

Brood presence shifts bumble bee foraging toward metal-free food despite lower sugar

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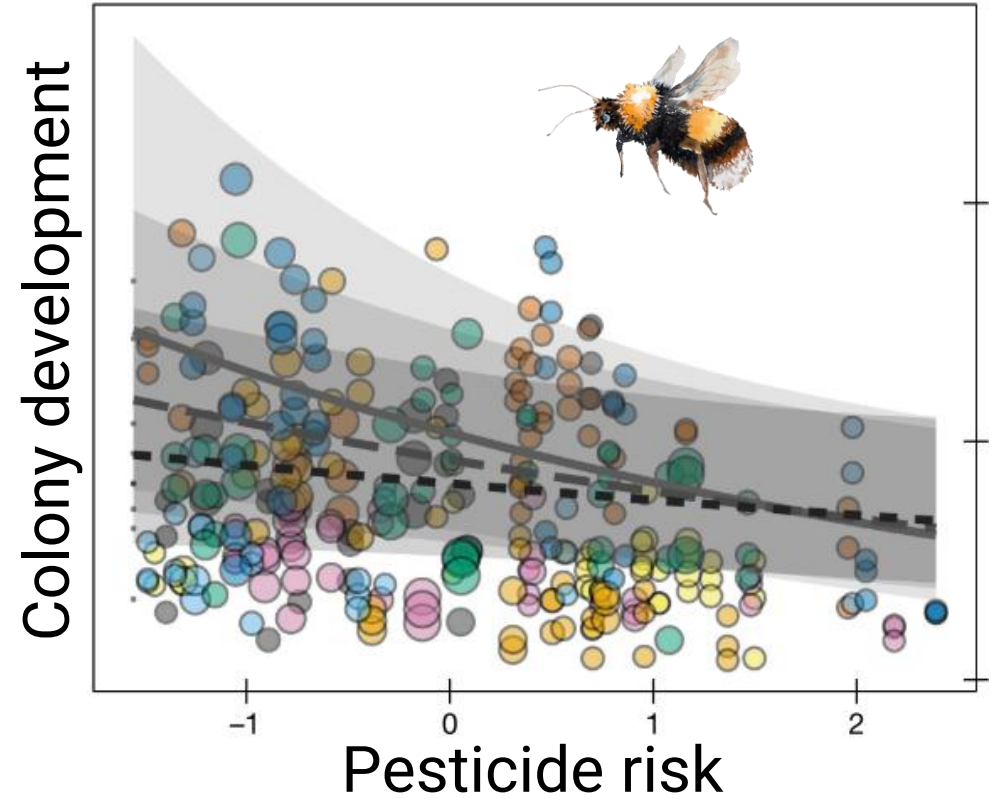
**Bees play crucial roles
in (agro-)ecosystems**



