Aus der Professur für Verhaltenskunde
der Agrar- und Umweltwissenschaftlichen Fakultät

Thesen der kumulativen Dissertation

Measuring cognitive-affective appraisal processes in pigs

zur Erlangung des akademischen Grades
Doktor der Agrarwissenschaften (doctor agriculturae (Dr. agr.))
an der Agrar- und Umweltwissenschaftlichen Fakultät
der Universität Rostock

vorgelegt von
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Verteidigung am 06. Juli 2018

1. Objectives of research

Modern definitions of animal welfare (in farm animals) explicitly underline the relevance of affective states. This leaves it absolutely essential to find valid measurements of those intrinsic processes. Affective states, like short-term emotions and long-term moods, can be described by a two dimensional model, measuring the state of arousal (low/high) on the one hand and the valence (negative/positive) on the other hand. Valence is the more relevant dimension when it comes to animal welfare, but is far more elusive. The focus of the cumulative thesis presented here, is the cognitive bias test, an approach originally developed in human psychiatric research and more recently used in various (farm) animal species to measure the valence of affective states based on optimistic (positive valence) or pessimistic (negative valence) evaluations of ambivalent stimuli. Cognitive biases are based on the linkage between affect and cognition, interacting by a whole range of networks in the brain. Putting it simple, the term 'cognitive bias' describes the shifting of cognitive processes under the influence of affective states, however, the underlying mechanisms of these complex interactions are not thoroughly understood yet. The first goal of my thesis was to provide a test design which is suitable for the usage in pigs. For this, I modified a spatial go/no-go judgement bias task (SJT) to enable repeated testing while animals show a graded response to ambivalent graded test probes. Furthermore the goal was to validate the test design and to better understand underlying mechanisms of cognitive-affective regulation. For this purpose, the thesis focuses on the serotonin (5-HT)-system by manipulating the 5-HT-availability in the brain. 5-HT is one important key player in the regulation of affective states - a depletion is supposed to generate a negative affective state, whereas an increase of 5-HT in the brain should induce a positive affective state. In order to provide evidence of the sensitivity of the test design to both extremes of the valence dimension, my thesis provides both: 5-HT depletion was conducted by pharmacological treatment and 5-HT increase was achieved using a more practically relevant approach. Here, 5-HT availability in the brain was increased supplementing the pig's diet with tryptophan (TRP), a precursor in the 5-HT synthesis. Complementing the studies by measurements of the 5-HT concentration in selected brain areas, as well as including measurements of the behavior in a standard behavioural test (OFNO), this thesis comprises the multifaceted characteristics of affective states and is expected to contribute to a better understanding of the complex mechanisms as one essential part in animal welfare science.

2. Main results

Training pigs in the SJT using a reward as positive and a mild punishment as negative reinforcer and additionally introducing a partial reinforcement to the training process

- enables animals to discriminate between two reference locations (positive vs. negative) as indicated by specific behavioural reactions (go/no-go);
- induces graded responses to graded probe cues;
- enables repeated testing of ambivalent test probes without subjects learning about the probe outcome.

Published in: Applied Animal Behaviour Science, 2017.

Pharmacological inhibition of the 5-HT synthesis using para-Chlorophenylalanine

- decreases the 5-HT concentration in brain areas relevant for cognitive-affective processes;
- results in a pessimistic evaluation of the ambivalent test probes in the SJT, indicating a negative affective state;
- does, however, not alter behavior in an open field/novel object test.

Published in: Physiology and Behavior, 2017.

Dietary supplementation of TRP increases 5-HT concentration in brain areas relevant for cognitive-affective processes.

A surplus of 5-HT acquired by dietary TRP supplementation

- results in a pessimistic evaluation in the SJT;
- does not alter behaviour in an open field/novel object test.

Published in: Journal of Veterinary Behavior, 2017.

3. Conclusion and Outlook

Understanding cognitive-affective appraisal processes (represented by the SJT) is of elemental interest, not only for fundamental research but for applied science as well. They provide the potential to objectively judge the affective state as one essential part of animal welfare. However, these processes are complex and flexible. While they are originating in the brain, which by itself is characterized by highly connected structures, circuits and networks, they are multifaceted, comprising physiological, behavioural and subjective components. The presented thesis therefore not only presents a standardized, validated test design, but addresses to the above mentioned complexity by integrating different components of affective states, represented by measurements of 5-HT in the brain (neurophysiological), behavioral tests (OFNO/SJT) and the cognitive-affective appraisal in the SJT (subjective).

Affective states are a relevant part of animal welfare, but to date, a broad range of unsolved questions remain. These concern their underlying mechanisms, their processing, their perception and their feedback to cognition and behaviour. The judgement bias test offers a promising tool to provide answers in this complex field. Therefore, it is of significant importance to both current and future animal welfare studies, as knowledge on animals' affective abilities may reveal new perspectives to improve and to evaluate husbandry systems. Finally, awareness of affective (subjective) abilities may shift the current perception of farm animals from being simple products to being complex, sentient individuals, with each having their own individual needs.