ISAE Creativity Award 2013
Prof **Mike Mendl** and Dr **Liz Paul**, University of Bristol, United Kingdom

Mike Mendl and Liz Paul developed a new approach to the assessment of animal emotion which draws on ideas and findings from human psychology, learning and decision-making theory, and evolutionary biology. They introduced a new technique for assessing animal emotion that involves measuring affect-induced biases in decision-making under ambiguity - so-called 'cognitive biases'.

Cognitive bias describes the influence that affective states have on cognitive processing and decision-making. By identifying how individuals perceive ambiguous situations, insight into their affective state can be gained. Affect-induced cognitive bias is a well-documented phenomenon in human psychology and is often measured using language-based tasks or questionnaires. Mike and Liz have creatively developed a new non-linguistic technique for its assessment in animals using a discrimination learning approach. Their work is therefore an excellent example of merging scientific disciplines, as it combines knowledge from human psychology and animal behaviour.

Furthermore, they have proposed a new framework for conceptualising animal emotion which takes a functional perspective on the dimensional (valence / arousal) model of core affective state and links an animal's experiences with its position in core affect space and its predicted decision-making. Long-term mood states are seen as a type of 'Bayesian prior' that reflect and log past experiences and inform adaptive decision-making under ambiguity. Its functional basis makes it applicable across species and generates *a priori* predictions for how positive and negative affective states alter decision-making. This predictive power is very unusual in measures of animal emotion which are often interpreted *post-hoc* as indicating particular discrete emotions (e.g. fear, happiness, grief), sometimes intuitively and with limited theoretical underpinning.

The 'judgement bias' method for assessing cognitive bias is now one of the most commonly used methods for studying affective states in applied ethology. Since their seminal 2004 *Nature* paper, a large number of peer-reviewed journal publications on this subject have been produced by groups around the world. Furthermore, the approach has been applied to a wide variety of species, including laboratory, production and companion animals. It is also one of the few techniques that specifically focuses on assessing affective valence. The ability to identify both positive and negative states (valence) is extremely important in the measurement of animal welfare. The study of cognitive bias is now almost a sub-discipline in applied ethology, and the approach has helped to raise the profile of animal emotion research within animal welfare science.

Selected publications
Harding, E.J., **Paul, E.S.** & **Mendl, M.** (2004). Cognitive bias and affective state. *Nature* 427, 312. *First animal cognitive bias paper published*.
Paul, E.S., Harding, E.J. & **Mendl, M.** (2005) Measuring emotional processes in animals: the utility of a cognitive approach. *Neuroscience and Biobehavioral Reviews* 29, 469-491. *Initial review and outline of the approach drawing on human psychology literature*.
Mendl, M., Burman, O.H.P., Parker, R.M.A., **Paul, E.S.** (2009). Cognitive bias as an indicator of animal emotion and welfare: emerging evidence and underlying mechanisms. *Applied Animal Behaviour Science* 118, 161-181. *Overview of the approach and published studies up to that time*.

Mendl, M., Burman, O.H.P. & **Paul, E.S.** (2010). An integrative and functional framework for the study of animal emotion and mood. *Proceedings of the Royal Society, B* 277, 2895-2904. *Presents a theoretical framework integrating core affective state with decision-making under ambiguity (cognitive bias) and providing a functional view on animal emotion.*

Mendl, M, Brooks, J, Basse, C, Burman, O, **Paul, E,** Blackwell, E & Casey, R. (2010). Dogs showing separation-related behaviour exhibit a 'pessimistic' cognitive bias. *Current Biology* 20, R839-R840. *An example experimental study that received widespread media attention.*