**Pesticide use is linked to
bee decline worldwide**



Pesticide use is linked to bee decline worldwide



Nicholson *et al.* (2024) *Nature*

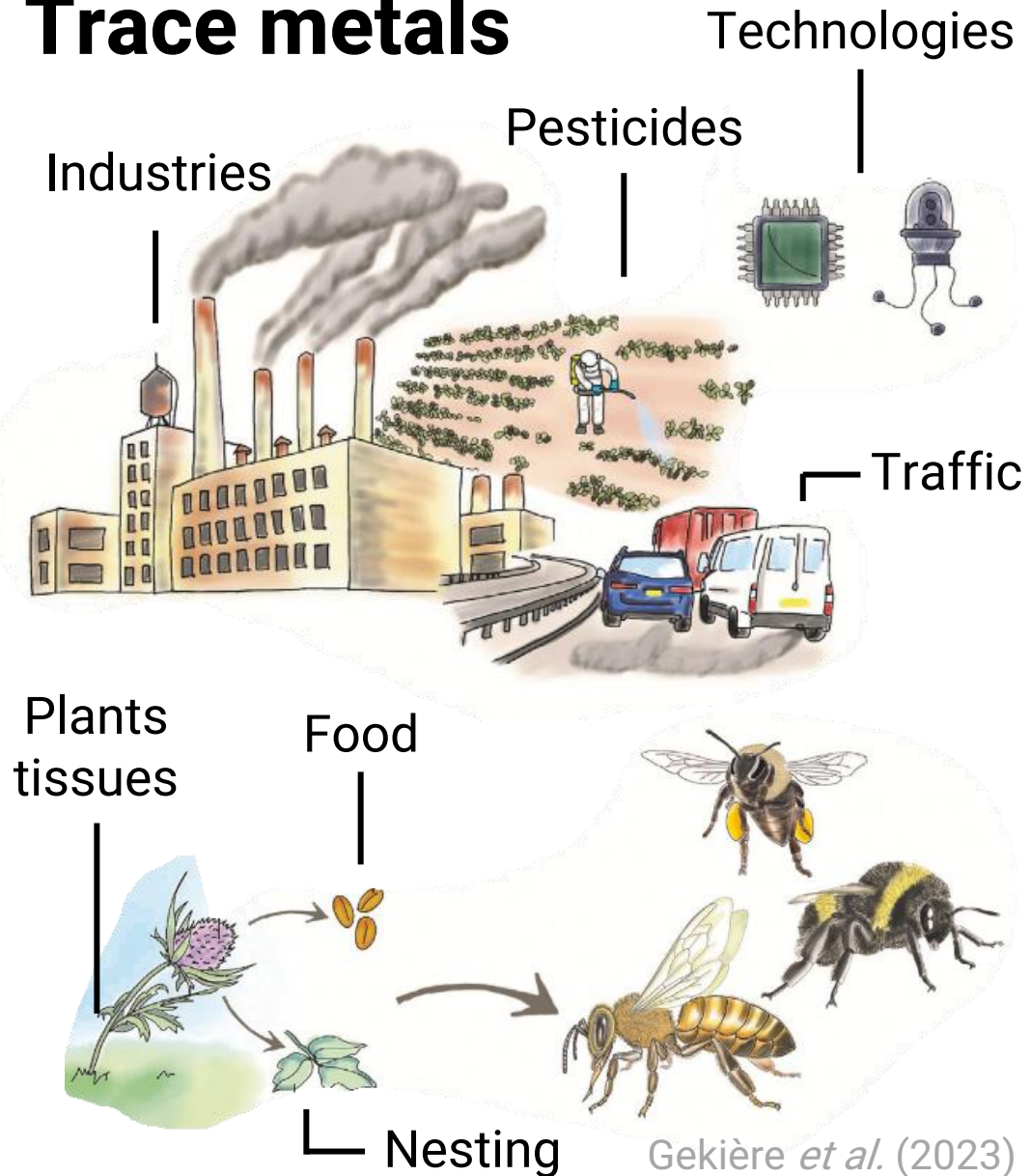


