synaptic bulk and neurites, or they might include increased cell genesis, for example, of glial or neuronal cells. Imaging results need to be compared with histological data for identification of the structural basis at the microscopic level of temporary, training-dependent structural changes in our brains. Bogdan Draganksi*, Christian Gaser†, Volker Busch†, Gerhard Schuierer‡, Ulrich Bogadahn*, Arne May*†Department of Neurology, and ‡Institute of Neuropsychology, University of Regensburg, Regensburg 93053, Germany

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Cognitive bias and affective state

Information processing by humans can be biased by their emotions — for example, anxious and depressed people tend to make negative judgements about events and to interpret ambiguous stimuli unfavourably1–4. Here we show that such a ‘pessimistic’ response bias can also be measured in rats that are housed in unpredictable conditions15,16. Our findings indicate that cognitive bias can be used as an indicator of affective state in animals, which should facilitate progress in animal-welfare studies.

We trained rats to respond by pressing a lever when they heard a tone associated with a positive event (delivery of a 45-mg food pellet) and to refrain from pressing the lever as a way to avoid a negative event (30 s of 70 dB white noise) when they heard another tone. Once the animals were able to score a correct response to each tone more than 50% of the time (binomial testing for three consecutive daily 30-min sessions), they were allocated to either ‘unpredictable’ housing, which induces symptoms of a mild depression-like state16–19, or to ‘predictable’ housing.

In ‘unpredictable’ housing, between zero and two negative interventions were made at random times on any one day — for example, the cage might be unfamiliar or tilted, or it could contain a stranger of the same species; sometimes the light/dark cycle would be temporally reversed or bedding tone and the ambiguous tones close to it (Fig. 1b) (t = −2.44, d.f. = 7, P < 0.05; two-tailed t-tests throughout). These rats also tended to show fewer responses to these tones (Fig. 1a) (t = 1.88, d.f. = 7, P = 0.1). Both findings were still evident when only the slopes of the responses to the ambiguous tones were analysed (latencies: t = −2.42, d.f. = 7, P < 0.05; proportions, t = 1.92, d.f. = 7, P = 0.09).

Overall, rats in unpredictable housing were slower to respond and tended to show fewer responses to ambiguous tones close to the positive tone and to this tone itself. The treatment groups did not differ (P > 0.2) in tests of feeding motivation (consumption speed of freely available food pellets10), anhedonia (amount of sucrose solution consumed22), activity (hole-board test), body-weight change across the test period, and response accuracy to training tones before and after the imposition of housing changes, indicating that none of these factors was likely to account for our findings.

By using ambiguous stimuli to probe animals’ relative anticipation of positive and negative events, we have shown that rats in unpredictable housing show behaviour indicating reduced anticipation of a positive event. This compares with findings for depressed or anxious humans, who also have reduced expectation of positive events14 and interpret ambiguous stimuli negatively15.

Our results call for further investigation of the underlying processes involved10,11. We find no evidence of enhanced anticipation of the negative event. This may be due to a floor effect and could be revealed using, for example, lever-pressing and nose-poking as counterbalanced positive and negative responses. It is possible that our technique could be adapted to detect an enhanced expectation of positive events — a correlate of ‘happy mood in humans’. Being able to assess positive as well as negative affect in animals is an important objective for animal welfare11.

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Animal behaviour

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