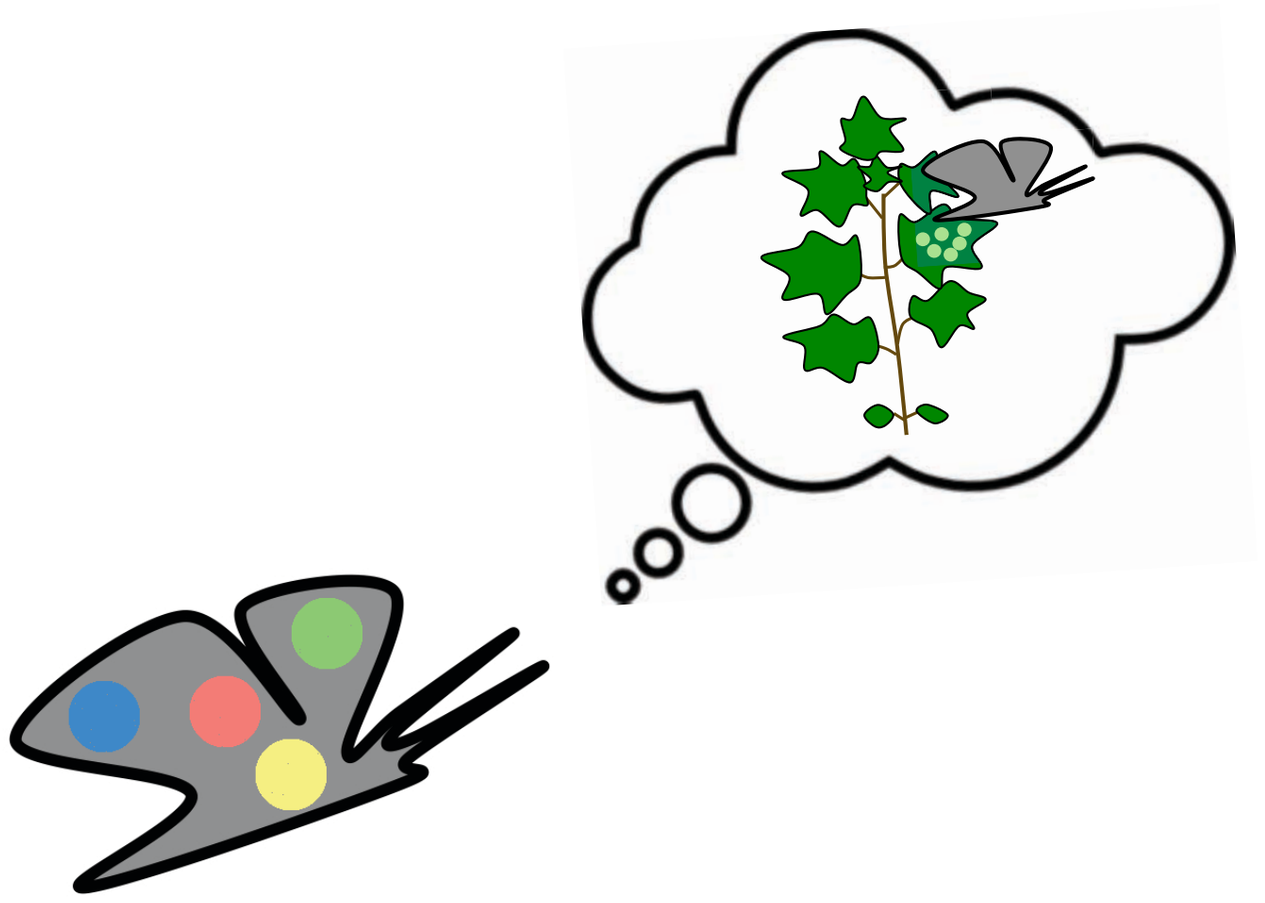
Do you remember when... ?

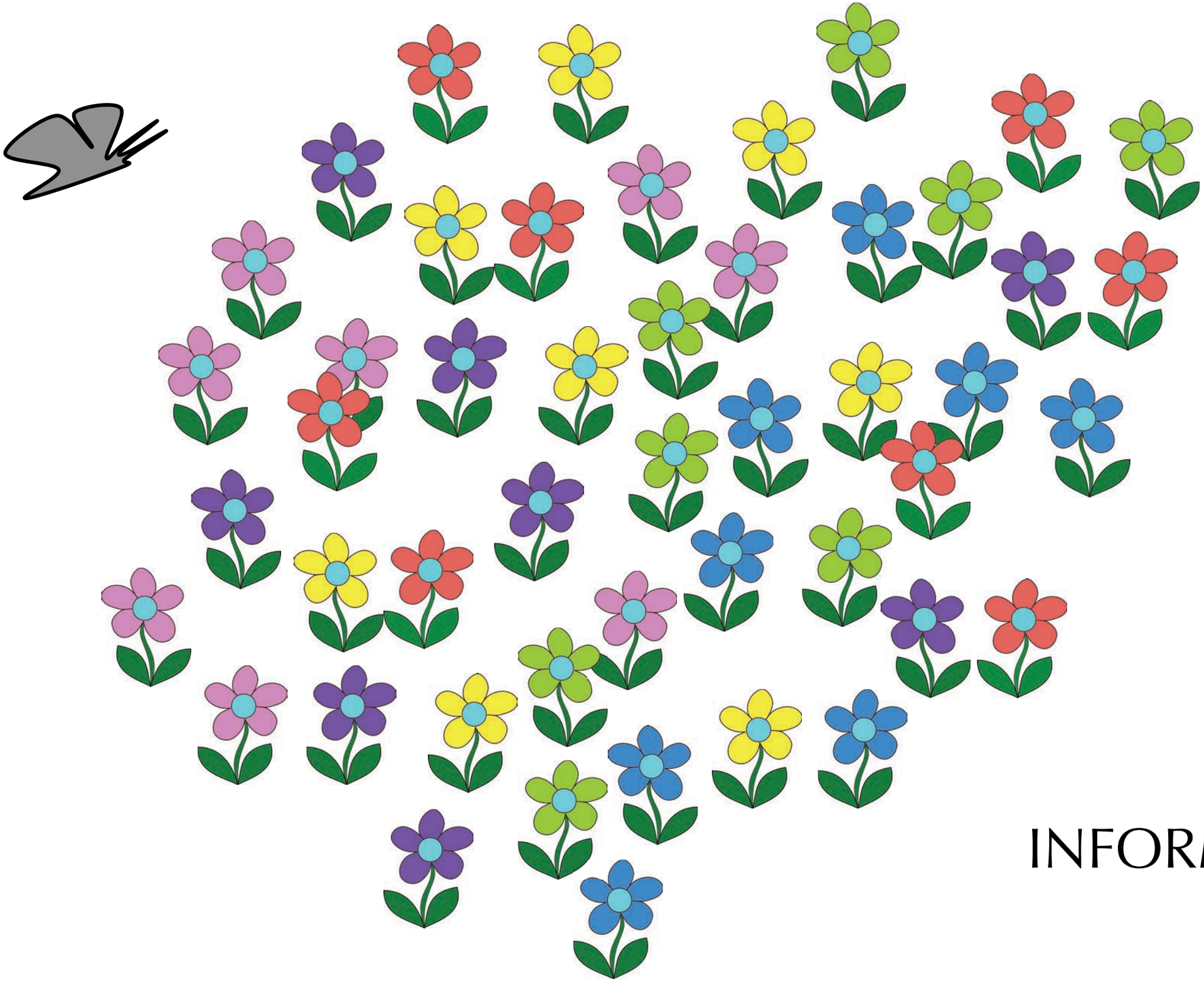
Effect of past experiences in future decisions in a noctuid moth



David Carrasco

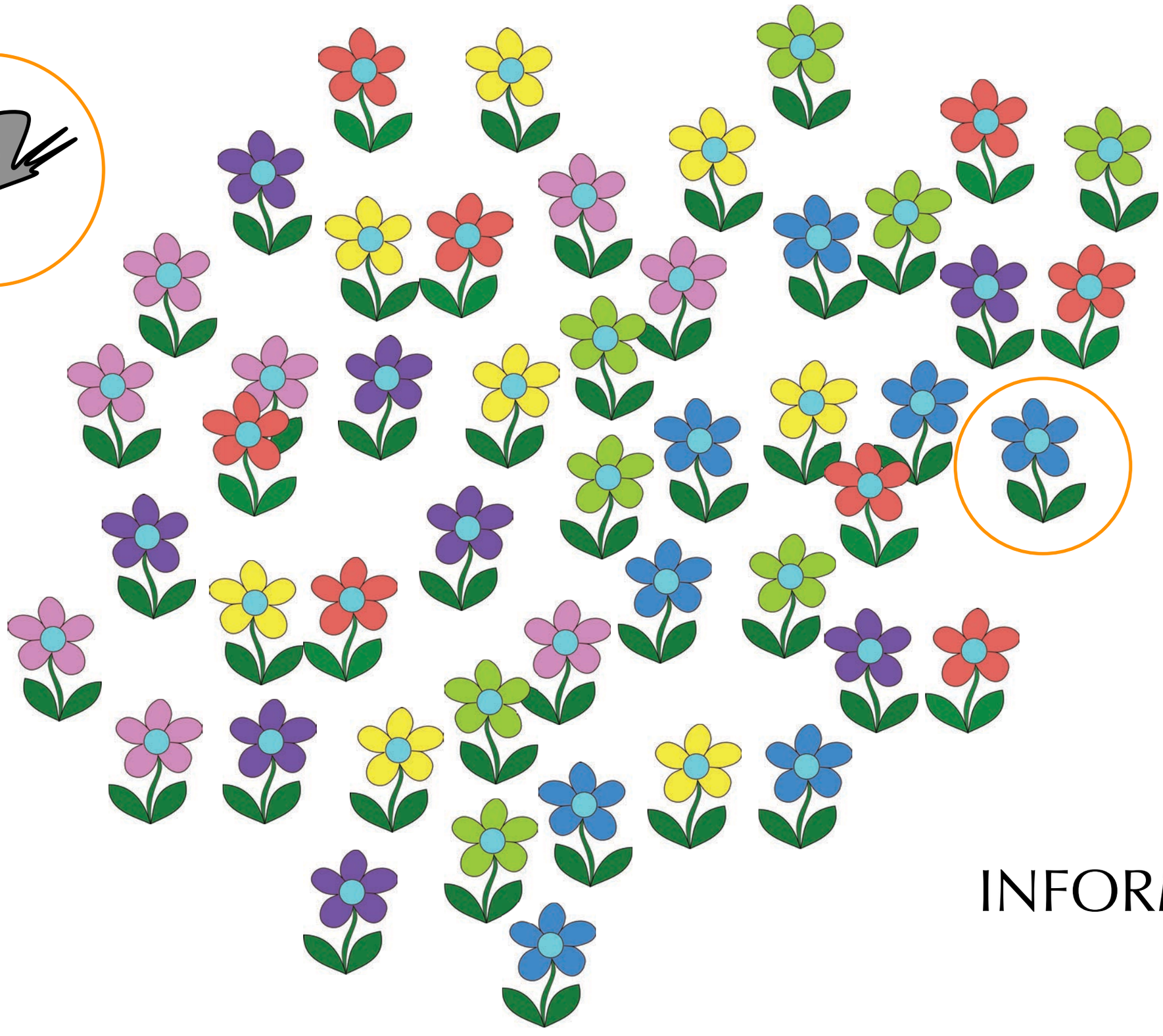
Which one would you choose?

Which one would you choose?



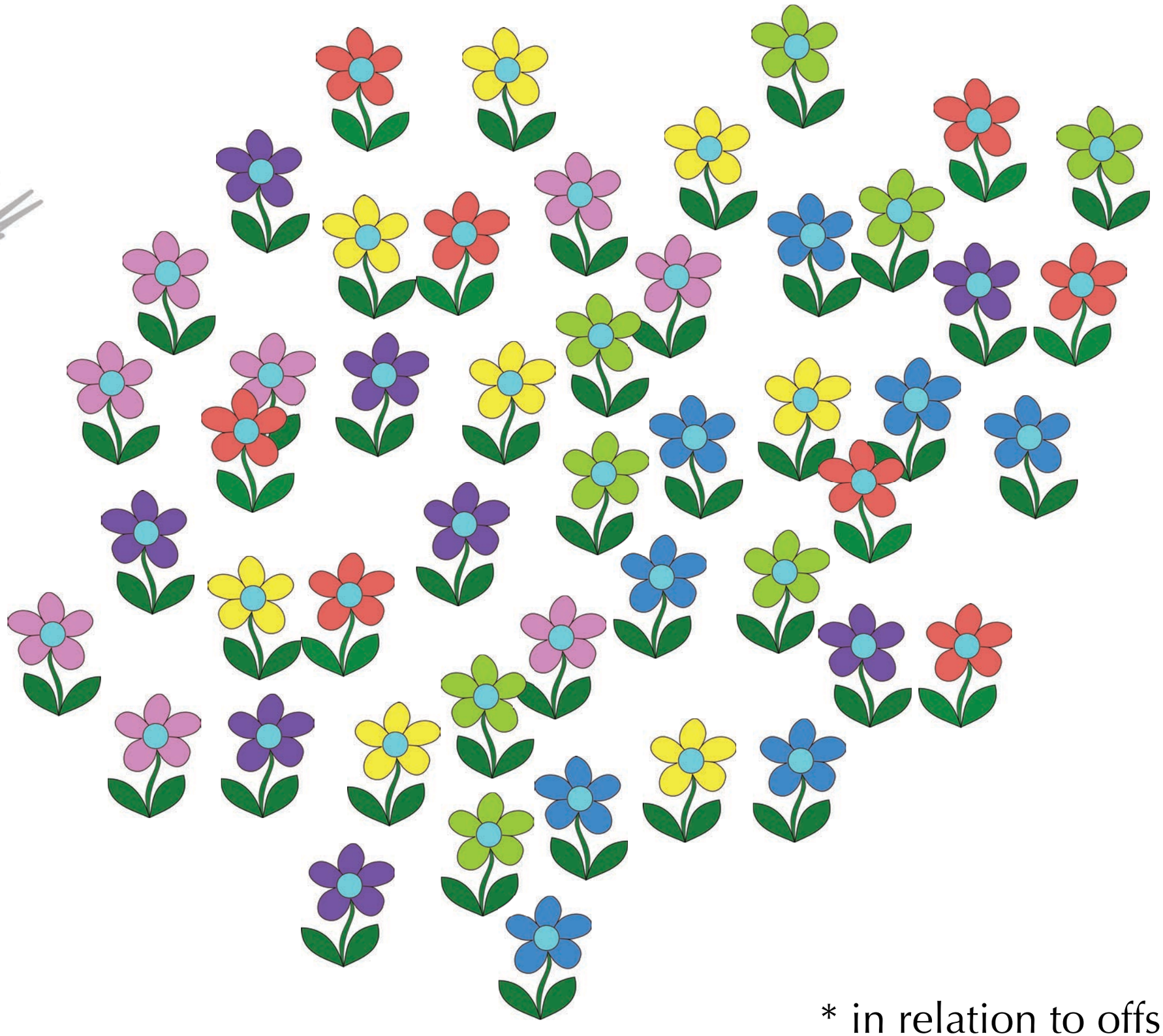
INFORMATION

Which one would you choose?



INFORMATION

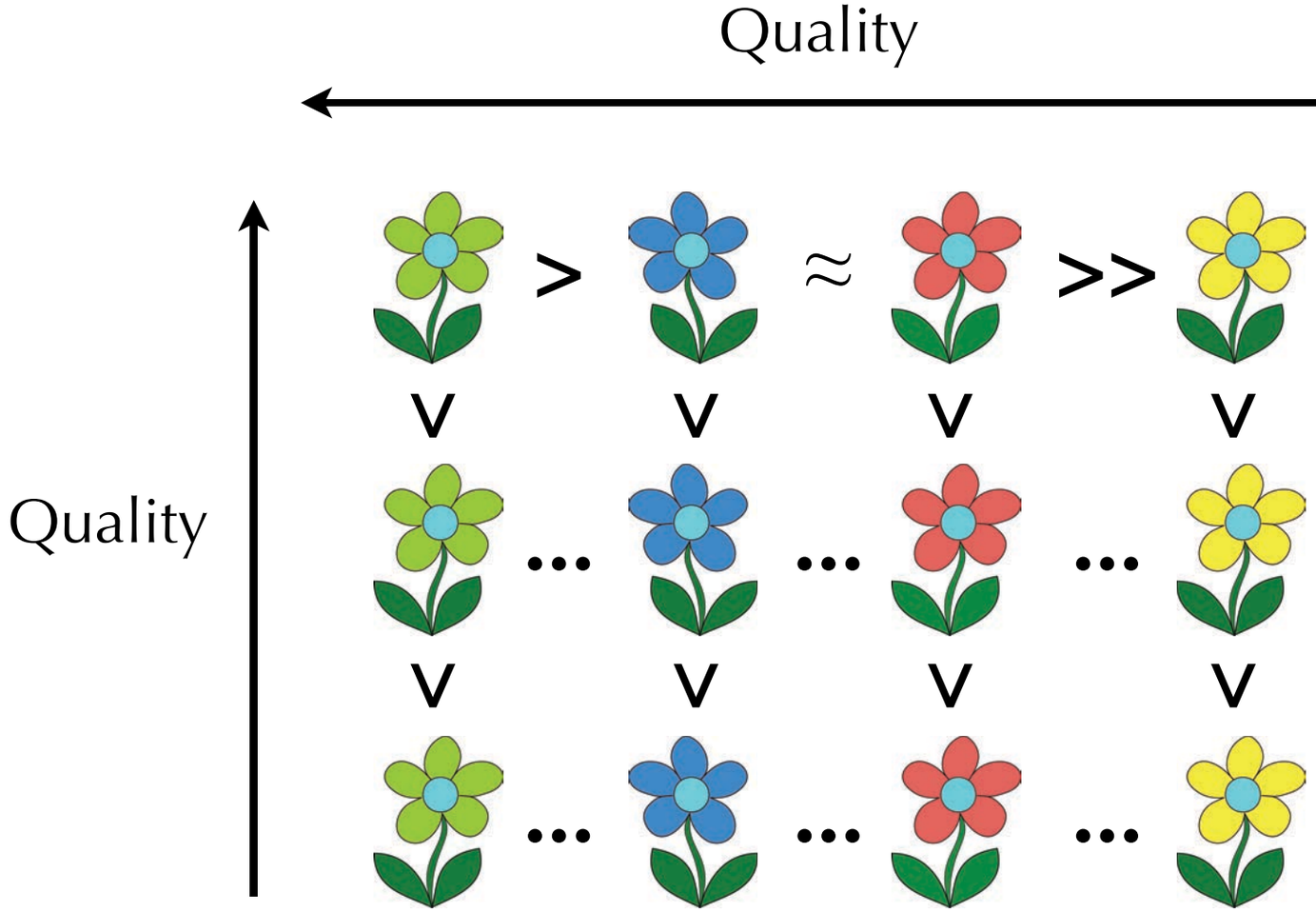
Plant Quality*



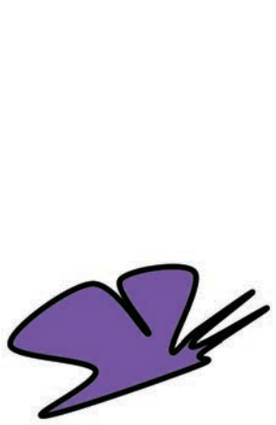
* in relation to offspring performance

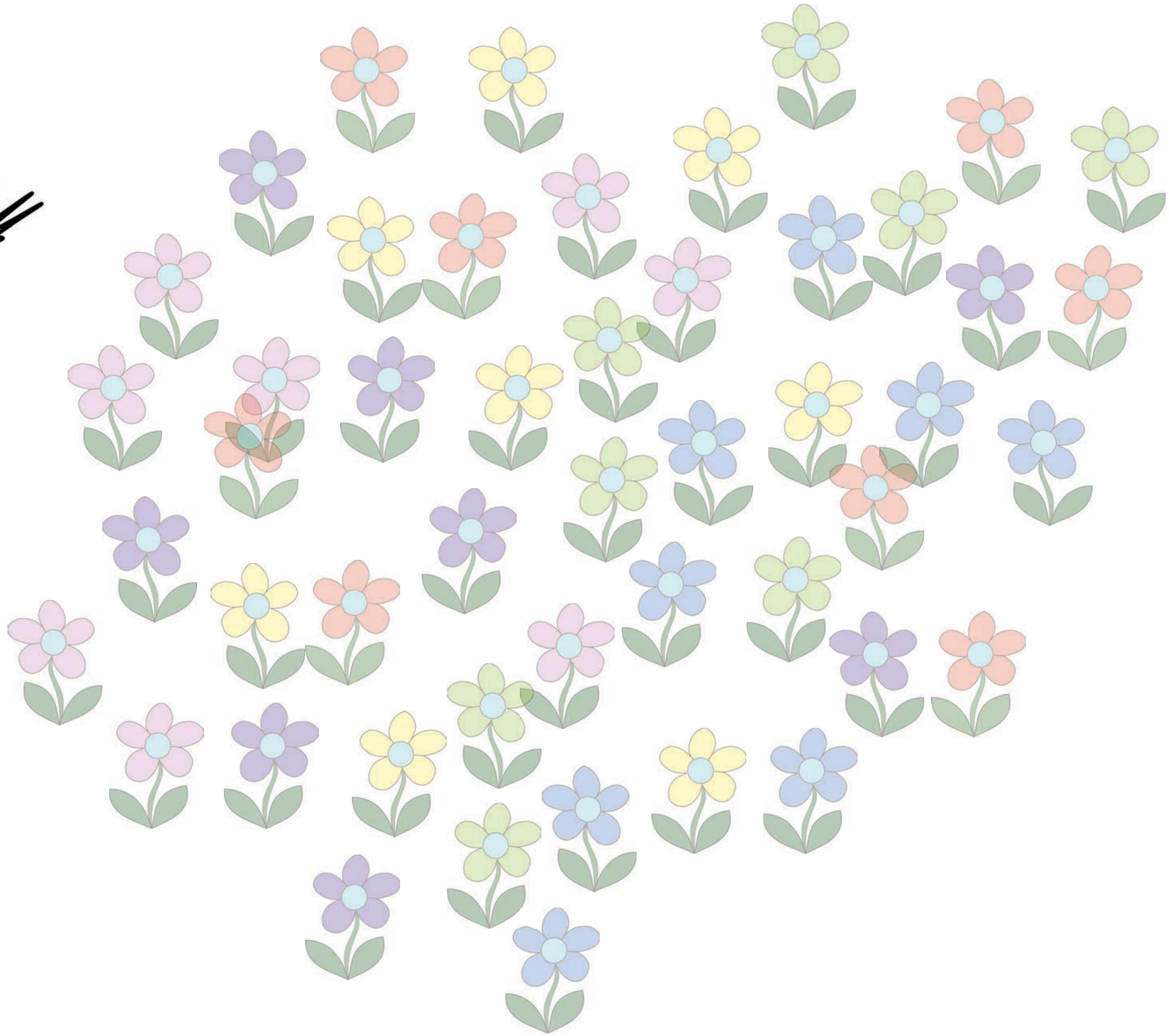
Preference-performance hypothesis

Females should lay eggs on those plants where offspring survival and development is the highest/best



