

Sexually dimorphic symptoms of happiness: using rat tickling to investigate the biology of positive welfare and resilience.

Vincent Bombail^{a*}, Salvatore Galgano^{a*}, Sarah Brown^{b*}, Jos Houdijk^a, Alistair Lawrence^{ab}

a: Scotland's Rural College (SRUC), Edinburgh, EH9 3RG, UK

b: The Roslin Institute and Royal (Dick) School of Veterinary Studies, University of Edinburgh, Edinburgh, EH25 9RG, UK

*: These authors contributed equally to this work.

1. RAT TICKLING (PLAYFUL HANDLING) LEADS TO POSITIVE AFFECTIVE STATES

- Juvenile rats (*Rattus Norvegicus*) enjoy heterospecific play (rat tickling; **Fig 1**) and produce UltraSonic Vocalisations (USV) as markers of positive affect
- We have reported (**Fig 2**) all rats enjoyed various forms of tickling (with 0, 1 or 4 pins), yet females prefer forms of play (P1) involving less pinning (n=16/treatment, N=128)

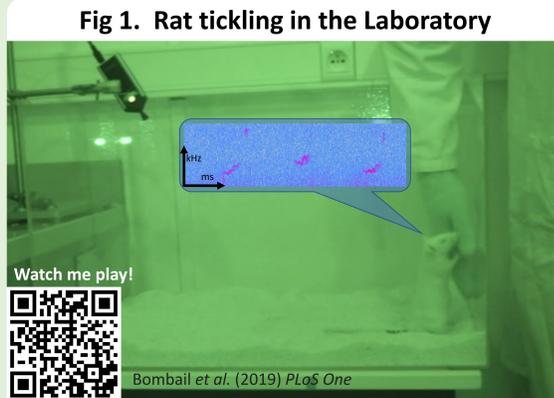
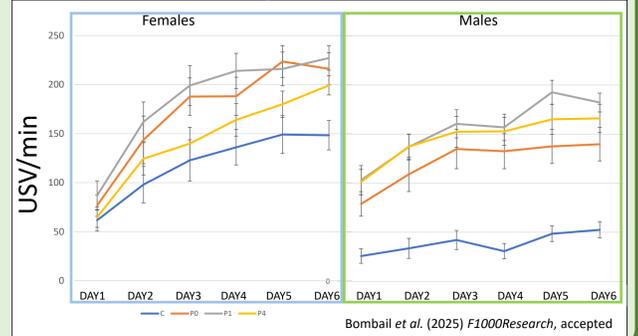


Fig 2. Sexually dimorphic enjoyment of rat tickling protocols



We used the rat tickling model to investigate physiological correlates of positive affective states

2. RAT TICKLING DID NOT IMPACT ANXIETY-LIKE BEHAVIOUR

- After 6 days of treatment, rats were tested on Elevated Plus Maze (EPM) and Open Field (OF) tests
- EPM/OF tests constitute mild stressors

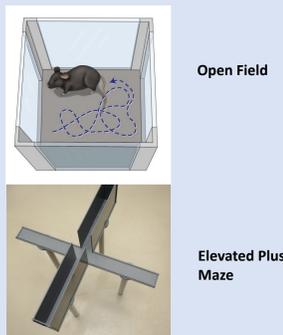
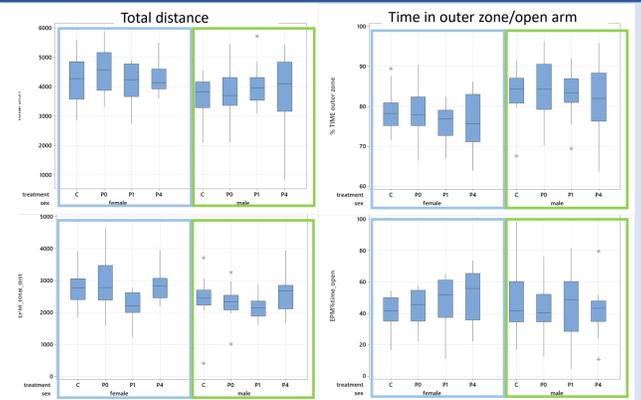
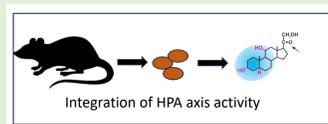
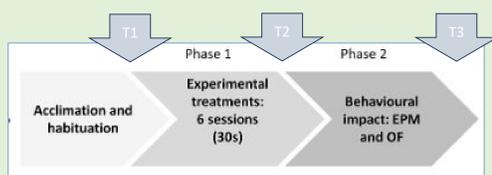


