

OPPORTUNITIES OFFERED BY RECORDING ULTRASONIC VOCALISATIONS (USV) TO INVESTIGATE THE BEHAVIOUR OF LABORATORY RATS

Vincent Bombail * [1], Sarah M. Brown [2], Tayla J. Hammond [1,2], Gaele Champeil-Potokar [3], Olivier Rampin [3], Isabelle Denis [3], Nicolas Darcel [3], Birte L. Nielsen [4], Alistair B. Lawrence [1,2]

[1] Animal and Veterinary Sciences Department, Scotland's Rural College (SRUC), Edinburgh, UK. [2] Roslin Institute, University of Edinburgh, UK. [3] INRAE PNCA Unit/AgroParisTech, Université Paris-Saclay, France. [4] Universities Federation for Animal Welfare, Wheathampstead, UK. *: vincent.bombail@sruc.ac.uk

1. INTRODUCTION

- Rats (*Rattus Norvegicus*) use USV to communicate emotional information, in response to social and nonsocial cues
- Emotions and cognition are linked; **recording USV is a cheap and informative window into the mind of laboratory rats**

2. RECORDING USV IS SIMPLE

- Recordings with ultrasonic microphone (sensitivity range: 10–160 kHz; M500–384, *Pettersson Elektronik, Sweden*) are analysed using Audacity, a free sound-recording programme (www.audacityteam.org)
- Spectrogramme-based analysis: total USV production or USV type can be analysed manually or with AI
- Examples: USV in response to rat tickling/playful handling (**Fig. 1**) or during an experimental meal (**Fig. 2**)
- At least 15 USV types have been described (**Fig. 3**). Rats 22kHz USV when experiencing distress, and 30-100kHz USV (50kHz) upon experiencing positive emotional states