**What about other
chemical threats?**

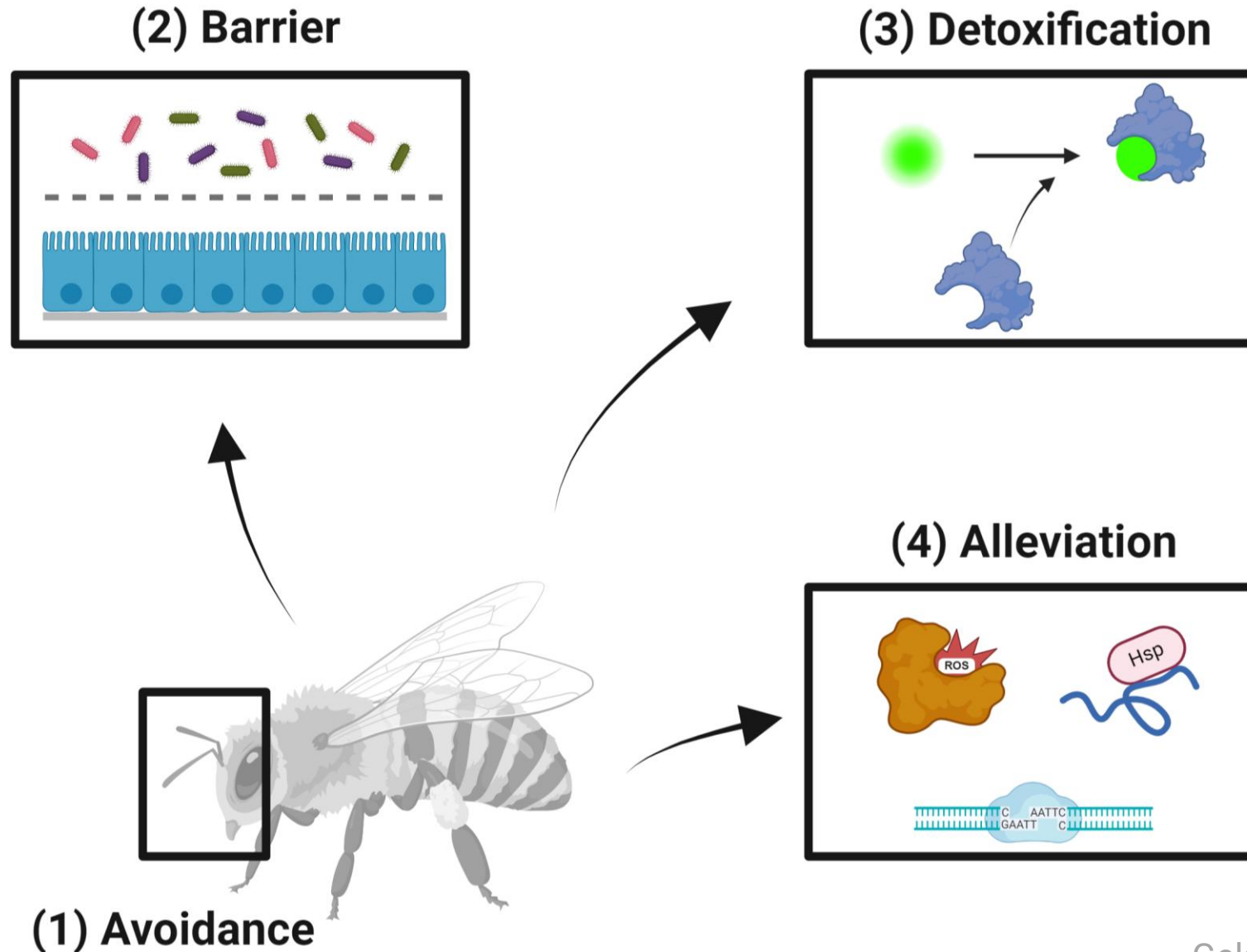
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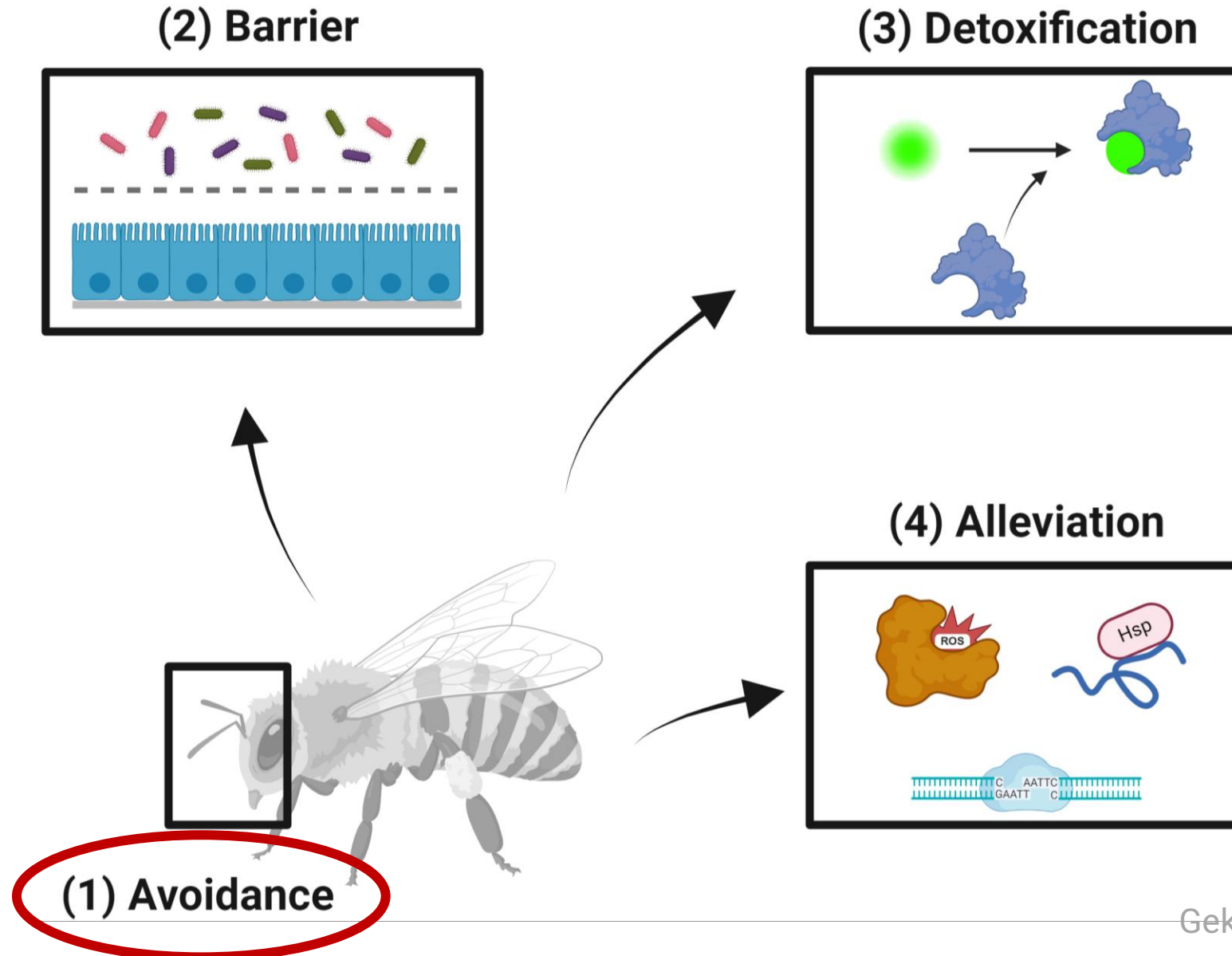
Trace metals