Insect: Specialists vs Generalists





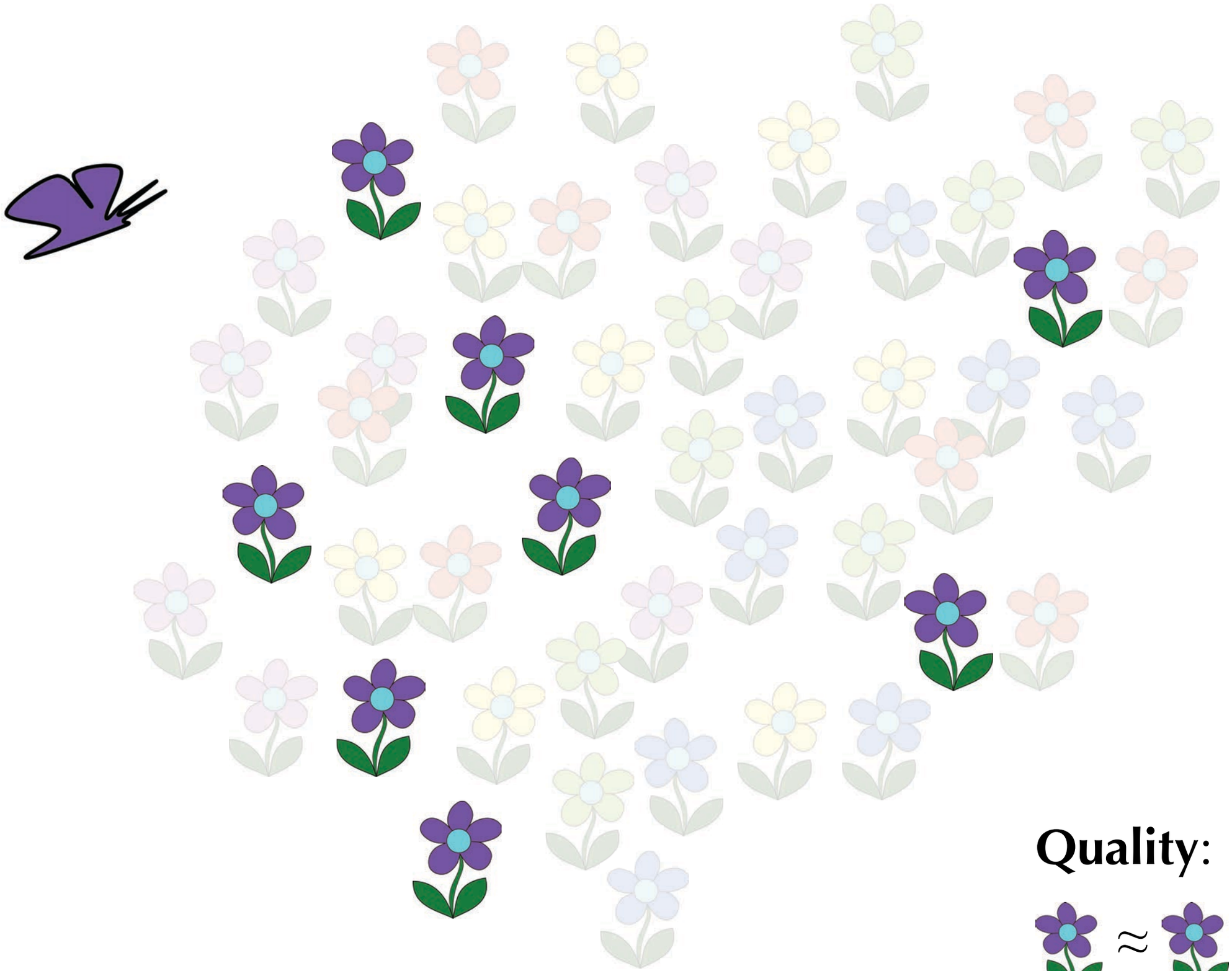
Specialists:

?

Specialists: filter out information

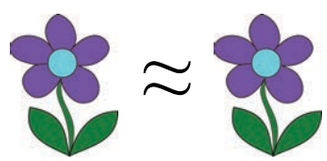
Genetically determined preferences

Specialists: filter out information



Genetically determined preferences

Quality:

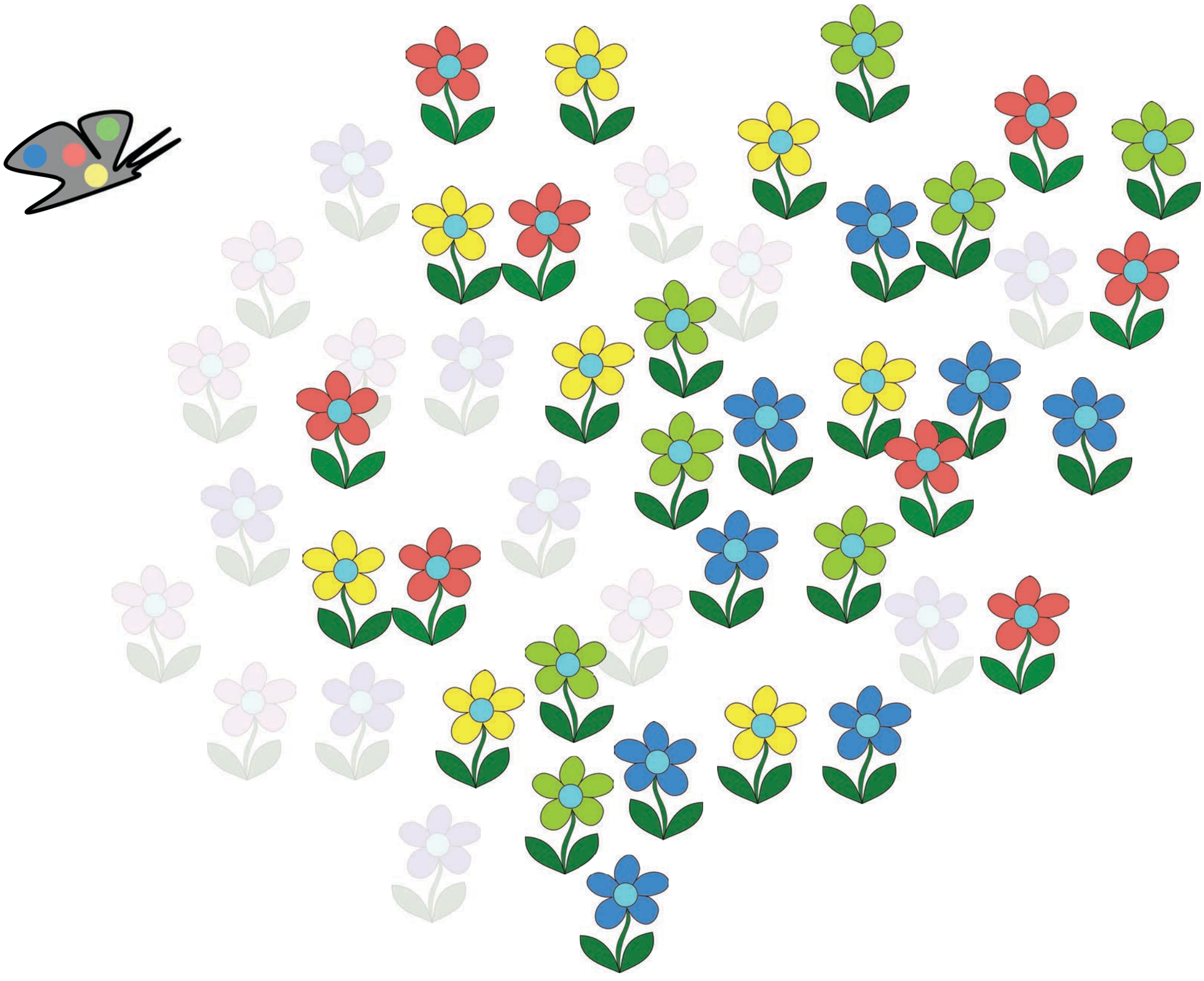


Generalists

?

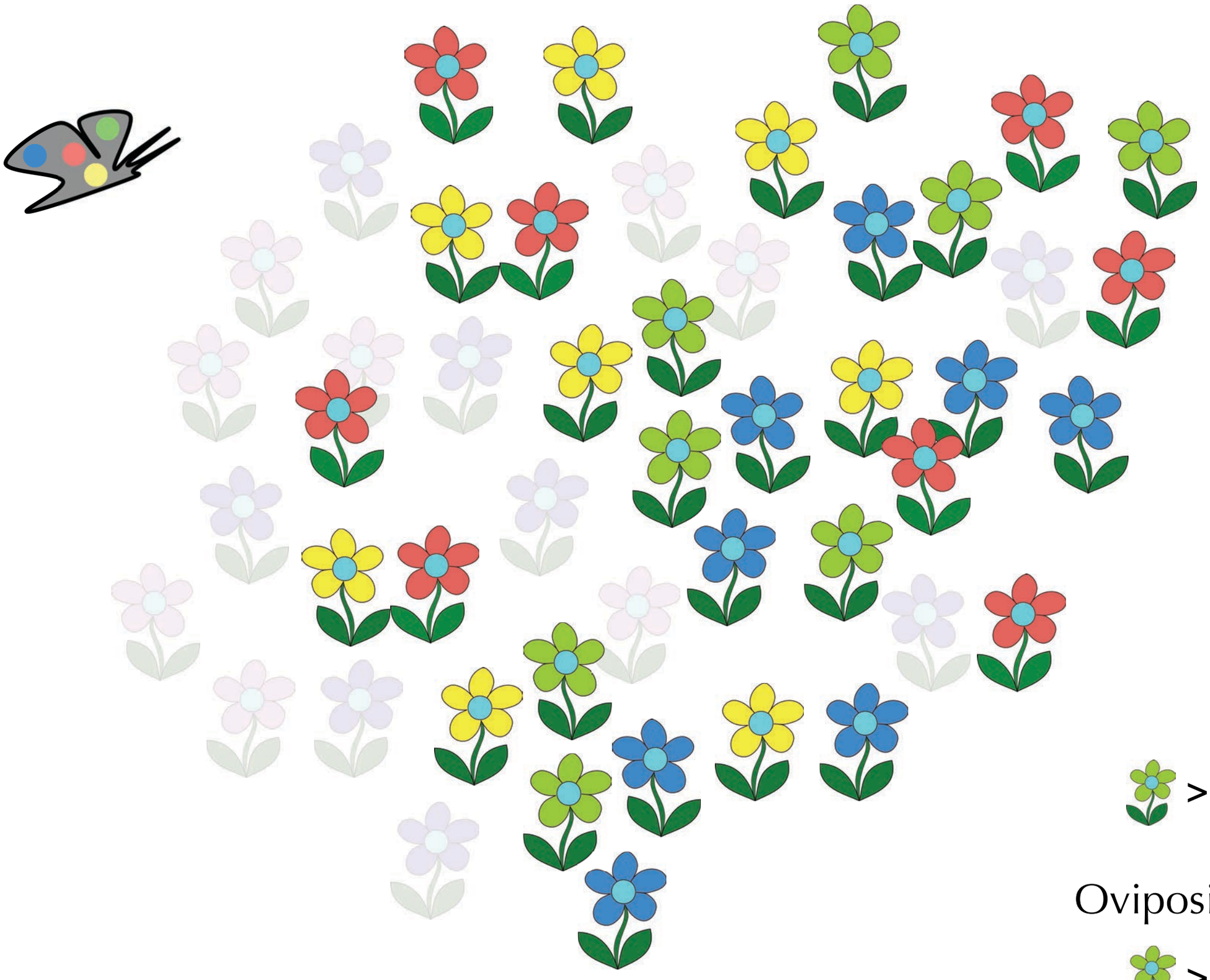
Generalists: filter out information, but how?

Generalists: filter out information, but how?



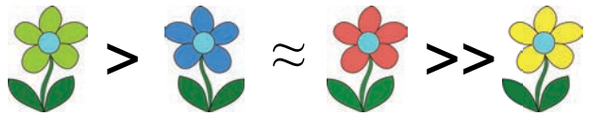
Genetically determined preferences

Generalists: filter out information, but how?

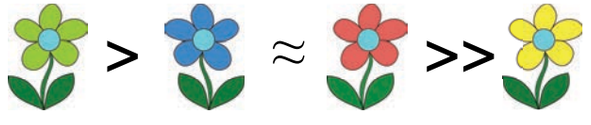


Genetically determined preferences

Quality:



Oviposition preference



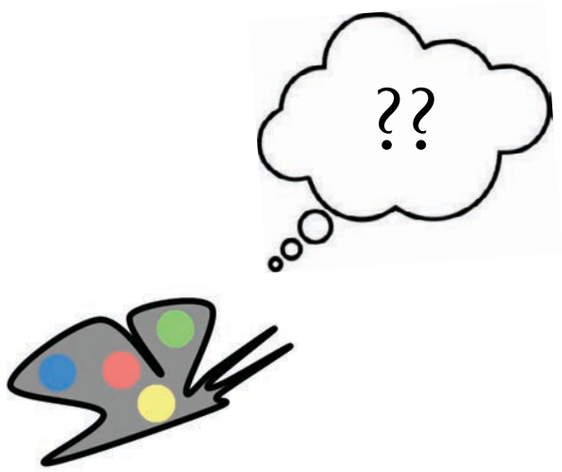
The broad host range of generalist herbivores → Problems at processing multiple sensory inputs

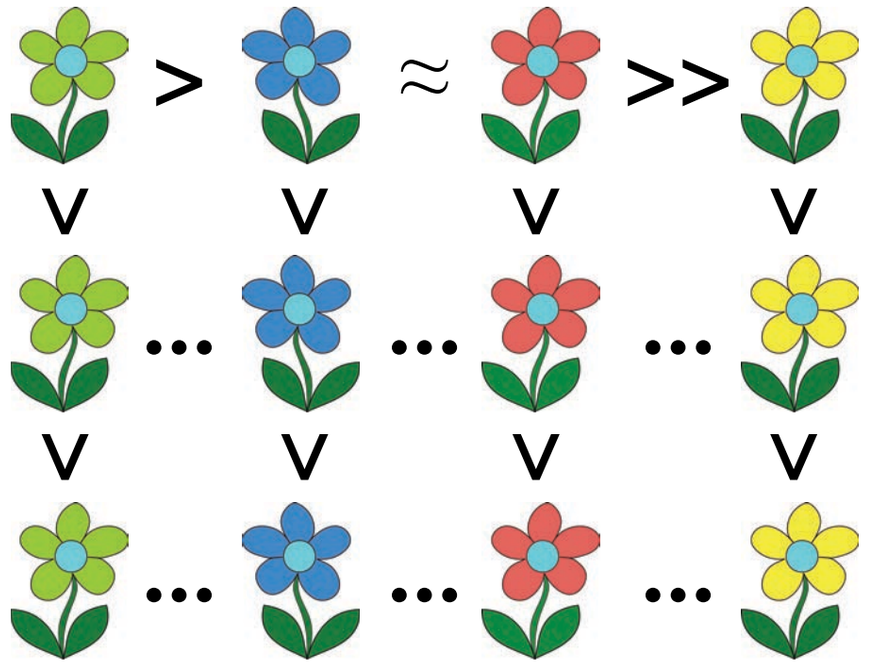
"Neural limitations"

(Bernays, Annu. Rev. Entomol., 2001)

Lower accuracy and longer decision time of generalist herbivores during oviposition

(Gripenberg, Ecol. Letters, 2010)





The broad host range of generalist herbivores → Problems at processing multiple sensory inputs

"Neural limitations"

(Bernays, Annu. Rev. Entomol., 2001)

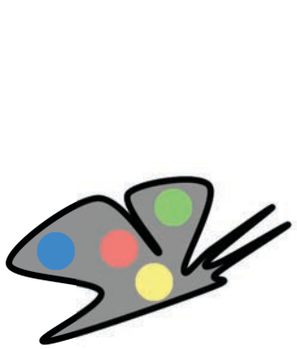
Lower accuracy and longer decision time of generalist herbivores during oviposition

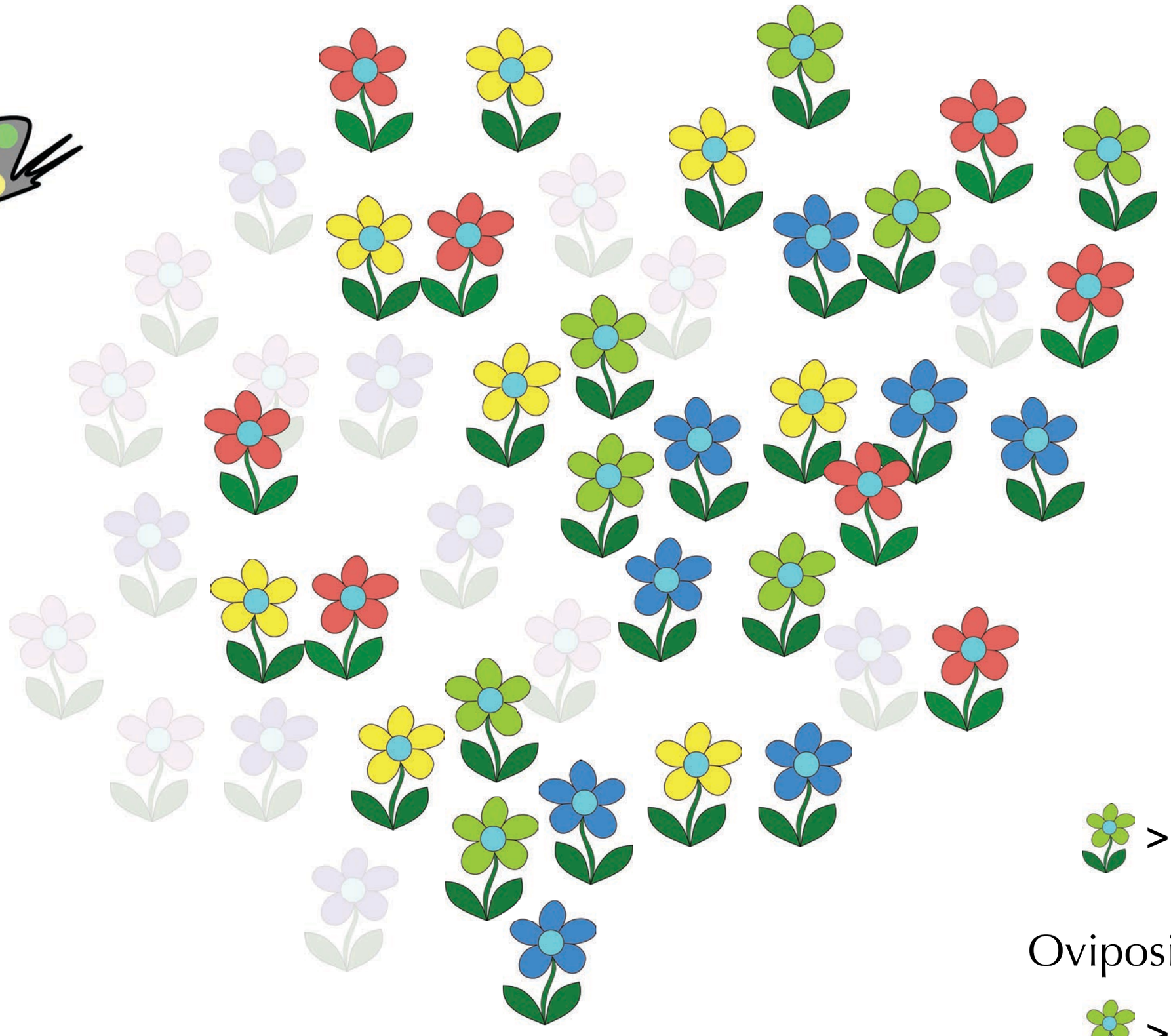
(Gripenberg, Ecol. Letters, 2010)

Generalists may rely on **previous experiences** during decision making: higher accuracy and fastest decision time

Particularly in **variable** environments

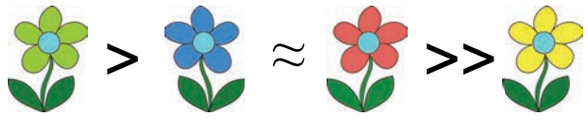
Constant environment



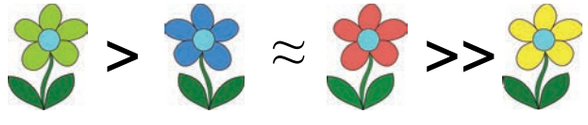


Genetically determined preferences

Quality:

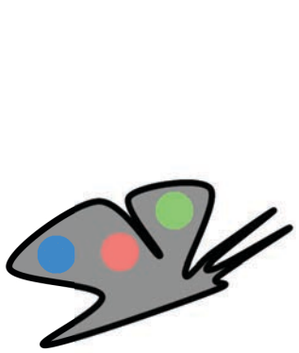


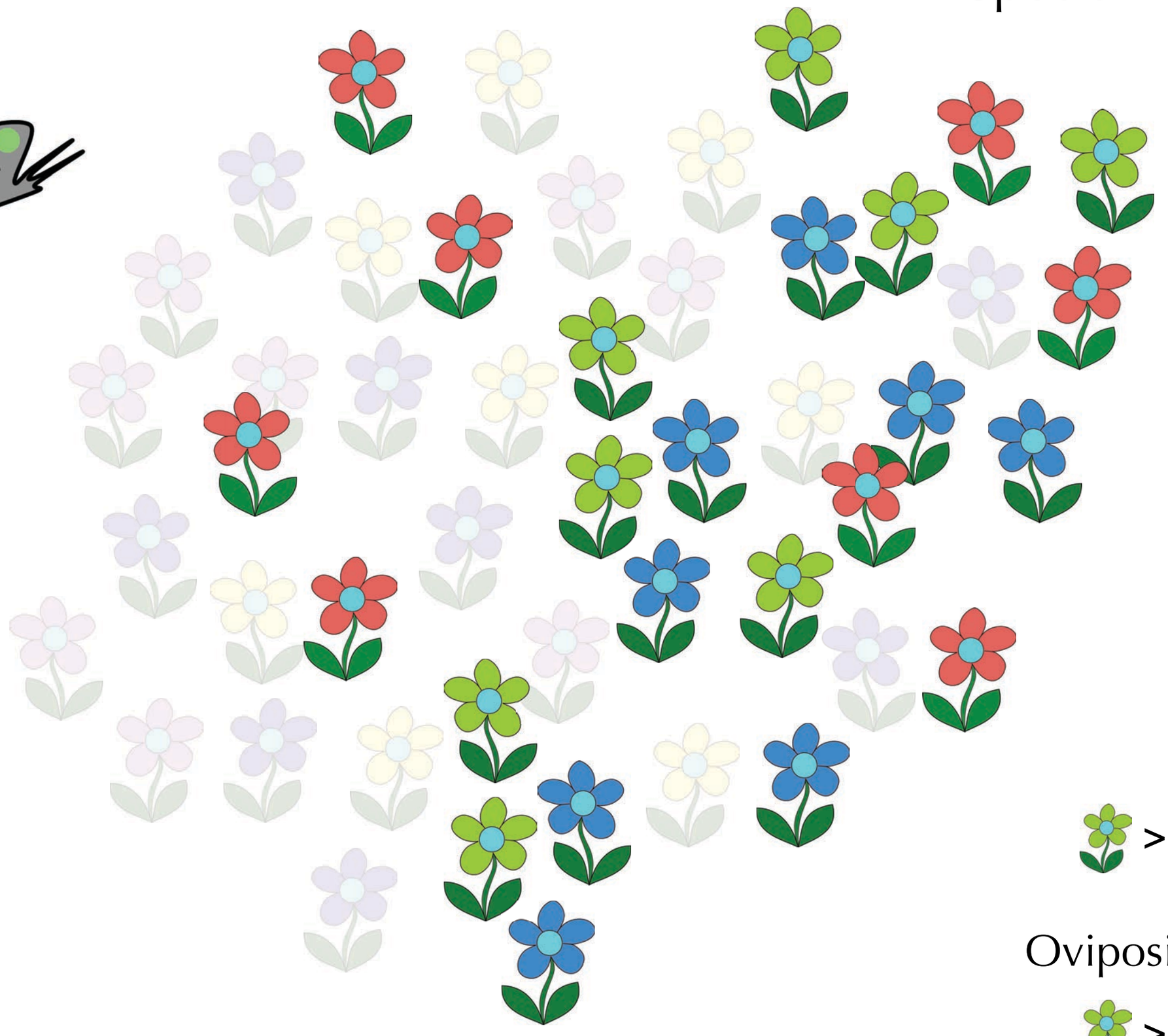
Oviposition preference



Constant environment

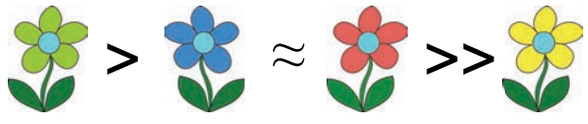
Specialization process



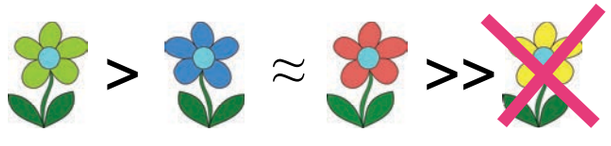


Genetically determined preferences

Quality:

