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## Poison dart frogs: Personality determines reproductive strategies

**Unlike their relatives, individuals of the poison frog *Allobates femoralis* are not poisonous but are captivating due to their different behavioral profiles: They successfully reproduce with different strategies depending on whether they are bold, aggressive or explorative. In addition, certain character traits are already present in this species at the tadpole stage. This is shown in two recently published studies by the University of Bern.**

Poison frogs of the species *Allobates femoralis* are common in the rainforests in South America. Their highly poisonous relatives, such as frogs of the genus *Phylllobates*, were frequently used by indigenous people of Colombia to extract toxins by rubbing the skin onto arrowheads for the purposes of hunting and fighting. *Allobates femoralis* frogs are not poisonous. Like many other animal species, however, they have distinct personality traits. Both the males and females, for example, may be particularly bold, aggressive, or eager to explore. Poison frogs mate with several partners over the course of a reproductive period and their character traits have a considerable influence on the reproductive strategies employed by individual animals.

Most of the previous studies in other animal taxa have examined the effect of personality traits on a single measure of reproductive success. In two recently published studies, researchers in the Institute of Ecology and Evolution at the University of Bern have presented new results on the effects of different combinations of personality traits in both males and females on different components of reproductive success. They examined the influence of personality on mating success, the number of clutches produced, as well as the numbers of offspring that survive into adulthood. The researchers were able to show that certain personality traits are already present in poison dart frogs at tadpole stage and that they also persist after the subsequent metamorphosis.

### **Behavioral experiments in the field and the laboratory**

Amphibians, and poison dart frogs in particular, are ideal for studying the relationships between behavior and reproductive success due to the complex interactions and delineations that occur between males and females during mate choice and the rearing of their offspring.

The research group led by Eva Ringler, Professor and head of the Division of Behavioral Ecology in the Institute of Ecology and Evolution at the University of Bern, studied a wild population of poison

frogs on a river island in French Guiana. This colony has been established for more than ten years. “The situation of this river island gives us the opportunity to work with free-living amphibians at the population level in a delimited area. On the one hand, we can investigate how individuals differ from each other in terms of their behavior. On the other, we can use genetic methods to assess individual reproductive success, and relate these measures to those of other individuals in the population,” explains Eva Ringler. The researchers also conducted behavioral experiments with frogs in the captive colony at the Hasli Ethological Research Station of the University of Bern. These studies generated the findings on the stability of the personality traits subsequent to metamorphosis.

### **No single behavioral type promises success in every case**

The personality traits of poison frogs were recorded in specific behavioral experiments. “To measure aggression, for example, acoustic signals were played back to trigger territorial defense behavior in the males,” explains Mélissa Peignier, the first author of the study. The researchers concluded that the personality traits boldness, aggression and exploration can have advantages or disadvantages for different components of reproductive success in both males and females, depending on the context. “There is no one behavioral type that generally promises success and prevails. It depends on the context,” explains Eva Ringler.

The team was able to demonstrate, for example, that the males which could attract several females as mates were either non-aggressive and non-exploratory, or very aggressive and exploratory. “Males with low levels of aggression are probably less competitive against more aggressive conspecifics. That’s why it is advantageous for them to stay protected in their own territory and wait there for female mating partners,” Peignier explains. “More aggressive males that don’t go exploring and stay in their own territory may have the problem of being unable to distinguish potential mates from rivals. Attacking an approaching female in one’s own territory obviously isn’t conducive to mating success,” says Peignier. Conversely, aggressive males with a high exploratory drive might increase their mating success by increasing their chances of settling in areas with high female density.

### **Character develops early and is stable**

Many animals demonstrate a high degree of consistency in their behavioral repertoire regardless of time or context. The stability in personality traits is especially interesting in amphibians, as they undergo major morphological and ecological changes during metamorphosis from tadpole to frog. “From behavioral experiments conducted in the laboratory we found that personality traits such as boldness and exploration, were already present in tadpoles and were retained even after metamorphosis,” explains study author Lauriane Bégué.

“The two studies demonstrate the importance of considering individual differences in ecological and evolutionary research. They also provide important insights into the mechanisms that both generates animal personality and maintains it over evolutionary time,” explains Ringler. The results further suggest that personality traits may have a physiological and/or a genetic basis. “Future studies should investigate the extent to which personality is inherited in poison frogs to better understand how genetic factors may constrain behavioral variation,” concludes Eva Ringler.

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