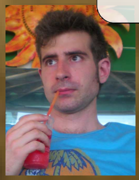
Speed and accuracy in nestmate recognition: an hover wasp prioritises face recognition over colony odour cues to minimise intrusion by outsiders



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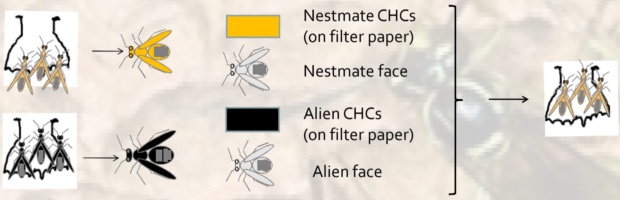
INTRODUCTION

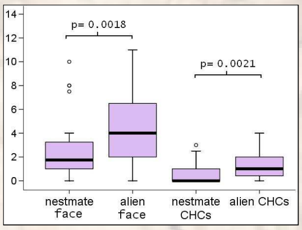
Social insects have evolved highly developed recognition systems enabling them to accept nestmates but reject alien conspecifics [1]. Chemical communication plays a crucial role in this ability [1]. Recently it was discovered that visual quality signals and individual recognition also play a role in some species of social wasps[2-4]. In the primitively eusocial social wasp *Liostenogaster flavolineata* (Vespidae: Stenogastrinae), individuals differ in their cuticular hydrocarbon profiles according to colony membership and each female also possesses a unique facial pattern. Since both chemical and visual channels mediate the recognition abilities in these wasps, this species represents a unique model to understand how vision and olfaction are integrated and the extent to which wasps prioritize one channel over the other to discriminate aliens and nestmates.

AIM

We quantified the relative importance of visual and chemical channels in recognising conspecifics when visual and chemical cues are presented alone or combined. We explored the speed and the accuracy of visual and chemical nestmate recognition and we explored how wasps integrate these sensory modalities to minimise the risk of colony intrusion by outsiders.

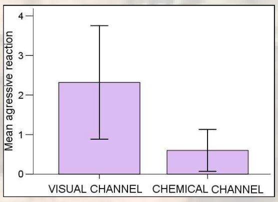
First assay

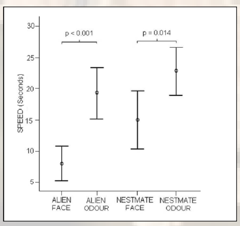




N of bites directed by resident females toward nestmate and alien visual stimuli (wasp deprived of CHCs) and nestmate and alien chemical stimuli (CHCs), (Friedman test, $\chi2=31.83$, df=3, p<0.001, n=30 colonies)

Quantifying the relative importance of visual and chemical channel, we found that the information about "alien status" is better conveyed by the visual cue than by the chemical one (paired t-test: t =2.37, n=30, p=0.027.

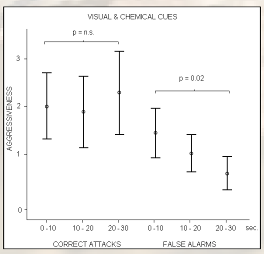




Speed of recognition:
The visual mode allowed faster responses than the chemical one either toward intruders (t-test: t=4.9, df=29, n=30, p<0.001) and nestmates (t=-2.6, df=29, n=30, p=0.014).

Accuracy of recognition:
Facial cues alone induced more false alarms (46% of cases) than chemical cues alone ($\chi2=7.96$, n=30, p<0.01). Odour cues alone resulted in more erroneus acceptances (66% of cases) than visual cues alone ($\chi2=13.78$, df=1, n=30, p<0.001).

When wasps could rely on both cues false alarms significantly decrease suggesting that odours might have a role in fine-tuning the recognition process.

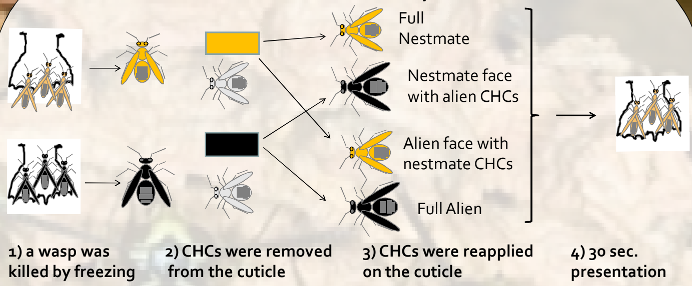


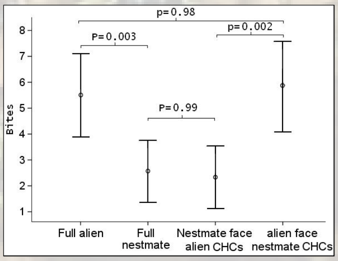
Trade off:
Overall, colonies responding faster to intruders did not commit an increased number of mistakes, suggesting that there is no speed-accuracy tradeoff in nestmate recognition (Spearman test: visual cues: ρ=0.12, n=60, p=0.82; chemical cues: ρ=-0,26, n=60, p=0.11; both cues together: ρ=0.073, n=60, P=0.59).

METHODS

The experiments were carried out in the field on one nest cluster (Malaysia). Overall, 50 colonies with a total of 233 females (mean 4.6 1 females per colony) were studied. In behavioural assays, the stimuli (see below) were presented to the resident females helding the lure 1 cm away from the nest for 30 sec.

Second assay





When resident females were allowed to use both stimuli to evaluate the lures, chemical cues were no longer considered to discriminate between alien and nestmate females (one way Anova, F=7.18, df=3, n=20, p<0.001).

Full alien females and crossed lures displaying an alien face lure and a nestmate odour triggered the same aggressiveness. Similarly full nestmate females and crossed lures displaying a nestmate face and an alien odour. triggered comparable level of aggressiveness.

DISCUSSION

Liostenogaster F. females are able to discriminate between alien and nestmate females using only visual or chemical cues. However, the two sensory modalities do not have the same accuracy. Facial cues, when presented without odour cues, induce an increased number of erroneous attacks on nestmates, but such attacks are quickly aborted and never result in serious injury. Moreover, visual cues allow faster responses than chemical ones. Odour cues, presented in isolation, result in a slow response and an increased number of erroneous acceptances of outsiders. Correspondingly, the chemical profiles are entirely ignored when the visual and chemical stimuli are presented together.
The cost of incurring in these two types of errors (i.e. attacking a nestmate or being peaceful to outsiders) might depend on the number of outsider visits experienced by colonies (that are often clustered). The possible existence of tradeoffs in using one mode or another to recognise nestmates in diverse ecological contexts merits further investigation.

Our findings have important implications for the understanding of multisensory integration in decision making in animal recognition systems.

[1] Lenoir A. et al. 2001. Annu. Rev. Entomol. 46, 573-599 [2] Tibbetts E.A. 2002. Proc. R. Soc. B.269, 1423-1428 [3]Tibbetts E.A. & Dale J. 2004. Nature 432, 218-222. [4] Baracchi D. et al. 2012. Anim. Behav. 85, 203-212

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