Lines of defences against pollution

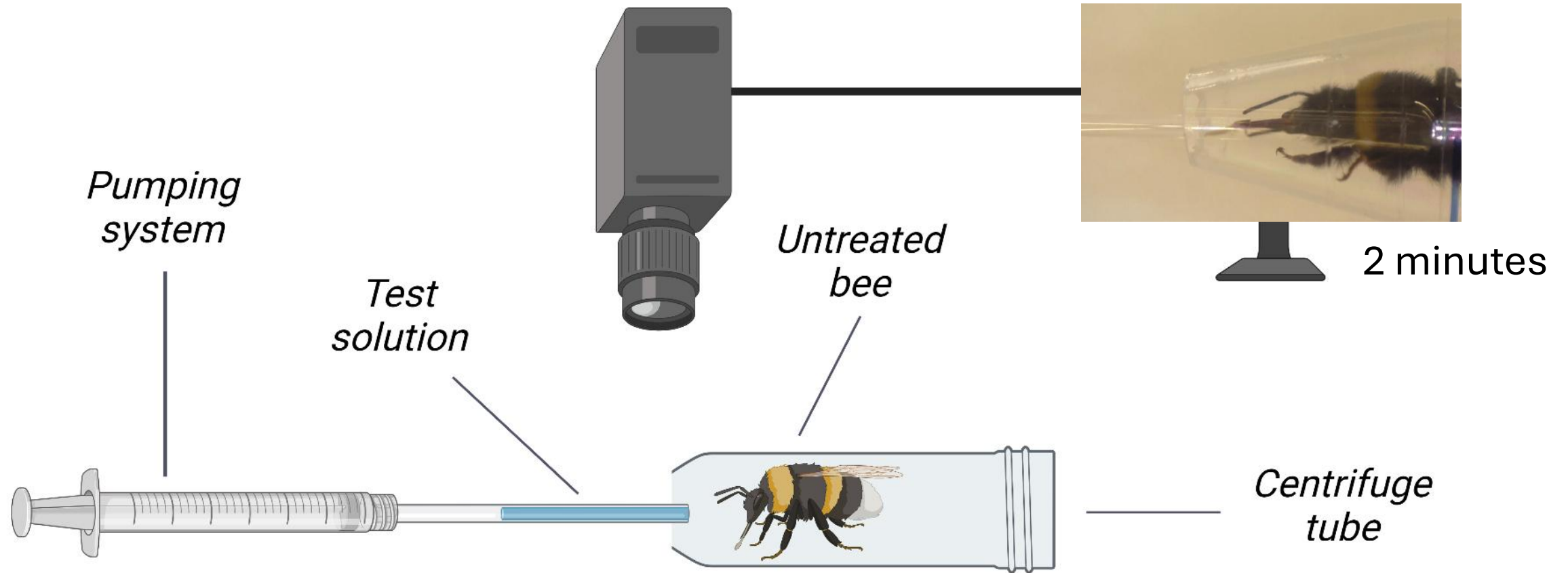


Lines of defences against pollution



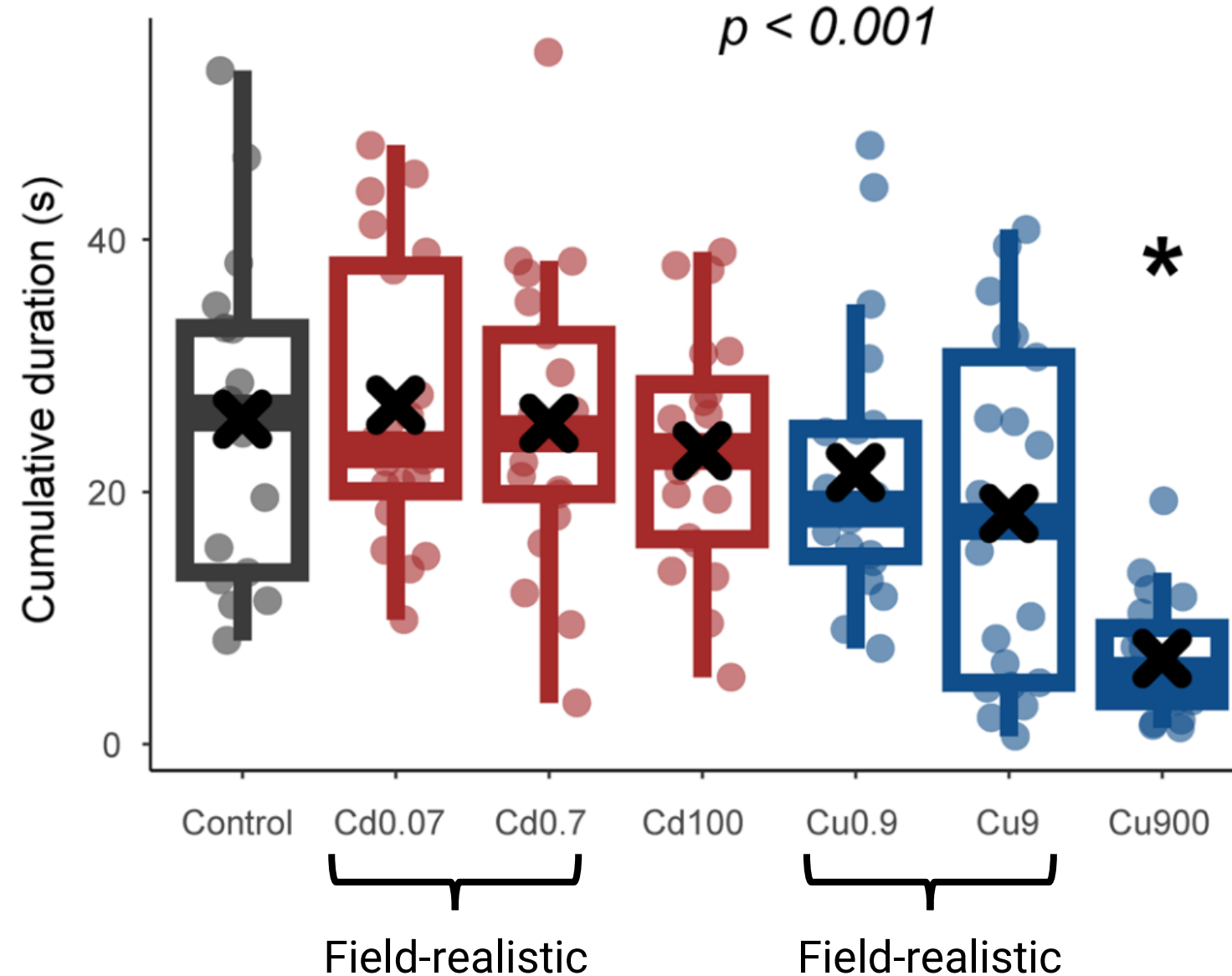
1

Can bumblebees detect metals in solution?



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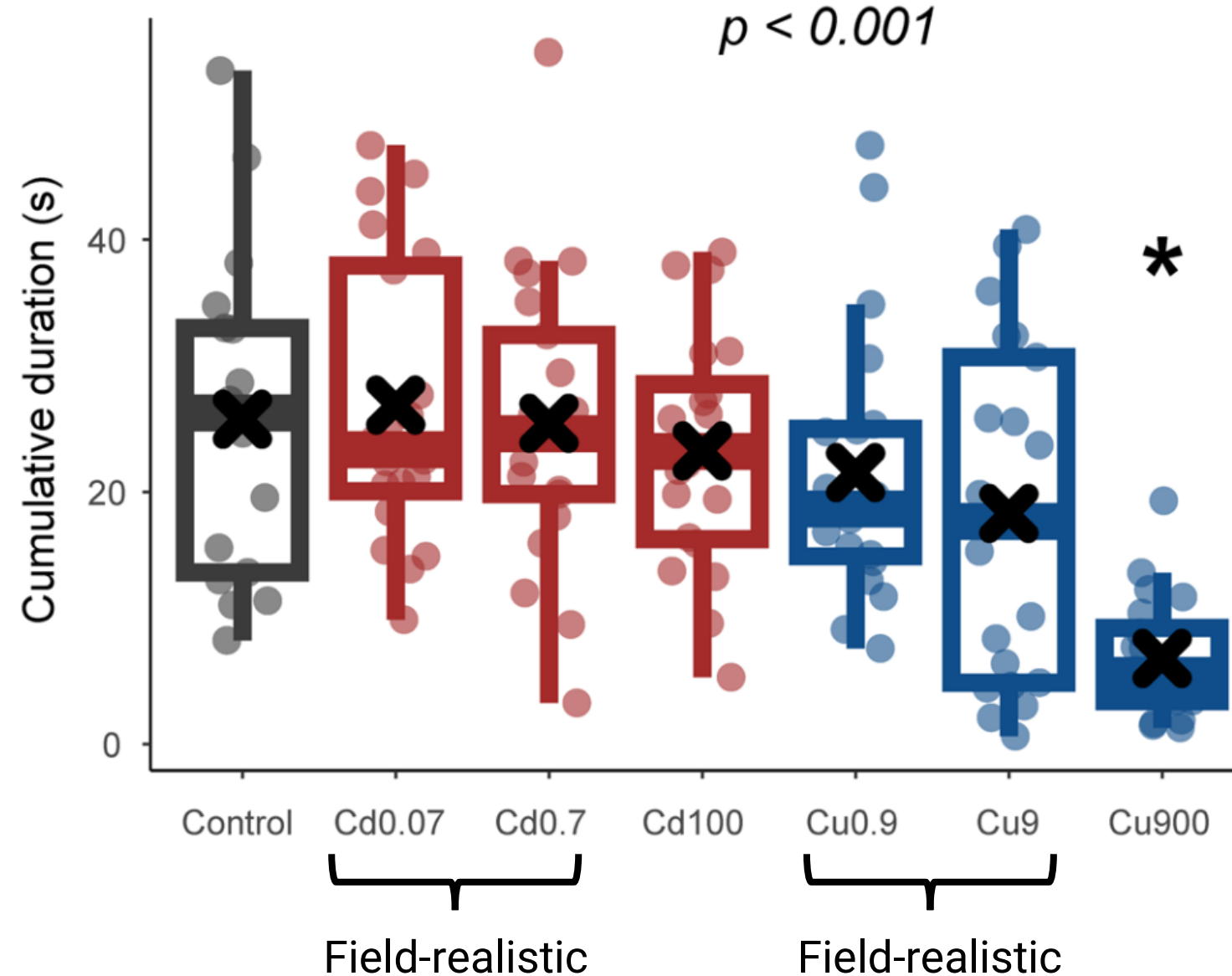


Gekièrè *et al.* (2024) *Ecotoxicology*

Bumblebees **cannot detect** field-realistic concentrations of metals through antennae or proboscis

1

Can bumblebees detect metals in solution?



