

Variability in rat behavior during exposure to CO₂

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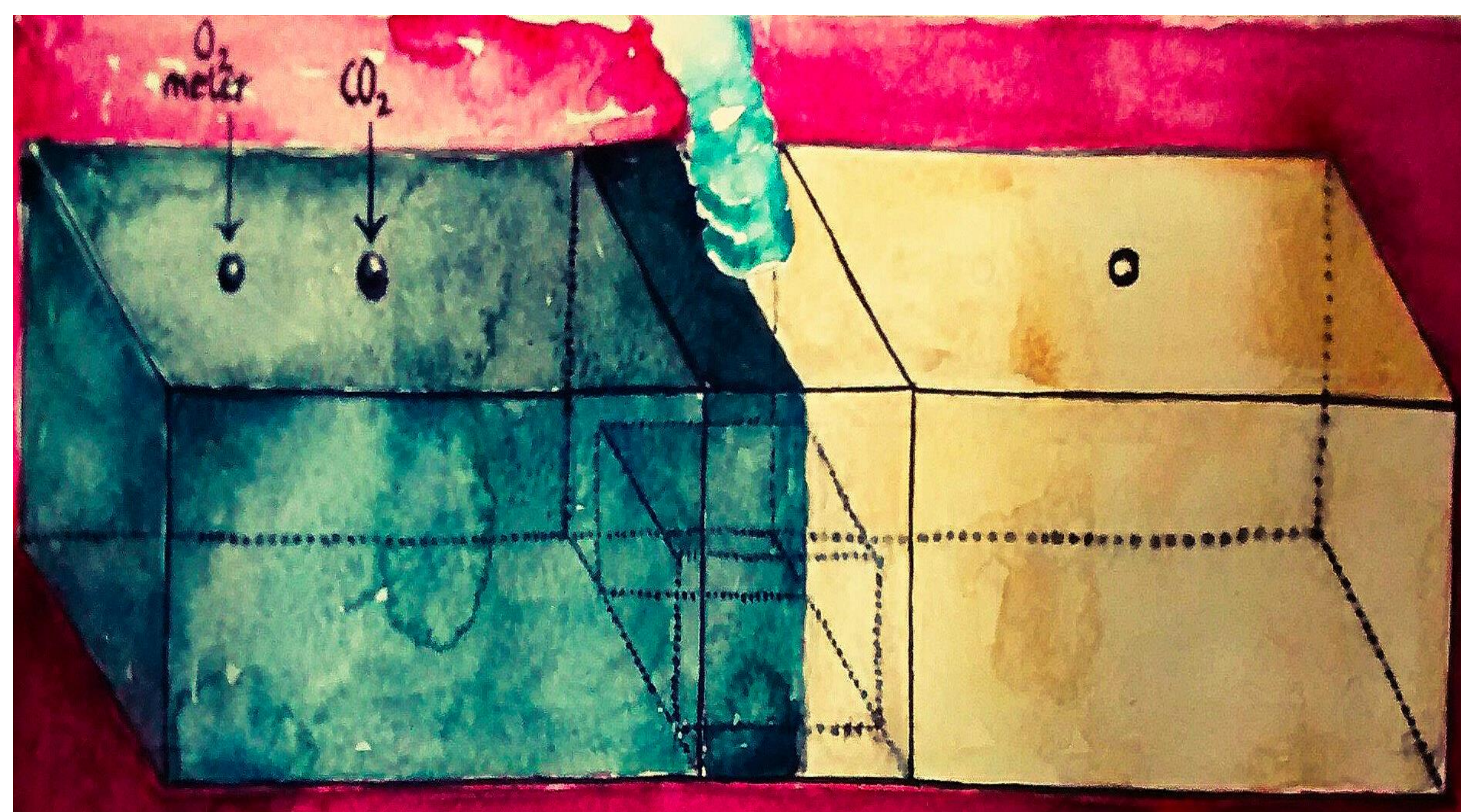
Introduction

Carbon dioxide (CO₂) is commonly used to kill rats. When provided the opportunity to escape (e.g. in aversion testing) all rats choose to avoid CO₂, but the concentration avoided is variable. When rats are unable to escape (i.e. during acute exposure) rats also vary in their behavioral response. These results suggest that rats, like humans, may vary in their sensitivity to CO₂. **The aim of this study was to assess if these differences are consistent within rats, and if the responses during forced exposure relate to those during aversion testing.**