Figure 1. Playful Handling in the Laboratory

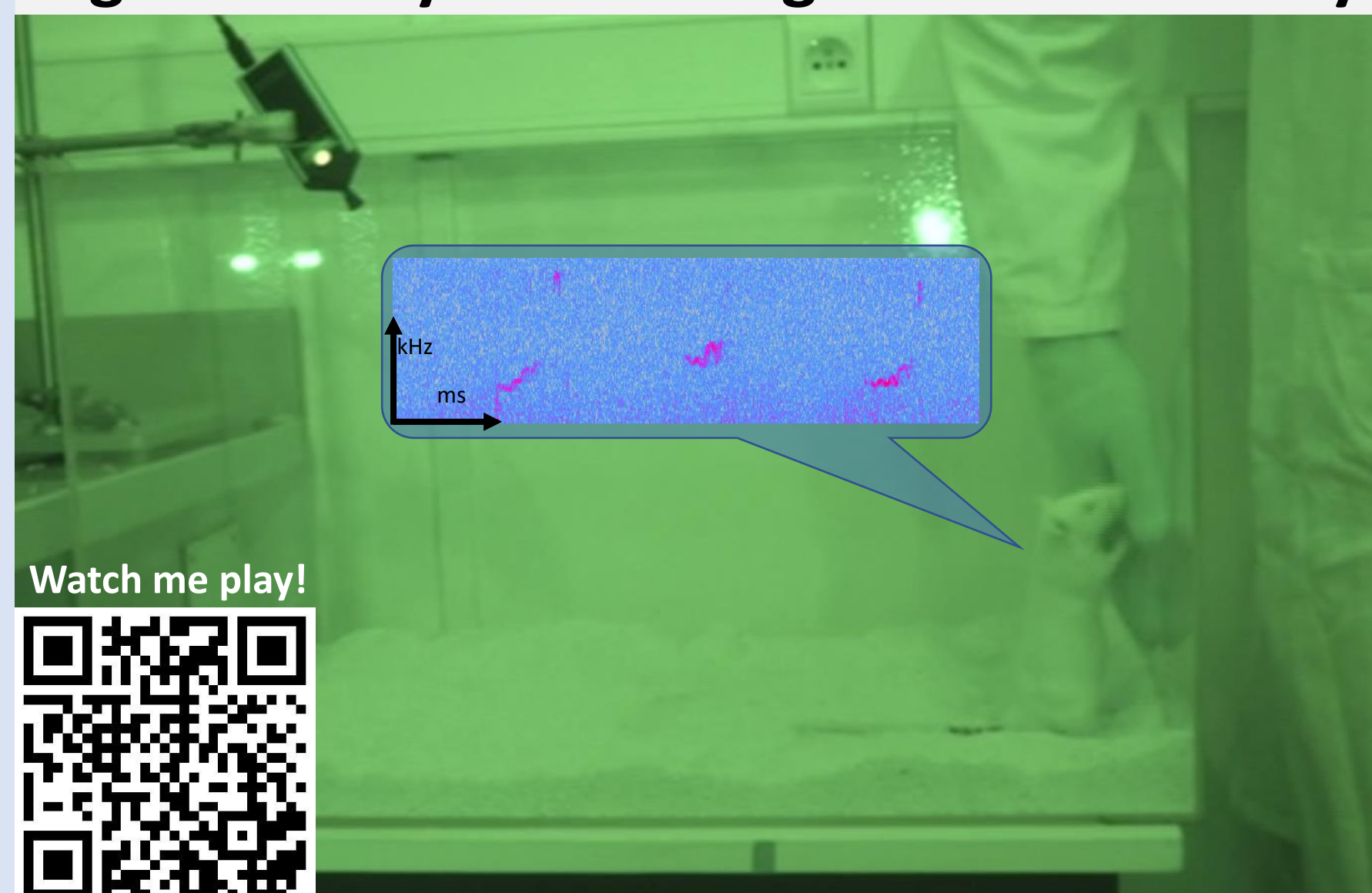


Figure 2. Response to an Experimental Meal

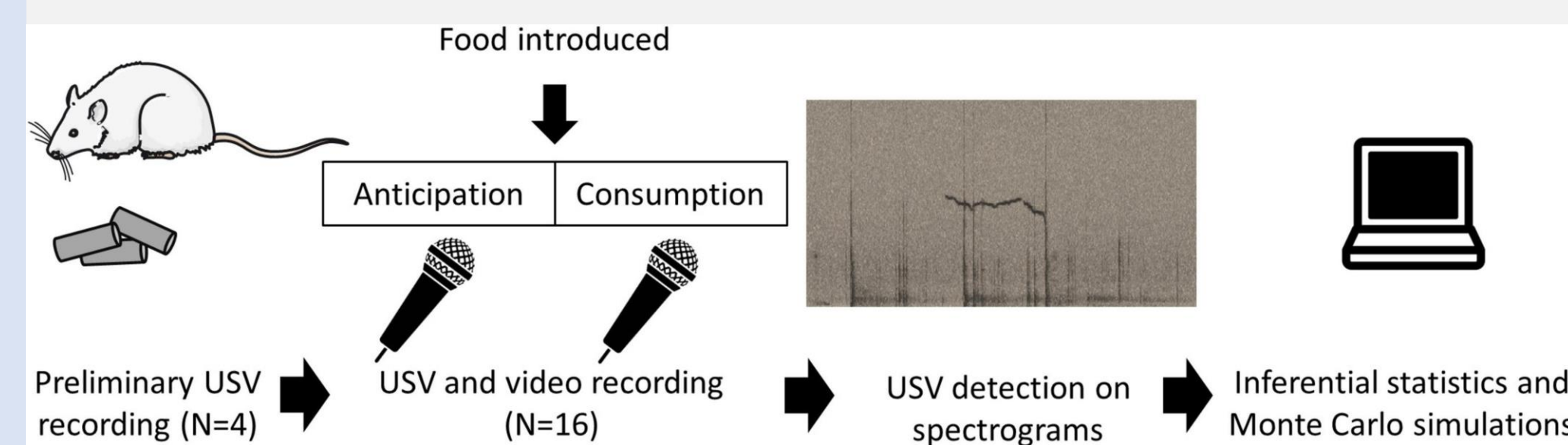
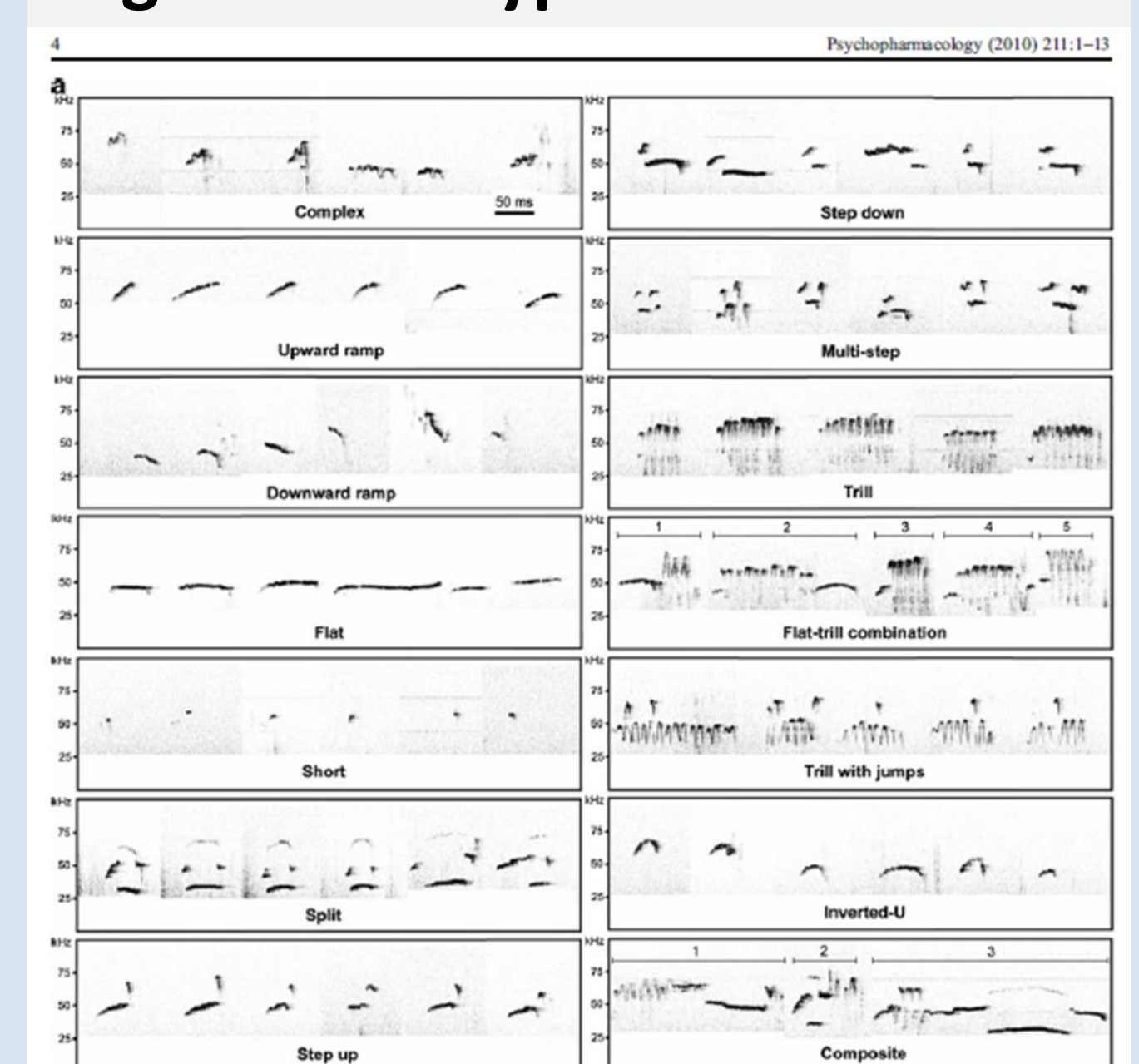


Figure 3. 14 types of 50kHz USV



Wright JM, et al. *Psychopharmacology (Berl)*. 2010;211(1):1–13

3A. APPLICATION 1: CONDITIONING OF POSITIVE AFFECTIVE STATES

- Rats enjoyed heterospecific play in presence of odours A and B (50kHz USV increased) (**Fig. 4**)
- USV production increased upon presentation of conditioned (A or B) odour (**Fig. 5**)
- Rats learnt to associate an odour with being tickled