Bumblebees **cannot detect** field-realistic concentrations of metals through antennae or proboscis

They actually rely on post-ingestive harmful damages to detect metals

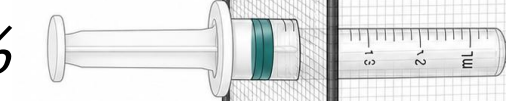


2

Do bumblebees avoid metals?

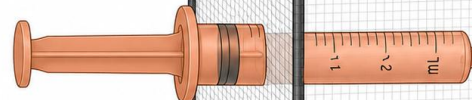
Measure daily
consumption
over time

Sucrose 50%

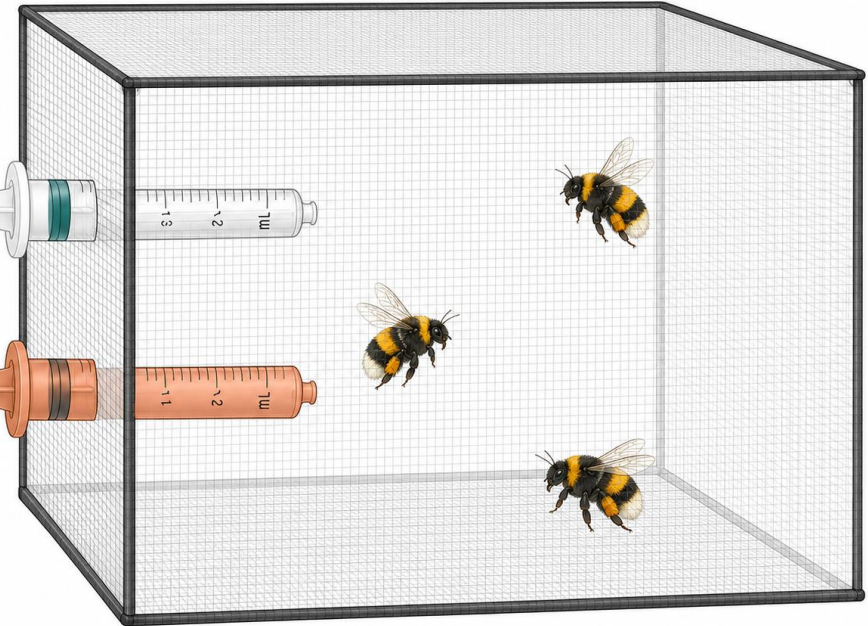


Optimal

Sucrose 50%



+ metal



Or



3

Do bumblebees make tradeoff between metal avoidance and sugar intake?