Methods

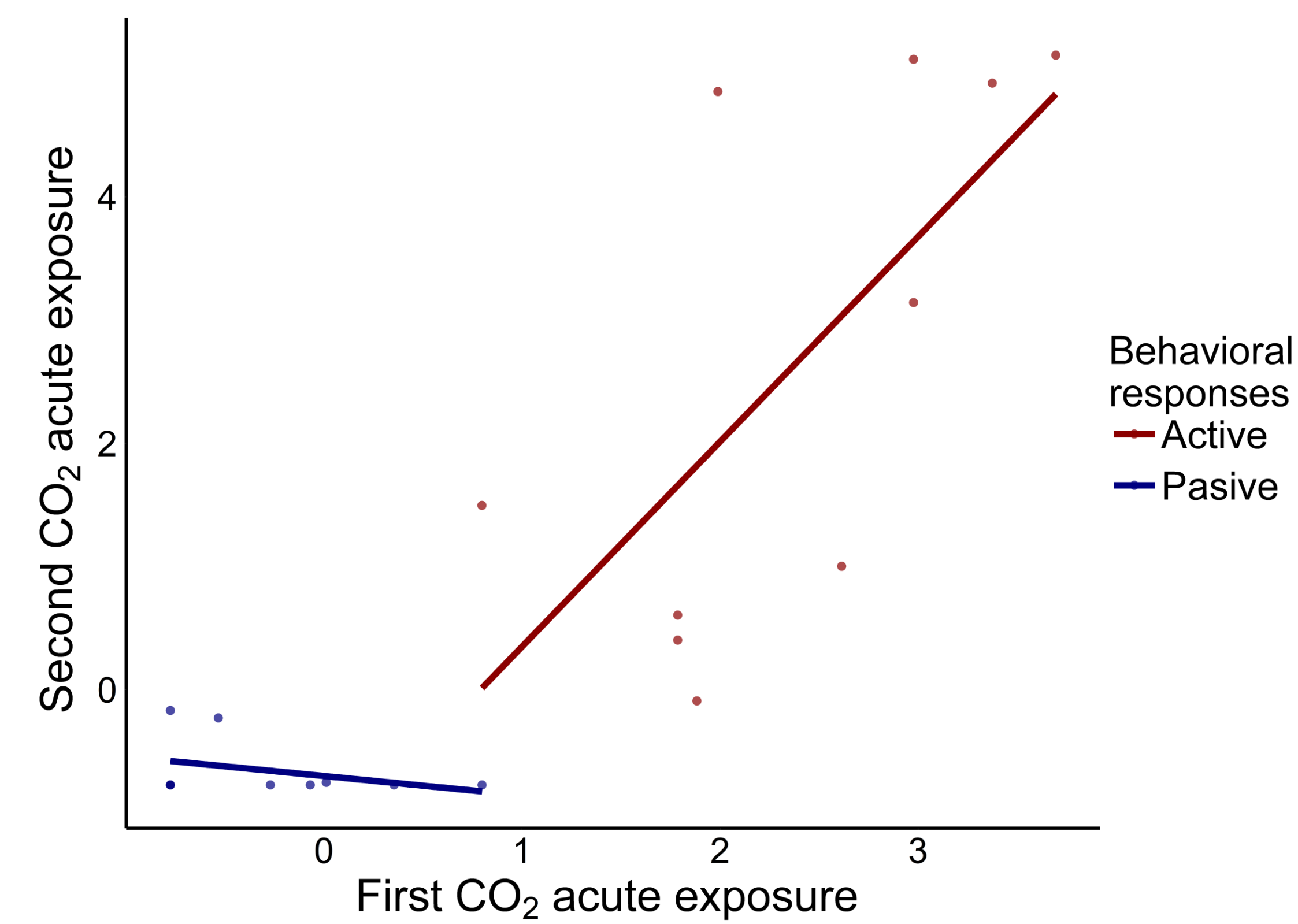


During acute exposure tests rats were exposed twice to CO₂ gradual fill (18% volume min⁻¹). Active responses consisted of rearing, locomotion, and escape attempts frequencies. The passive response was time immobile (i.e. freezing time). All responses were standardized as z-scores, and these values were added together to provide sum score in the case of the active responses.