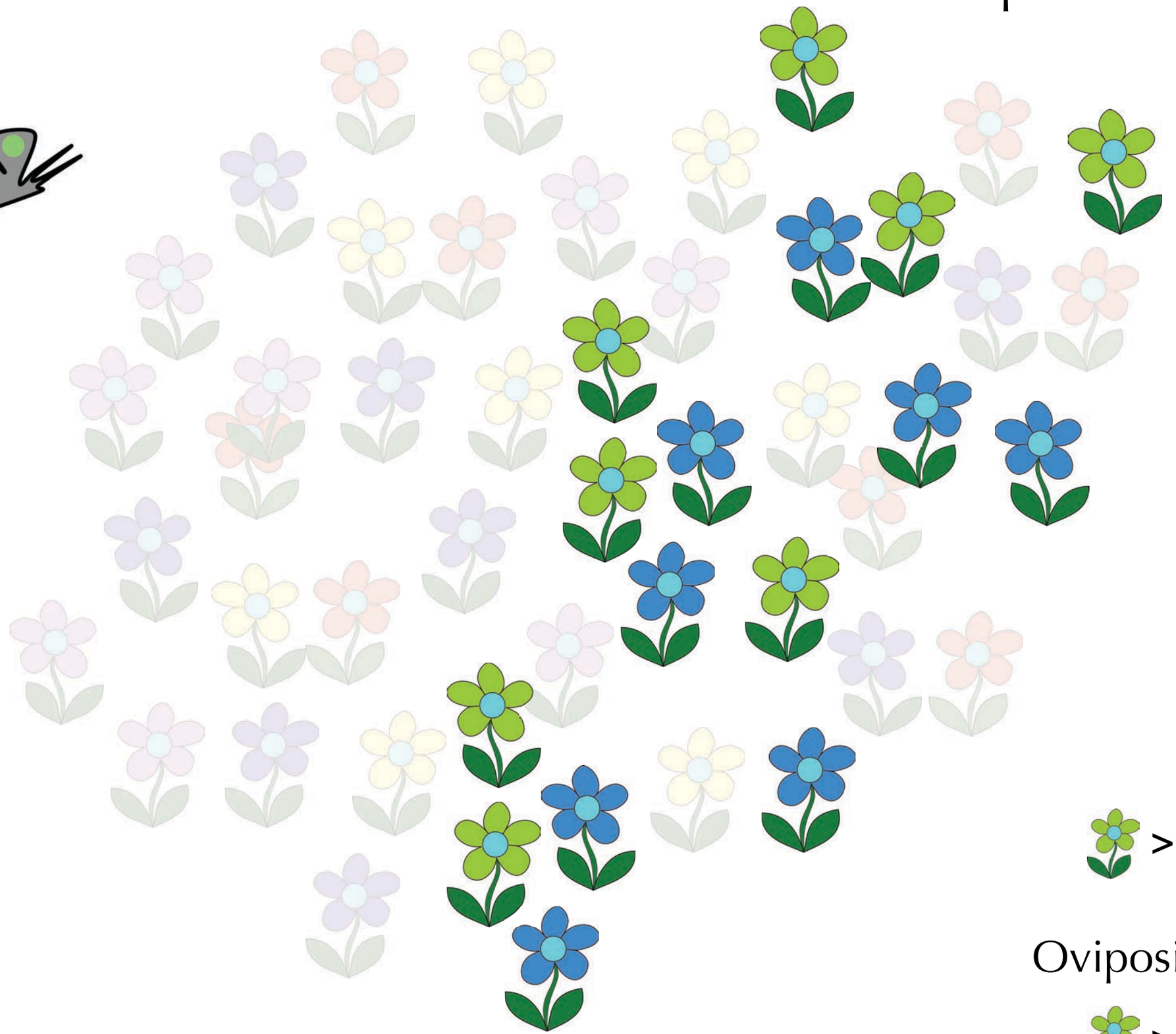


Oviposition preference



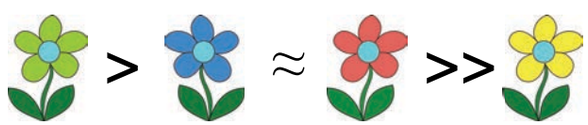
Constant environment

Specialization process

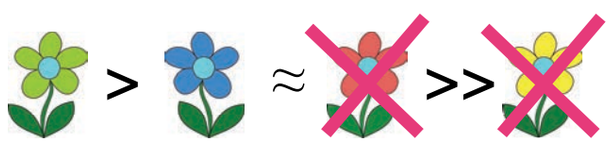


Genetically determined preferences

Quality:

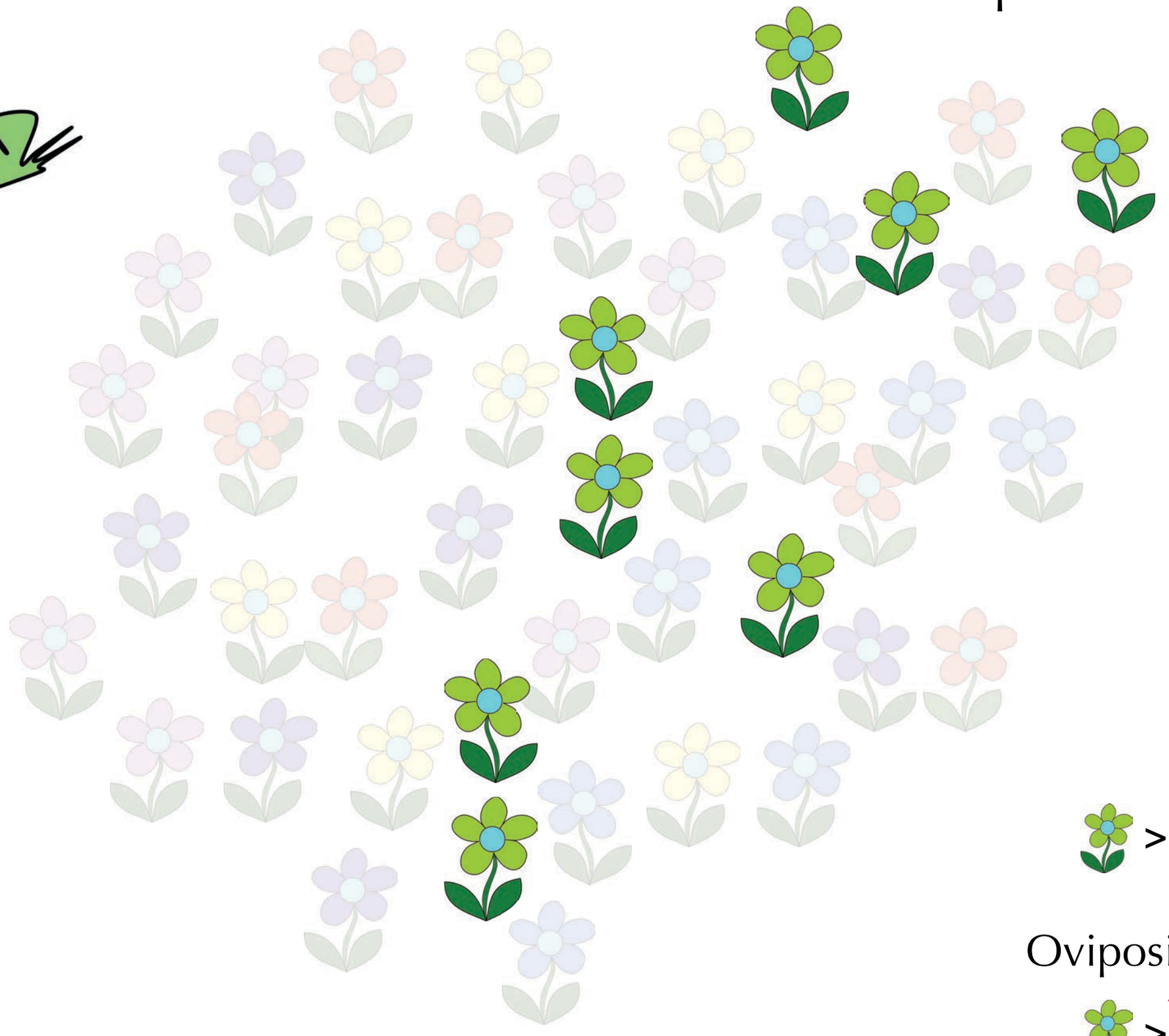


Oviposition preference



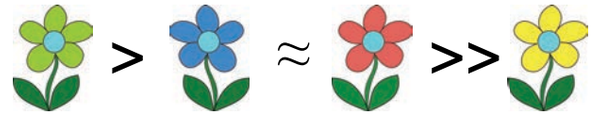
Constant environment

Specialization process

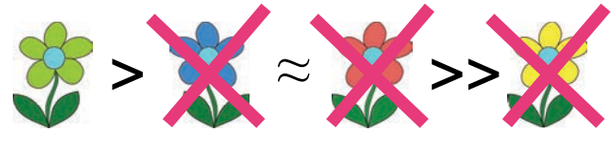


Genetically determined preferences

Quality:

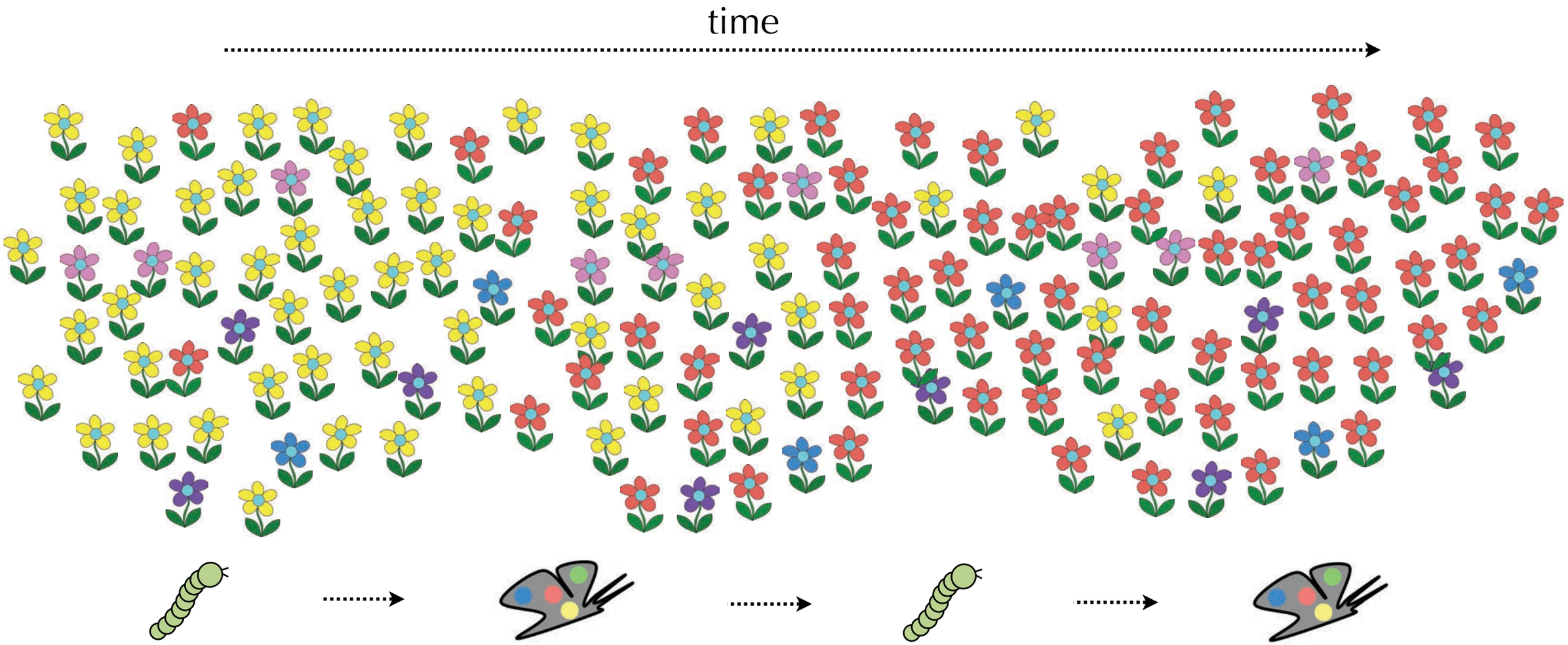


Oviposition preference



Variable environment

Between generations



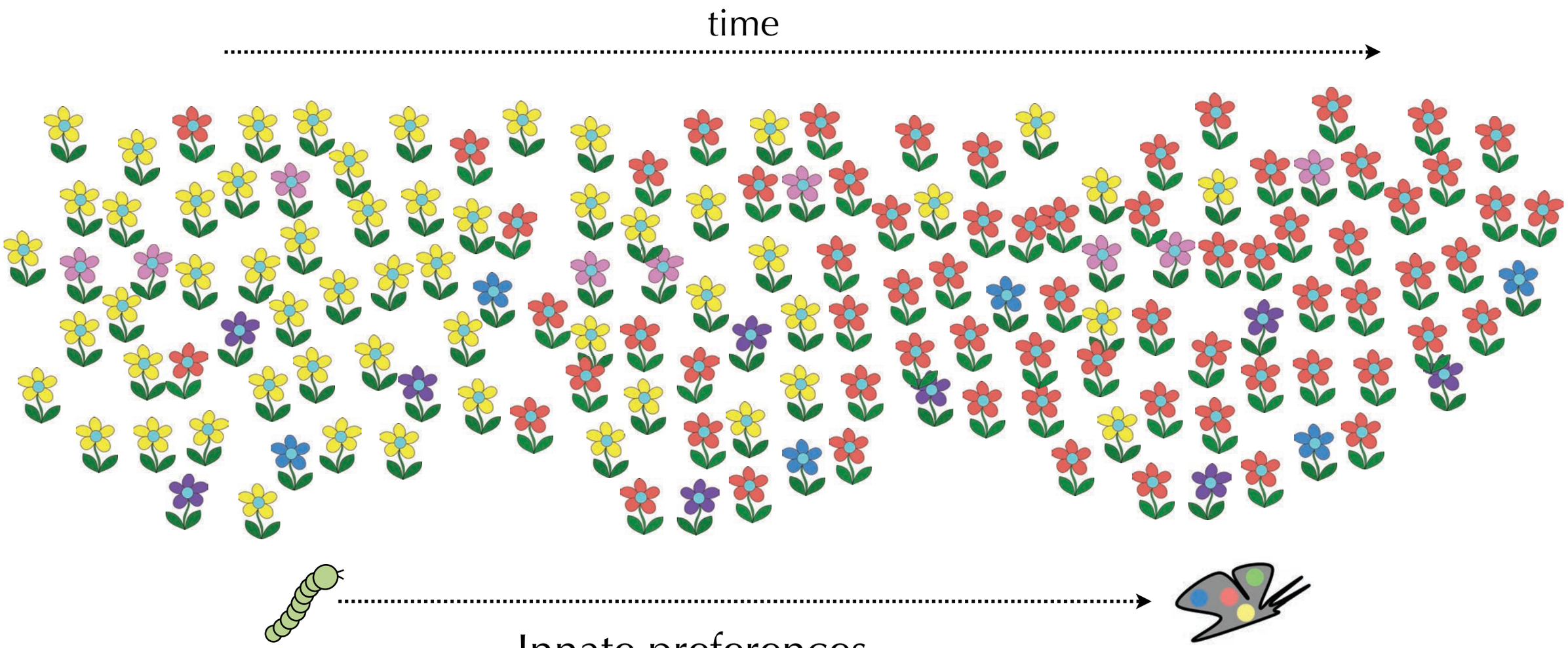
Innate preferences

+

Previous experience

Variable environment

Within generations



Innate preferences

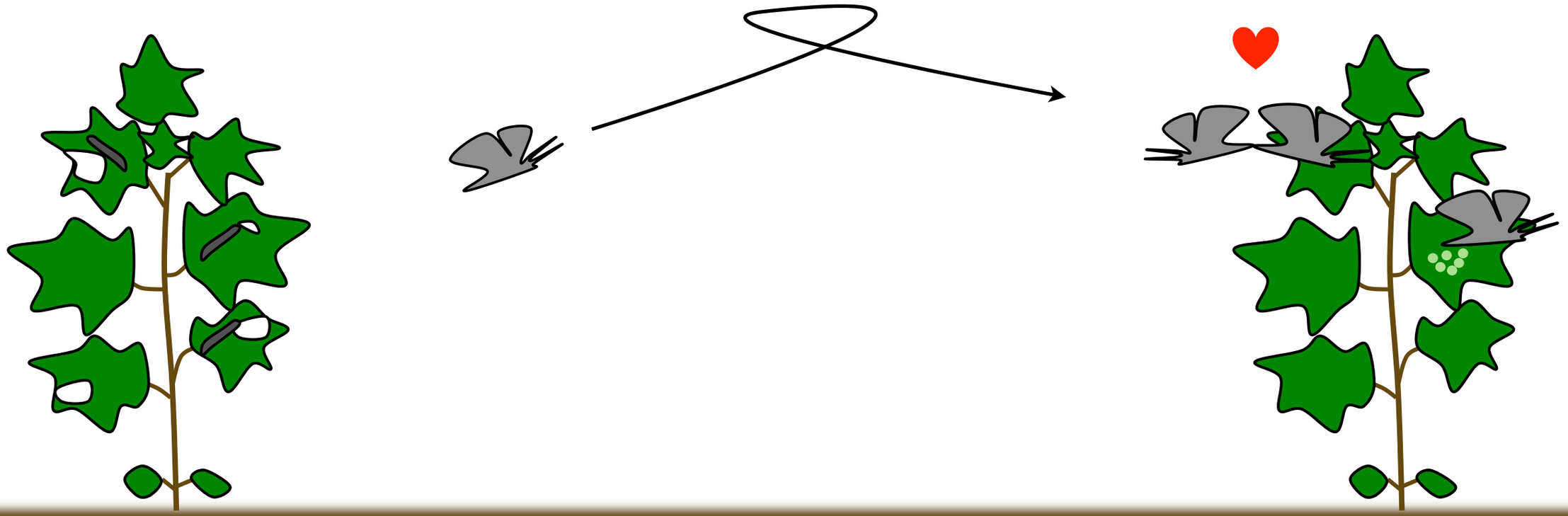
+

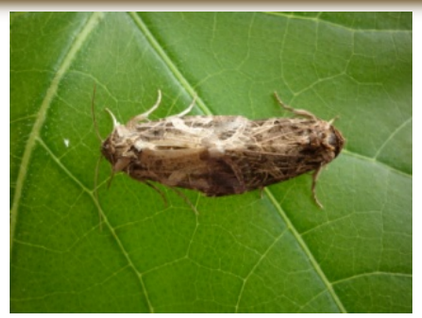
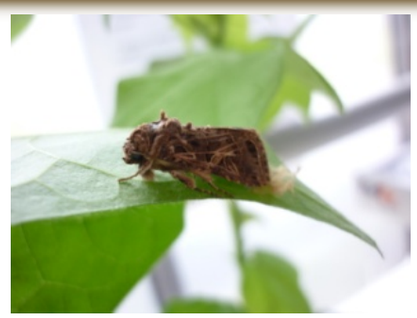
Previous experience ???

SOMETHING ELSE ???