Measure daily
consumption
over time

Sucrose 20%

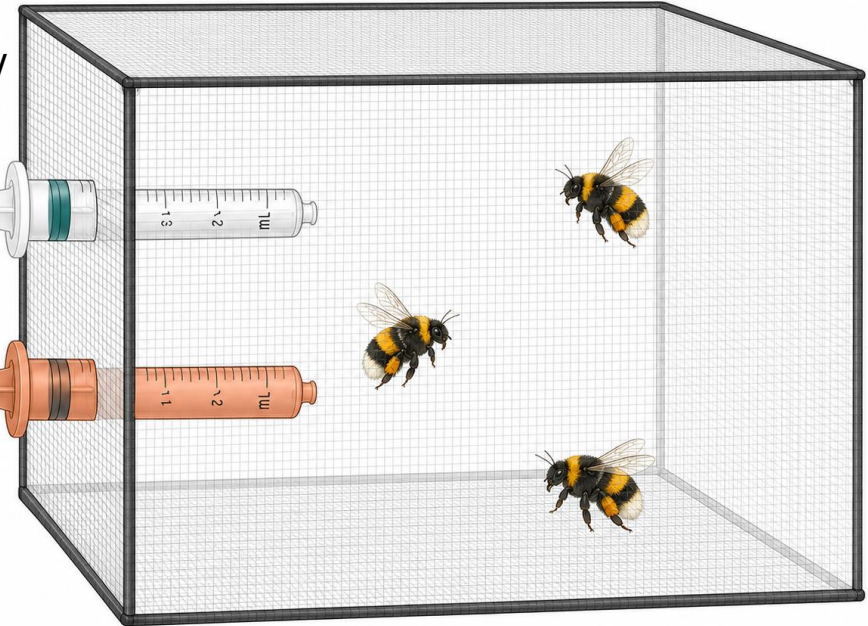
Suboptimal

Sucrose 50%

+ metal



Or

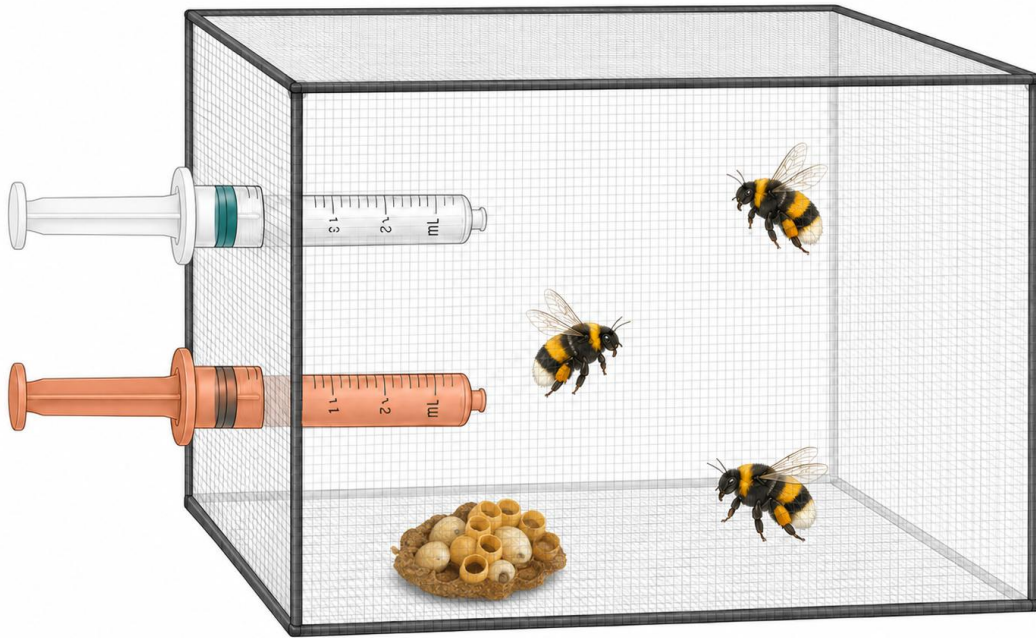


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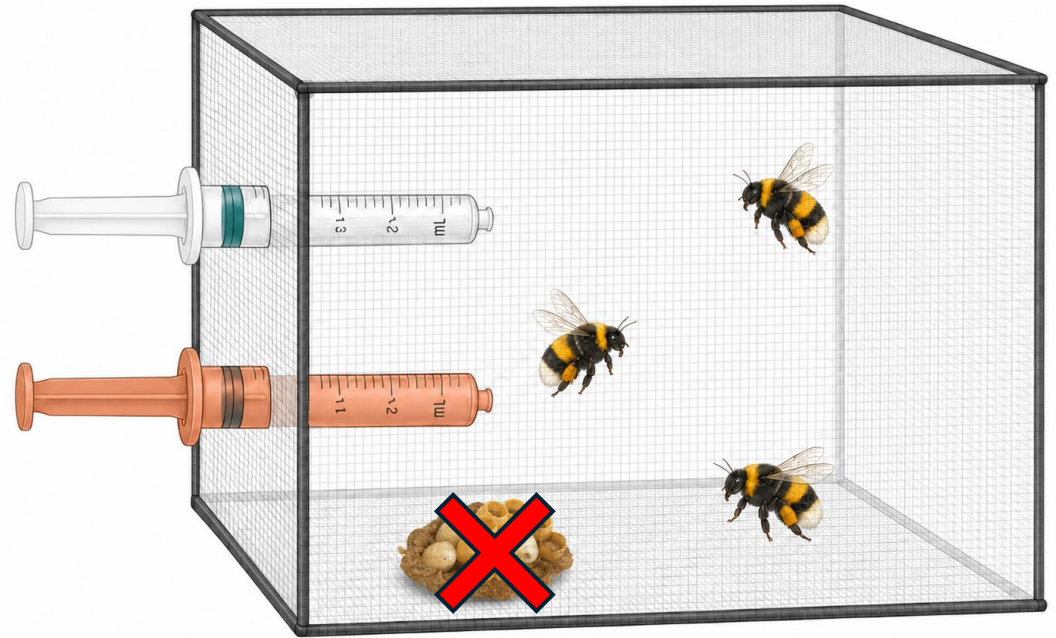
3

What about brood influence?

Effects on metal avoidance and trade-offs



With brood



Without brood

Our hypothesis

Risk-averse parenting:
Bumblebees prioritise **metal**
avoidance over sugar intake to
safeguard **offspring**

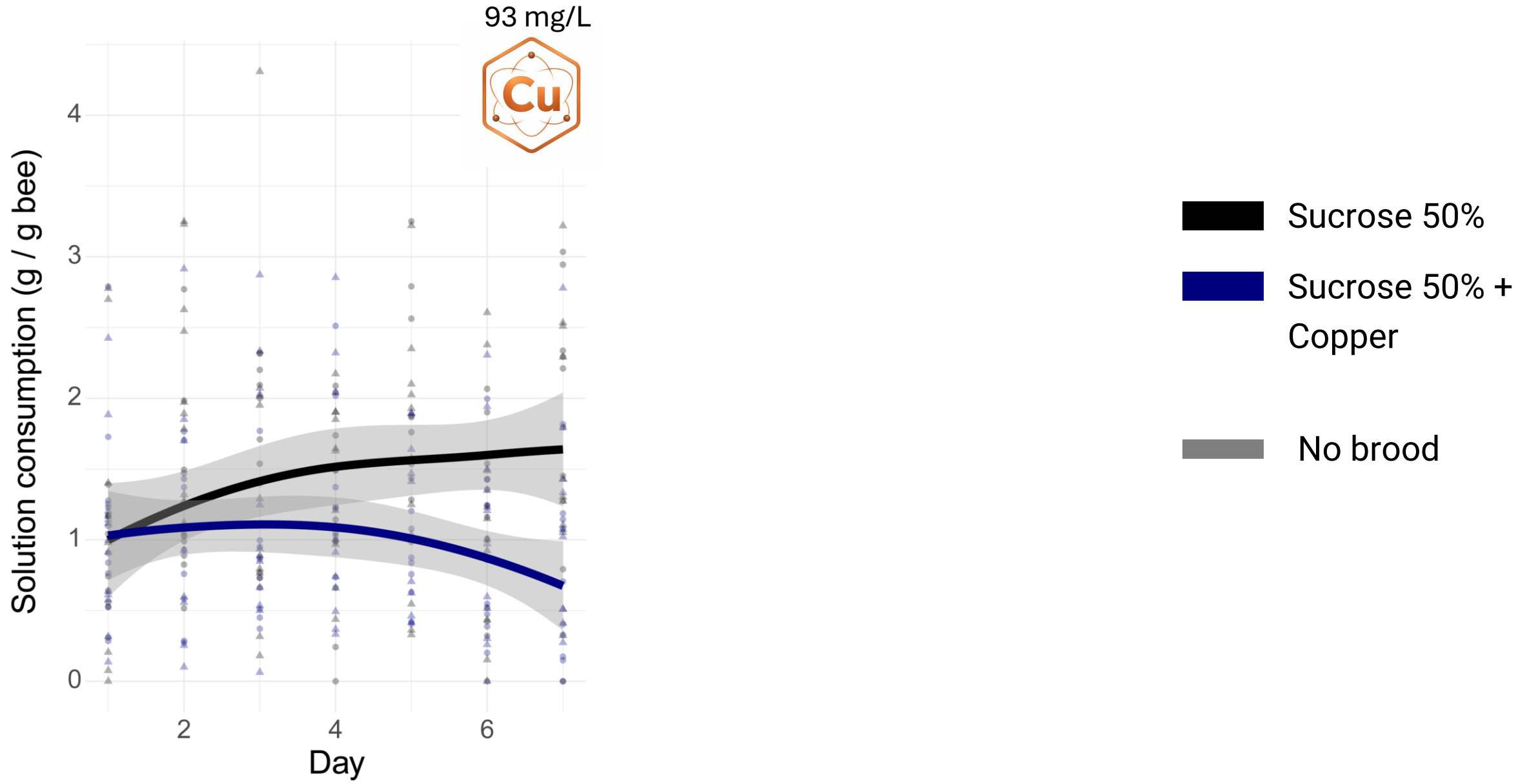


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Do bumblebees avoid metals?

