Is every female equal? Caste biasing in a primitively eusocial insect

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Introduction
The evolution of eusociality is a major transition in evolution. One defining feature is a division of labour, where some individuals have lifetime sterility (worker caste), whilst others remain reproductive (queen caste)\textsuperscript{1,2}.

Primitively eusocial insects, like Polistes paper wasps, represent the earliest stages of eusociality. Adults have behavioural not morphological castes and can switch roles as adults (totipotency).

Current literature suggests Polistes may not be as primitive as previously thought, with evidence of caste biasing early in development through mechanisms such as mechanical signalling\textsuperscript{3} and larval nutrition\textsuperscript{4}.

Here we examine individual caste variation in the wasp, Polistes canadensis (Fig. 1).

Investigating if females are bias towards particular caste roles as evidenced by diverging behavioural profiles.

Methods and Materials
- Data collected April - August 2012 in Panama.
- 400 females on 9 nests were individually marked on emergence and monitored daily for 3 months.
- Behavioural observations were conducted every 3-4 days.
- Behaviours were categorised as Dominant, Maternal or Neutral (Fig. 2.).

![Fig. 2. Venn diagram of behaviours in P. canadensis](image)

Results
Age has a significant effect on the expression of maternal behaviour GLMM: $X^2 = 2233$, d.f. = 1, $P = <0.0001$

But the direction of this expression differs among individual wasps (e.g. Fig. 3.)

57\% of wasps show an increase of maternal behaviour with age
15\% of wasps show a decrease of maternal behaviour with age

![Fig. 3. Differing patterns of the direction of maternal behaviour with age for individual wasps](image)

Conclusions
- Females change their investment in indirect fitness with age.
- There maybe two different strategies:
  1) committed worker
  2) potential reproductive
- Not all females are equal

Future Work
Explain individual differences in maternal behaviour with age
Investigate 2nd hypothesis: “females differ in totipotency, this is apparent during development” by assessing:
1) Developmental periods of larvae and pupae
2) Differential expression of queen and worker genes of emerging wasps

Hypothesis
1) Workers differ in their expression of dominance and maternal behaviour over time

Is this behaviour fixed? OR Can individuals change their behaviour over time?

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References
\textsuperscript{1}Bourke, A. F. G. (2011) Principles of Social Evolution, Oxford University Press.
\textsuperscript{2}Bell, E and Sumner, S. (2013) eLS.