The Egyptian cotton leafworm (*Spodoptera littoralis,* Noctuidae)

The Egyptian cotton leafworm (*Spodoptera littoralis*)



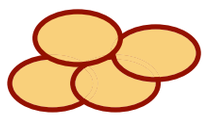



The Egyptian cotton leafworm (*Spodoptera littoralis*)

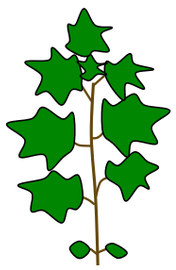
> 40 plant <u>families</u>

Methods

Larval food

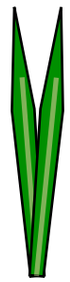


Artificial diet
potato based

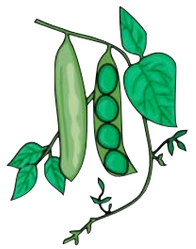


Cotton
Gossypium hirsutum
Malvaceae

Clover
Trifolium alexandrinum
Fabaceae



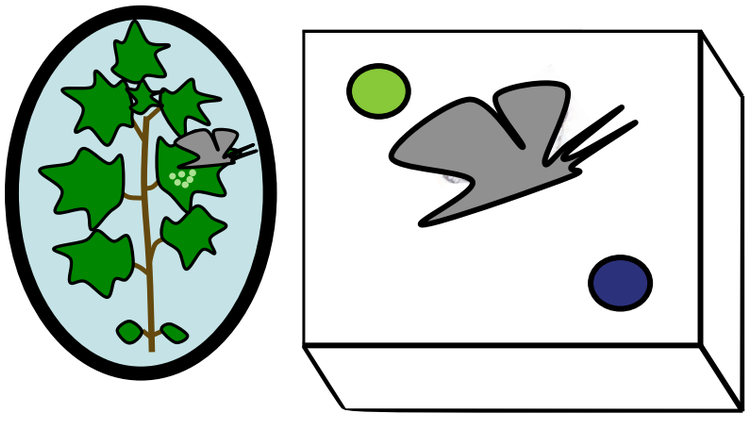
Maize
Zea mays
Poaceae



Cowpea
Vigna unguiculata
Fabaceae

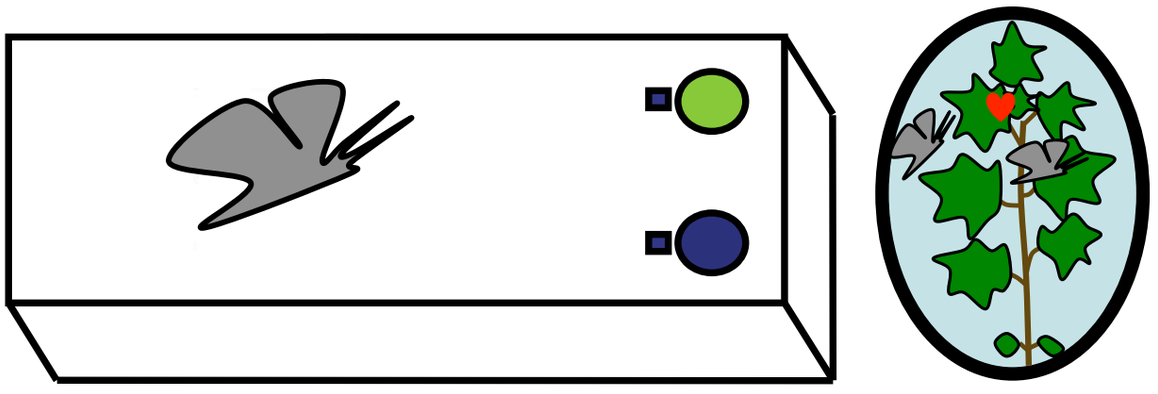
Cabbage
Brassica oleracea
Brassicaceae

♀

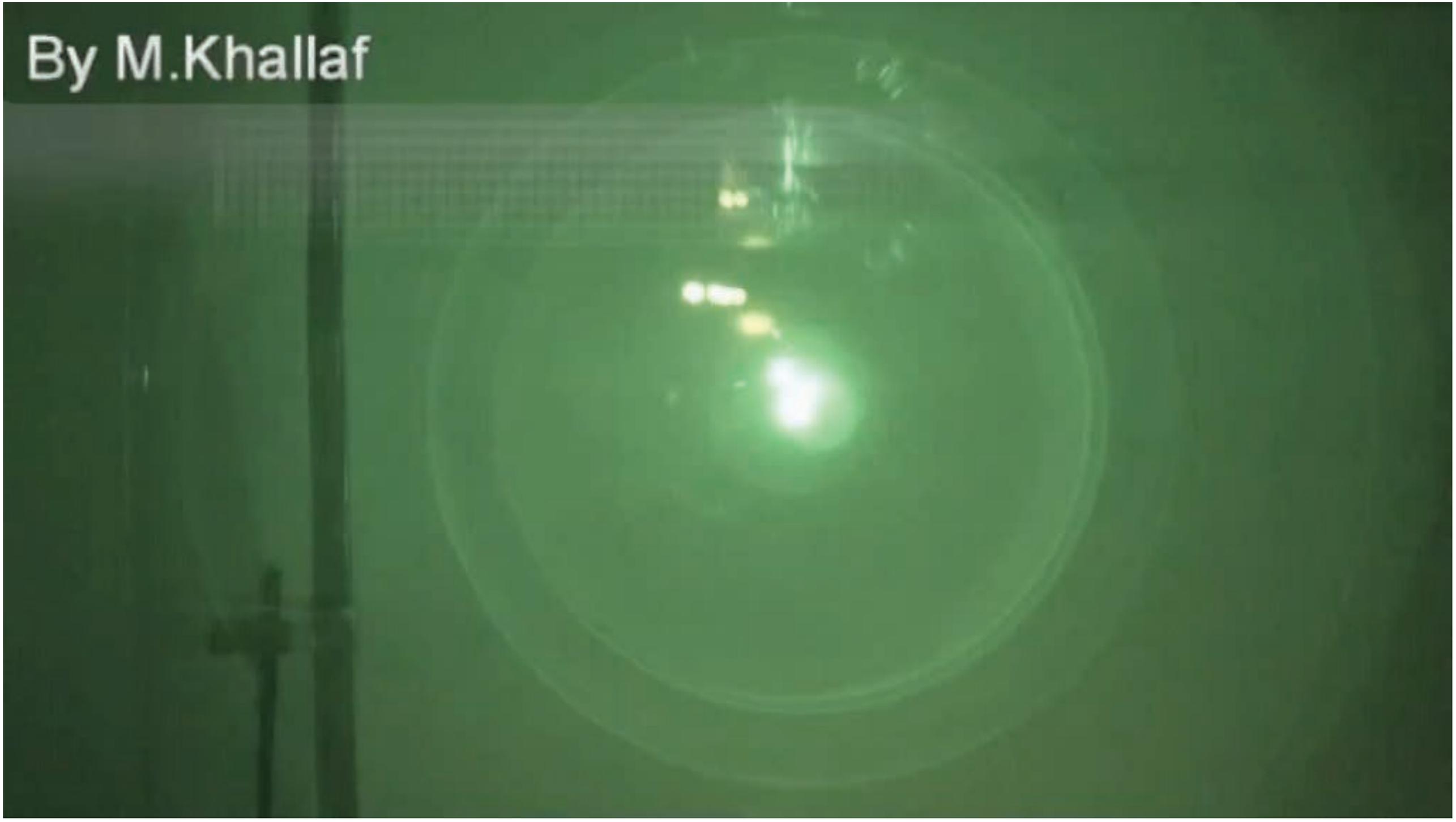


Two-choice oviposition

♂

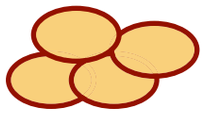


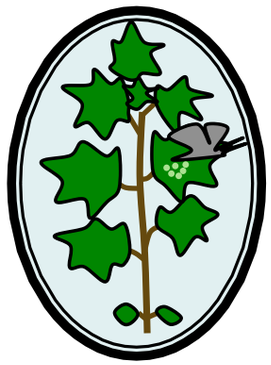
Two-choice wind tunnel


By M.Khallaf

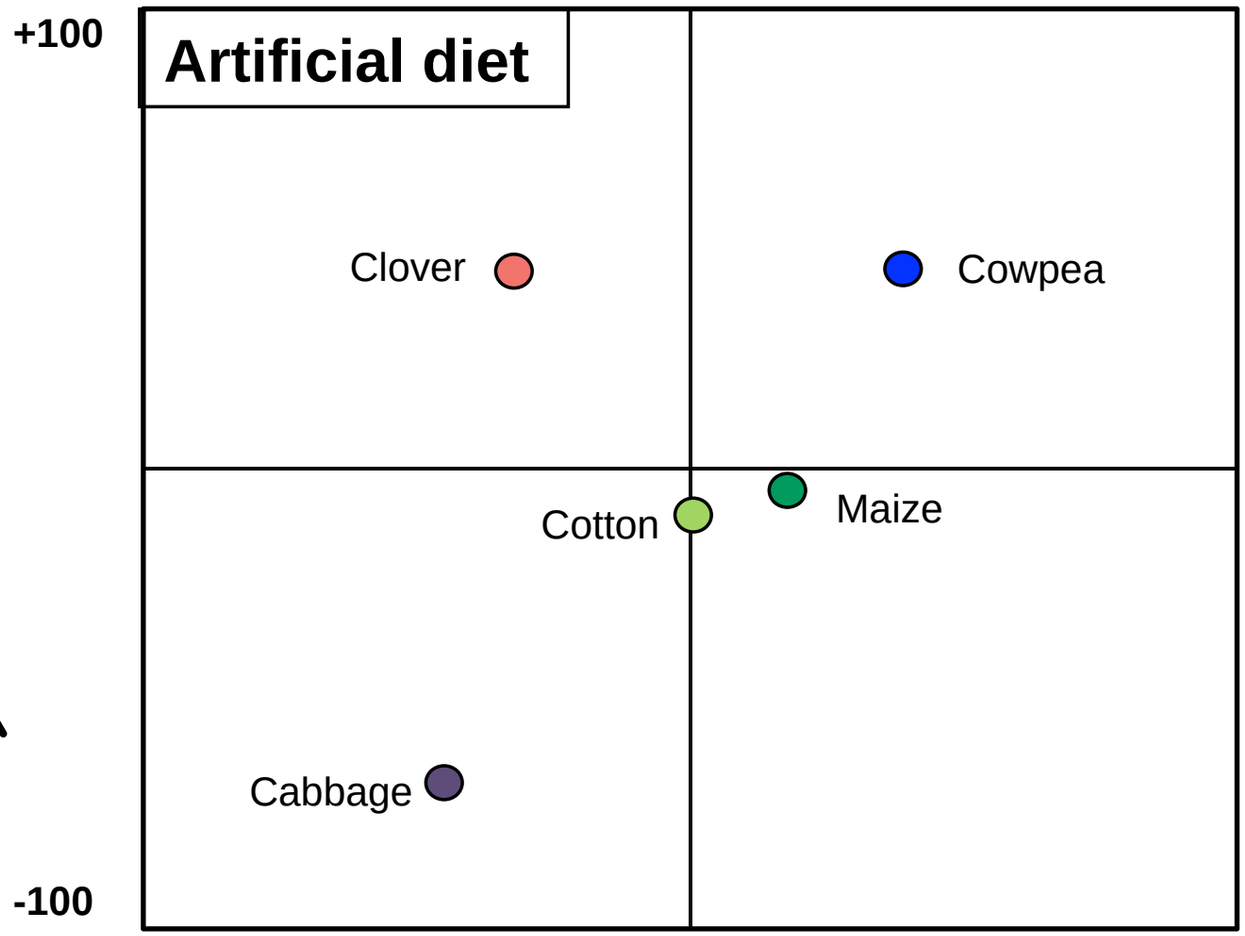
Innate preferences

Larval food



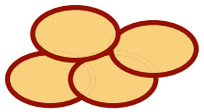


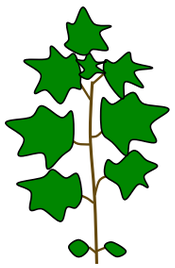
Female

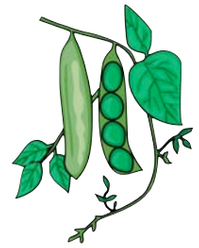


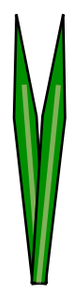
Thöming et al. Ecology 2013

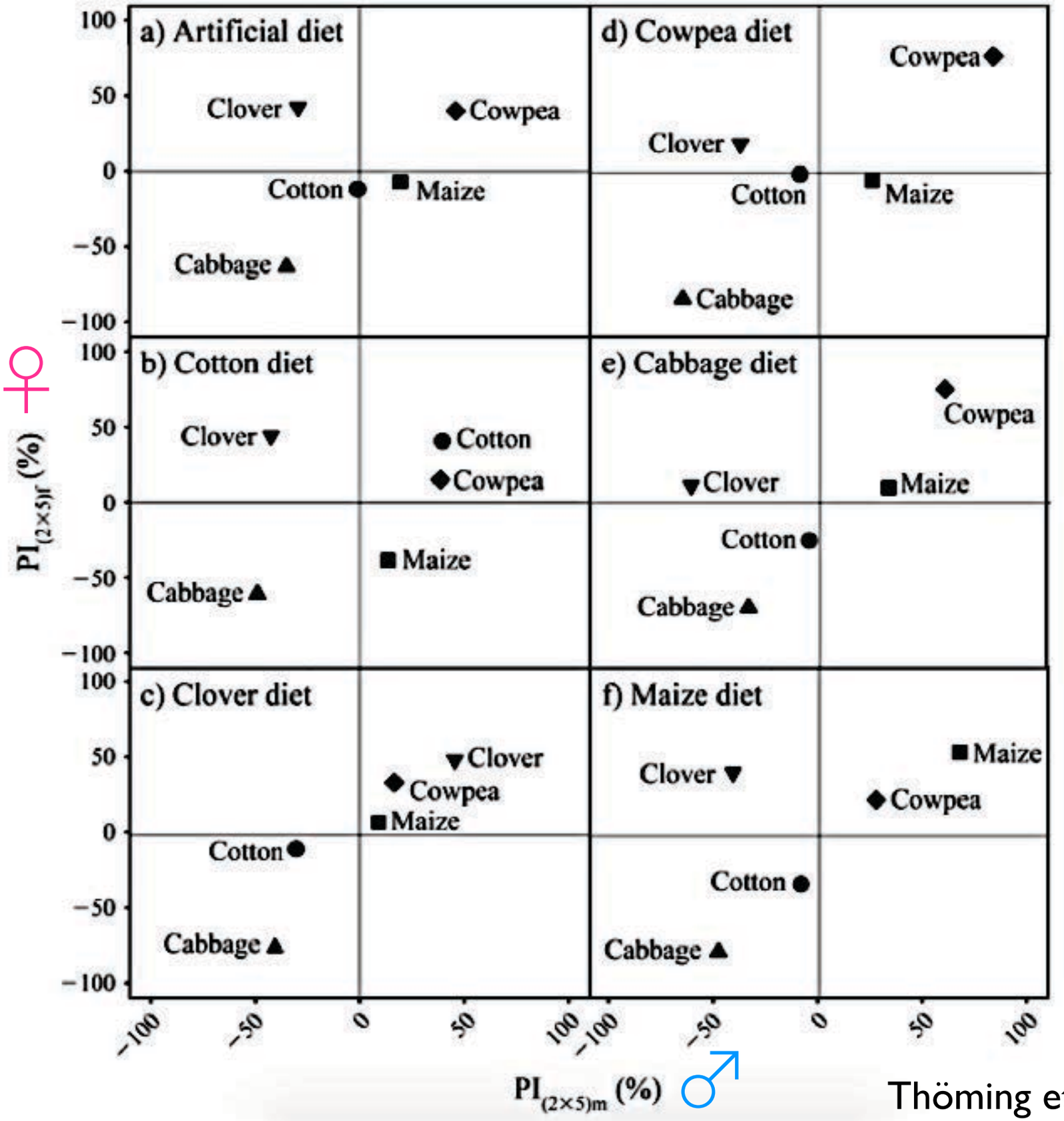
Modulation of innate preferences by larval experience





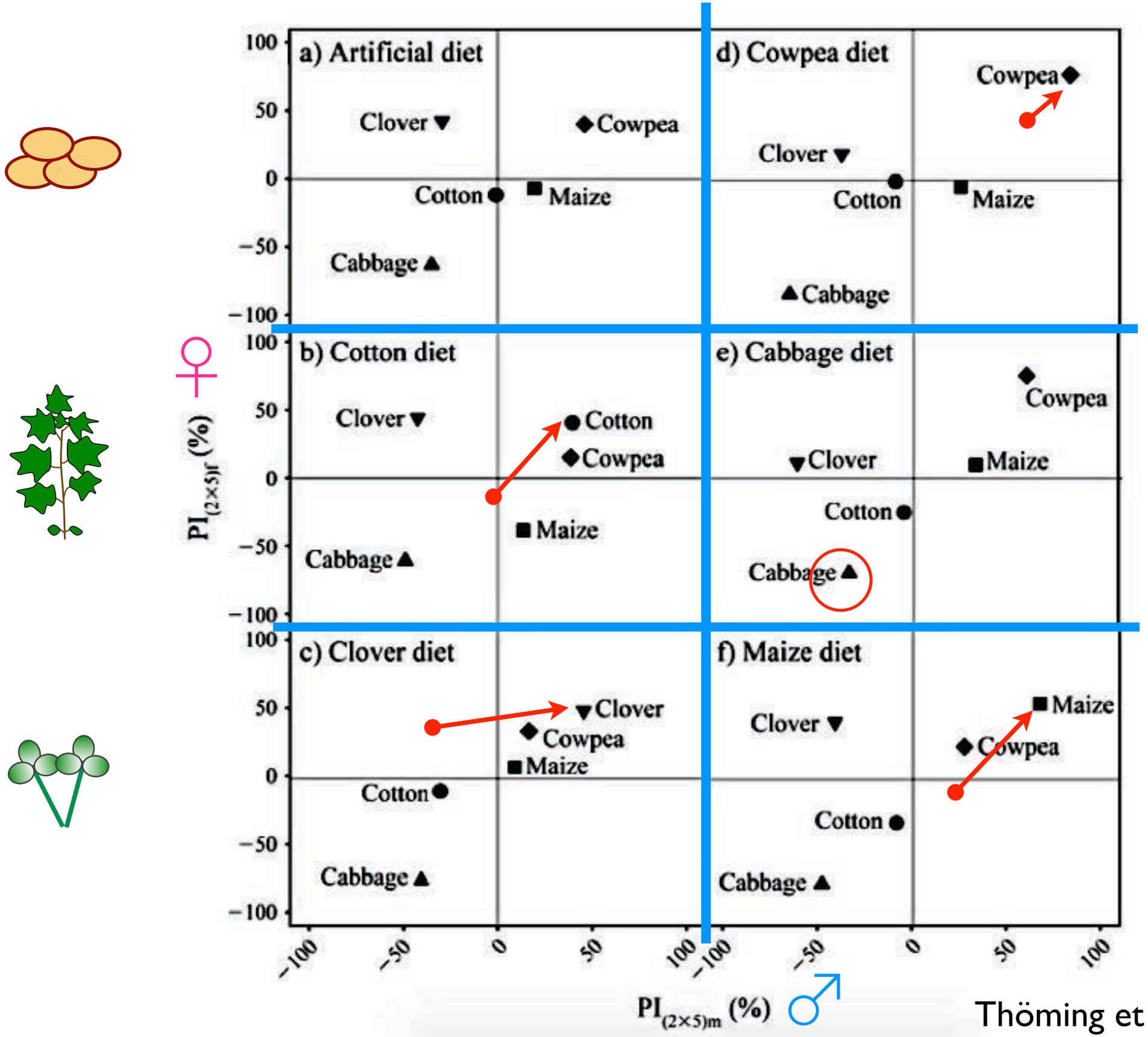






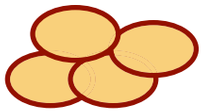
Thöming et al. Ecology 2013

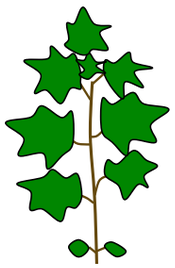
Modulation of innate preferences by larval experience

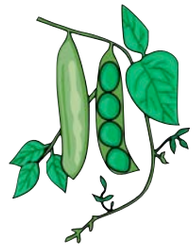


Thöming et al. Ecology 2013

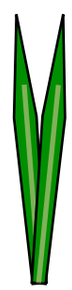
Modulation of innate preferences by larval experience

