

Personal and public information tradeoff in defensive responses to threat



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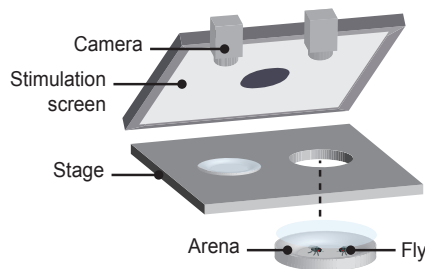
Background

A major benefit of group formation results from the ability of individuals to integrate personal information about the environment with social information to guide their behaviours. Weighing personal and social information is crucial before responding to potential threats, as failure to detect a predator, but also engaging in metabolically costly defense responses in a low threat environment, may impact individual fitness. Flies respond to an inescapable, repetitive, looming stimulus that mimics an object on a collision course with freezing (Zacarias et al, 2018). In groups, beyond the available personal information about threats, flies rely on social information in the form of motion cues, which are indicative of both danger and safety, being more likely to freeze if others are also freezing, and more likely to resume movement when others are moving (Ferreira & Moita, 2020). We hypothesized that the weight of personal information is stronger if the available personal information is more ambiguous.

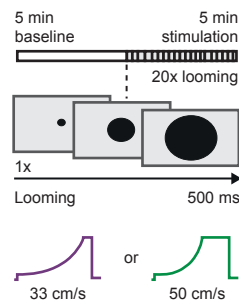
Questions

1. Do flies rely more on motion cues from others to infer safety/danger when exposed to more ambiguous inescapable looming stimuli?
2. How does changing the social cues impact flies' responses to looming stimuli with varying ambiguity?

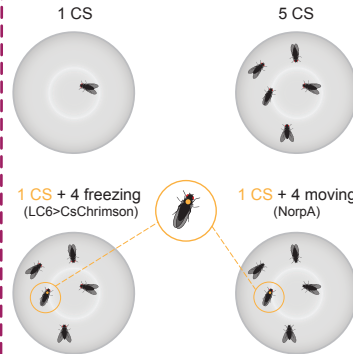
Set-up



Protocols



Conditions

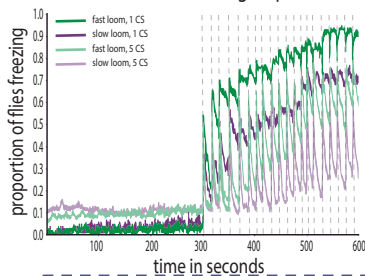


Analysis

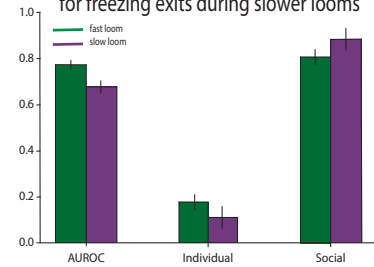
1. IdTracker (Perez-Escudero et al., 2014) for (x,y) per individual
2. Fly motion quantifier (Champalimaud Software Platform) for pixel change

Individual flies versus groups of 5

Flies freeze more to fast looms, both alone and in groups

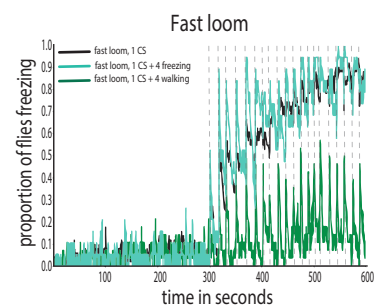
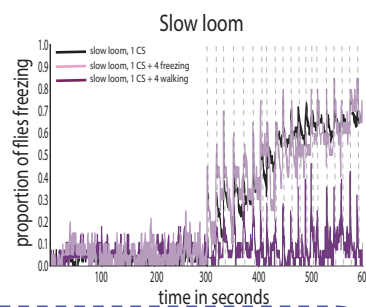


Model shows that social cues are more important for freezing exits during slower looms

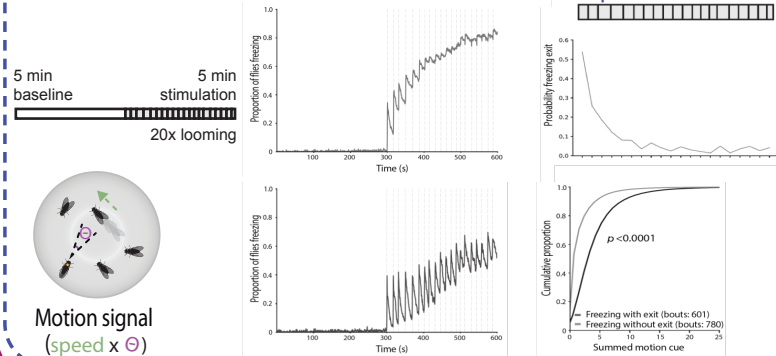


Results

Flies surrounded by walking versus freezing flies



Model explanation



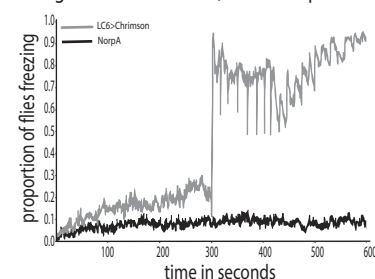
- Individual flies break from freezing with decreasing probability after multiple looms.

- Flies in groups are continuously exposed to motion cues and freeze less than individuals.

- Amount of motion cues contributes to probability of breaking from freezing in groups

- Model calculates the contribution of individual and social cues that lead to flies breaking from freezing

Freezing of the surrounding flies: high in LC6>Chrimson, low in NorpA



Conclusion and future directions

Conclusion:

- Flies respond stronger to a faster loom, indicating they perceive it as a less ambiguous threat
- Flies surrounded by other flies that freeze upon looming stimuli respond with more freezing, while flies surrounded by walking conspecifics freeze less to both slow and fast looms.
- Flies can use both safety and danger cues from their social environment

Future directions:

- Further examine how threat ambiguity influences the use of social danger cues.
- Manipulate group structure with different numbers of flies freezing/moving for both loom

References and Acknowledgements

References:

Zacarias, Namiki, Card, Vasconcelos, and Moita; *Speed dependent descending control of freezing behaviour in Drosophila melanogaster*, Nature Communications, 2018.
Ferreira and Moita, *Behavioural and neuronal underpinnings of safety in numbers in fruit flies*, Nature Communications, 2020.

Acknowledgements:

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