Figure 4

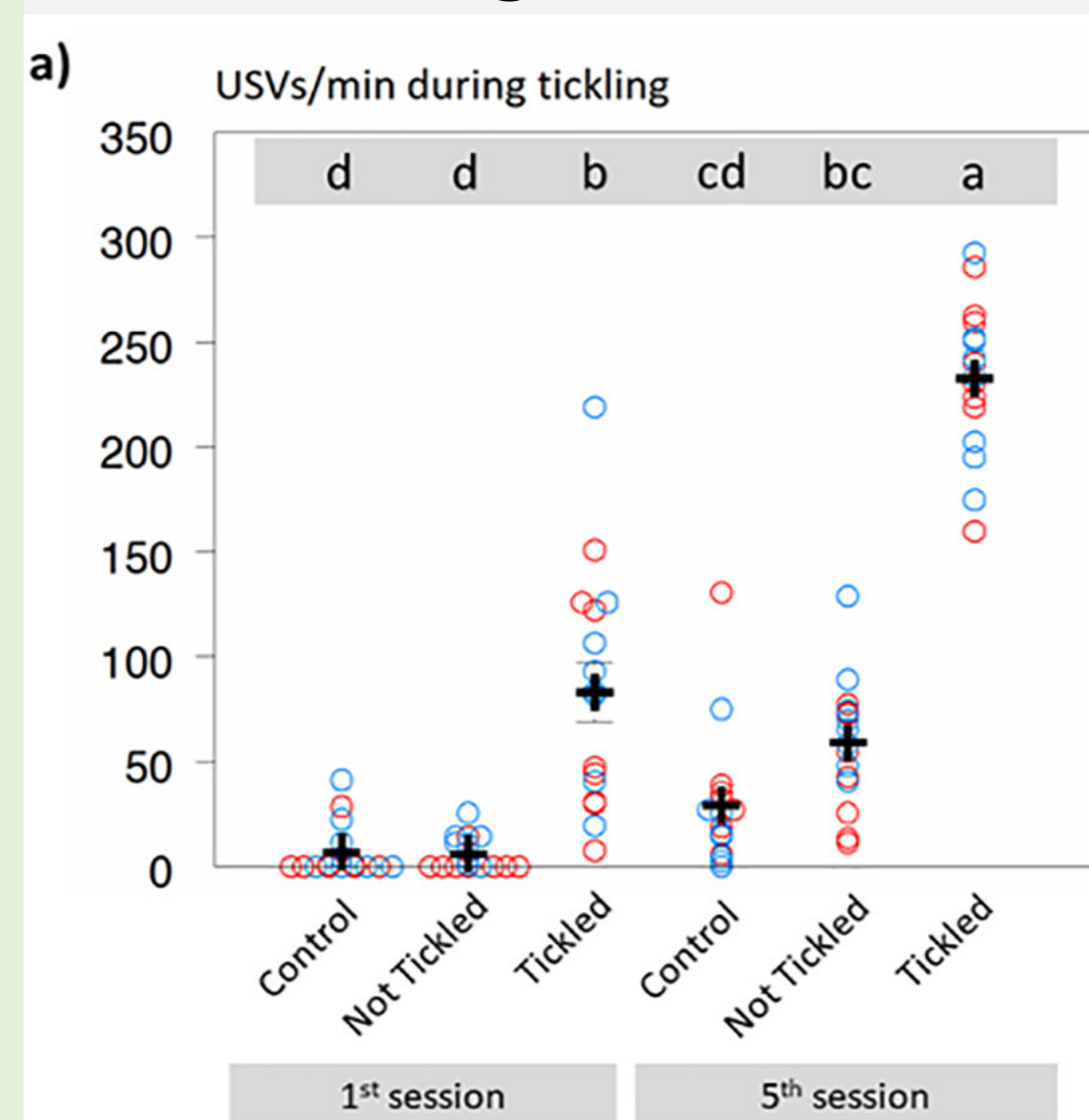
