

Cerebral and behavioural lateralization in animal emotions: implications for translational research

Cerebral lateralization is the ability of the left and right side of the brain (the hemispheres) to independently control bodily functions. This creates a side bias, or asymmetry, in physical movements and behavioural responses. The best-known example of this is handedness in humans, in which 90% of the human population is right-handed. Lateralization in humans is strongly associated with mental disorders, whereby people with autism, ADHD and schizophrenia are around 1.5 times more likely to not be right-handed (left-handed or no side bias). This relates to the functioning of the brain hemispheres and may already develop early in life. Information is largely missing on lateralization in animal species that are used for human biomedical research. This hampers the translation of research outcomes from animal models to humans. Our project goal is to increase the understanding of brain and behavioural lateralization in large mammal model species used in biomedical research. This will benefit research in medicine, psychiatry, neuroscience, developmental biology, behavioural ecology and ethology. In the project, we will address several theories about lateralization that currently conflict between the human and non-human animal literature. Specifically, studies done in humans suggest a right hemispheric dominance for processing emotions, whereas studies from animals suggest that negative emotions are related to the right hemisphere and positive emotions to the left hemisphere. We will first explore which of these emotional lateralization theories is most correct for pigs and sheep (Aim 1). Pigs and sheep are valuable research models for human biology, including neuroscience. We expect that left and right behavioural biases are present during situations that elicit strong emotions. As these species are also used to study mental disorders in humans, it is important to know how their brain process information. We therefore will study brain lateralization in response to positive and negative events and long-term moods (Aim 2) in pigs and mice. Pig brain tissue will be assessed for lateral differences related to mood, while in-depth analyses of brain activation will be better achievable in mice. Moreover, mice with known defects for emotional regulation (mice bred as model for autism spectrum disorders) will be compared to healthy animals to create a more direct route to studying lateralization in the context of mental disorders. With the information gained in the previous steps, we will then investigate the development and stability of brain and behavioural lateralization during early life (Aim 3) in pigs and sheep. The project largely uses existing high-quality data and brain tissues that have been obtained in previous research of the research team but has not been explored for lateralization. Using existing material substantially reduces the need for research animals, thereby contributing to more ethical scientific practices. Furthermore, pigs and sheep are important livestock species for which knowledge on lateralization can help to improve animal welfare, therefore broadening the benefits to society. The project is expected to result in increased understanding of the biological processes related to brain and behavioural lateralization in pigs and sheep. The project output will include databases, scientific publications and media articles. The interdisciplinary project has a strong international collaboration with research institutes in the United Kingdom. The expertise of the combined research teams, facilities and previous pilot work of the involved researchers provides this project with a high potential for impactful research with relevance across disciplines.