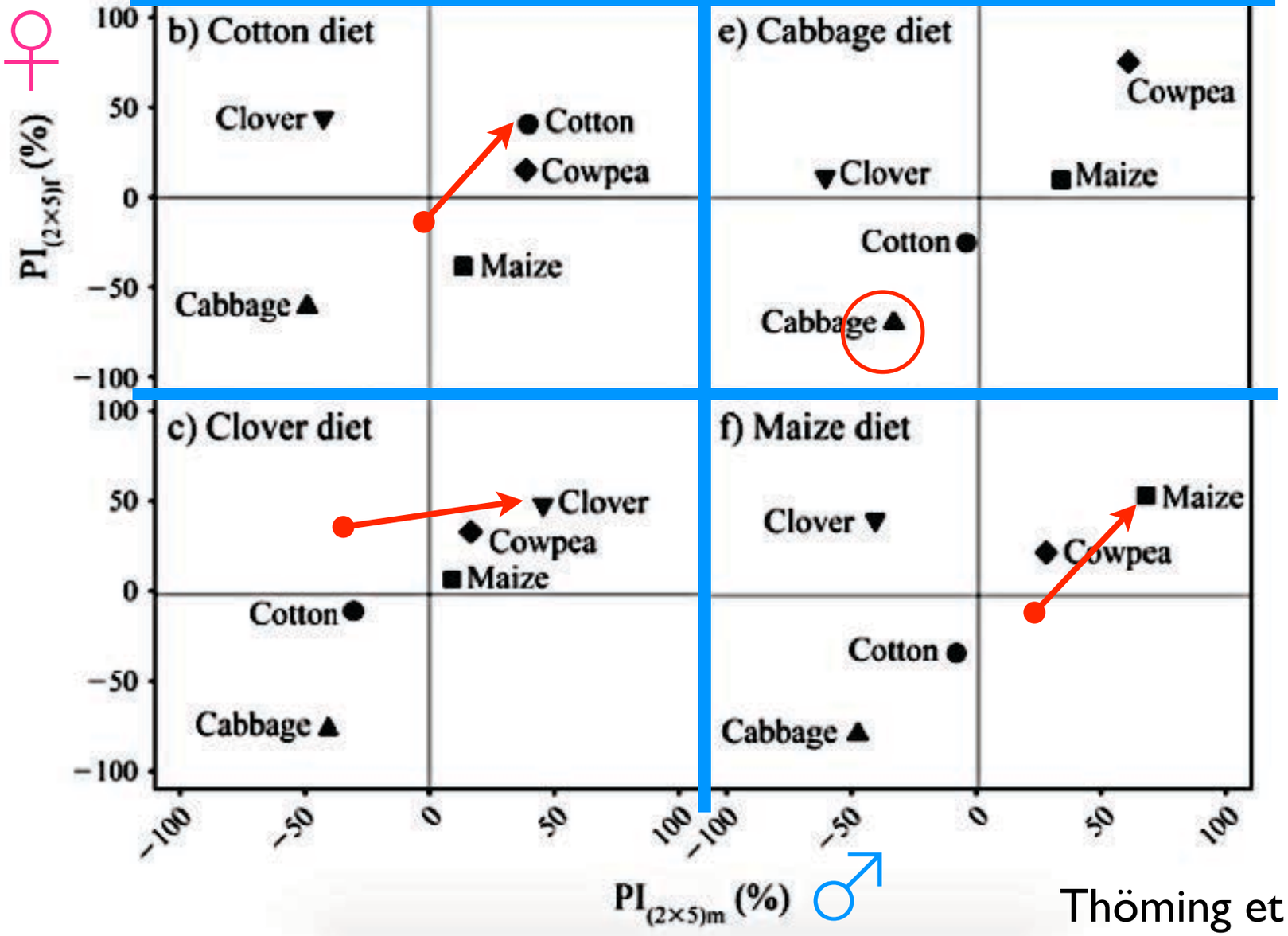






Glucosinulates



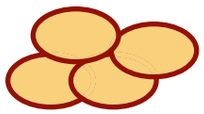


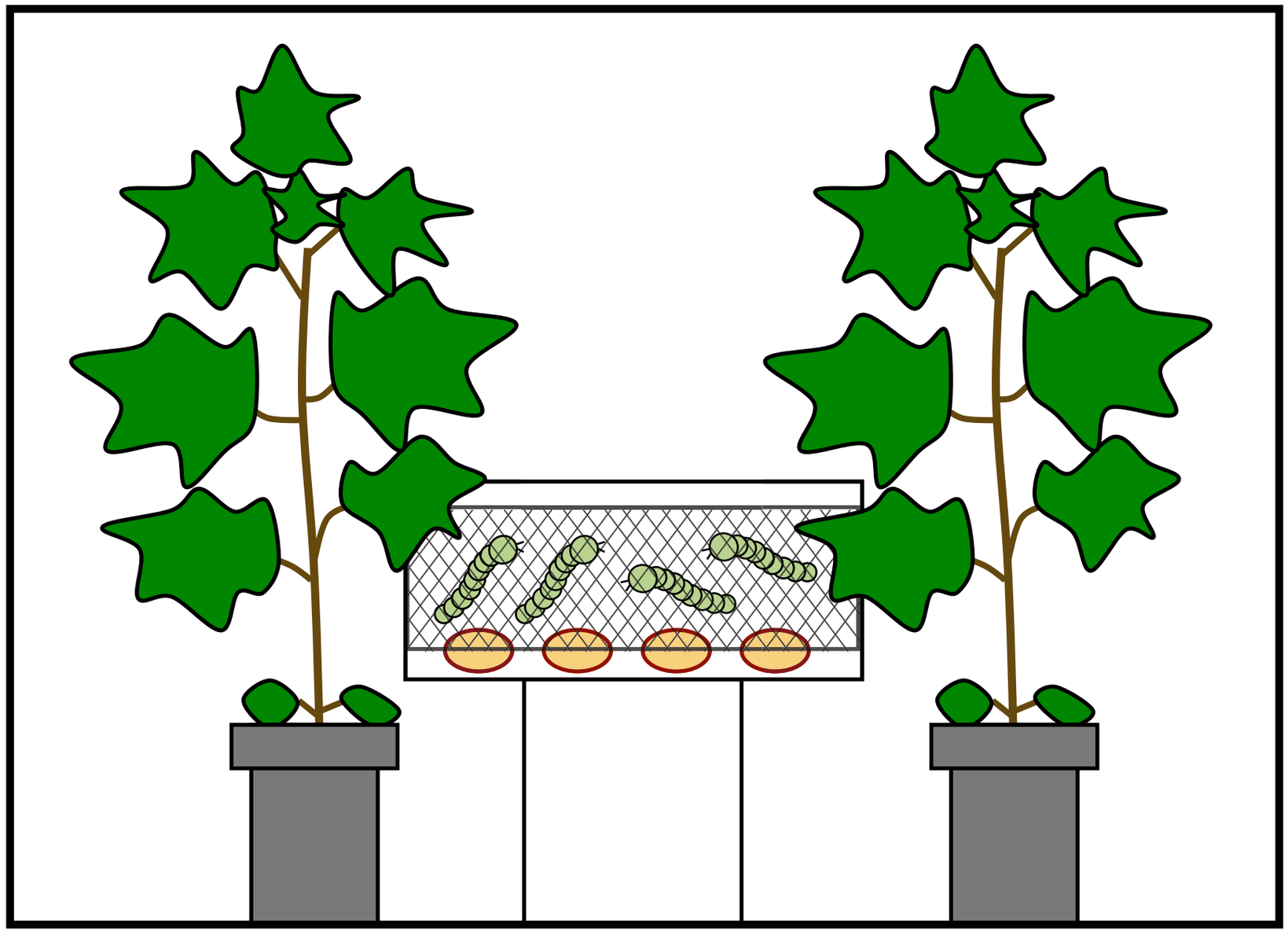
Thöming et al. Ecology 2013

Modulation of innate preferences by larval experience

Dissociation odor - food

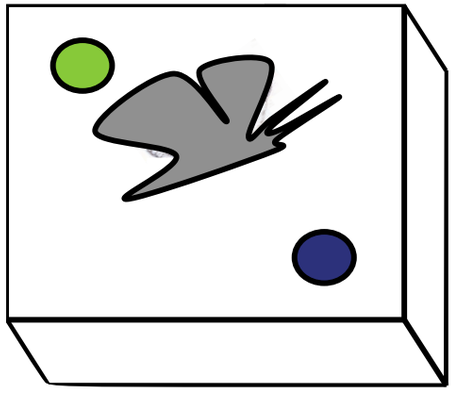
Larval food





Control = NO plants

♀



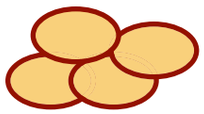
Two-choice oviposition

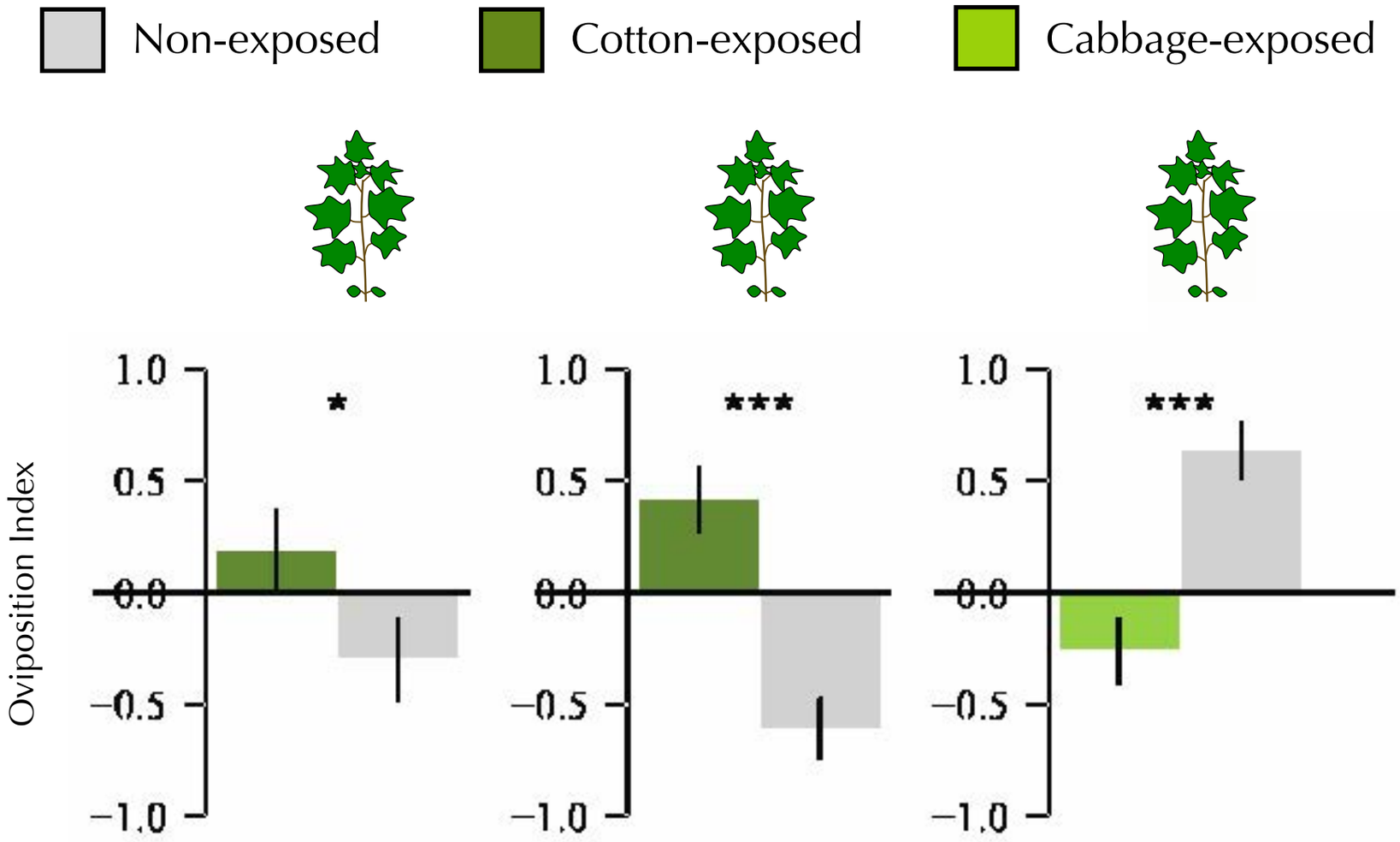
Lhomme et al. , submitted

Modulation of innate preferences by larval experience

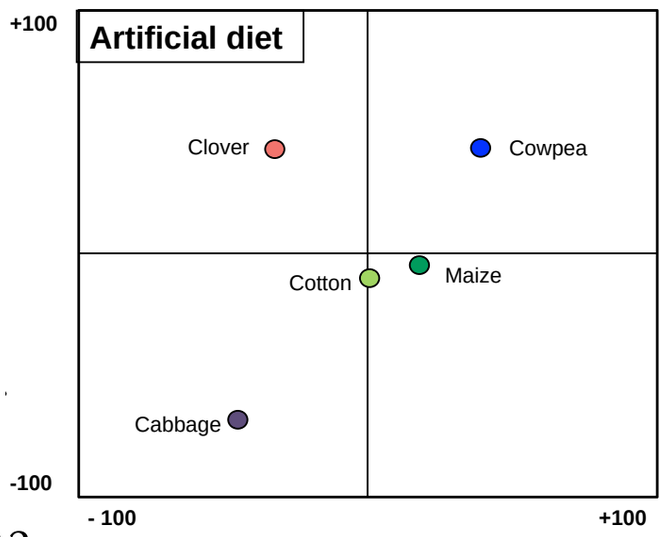
Plant odor larval exposure

Larval food





Innate preferences

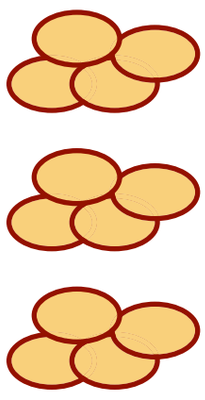


Lhomme et al. , submitted

Modulation of innate preferences by larval experience

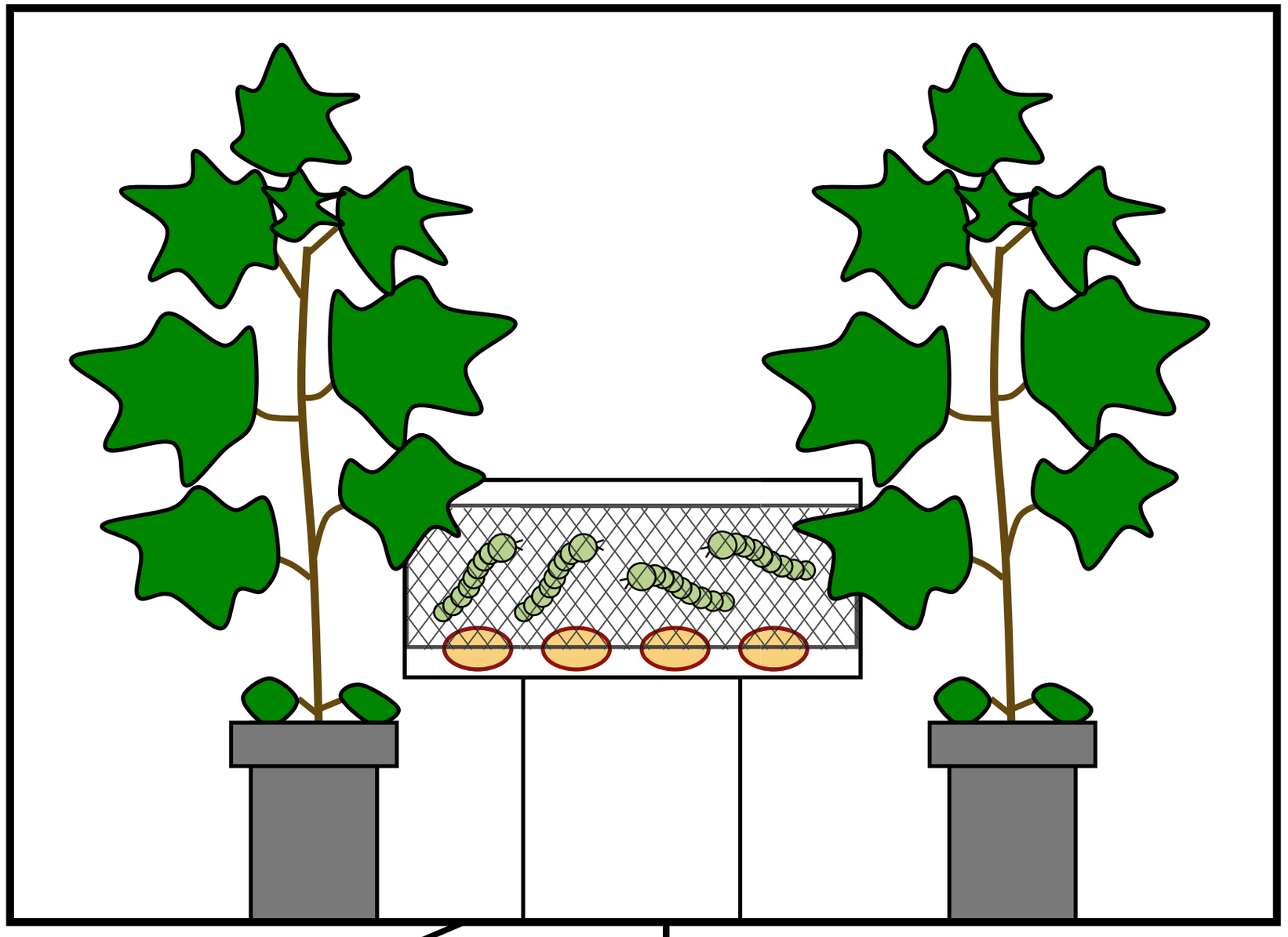
Dissociation odor - food

Larval food



+ Caffeine

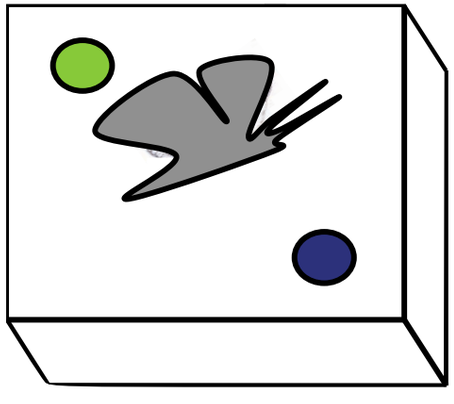
- Protein



Control = NO plants

♀

Larvae



Two-choice oviposition

Y-tube olfactometer

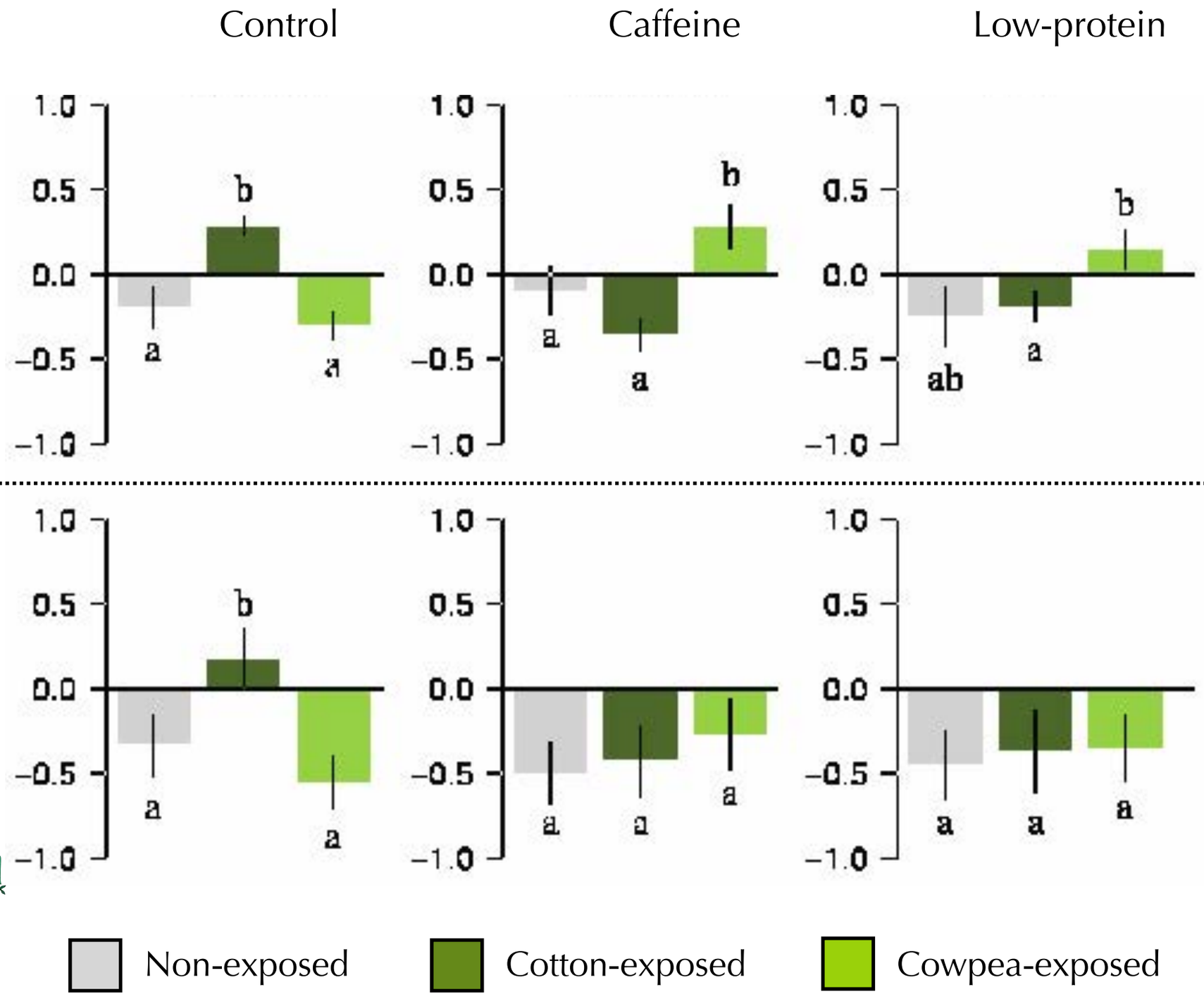
Lhomme et al. , submitted

Modulation of innate preferences by larval experience

Plant odor larval exposure + Diet

Y-tube olfactometer

2-choice oviposition



Lhomme et al. , submitted

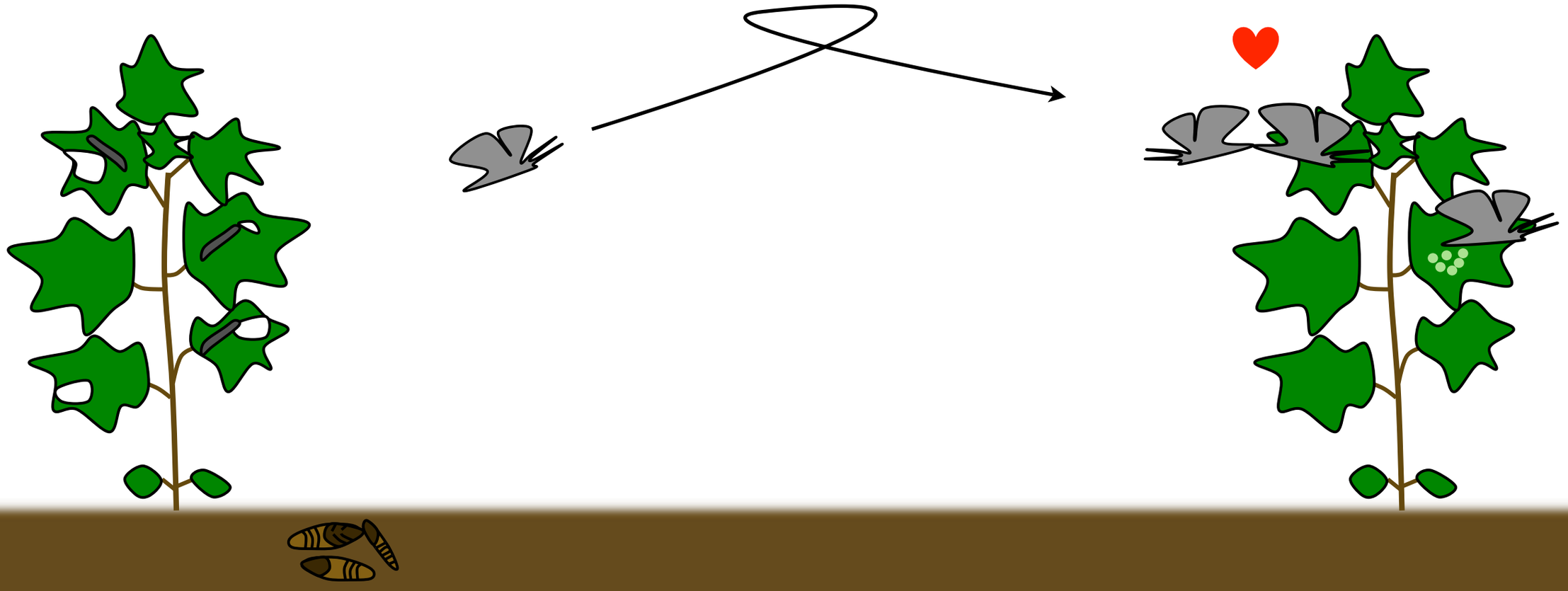
Modulation of innate preferences by larval experience

