

## The impact of emotions on the health condition of honeybees

Emotions are a very important aspect of life, affecting our behaviour and well-being and our ability to make important decisions and perceive reality. Research on the impact of different emotions on human behaviour is quite common, but this is not the case for emotions in animals. Research on animal emotions and the impact of these emotions on various aspects of their lives is still quite controversial. Animals cannot simply tell us how they feel; therefore, in order to examine the emotional state of animals, we undertake research on their cognitive abilities and measure their behaviour in specific situations or the changes that occur in their physiology. In recent years, animal emotion research has been experiencing a renaissance, and the existence of emotions has been confirmed in many animal groups, including fish, rats, pigs, dogs, sheep and many others. Furthermore, emotions are characteristic of not only vertebrates but also invertebrates, including insects, which have emotions that directly affect their behaviour and physiology. Previous studies have shown that a honeybee that has been exposed to a simulated predator attack—i.e., experienced negative emotions—has worse judgement than that of an individual who has not experienced an attack. On the other hand, bumblebee individuals that experience positive emotions are more likely to take on additional activities when they find an unexpected reward.

Knowledge about emotions is not limited to how they affect human (or animal) behaviour or decision-making, as it turns out that the health condition of living organisms also depends on their emotional state. Many studies in this medical field indicate that "happy" people have better health and get sick less often, and even if disease occurs, it is milder and individuals have a better recovery. The opposite is true for people frequently exposed to "bad" emotions; this directly reduces the body's immune response, which is associated with more frequent disease. The impact of emotions on animal health is a fairly new topic; thus far, several studies have been conducted on orangutans and dogs, which show that animals have the same reactions as those of humans. However, this aspect of invertebrate research has not been studied at all until now. Therefore, the purpose of my research is to answer the question of whether emotions can affect the health of insects and I address this question by performing experiments on honey bees.

To answer the main research question, I am planning a series of experiments, which are organized into three main groups: (1) I will try to answer the question of how emotions affect disease prevention; (2) I will test how emotions affect the course of disease in previously infected individuals; and (3) I will assess how different emotions affect the physiology and immune defence of a honey bee. In each of the three experiments, I will use different factors that affect emotions in animals (odours and light levels) as well as different factors that cause diseases and intoxication (the bee parasite *Nosema*, pesticides and alcohol). In addition, as a control test, I intend to do research showing that the factors used (odours and light) truly affect the emotional state of bees. This part of the research has been done previously, but for potential readers, such additional information is necessary. In addition, I want to mention that the honey bee was chosen purposely because (1) it is one of the economically important insects, used in both the production of honey and pollination of crops, (2) it is an insect for which the existence of emotions and factors that affect these emotions directly have already been described, (3) it lives in groups, and emotional state may depend on contact with other individuals, (4) recently, a decrease in bee colonies and their worsening condition has been observed, (5) it is a model species in many studies, and procedures already exist to facilitate research, and (6) the project manager has experience working with these animals.

Answers to the questions contained in the presented project are important for several reasons: (1) they show us how commonly emotions impact animal health; (2) they will provide evidence that not only parasites and diseases are responsible for a decrease in the number of pollinators but also the conditions in which these organisms live (i.e., if the organisms live in stressful conditions, there is a chance that every disease will be more severe); (3) they may be used in the future to develop methods for protecting pollinators or to strengthen the condition of bee colonies.