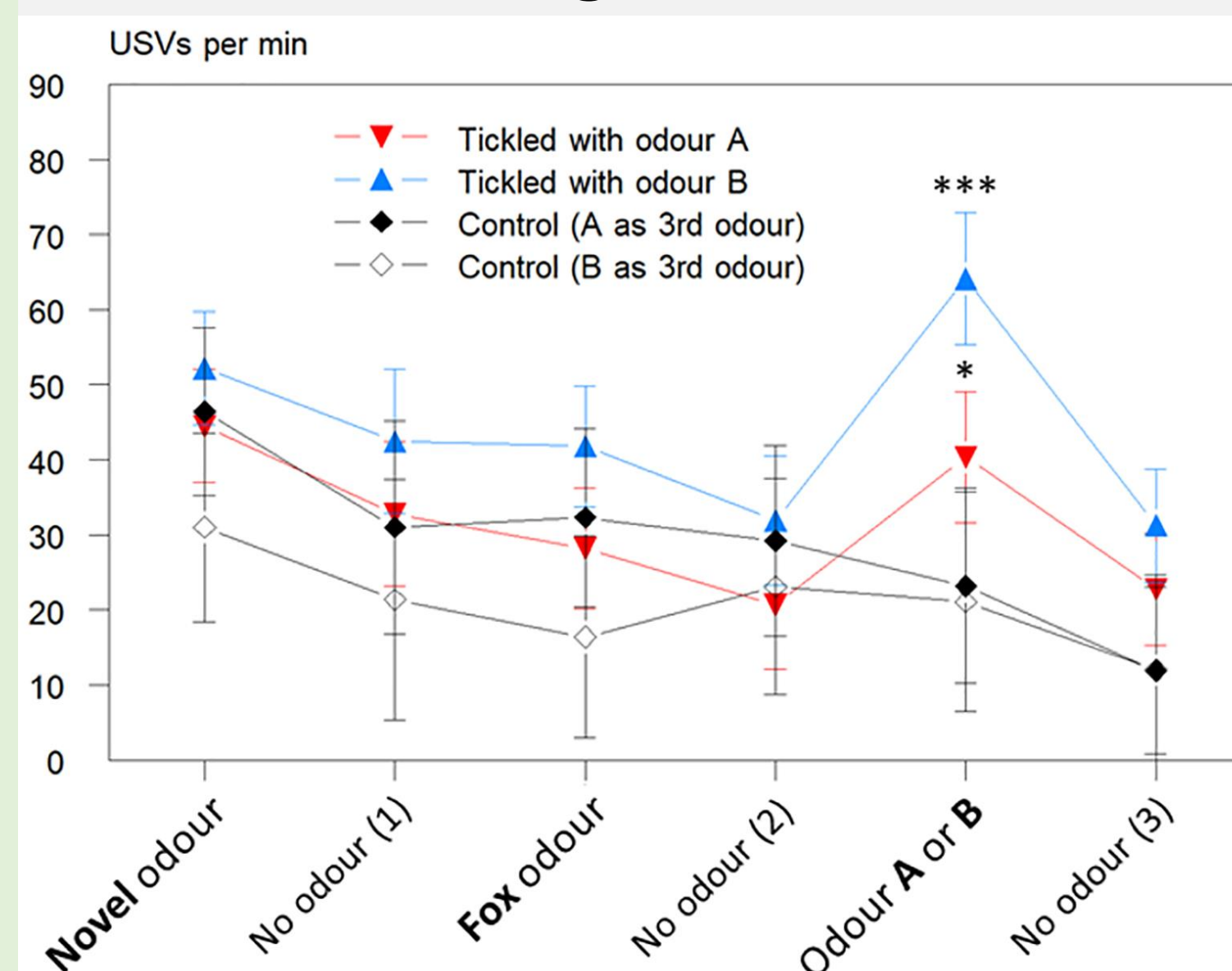