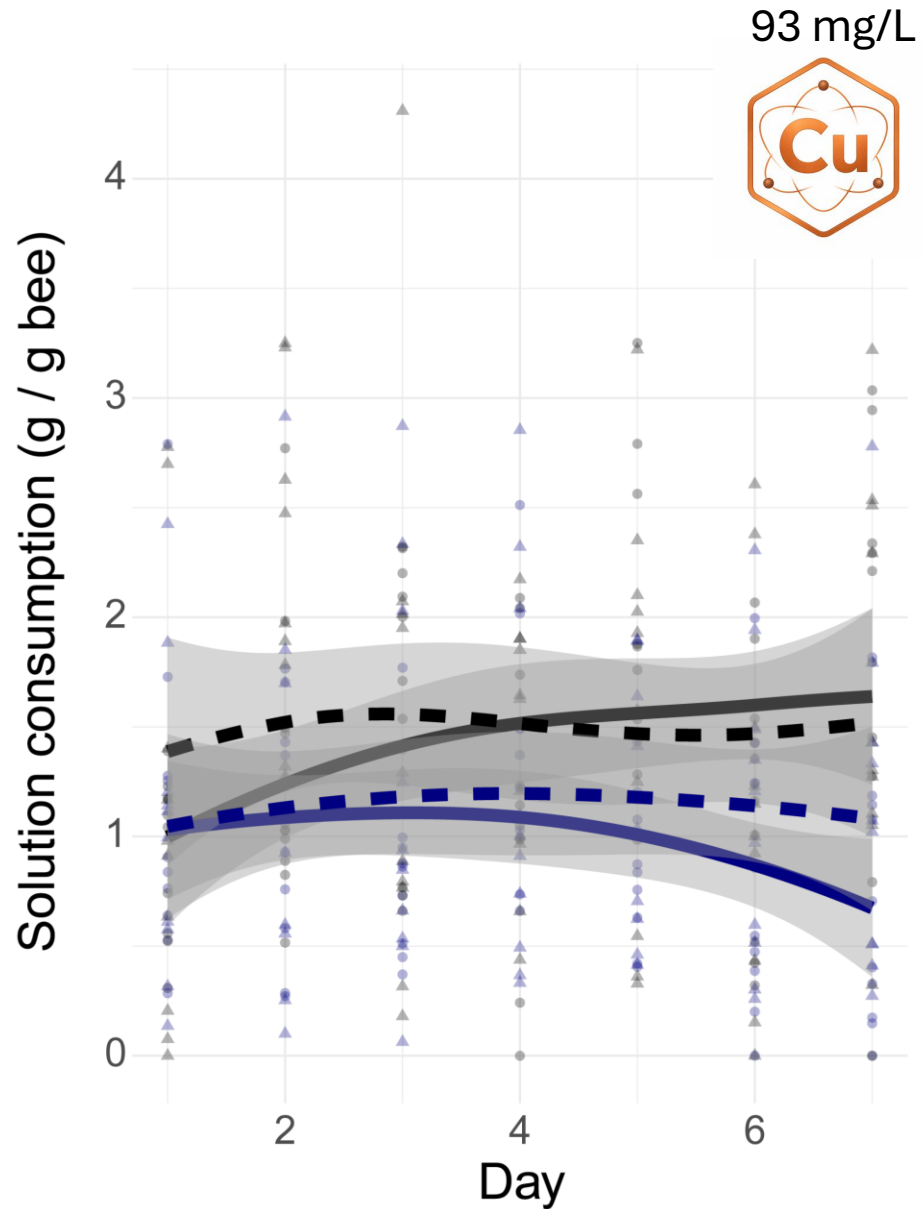
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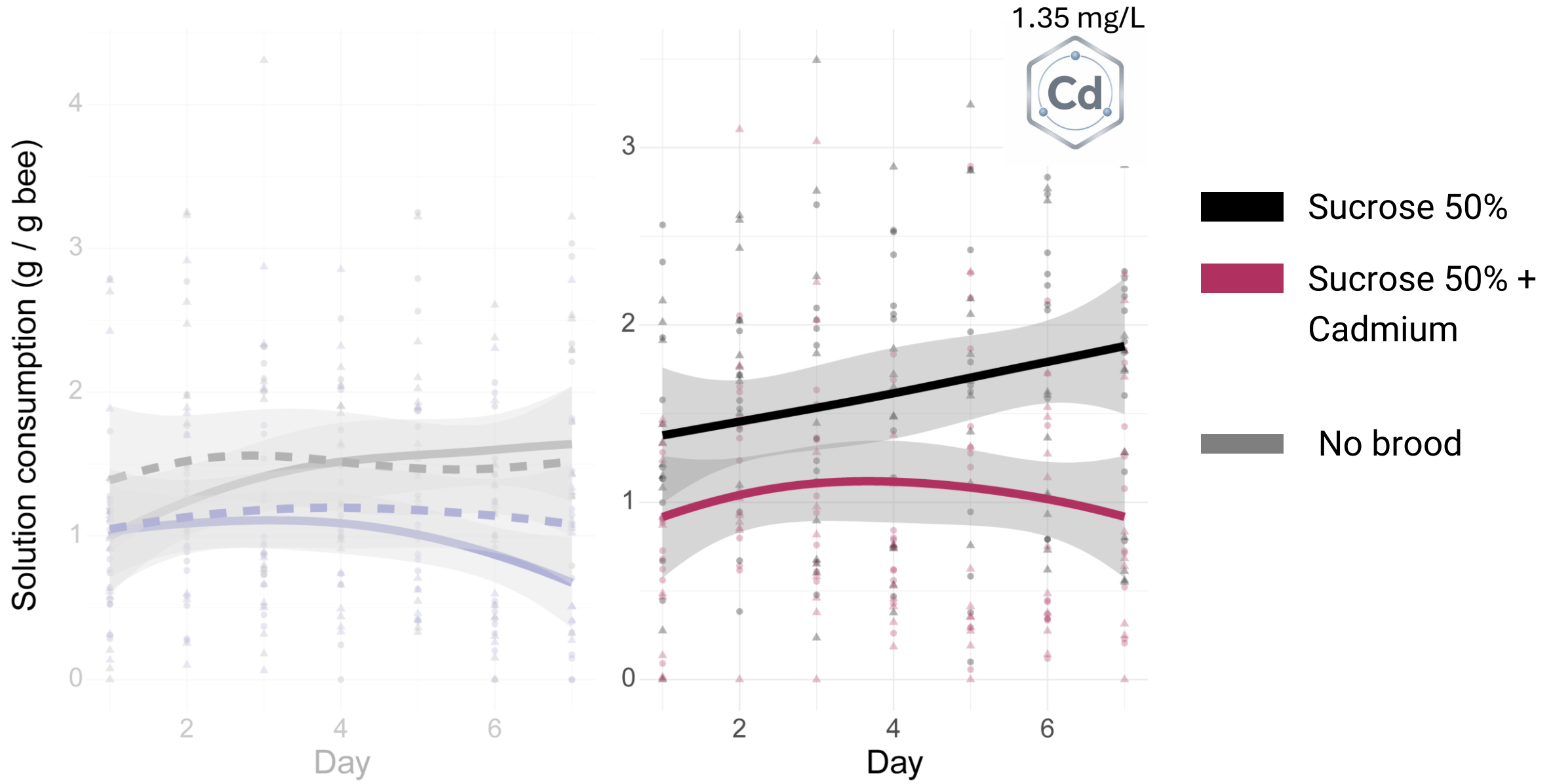
Do bumblebees avoid metals?