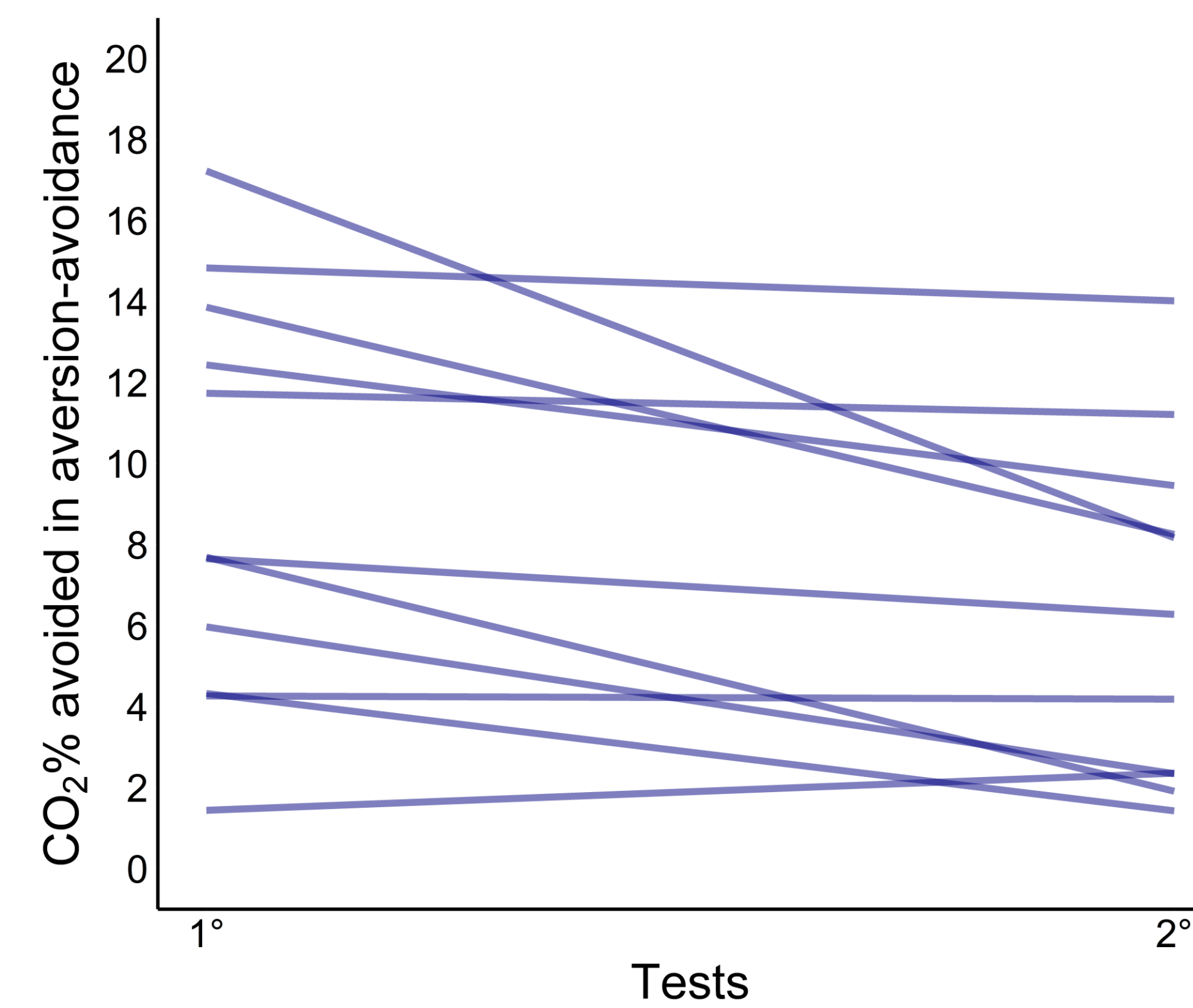


Rats were tested twice in the aversion-avoidance test, assessing motivation to avoid CO₂ gradual fill (18% volume min⁻¹) in a preferred dark chamber versus escaping to a bright chamber (1650 lux). The CO₂ concentration at which rats left the dark chamber was recorded.