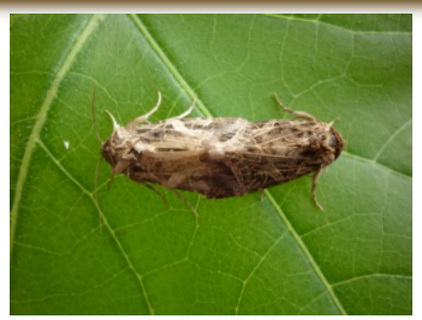
Plant odor larval exposure + Diet

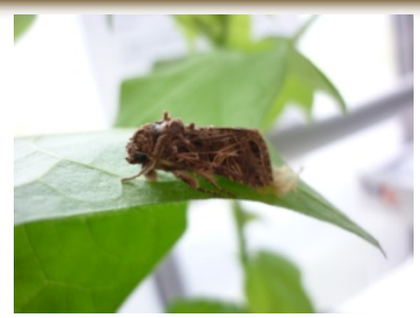
Y-tube olfactometer

2-choice oviposition

Lhomme et al. , submitted

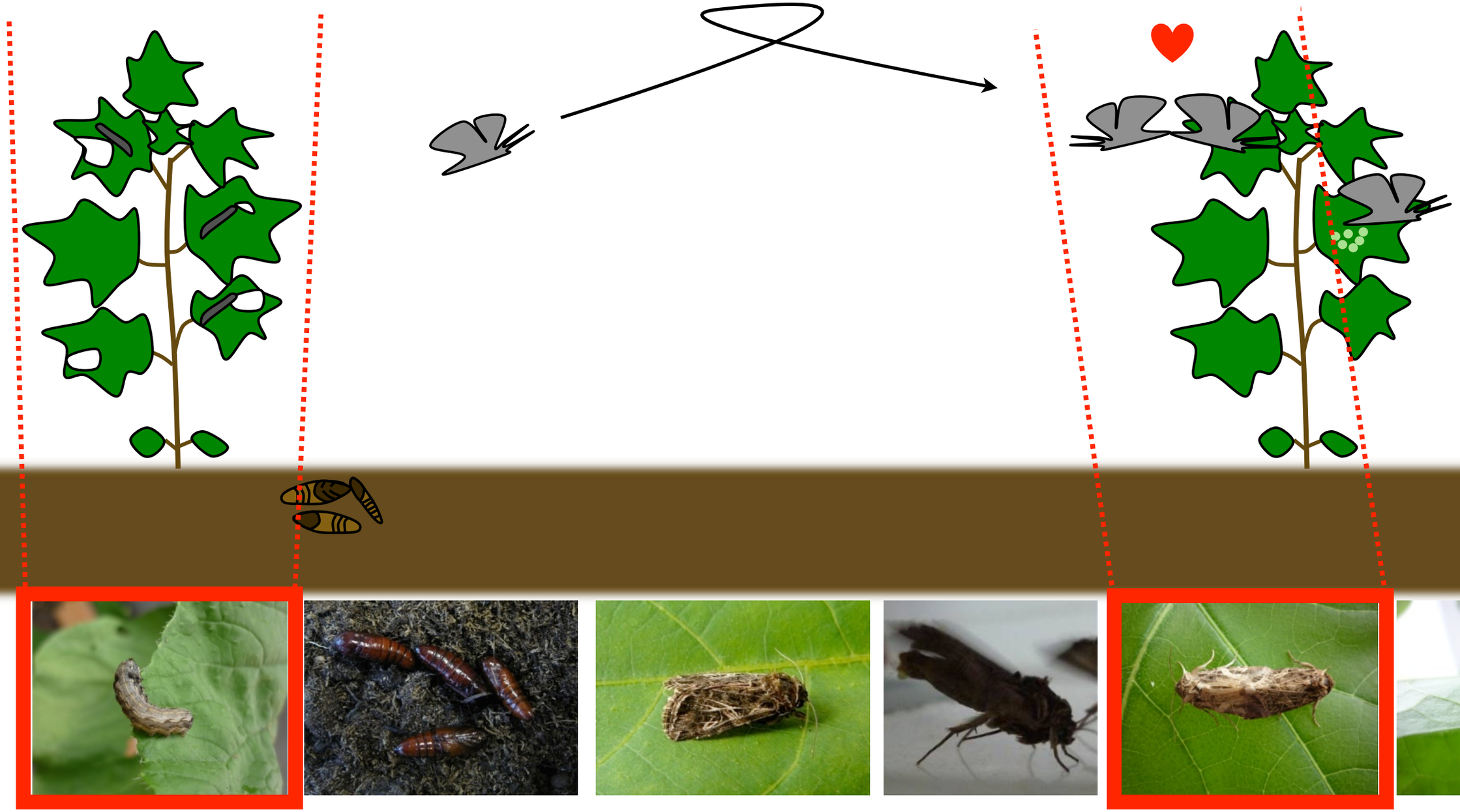






REWARD

REWARD



Modulation of innate plant preferences by previous experience

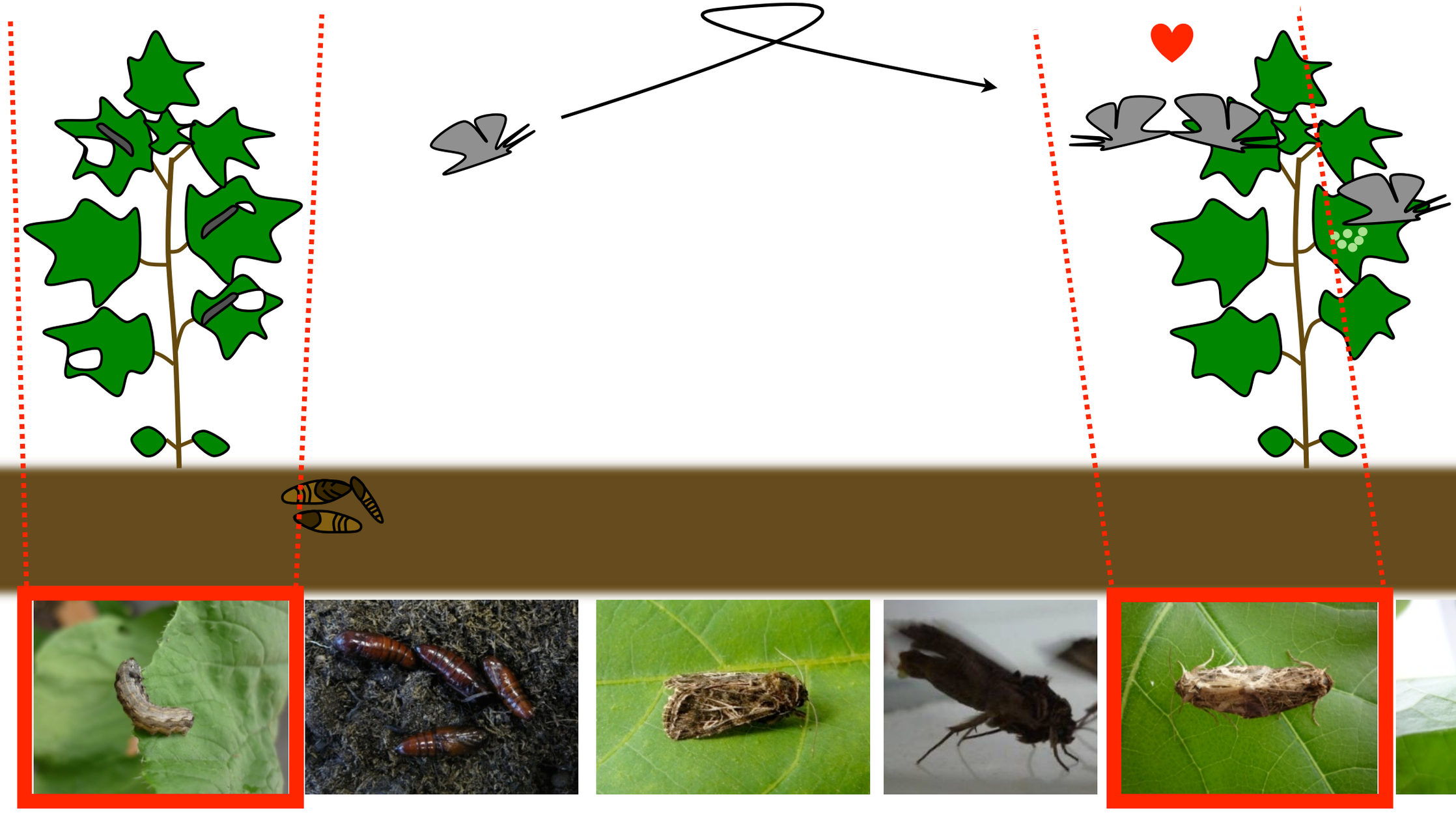
Memory Formation

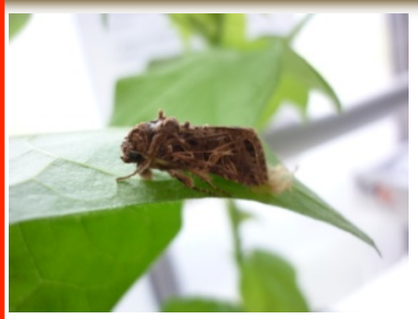
✔

?

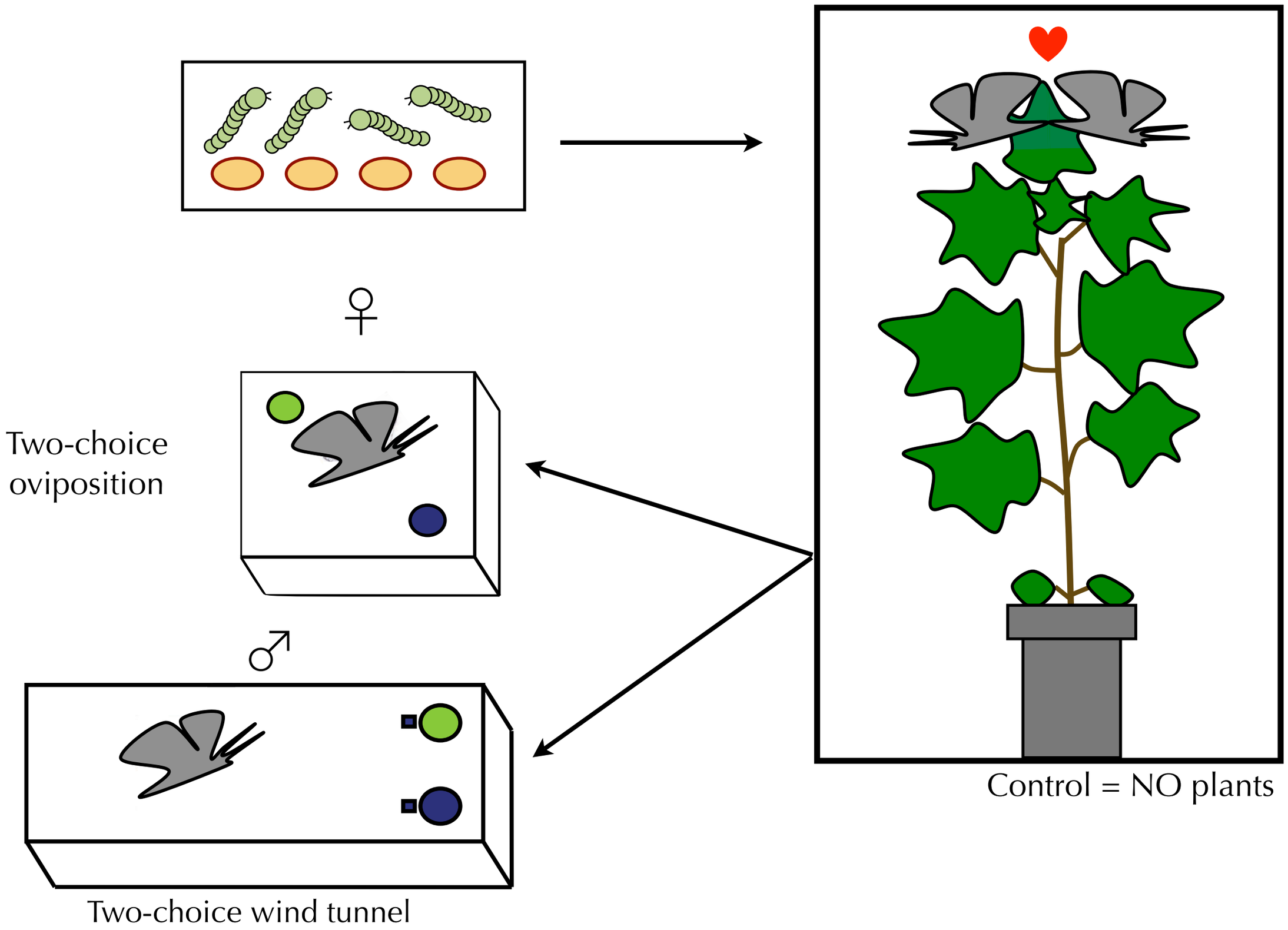
REWARD

REWARD



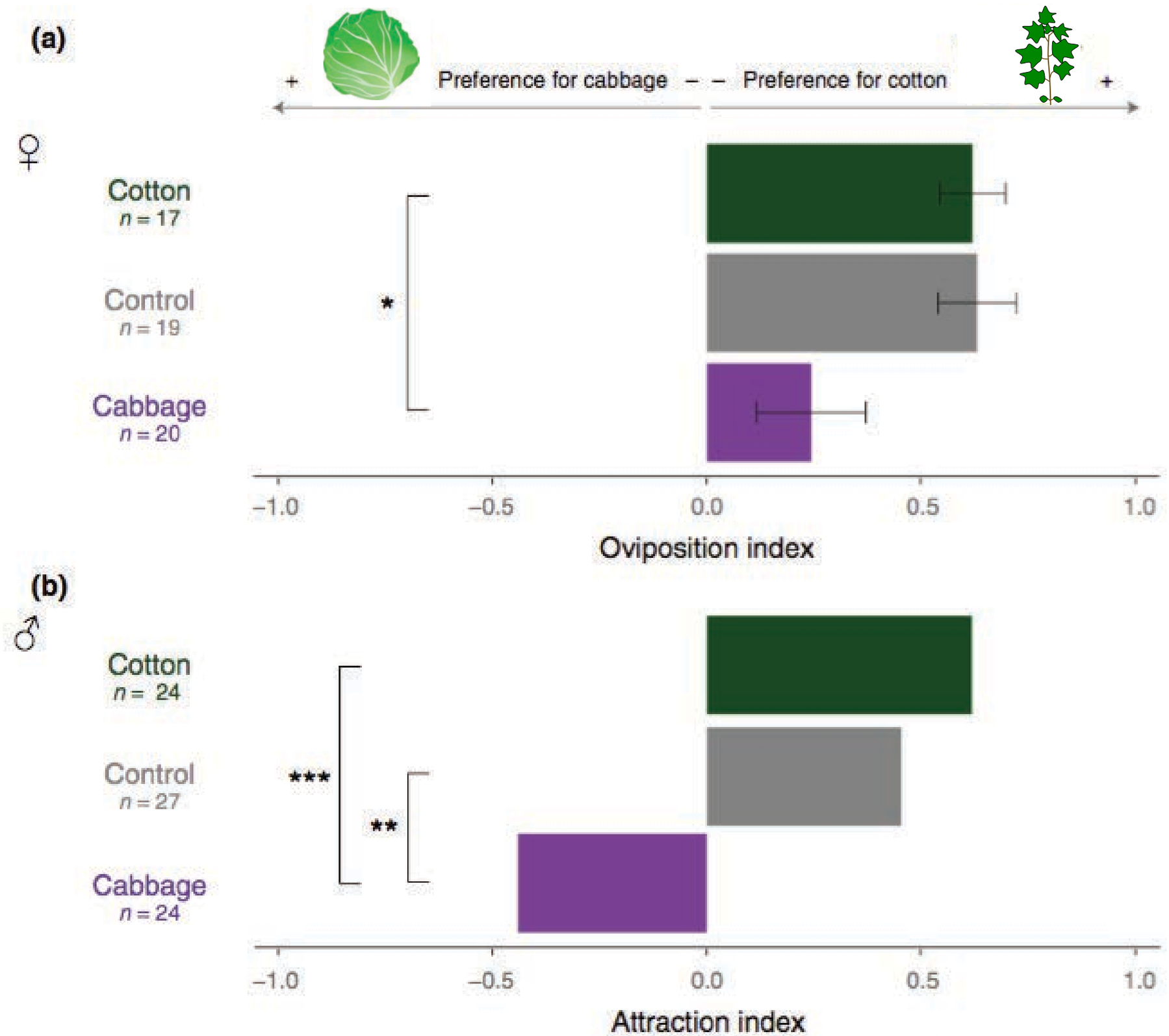


Modulation of innate preferences by mating experience



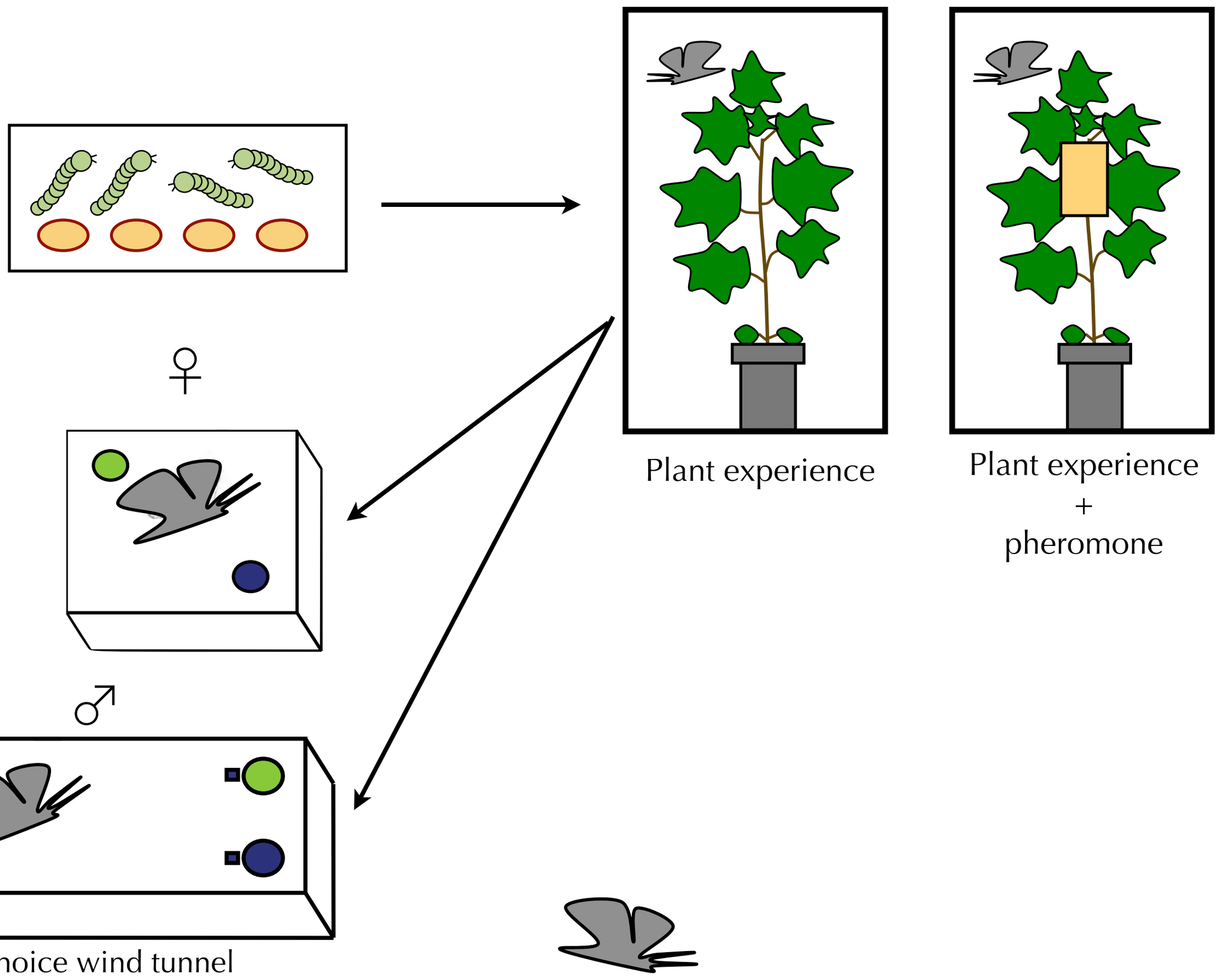
Modulation of innate preferences by mating experience

