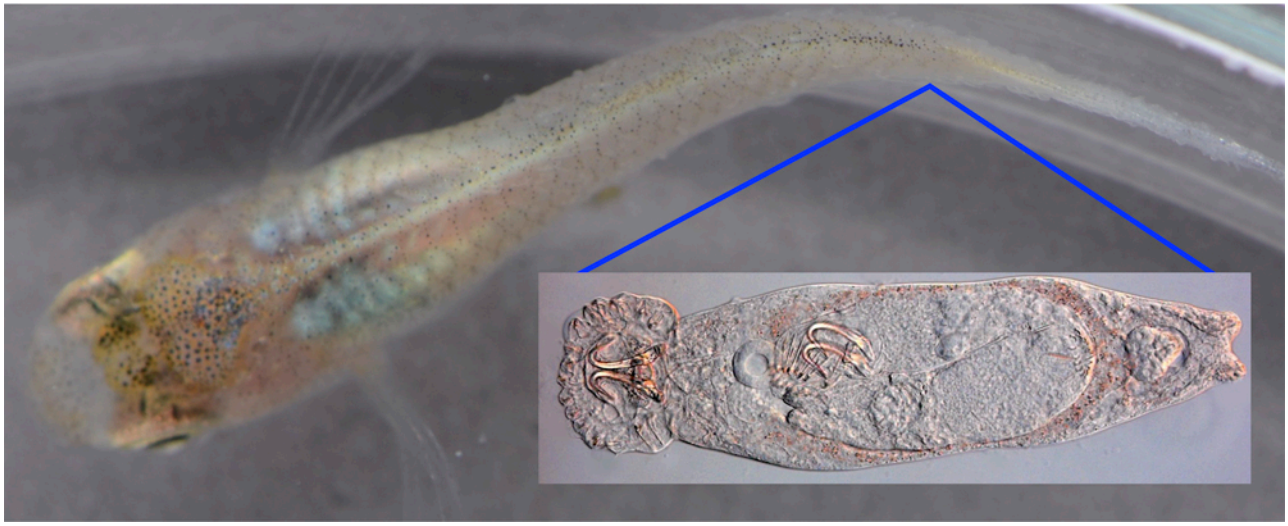

Fig. 1. This image shows a female guppy (*Poecilia reticulate*) infected with several parasitic worms (*Gyrodactylus turnbulli*). These transparent worms make the tail end of the fish’s body appear ‘fluffy’. The inset (image credit: Jo Cable) shows a magnified view of one of these worms.

Clearly then, imprinting is a powerful force in guiding animal behaviour, and given that it helps animals identify individuals that will boost their chances of survival (such as kin), and reproduction (such as appropriate mates), it is commonly viewed as having a positive influence on behaviour. There are, however, rare exceptions. For example, there are three colour morphs of buzzard: a dark, a light and an intermediate morph. The intermediate colour morph survives better and produces more offspring than the other two morphs, so dark and light morph birds should maximise the number of intermediate morph offspring they produce (by preferentially mating with individuals of a different morph) and yet, due to imprinting, buzzards prefer to mate with individuals of the same morph as their mothers, so the less successful morphs are maintained.

In this paper, we investigated another example of imprinting having a potentially negative influence on animal behaviour, in that it may promote the spread of infectious diseases. It is well established that sick individuals smell different to healthy ones, and that many animals can use this difference to avoid potentially contagious individuals. For example, healthy lobsters, mice, cockroaches, chimps, bees and tadpoles, and even humans all seem to spend less time with members of their species that smell of disease. We describe an experiment in which we tested whether imprinting is a powerful enough force in fish behaviour to make healthy fish prefer the smell of contagious shoal mates to that of healthy shoal mates.