Fig 3. behavioural markers of anxiety



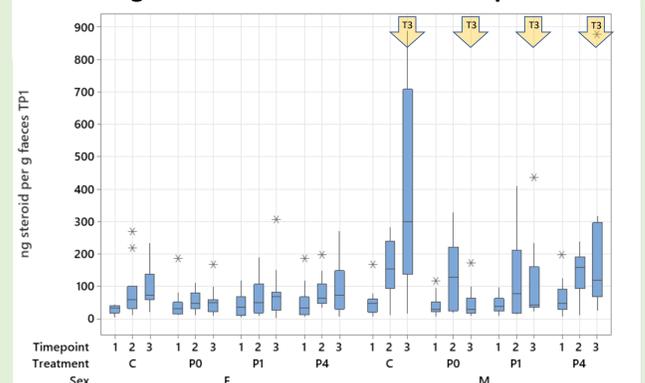
3. FOLLOWING MILD STRESS, REDUCTION IN FECAL CORTICOSTERONE METABOLITES (FCM) IN MALES ONLY

- Feces collected pre- (T1) and post (T2)-tickling, and after the EPM/OF tests (T3); 5 α -Pregnane-3 β ,11 β ,21-triol-20-one was assayed
- Tickling (6 days) did not affect FCM (note: sex differences in HPA axis)
- Rat tickling reduced FCM following a mild stress in males (at T3)



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Fig 4. FCM measures in fecal samples



4. RAT TICKLING AFFECTED CAECAL MICROBIOTA IN FEMALES ONLY

- From caecal DNA: sequenced the V4 region of the 16S rRNA gene
- No significant impact of treatment on richness and diversity (Fig. 5)
- However *Turicibacter* spp. increased in females, in the most enjoyable treatments only, with fewer pins during tickling (Fig. 6.)

Fig 6. Relative abundance of *Turicibacter* spp.

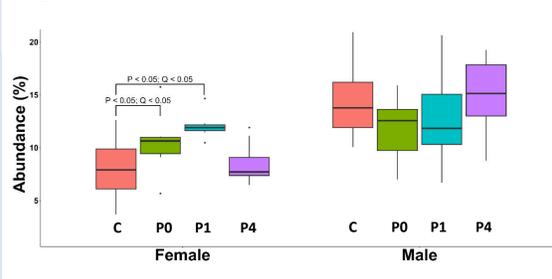
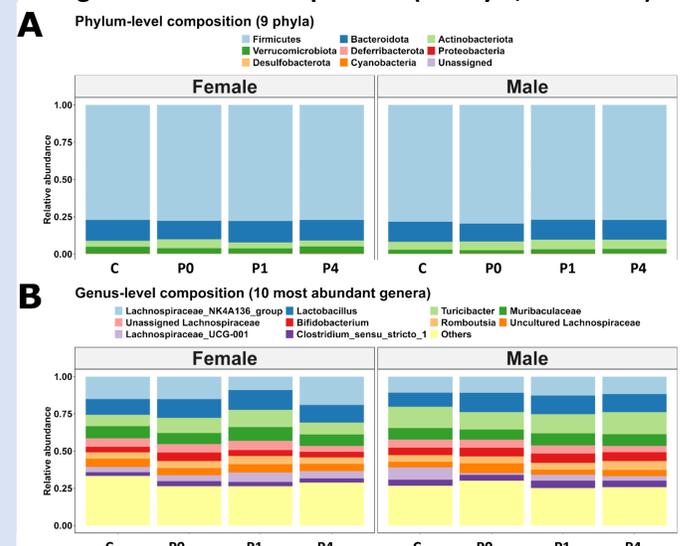


Fig 5. Microbiota composition (A: Phyla, B: Genera)



5. RAT TICKLING AFFECTS MALES AND FEMALES DIFFERENTLY: IMPLICATIONS FOR WELFARE PHYSIOLOGY

- Sex difference in physiology must be taken into account to investigate how positive experiences shape the physiological-microbial axis, with a view to improving welfare and resilience to challenges.
- Future research will aim to unravel the relationship and balance between positive and negative affective states
- Is happiness just a little less sadness?



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