Plant odor exposure during mating



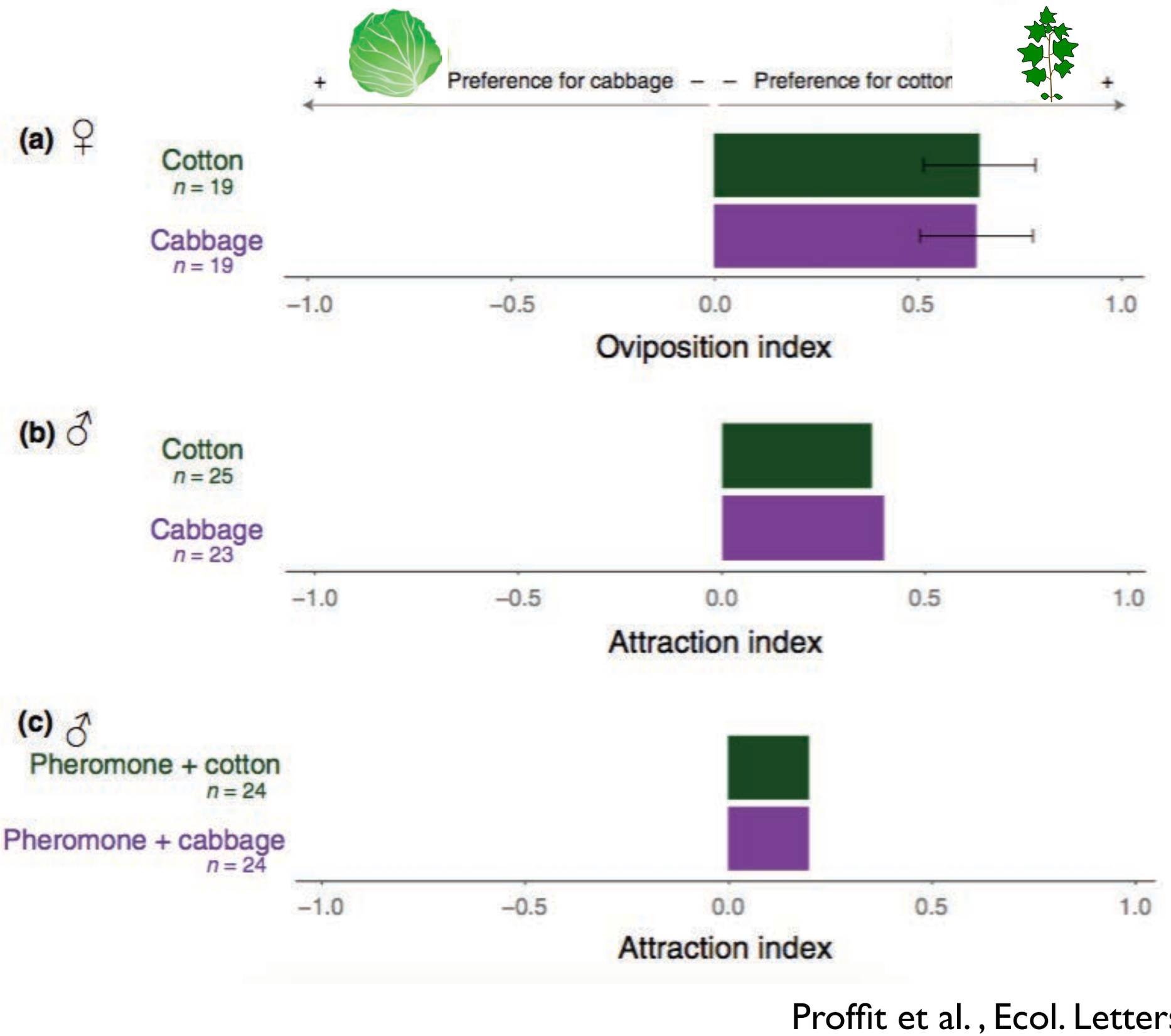
Proffit et al. , Ecol. Letters 2015

Modulation of innate preferences by mating experience



Modulation of innate preferences by mating experience

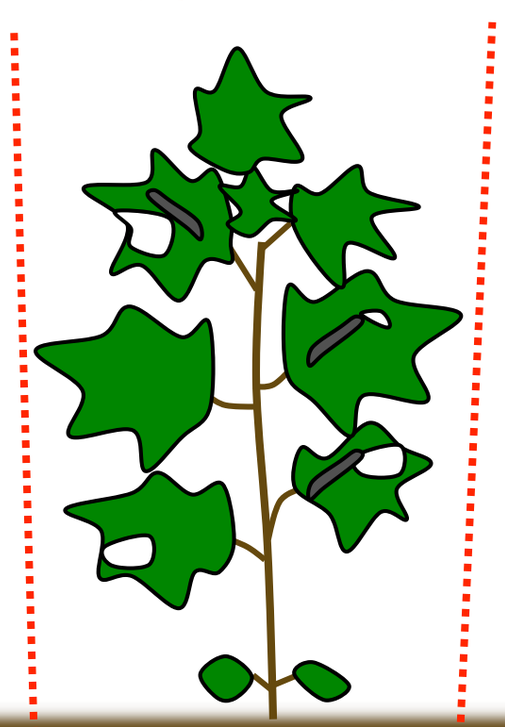
Plant odor exposure + No-mating

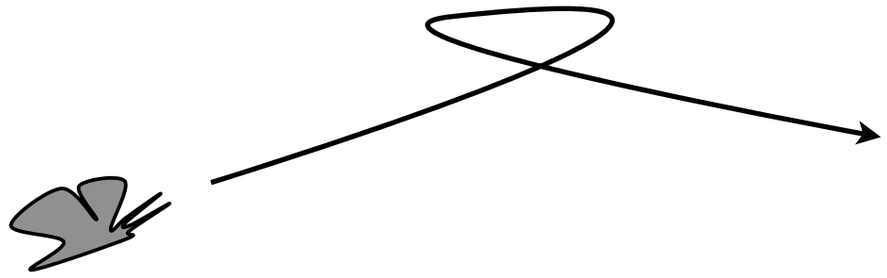


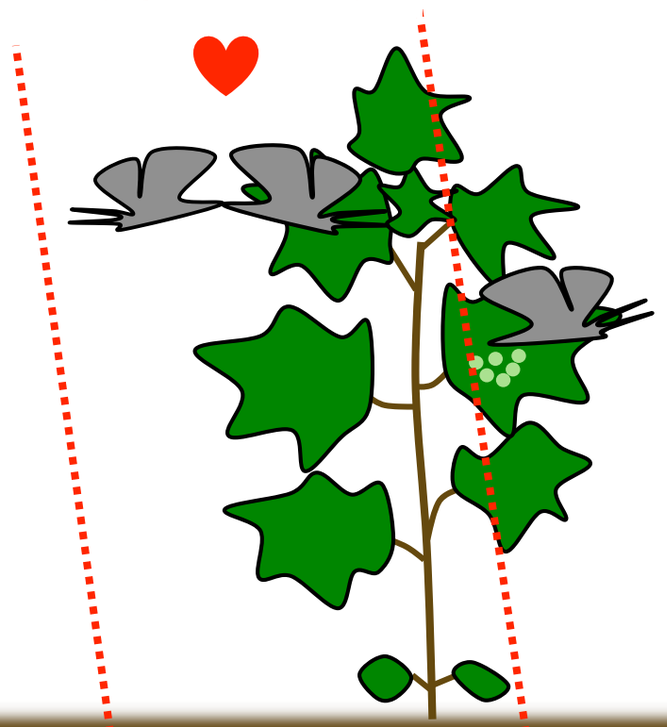
Proffit et al. , Ecol. Letters 2015

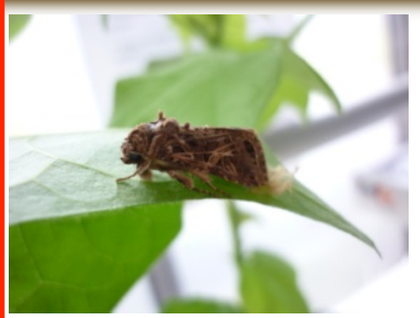
REWARD

REWARD



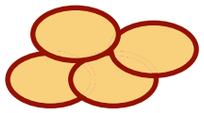


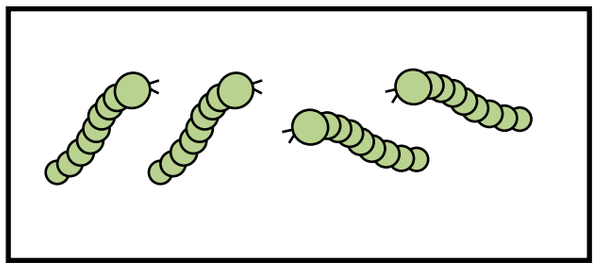


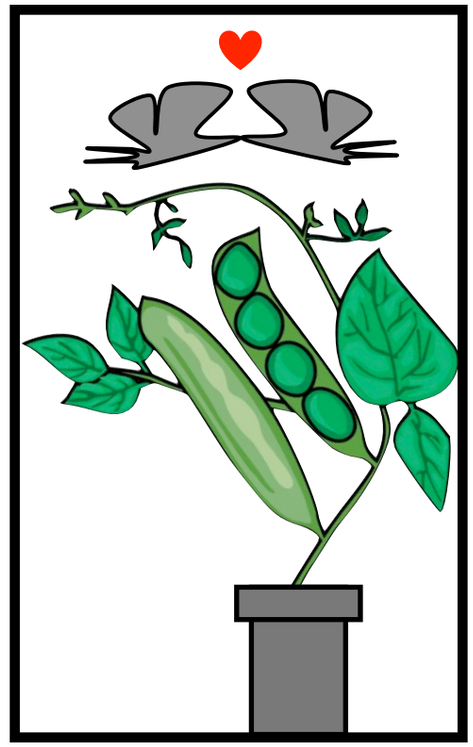


Modulation of innate preferences by larval and mating experience

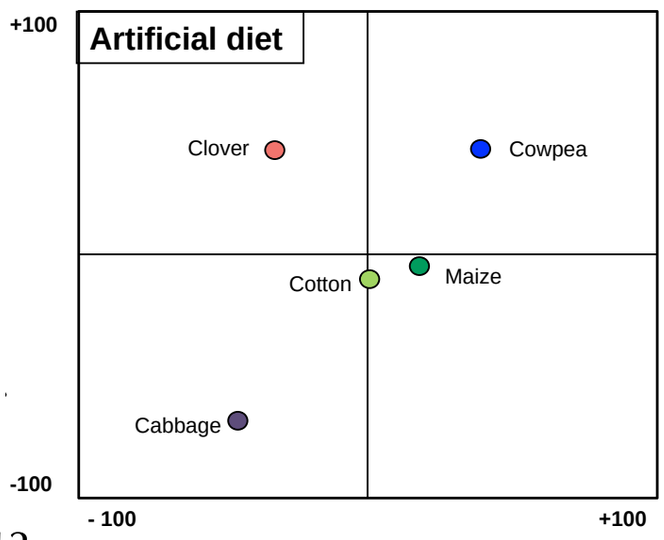
Larval food



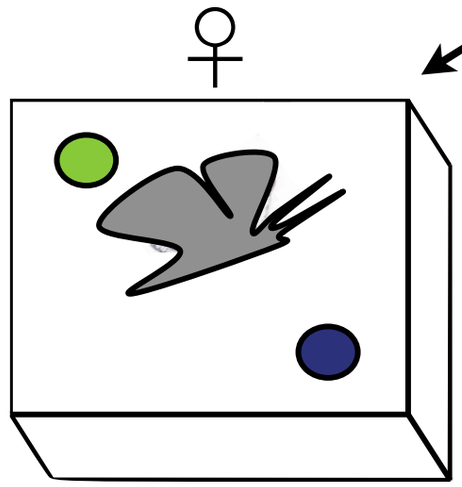




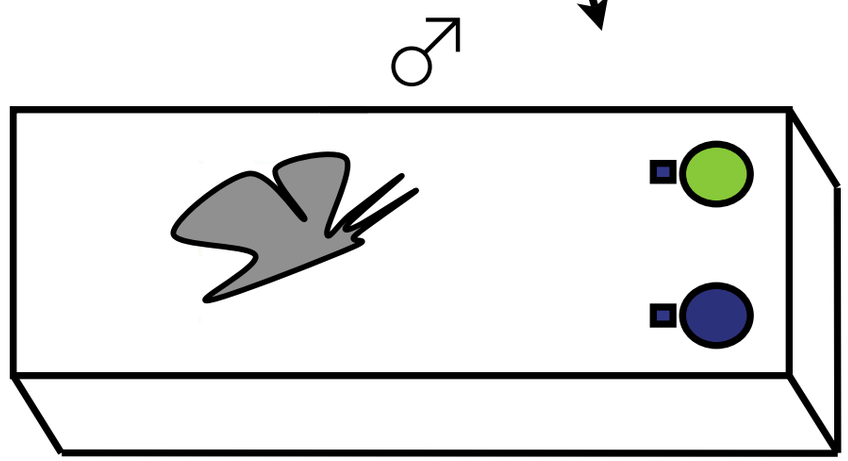
Innate preferences



Control = No plant

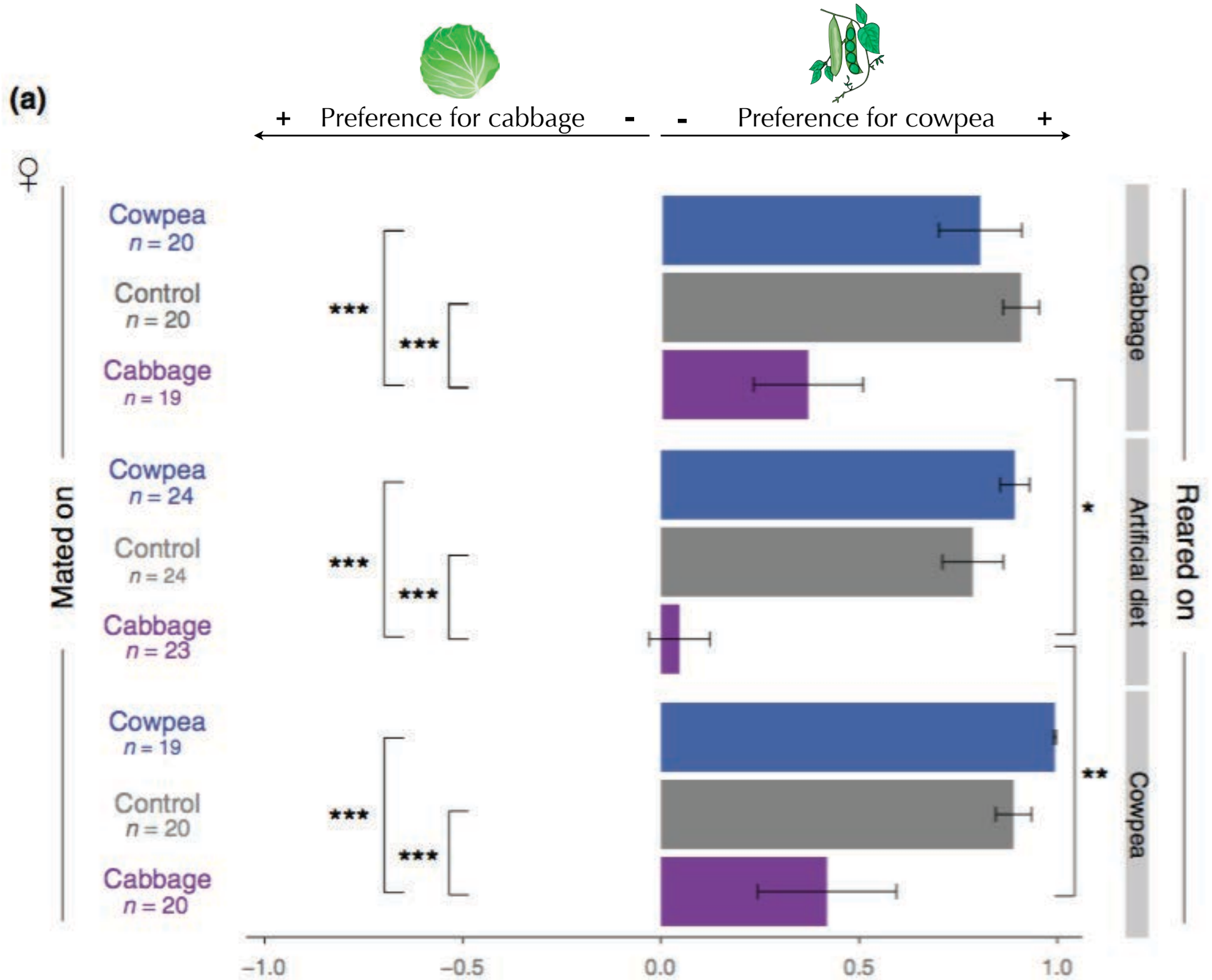


Two-choice oviposition



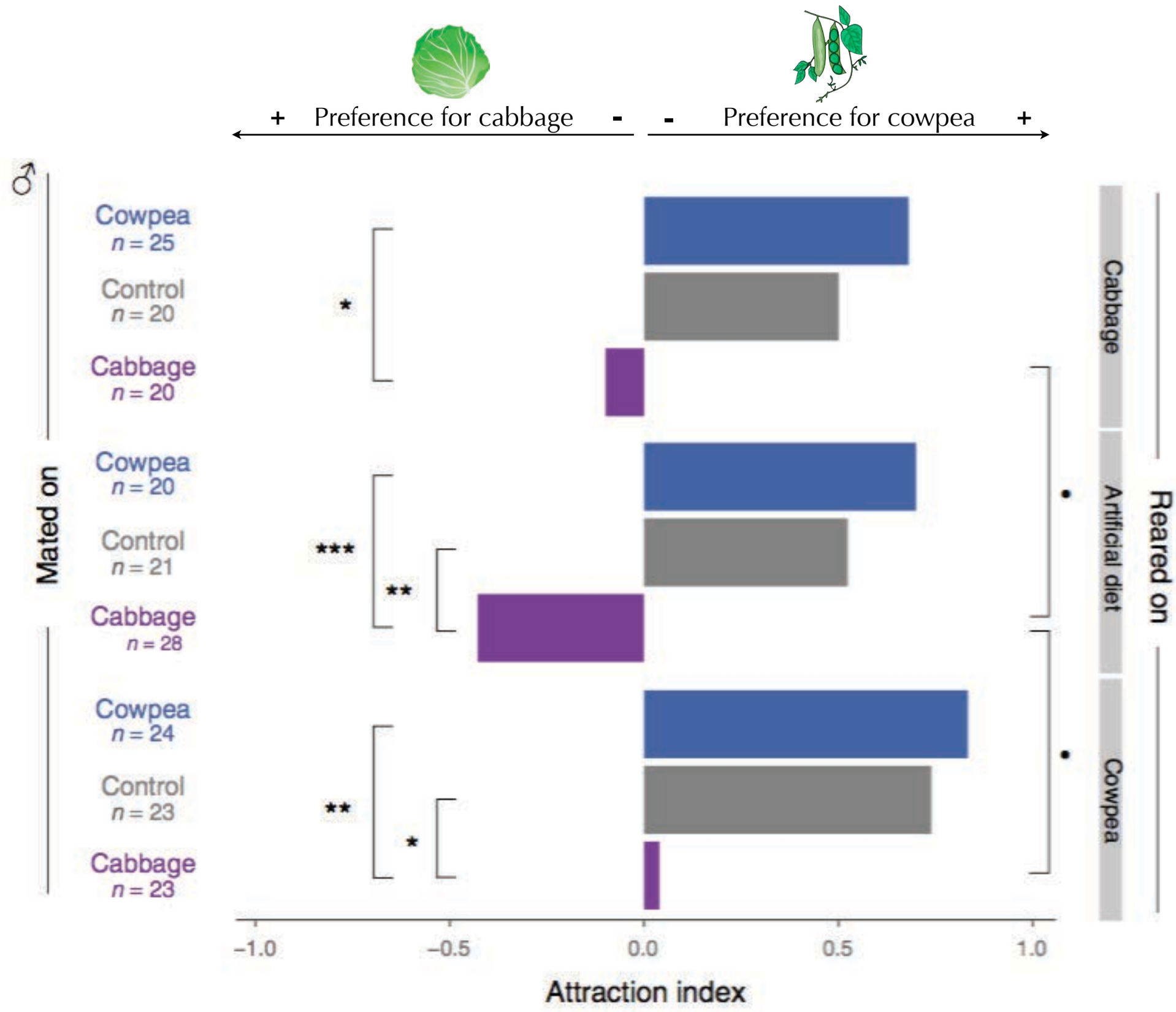
Two-choice wind tunnel

Modulation of innate preferences by larval and mating experience



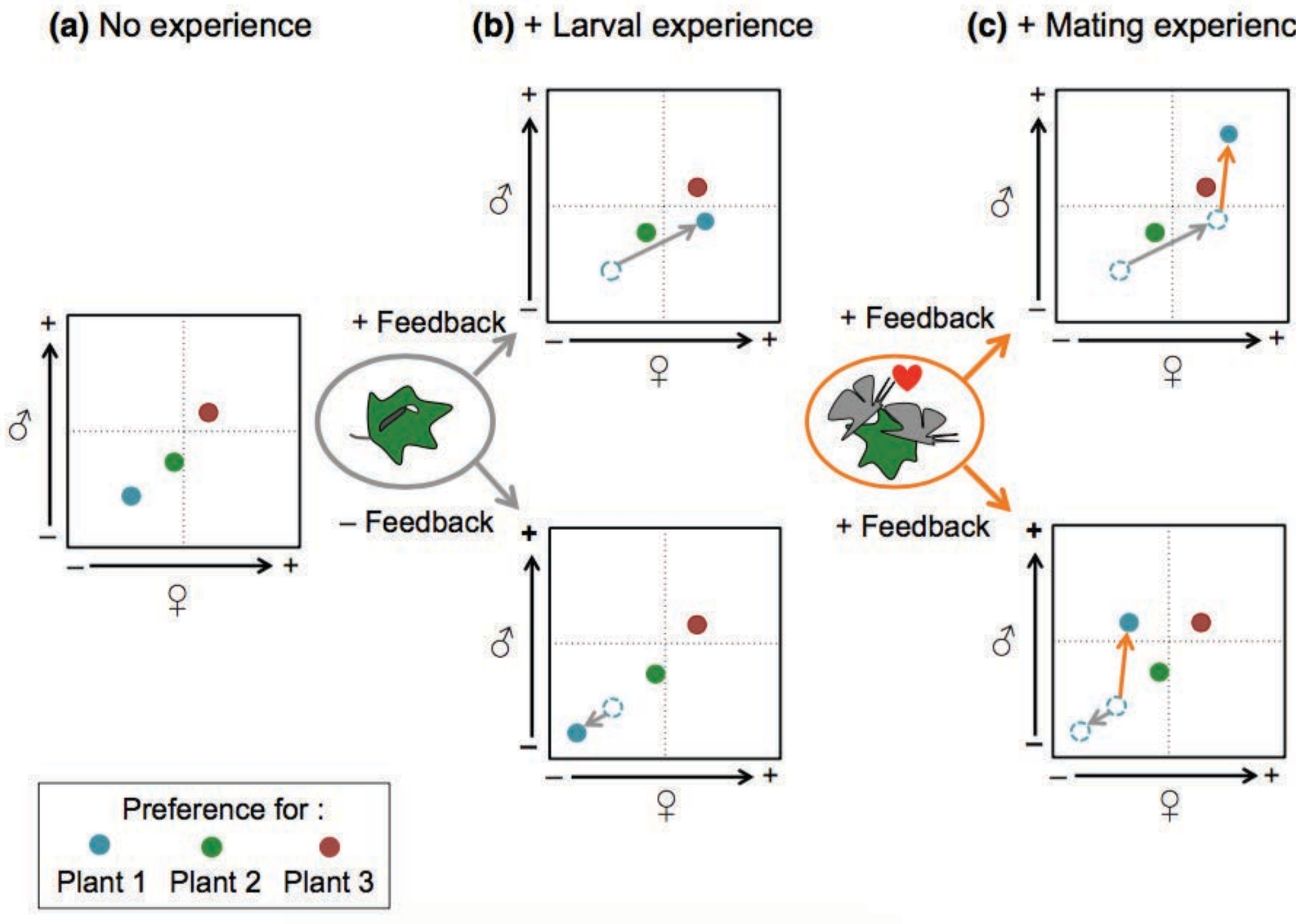
Proffit et al. , Ecol. Letters 2015

Modulation of innate preferences by larval and mating experience



Proffit et al. , Ecol. Letters 2015

Modulation of innate preferences by larval and mating experience



Summary

- Innate plant preference hierarchy is modulated by:
    + larval experience
    + mating experience

- Rewarding experiences will favor long term memory formatio

- Larvae are able to form short-term aversive memory

Summary

- Innate plant preference hierarchy is modulated by:
    + larval experience
    + mating experience

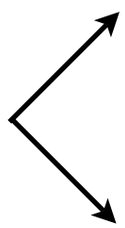
- Rewarding experiences will favor long term memory formatio

