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Evolution & Behaviour

Why so Aggressive? Bringing the Past into the Present

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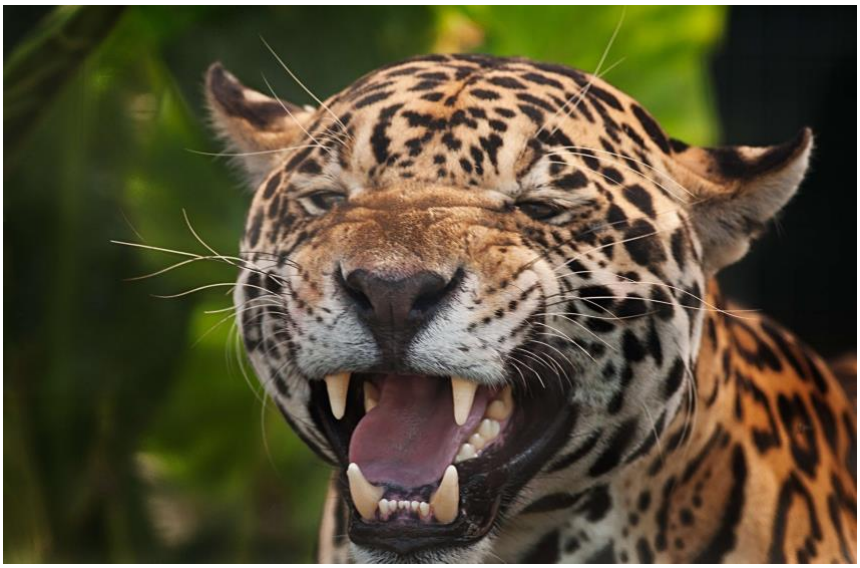
ABSTRACT

Animals change their aggressive behaviour across contexts, potentially due to lingering effects of past experiences. We tested the aggression in fruit flies before and after they were placed in a vial for 4-days, varying the group composition and the intensity of food competition. Male aggression changed after the 4-day period, showing how specific past experiences can alter future aggressiveness.



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When engaged in a conflict with another, many animals will behave aggressively. We see it in dogs at the dog park, in fish in a fish tanks, in people with bullies at school, and even flies at a garbage bin. However, precisely what motivates an animal to behave aggressively can be complex. Animals can adaptively use aggression in competition, as aggression can result in accessing limited resources. However, we also frequently observe animals engaging in aggressive interactions when such behaviour appears “maladaptive”. In our study, we were interested in how past experiences influence an animal’s aggressive behaviour.

Aggression is considered a personality trait in humans and animals, meaning certain individuals are predisposed to behaving more or less aggressively. However, aggression is also a highly plastic trait, and individuals can modify their aggression depending on the context. For example, in dominance hierarchies, high ranking individuals may frequently use aggression, low ranking individuals may rarely use aggression. In contrast, aggression in mid-ranking individuals will depend on the rank of their competitor.

In addition to personality and present context, past experiences can also influence an animal’s aggressiveness. That is, competitive experiences or specific social environments can have lasting effects on individuals, resulting in modifications of future behaviour. There is evidence that both the intensity

of competition and the social environment can induce persistent effects on aggression. However, how these two factors intersect to influence future aggression is unknown.

To study how aggression is affected by previous experiences, we used two strains of fruit flies, one that was highly aggressive and one much less aggressive. We placed flies in groups which varied in size and composition in a vial with restricted food for 4-days. The group size was our proxy for competition. Small groups of 30 flies had ample food (and therefore no competition), whereas the same amount of food in large groups of 300 flies would lead to intense food competition. The social composition was measured by mixing the two strains in 5 combinations. All one strain, strains evenly mixed (50% each), and strains unevenly mixed (25% one strain, 75% the other). We used all five social combinations in both large and small groups.

We were specifically interested in any changes in aggression following the 4-day period and implemented a "before" and "after" experiment. We compared male and female aggression from both strains by placing focal flies in an arena containing a single food patch and an unfamiliar fly and counted the number of aggressive behaviours. We did not measure any aggression during the 4-day period since we were only interested in how the social and competitive experience may influence future aggressiveness.

In comparing average aggression before and after the 4-day period, we found the effects of both group size and social environment only in male flies. We observed no changes in female aggression, regardless of the social or competitive experience during the 4-day period. In contrast, male aggression was influenced by a combination of the intensity of competition and social environment. If we placed males in groups containing on one strain, they became more aggressive, regardless of group size. Additionally, when we put males in large groups with both strains evenly mixed, their aggression levels decreased. In contrast, both aggressive and non-aggressive males increased their aggression when their strain made up 25% of the group, but only in large groups.

Our results indicate that aggression in male flies is affected by past experiences. The direction of the behavioural shift following the 4-day period depended on the specific social makeup and the intensity of food competition. Since we measured aggression in an environment different from that wherein the social effect occurred, we conclude that the social and competitive experiences can persist not only through time but also contexts. Although the direction of the shift in aggression differed with the social environment, past social experiences can influence future behaviour, even when the context changes.

From our study, we can clearly see that the aggression we often observe in dogs, fish and people likely reflects not only their current environment but also their previous experiences. Social experiences, particularly those involving competition between individuals, can have lasting effects in animals. They may alter aggressive behaviour in future, and across different environments, even if such behaviour is not optimal. Aggression in the present is, therefore, at least partly motivated by past experiences. This evidence adds to our understanding of the complexity of aggression.