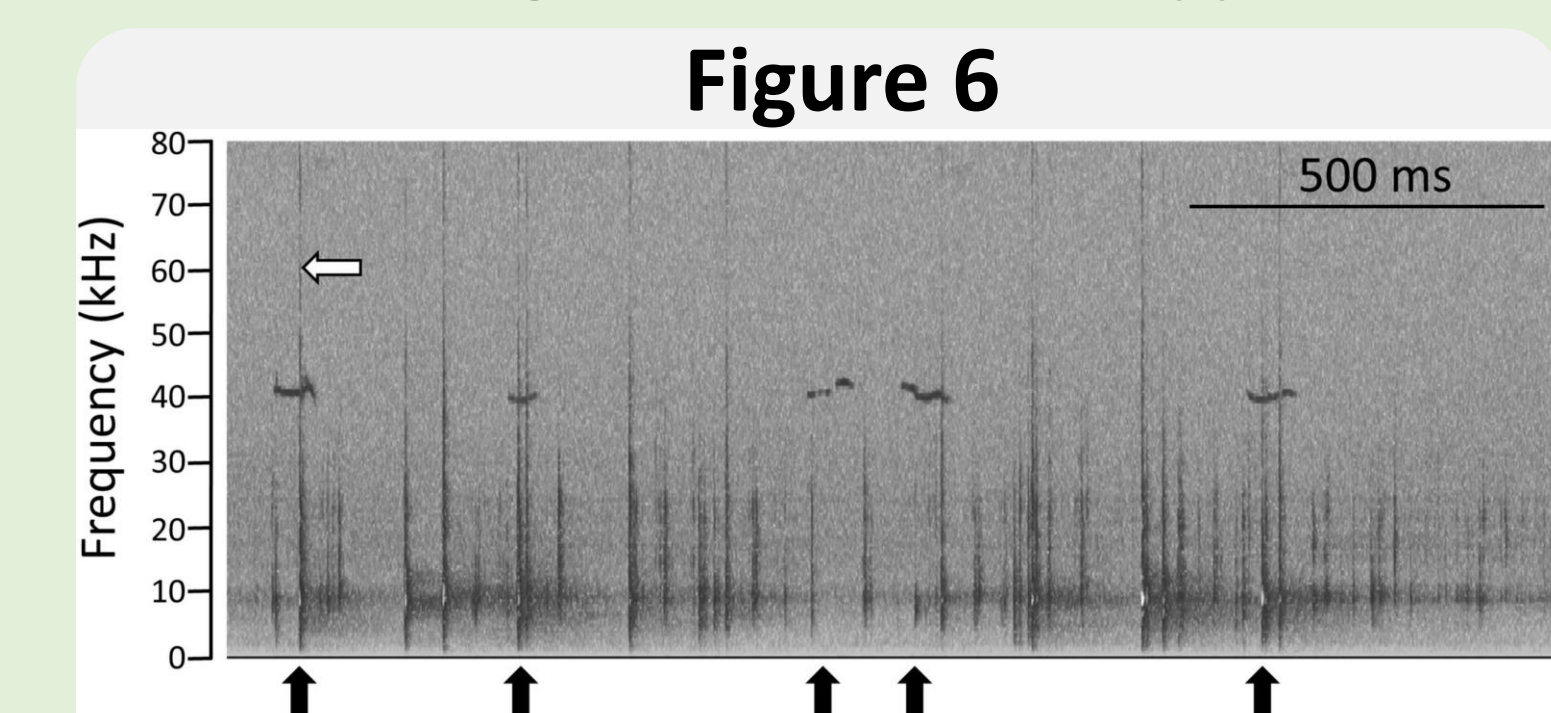
Figure 5



Bombail V, et al. *PLoS One*. 2019;14(6):e0212829

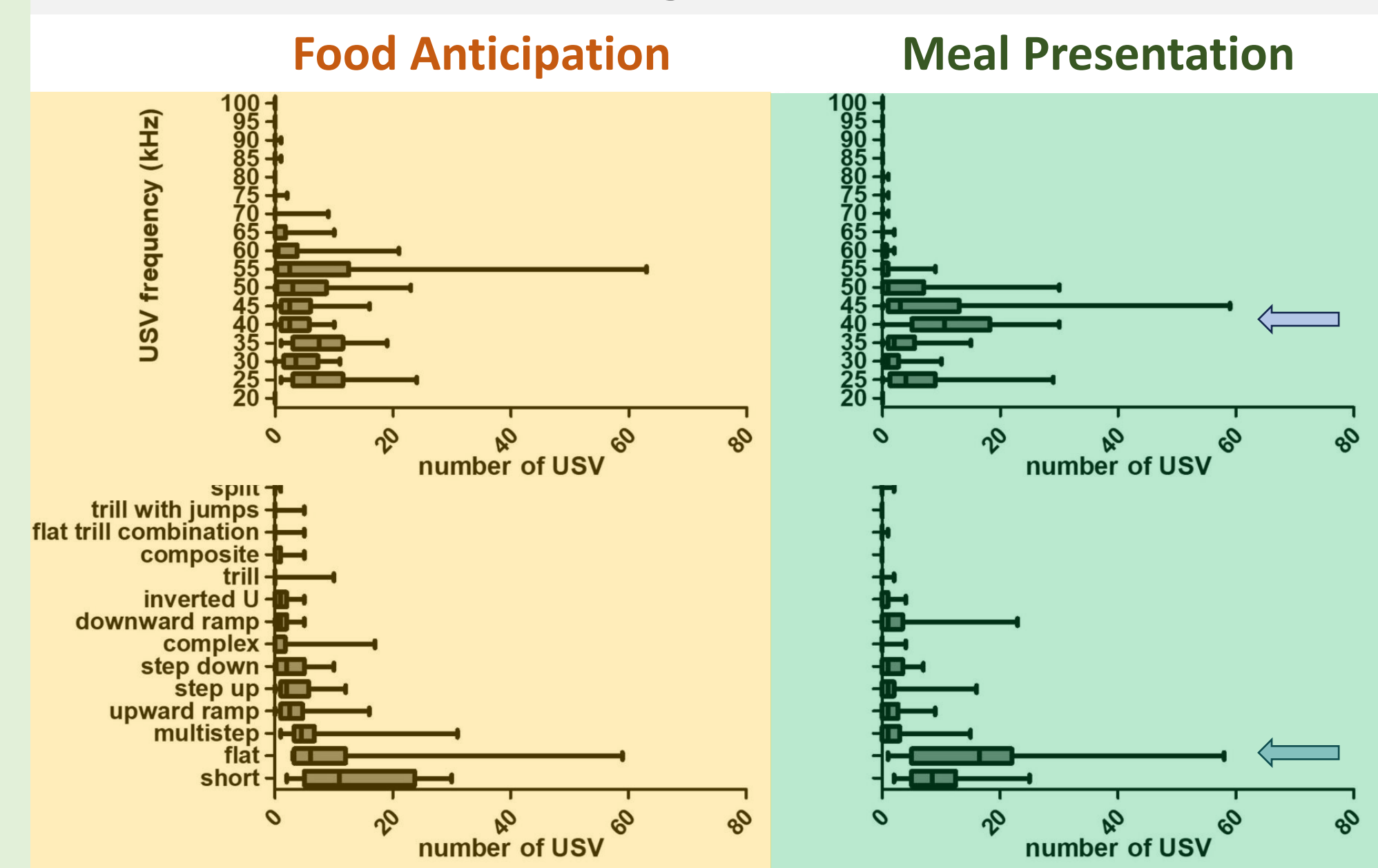
3B. APPLICATION 2: RATS CHIRP WITH THEIR MOUTH FULL

- We identified a feeding-related USV type (flat, 40kHz) (**Fig. 6**)



- Meal presentation** not associated with changes in total USV production, but changes in the **types of USV produced**, relative to control (food anticipation) (**Fig. 7**)

Figure 7



Champeil-Potokar G, et al. *Front Behav Neurosci*. 2023;17:1089631

4. IN CONCLUSION: OPPORTUNITIES AND CHALLENGES

- Recording rat USV is a **promising, non-invasive tool** to investigate responses to stimuli, and enrich the study of cognition
- Further work on USV significance should be **informed by studying behavioural correlates of vocalisation production**
- We are organising a **NC3R-funded workshop** in **March 2024** about recording USV in lab animals, *USV for the people (and for the rodents)*, please email vincent.bombail@sruc.ac.uk for more information