- Larvae are able to form short-term aversive memory

Experience increases selectivity in generalist insects

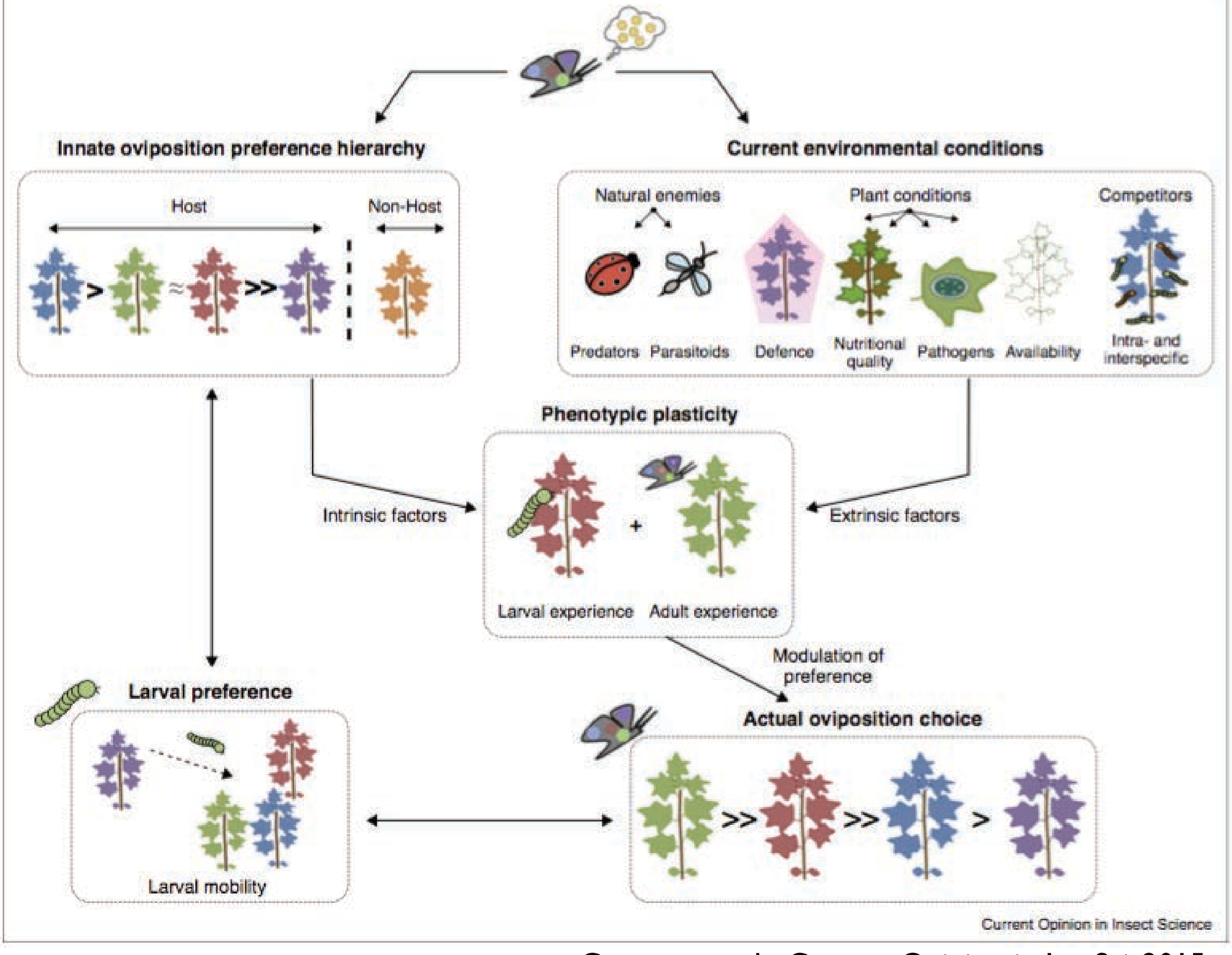
By fine tuning of multiple choices

Improve decision making



Time

Accuracy

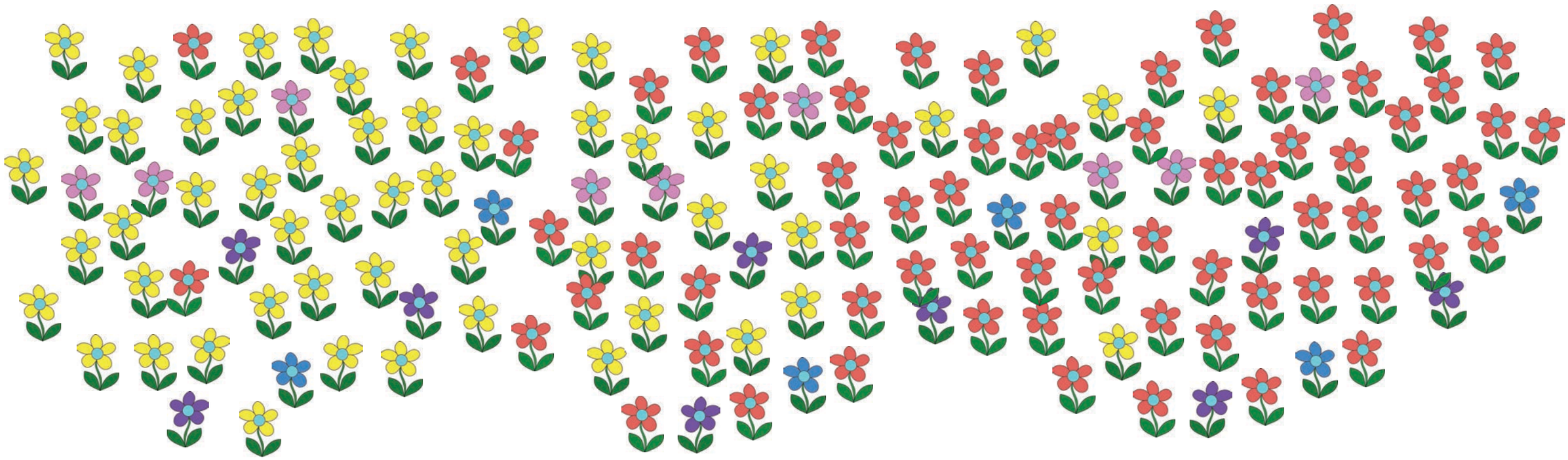


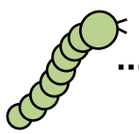
Carrasco et al. , Current Opinion in Ins. Sci. 2015

Variable environment

Within generations

time





Innate preferences

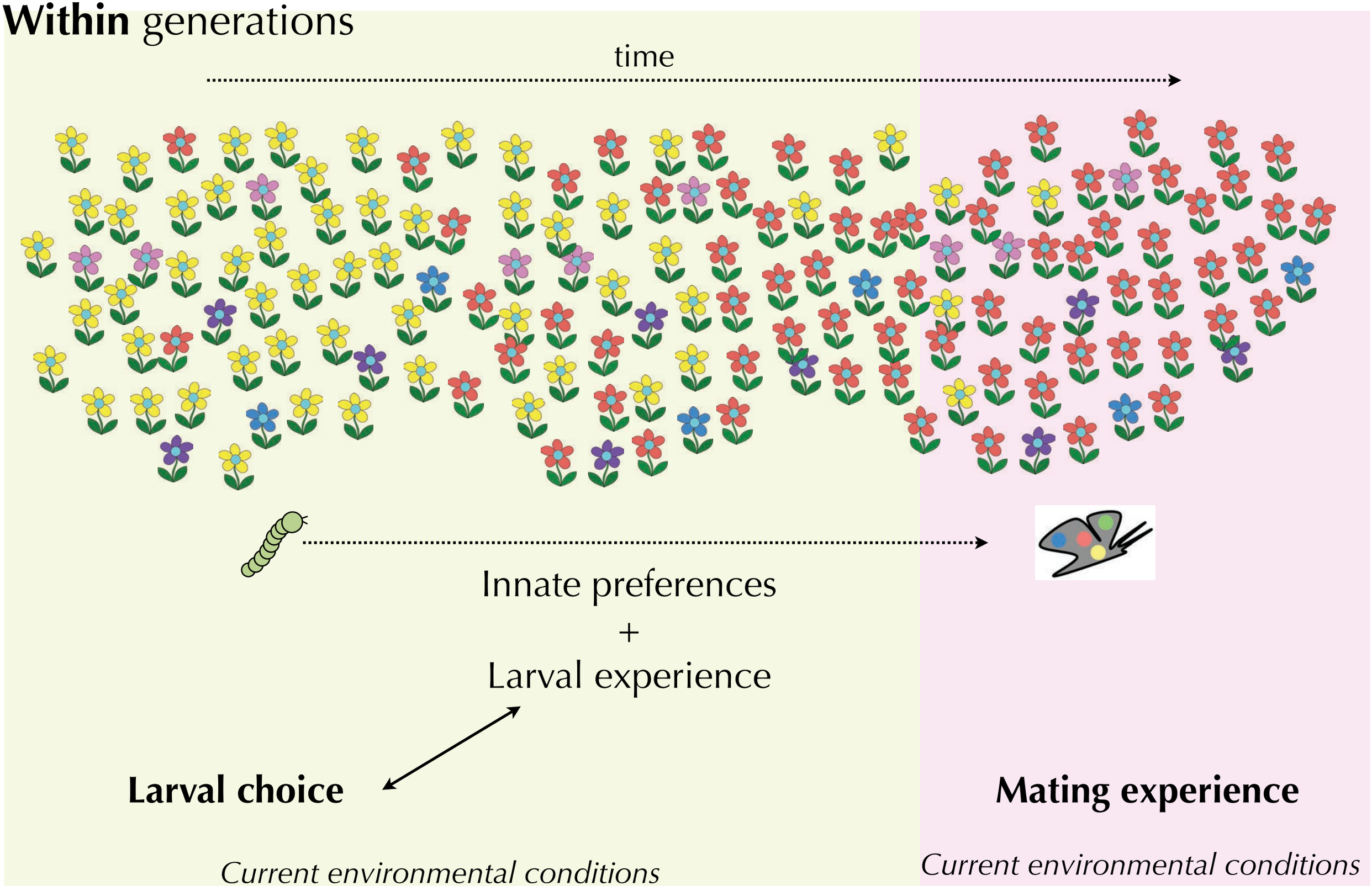
+

Previous experience ???

SOMETHING ELSE ???

Variable environment

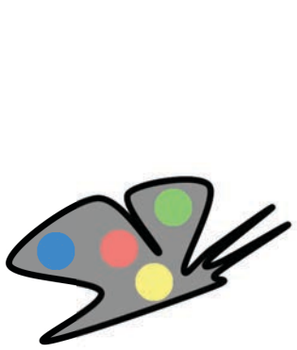
Within generations

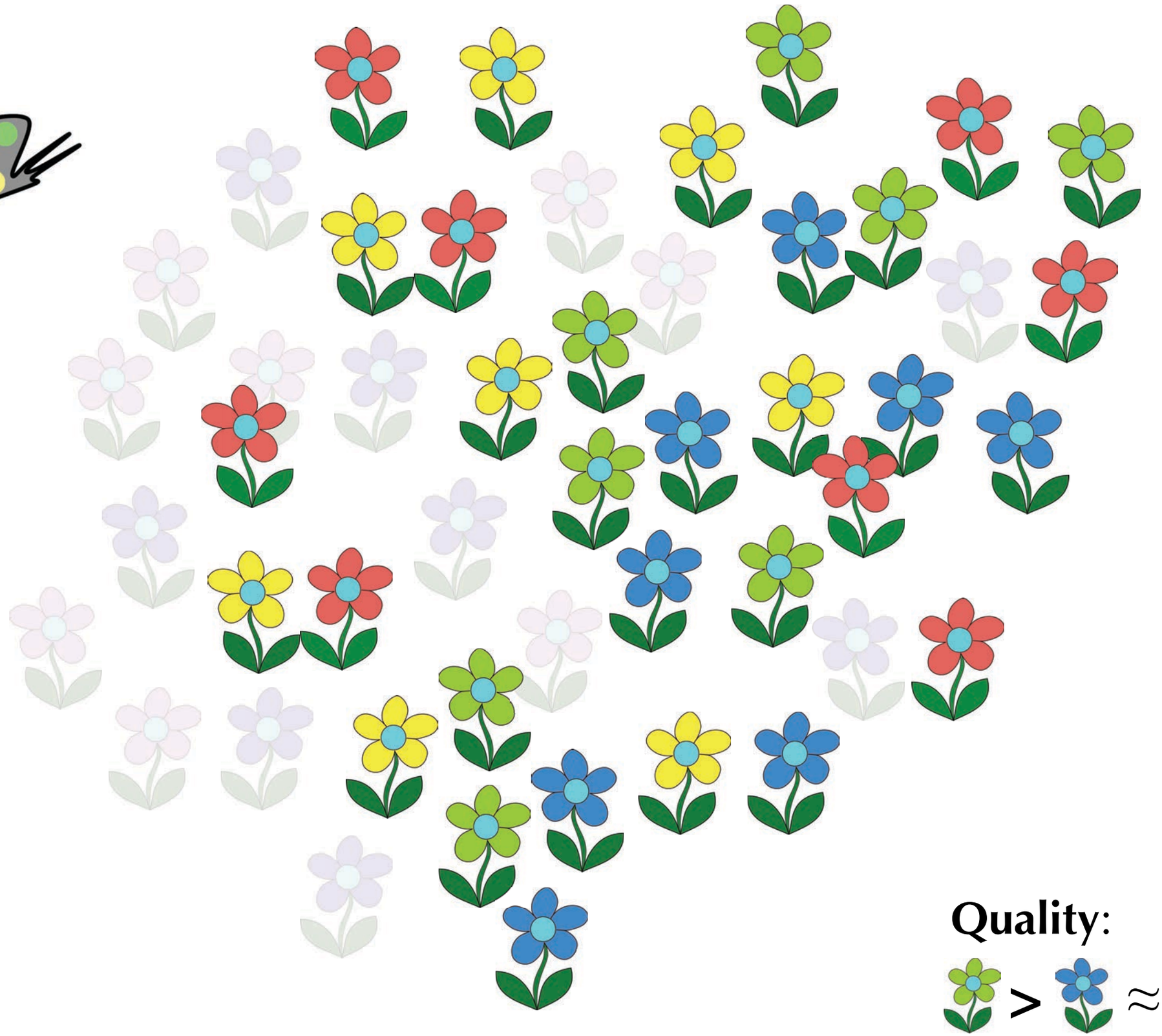


Acknowledgements

Thank you!

Constant environment



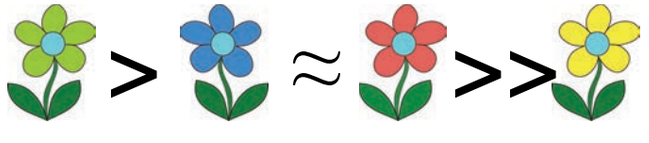


Genetically determined preferences

+

Experience based preferences

Quality:



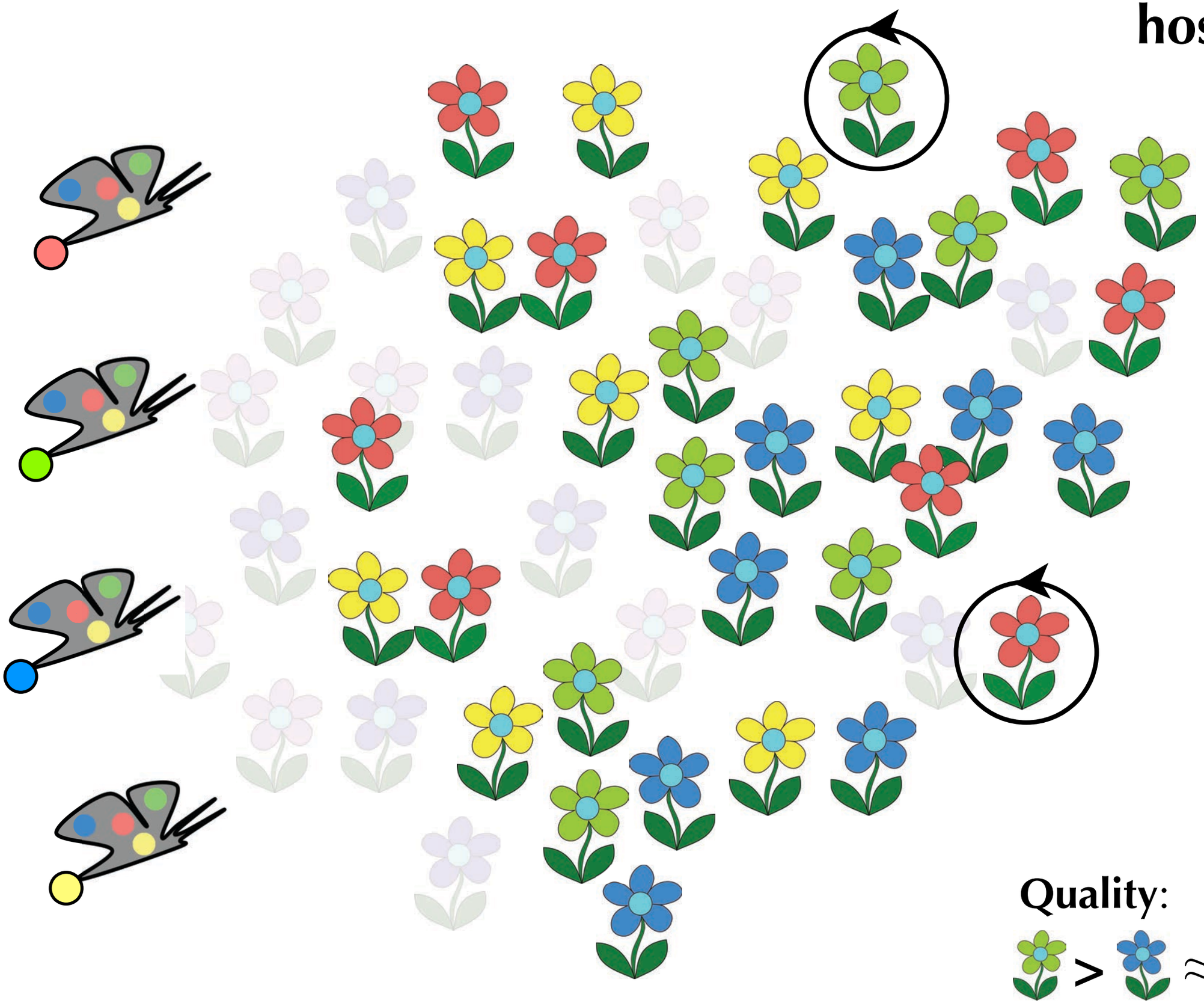
Constant environment

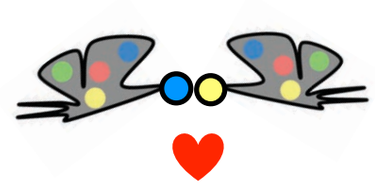
Host fidelity or host races

Genetically determined preferences

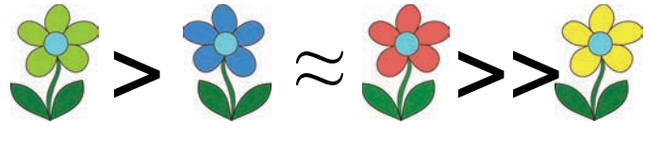
+

Experience based preferences

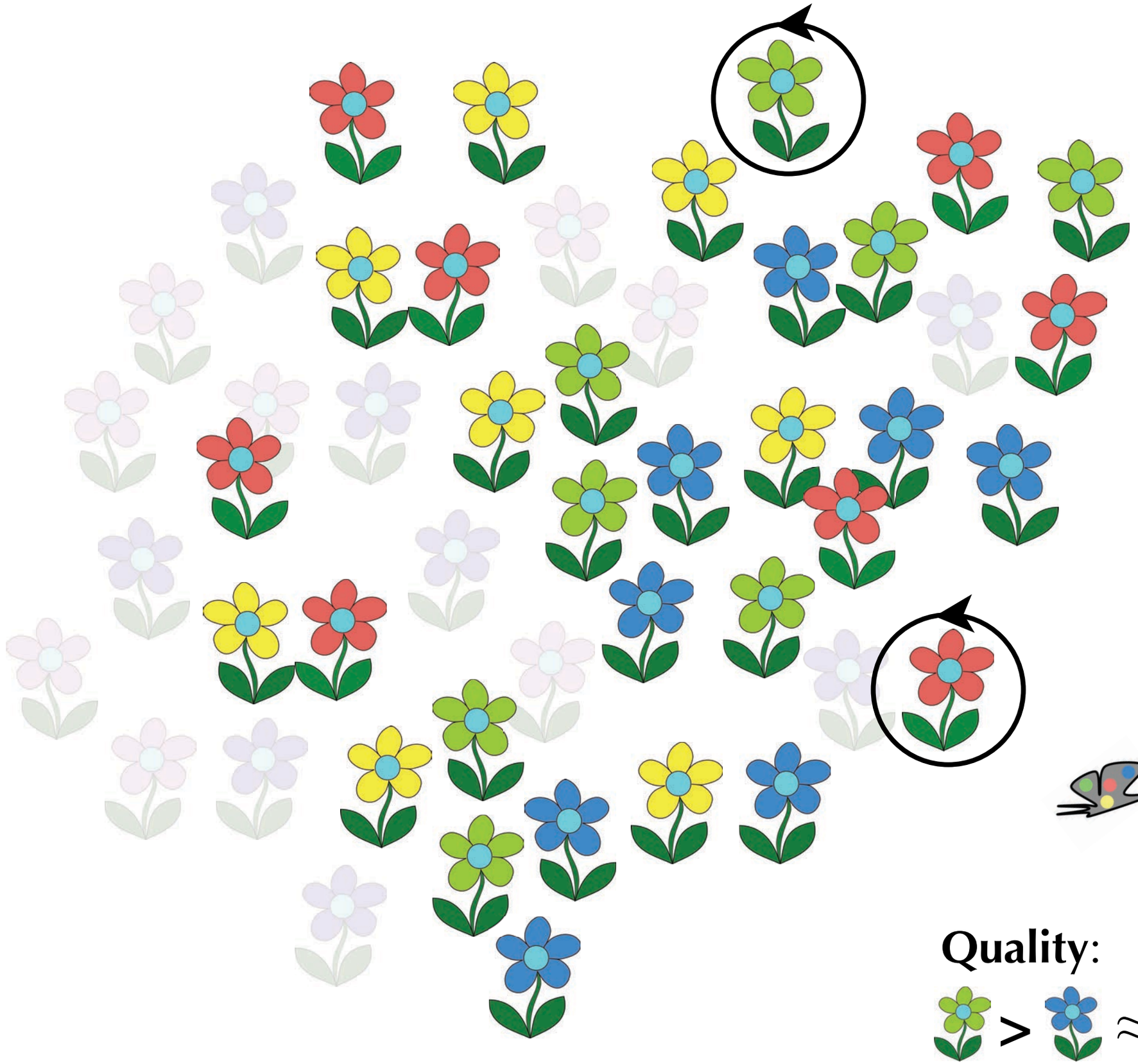




Quality:



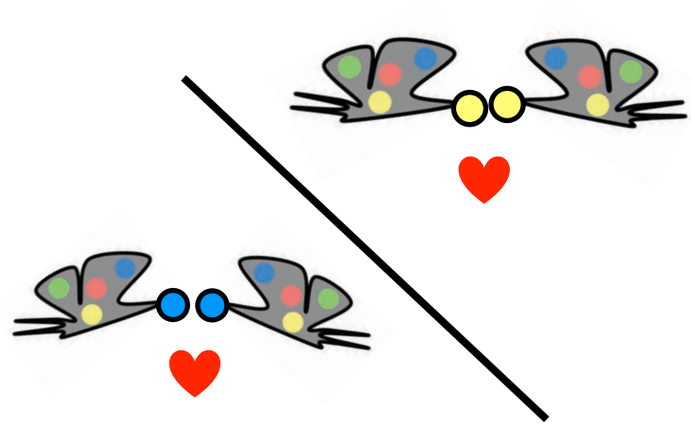
Constant environment



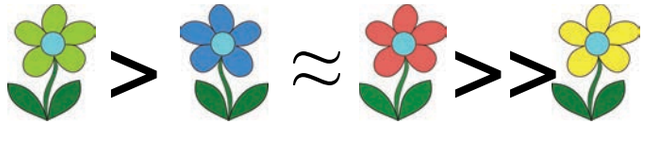
Genetically determined preferences

+

Experience based preferences



Quality:



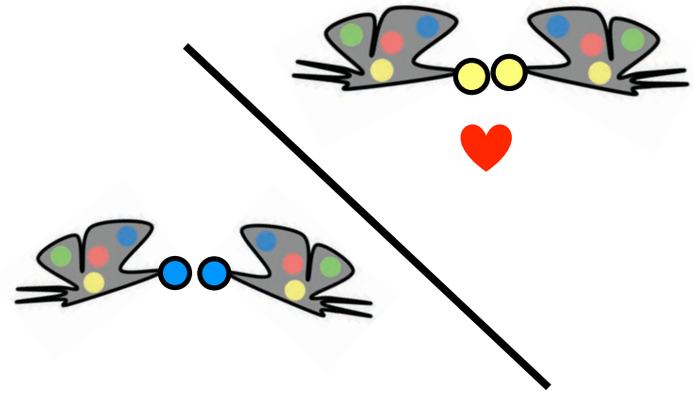
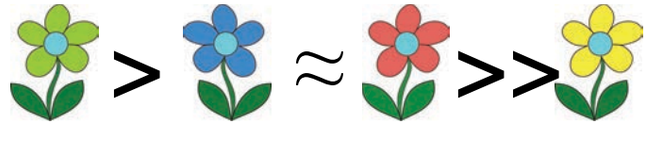
Constant environment

Speciation process

Genetically determined preferences

+

Experience based preferences



Quality: