

Age polyethism

Age polyethism promotes worker longevity



Size polymorphism

Task allocation depends on worker's body size

Dimorphic or polymorphic sizes



Pheidole ants are dimorphic

Big, major workers: attack & defense

Small, minor workers: attend to nest, brood care

Regulation of body size by genes

Patrilineal genes contribute to daughters' morphs

Enhanced genetic variability may lead to more complex divisions of labor

Jaffé et. al. 2007

Response threshold: need-base flexibility

Tasks are reallocated according to deficiencies

Majors are more active in brood-care when there are less minors tending to the brood.

Minors increase the rate of brood-care when there are less minors tending to the brood.

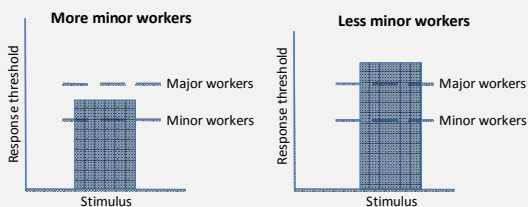


Brown and Traniello 1997

Response thresholds

Task allocation depends on threshold levels

Pheidole ants



High proportion of minor workers keep the brood stimulus low. Mostly minors tend to broods.

Low proportion of minor workers raises the brood stimulus demand. Majors tend to broods, and minor increase brood-care rate.

Learning

Learning affects a wide variety of behavior

Can prior learning experiences affect task allocation in social insects?

Hypothesis: Success would increase a worker's tendency to stick to a task. Failure would decrease a worker's tendency to stick to a task.

Ravary et. al. 2007

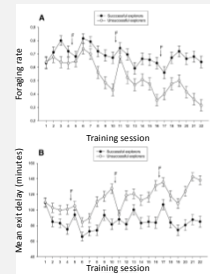
Methods

- *Cerapachys* ants
- Trained naïve workers to find food
 - ½ always successful, ½ never successful
- Observe 2 short-term behaviors during training
 - Foraging rate (# foraging attempts/# training sessions)
 - Mean exit delay (amount of time it takes for worker to leave nest to find food when entrance is opened)
- Observe long-term behavior in task allocation

Ravary et. al. 2007

Short-term results

Successful workers had a higher foraging rate.
Unsuccessful workers had a lower foraging rate.

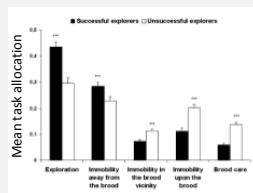


Successful workers had a lower mean exit delay.
Unsuccessful workers had a higher mean exit delay.

Ravary et. al. 2007

Long-term results

Successful workers explored more often and rested away from the brood.



Unsuccessful workers took on nursing tasks and rested near the brood.

Ravary et. al. 2007

Ravary et. al. (2007) Discussion

Individual experience affects task allocation

Experience may modify response thresholds

Task allocation by learning may increase colony efficiency and resilience

Conclusions

Plays major role in the success of social insects

Dynamic regulations

- Age polyethism
- Body size polymorphism
- Response threshold
- Learning



Conclusions

Mechanism use may be context-dependent

Complex mechanisms may enhance specialization in tasks



Current studies in division of labor

Future reproductive potential in bumblebee workers (Jandt and Dornhaus, in review)

Nature vs. nurture in caste differentiation (Schwander et. al. 2006)

Assessing own health status as indicator of becoming a forager in honey bees (Tofilski 2009)

Discussion questions

- Why isn't division of labor adopted in all circumstances of group living?
- Is division of labor really efficient?