Variation in fear responses, how does that work?

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Introduction

Animals can display a wide range of fear responses, which can change with experience[1,2]. Variation in fear responses can be linked to differences in personality and physiology[3]. Yet, how these factors relate to each other remains unclear[4, 5, 6].

Objectives

- Investigate links between personality and fear responses.
- Explore the role of octopamine on personality and fear responses.

Methods

*Fig 1. Mediterranean Field crickets (*Gryllus bimaculatus).

Ninety-six adult male Mediterranean Field crickets (Fig. 1) were subject to behavioural tests for boldness, activity, and variation in fear responses (assessed by inducing immobility for ten consecutive times). To determine the effect of octopamine, I manipulated its concentration by injecting 1.5 µg of Octopamine-hydrochloride diluted into 10 µl of phosphate-buffered saline. Control crickets were injected with only phosphate-buffered saline.

Results & Discussion

- Variation in the initial fear responses observed in control crickets was linked to boldness: bolder individuals remained immobile longer than shyer individuals after the first simulated attack (Wilcoxon test, $P = 0.04$).
- Variation in the initial fear responses was not affected by manipulated levels of octopamine, differently from what previous studies showed[4].
- Octopamine increased immobility over ten consecutively simulated attacks in bolder individuals, resulting in crickets becoming sensitized to the stimulus (Regression model, $P_{\text{BOLDER INDIVIDUALS}} < 0.01$, Fig. 2).

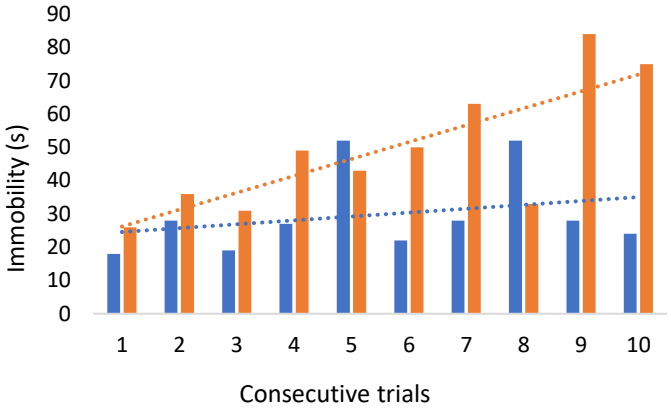

Fig. 2. Behavioural responses to ten consecutively simulated attacks in bolder individuals injected with phosphate-buffered saline (blue), or with octopamine (orange). Values are presented as medians.

Conclusion

Octopamine played a role in the variation of fear responses, with a link to boldness, inducing the process of short-term sensitization, previously connected only to serotonin[7,8]. These results suggest that octopamine can influence an individual's survival rate to predator attacks, with high levels enhancing the fear responses.

References

[1] Boissy, 1995. Fear and Fearfulness in Animals. *The Quarterly Review of Biology*, *70*(2), 165–191. [2] Steimer (2002). The biology of fear- and anxiety-related behaviors. *Dialogues in clinical neuroscience*, *4*(3), 231–249. [3] Engel & Schmale, 1972. Conservation withdrawal: a primary regulatory process for organic homeostasis. *Elsev*; 57–95. [4] Adamo et al., 2013. The behavioural effects of predator-induced stress responses in the cricket (*Gryllus texensis*): the upside of the stress response. *The Journal of experimental biology*, *216*(24), 4608–4614. [5] Jones et al., 2011. Octopamine and serotonin have opposite effects on antipredator behavior in the orb-weaving spider, *Larinioides cornutus*. *Journal of comparative physiology*, *197*(8), 819–825. [6] Nishi et al., 2010. Biogenic amines, caffeine and tonic immobility in *Tribolium castaneum*. *Journal of insect physiology*, *56*(6), 622–628. [7] Brunelly et al., 1976. Synaptic facilitation and behavioral sensitization in Aplysia: possible role of serotonin and cyclic AMP. *Science (New York, N.Y.)*, *194*(4270), 1178–1181. [8] Walters et al., 1983b. Mechanoafferent neurons innervating tail of Aplysia. II. Modulation by sensitizing stimulation. *Journal of neurophysiology*, *50*(6), 1543–1559.