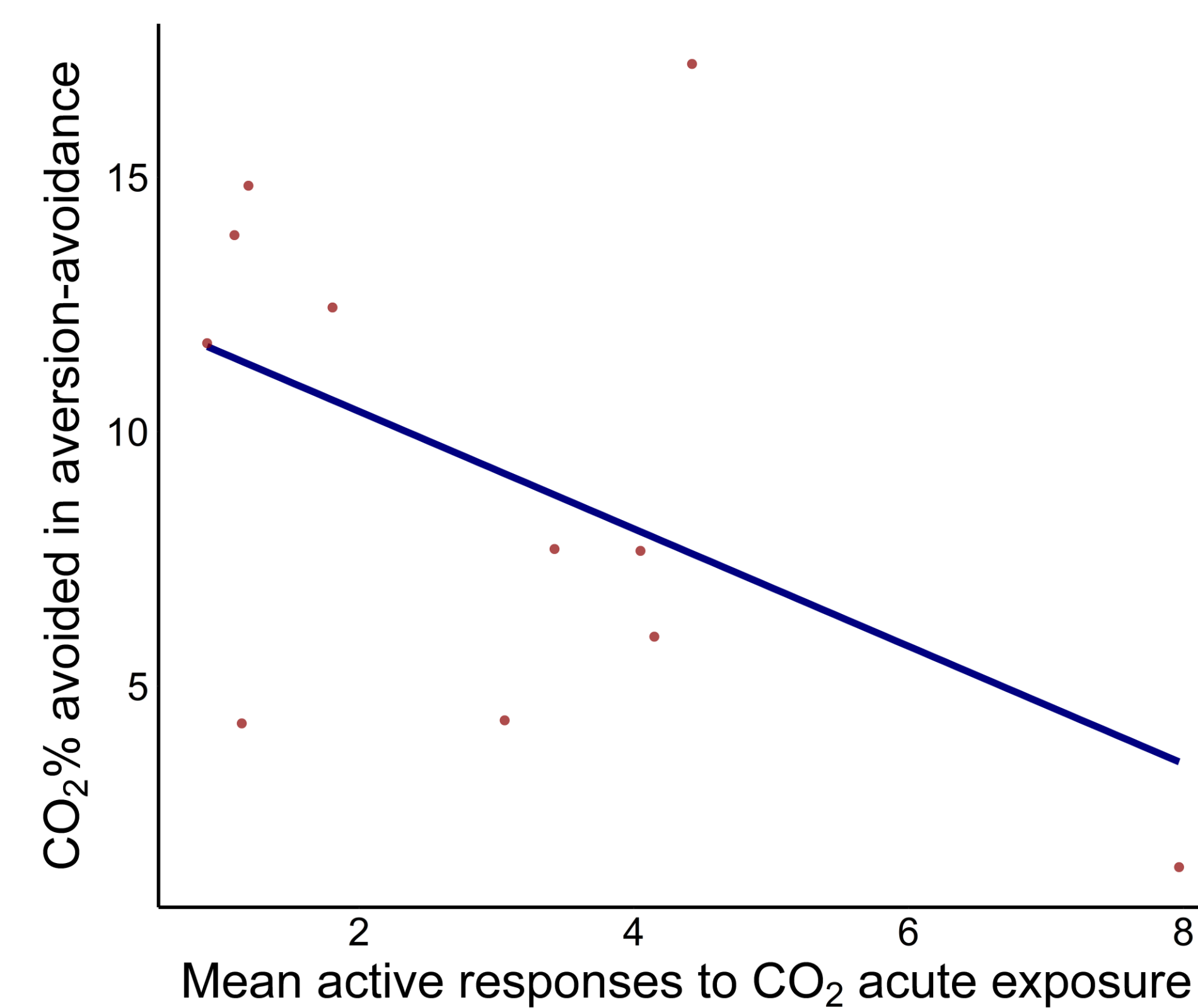
Results



Active responses were highly consistent within rat ($n=11$) between the first and second exposure to CO₂ ($r = 0.84, p < 0.01$). Passive responses were not consistent between exposures ($r = -0.38, p = 0.26$).



Rats were highly variable in the CO₂ concentration at which they escaped from the dark to the light chamber, but individual rats were consistent in this response across two tests ($p < 0.01, r = 0.81; n = 11$).



The mean (across the two tests) CO₂ concentration at which rats escaped from the dark to the light chamber was negatively correlated with the mean (again averaged across the two tests) active response during acute exposure ($r = -0.55, p = 0.08; n = 11$).

Conclusion

Active responses during acute exposure and in aversion-avoidance tests were highly variable between rats but consistent within rats. Active responses during forced exposure to CO₂ were related to the strength of aversion in the aversion-avoidance test. We conclude that rats vary in sensitivity to CO₂. Further research is needed to determine if this variability in rats, as in human subjects, is related to differences in the affective responses evoked by CO₂ (e.g. anxiety, dyspnea).