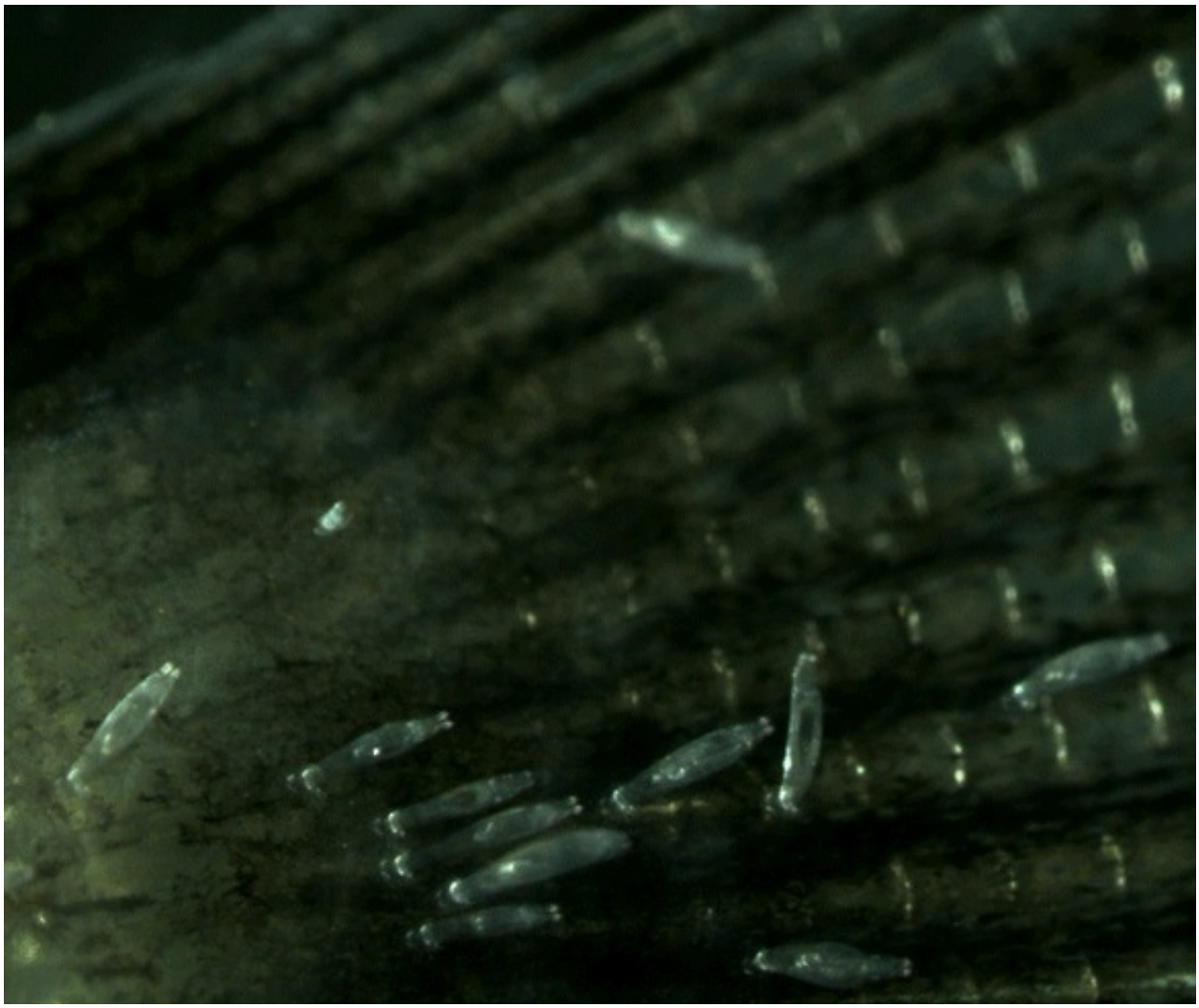

Fig. 2. This image shows how *Gyrodactylus turnbulli* moves on the surface of a guppy tail. The worms can move around on the surface of their current host fish, and transmit to new hosts when two fish come into close proximity, such as in a shoal. Video credit: Michael Reynolds.

In our experiment, we used small tropical fish, guppies, and a parasitic worm that lives on their skin. The worm, *Gyrodactylus,* moves between fish when they are close together, such as in a shoal, so spending time with infected shoal mates likely increases a fish's risk of contracting an infection. We raised juvenile fish with adults that had suffered from the disease caused by *Gyrodactylus,* or with healthy adults. We tested these 'disease-imprinted' or 'healthy-imprinted' juveniles once they had grown to adulthood on whether they preferred the smell of healthy or diseased shoalmates. Disease-imprinted fish showed a strong preference for the smell of diseased shoalmates, whereas healthy-imprinted fish avoided the smell of disease. As well as demonstrating that imprinting is powerful enough to lead to maladaptive behaviour, this disease-imprinted behaviour is likely to change how diseases spread through populations. Of course, the closer you are to an individual infected with a contagious disease, the more likely you are to catch it. Therefore, if juvenile animals imprint on the smell of diseased adults, for example in aquaculture tanks, high density farms, or even in the wild, this will reduce their avoidance of the disease, and may even increase their chances of becoming infected.

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