



Automated Thermal and Motoric Operant Task Differentiates Between Inflammatory and Neuropathic Animals

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INTRODUCTION

We explore two new automated methods to quantify the impact of pain on the overall behavior of the organism. Most current methods for assessing pain in animals are based on reflexive measures and require interaction between the observer and the animal. We test the hypothesis that different models of pain (inflammatory or neuropathic) can be differentiated based on performance on these devices. Both methods take advantage of the animal's natural preference for a dark environment.

METHODS

We used a box divided into two compartments: dark and bright. The apparatus was a clear plastic box with half painted black. Both compartments were equipped with an infrared sensor to detect the entry of the animal.

In the motoric operant task (angle track), one end of the box was raised so that the animal had to climb uphill to go from the light to dark compartment.

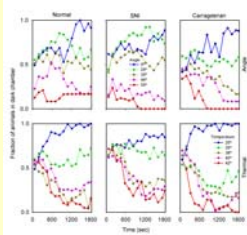
In the thermal operant task (thermal track), the floor of the dark compartment was heated to a given temperature, while the light compartment remained at 25 °C.

Three groups of rats: 1) normal, 2) neuropathic injury pain (spared nerve injury model), and 3) inflammatory pain (intraplantar injection of carrageenan model).

Rats were individually placed in the light box and their crossing between chambers was monitored automatically for 30 minutes. The angle of the box, or the temperature of the dark compartment, was altered to adjust the amount of challenge to the animal's natural preference.

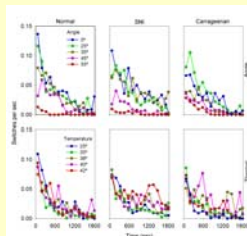
We analyzed the position of the animals with respect to time as well as their rate of switching between compartments.

Fraction of Animals in the Dark



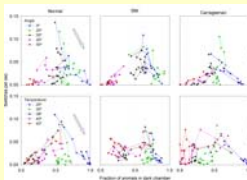
In general, the higher the challenge the less time the rats spend in the dark chamber.

Average Mobility



Rats begin the experiment with high mobility. As time passes, rats in all groups move less frequently.

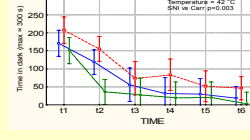
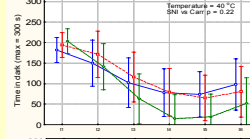
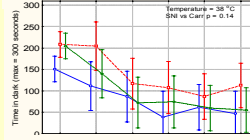
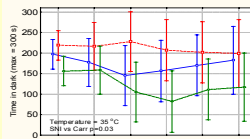
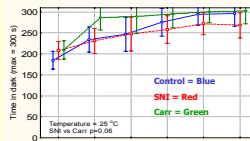
Composite Plot



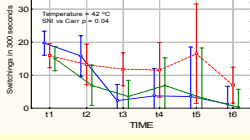
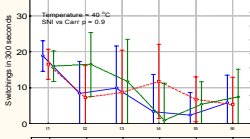
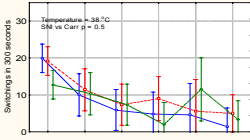
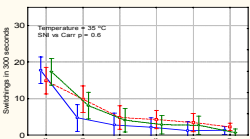
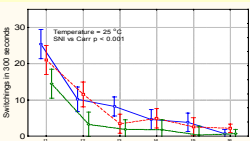
Rat mobility decreases until they settle into a position that is a function of the challenge level. Injured rats show various abnormal patterns.

Behavior on Thermal Track

Time in the Dark



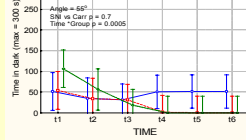
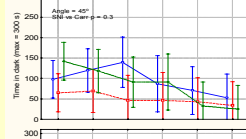
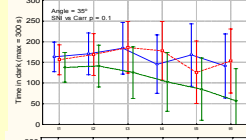
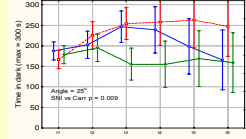
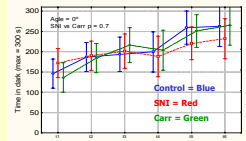
Mobility



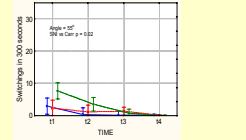
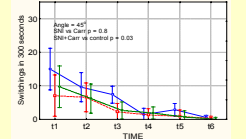
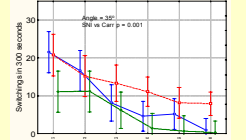
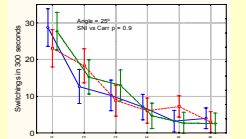
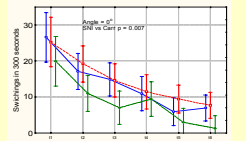
SNI rats spend less time in the dark at 25°C and more time in the dark at 42°C than Carr, and are more mobile at these temperatures than Carr.

Behavior on Angle Track

Time in the Dark



Mobility



At 35° angle, the difference between SNI and Carr rats is most apparent. At this angle, SNI rats spend more time in the dark and are more mobile than Carr.

SUMMARY

The presented results suggest that the Angle Track and Thermal Track may be useful in assessing the global impact of different types of pain on behavior.

Both inflammatory and neuropathic pain reduce the tactile threshold by about 80-90%, yet in many of the Angle Track and Thermal Track results, these pain types produce opposite changes from the behavior of healthy rats.

The results suggest that neuropathic injury pain is less affected by the motor challenge and is less bothered by heat, while inflammatory injury pain shows more aversion to heat and to motoric challenge.

Individual rat pain thresholds for the injured limb did not correlate with that animal's behavior on the Angle Track or Thermal Track tests.