

IGN-Forschungspreis 2019

DR. ANNIKA KRAUSE

*Affective-autonomic states of domestic pigs
in the context of coping and animal welfare*

Dissertation Universität Rostock 2019

Summary

This thesis focusses on the investigation of affective-autonomic states in domestic pigs (*Sus scrofa domestica*), by using an implantable telemetric technology capable of assessing both branches (parasympathetic and sympathetic) of the autonomic nervous system in the context of individual coping and animal welfare.

Gaining better insight into affective states of (farm) animals plays an important role in terms of understanding and improving animal welfare. One approach to objectively assess an organism's affective state is the measurement of autonomic activity, which is viewed as a major component of the affective state in many theories of emotion. Common approaches in this field measure cardiac activity by the means of external systems providing reliable parameters indicative for parasympathetic activity, whereas there does not appear to be any valid index that adequately reflects sympathetic modulation of the heart. Advances in technology have provided implantable telemetric systems which enable the additional analysis of vascular fluctuations. This allows examining sympathetic function exclusively, which complements information about subtle changes in autonomic activity in the context of affective states and enables conclusions about the valence and arousal dimensions of affect.

Based on this, the first aim of this thesis comprised the establishment of an implantable telemetric method for measuring both branches of the autonomic nervous system in order to provide a valid tool for the objective evaluation of affective-autonomic states in free-moving pigs.

However, affective states may vary between individuals based on the perception of individually relevant interactions with the environment, including the ability to respond to and cope with challenges. Thus, individual reaction pattern, such as coping styles, may influence the underlying mechanisms of the affective state in a specific situation. Therefore, the second major aim of this thesis was the investigation of individual coping styles and their specific role in the context of affective-autonomic reactions of pigs in different housing-relevant situations within the two-dimensional model of affect. The thesis is divided into three chapters.

Chapter I provides a general introduction into the topic of affective states, their relevance for the evaluation of animal welfare as well as their interaction with autonomic functioning and individual coping styles. This is followed by a description of the proximate neurophysiological pathways underlying affective states. After illustrating the current methods to measure autonomic activity in the context of affective states including their implication, the key structure of this thesis is highlighted in the overarching context of the integrated studies, as well as the according hypotheses.

IGN-Forschungspreis 2019

Chapter II provides three studies that were published as part of this thesis.

Study 1 addresses the establishment of a new telemetric technology as a valid tool for the objective investigation of both branches of the autonomic nervous system in domestic pigs and has been published in *The Veterinary Journal* 207, 140-146 (2016). The first aim in this study was the development of a stringent surgical procedure for the implantation of a telemetric device for the continuous measurement of electrocardiogram (ECG) and blood pressure (BP) in free-moving pigs. The second aim comprised the functional assessment of the recorded parameters which included data processing, detection performance, and controlling the reliability of obtained parameters for application in two different behavioural situations with different physiological demands (resting vs. feeding). The major findings revealed technical and surgical issues in four pigs concerning catheterization and detachment of ECG leads. These issues were solved and a list of recommendations for future studies was given. Detection performance decreased with elevated activity level, but manual correction was able to reliably eliminate errors. Generally, blood pressure was less susceptible to movement artefacts compared to ECG. This study demonstrated the usability of the telemetric system for the reliable registration of cardiovascular parameters in pigs permitting to draw conclusions about both branches of the autonomic nervous system and hence, the current affective state of the animal. This served as a basis for study 2 and 3 of this thesis.

Study 2 provides a mathematical-statistical approach concerning the calculation of cardiac parameters and has been published in *Frontiers in Veterinary Science* 2, 52 (2015). Based on the findings from study 1 regarding BP-signal being less susceptible to movement artefacts than ECG, the major aim of study 2 was to clarify whether the BP-signal can be used instead of the ECG to determine heart rate (HR) and its variability (HRV) in pigs in different behavioural situations. Several statistical and mathematical methods were applied with different explanatory power. The major findings showed that HR data recorded via BP agree well with those recorded using ECG independently of the activity of the subject, whereas ECG and BP cannot be used interchangeably in the context of HRV in domestic pigs. This finding contributes to the validity and application of cardiac parameters in future studies.

Study 3 transfers the methodological findings from study 1 and 2 in to the application in an experimental context addressing the link between affective-autonomic states and individual coping characteristics in domestic pigs and was published in *Frontiers in Behavioral Neuroscience* 11, 103 (2017). The main aim was the investigation of affective-autonomic states using parameters that reflect both branches of the autonomic nervous system simultaneously in pigs in different housing-relevant situations and the relationship to their individual coping styles. The major findings confirm that the respective coping styles were related to context-specific differences not only in the general autonomic response during resting and feeding conditions, but also in the behavioural and affective-autonomic response in the context of a repeated human-animal interaction. This indicates individual differences in the subject's affective appraisal of the situation.

Chapter III provides the general discussion of the findings from the three studies and comprises a discussion of the establishment of the telemetric system addressing the methodological approach of this thesis followed by a section on the relationship between affective-autonomic states and individual coping styles. Additional sections include perspectives for future studies and provide the final conclusions of the thesis.

IGN-Forschungspreis 2019

Understanding affective states and appraisal processes is of elemental interest in the context of animal welfare. Gaining better knowledge of the complexity of affective states regarding their underlying mechanisms and their individual perception and processing is important to reveal new perspectives to both current and future animal welfare studies. This will (hopefully) direct our perception of domestic pigs from being a production species more to being complex individuals with each having their own individual characteristics, emotions and needs. This would be a significant step in the direction of improving farm animal husbandry and welfare.