- Sucrose 50%
- Sucrose 50% + Copper
- No brood
- Brood

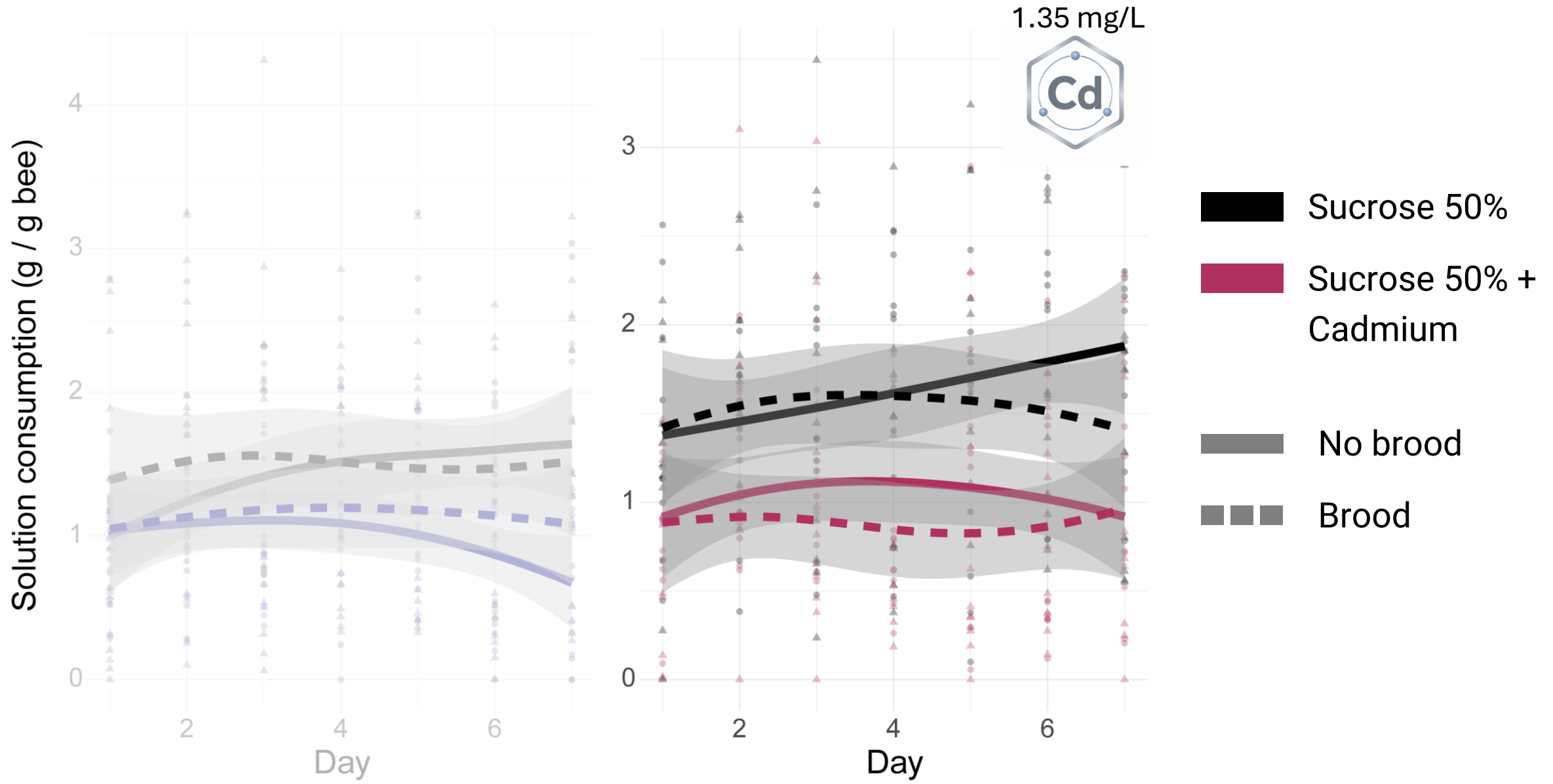
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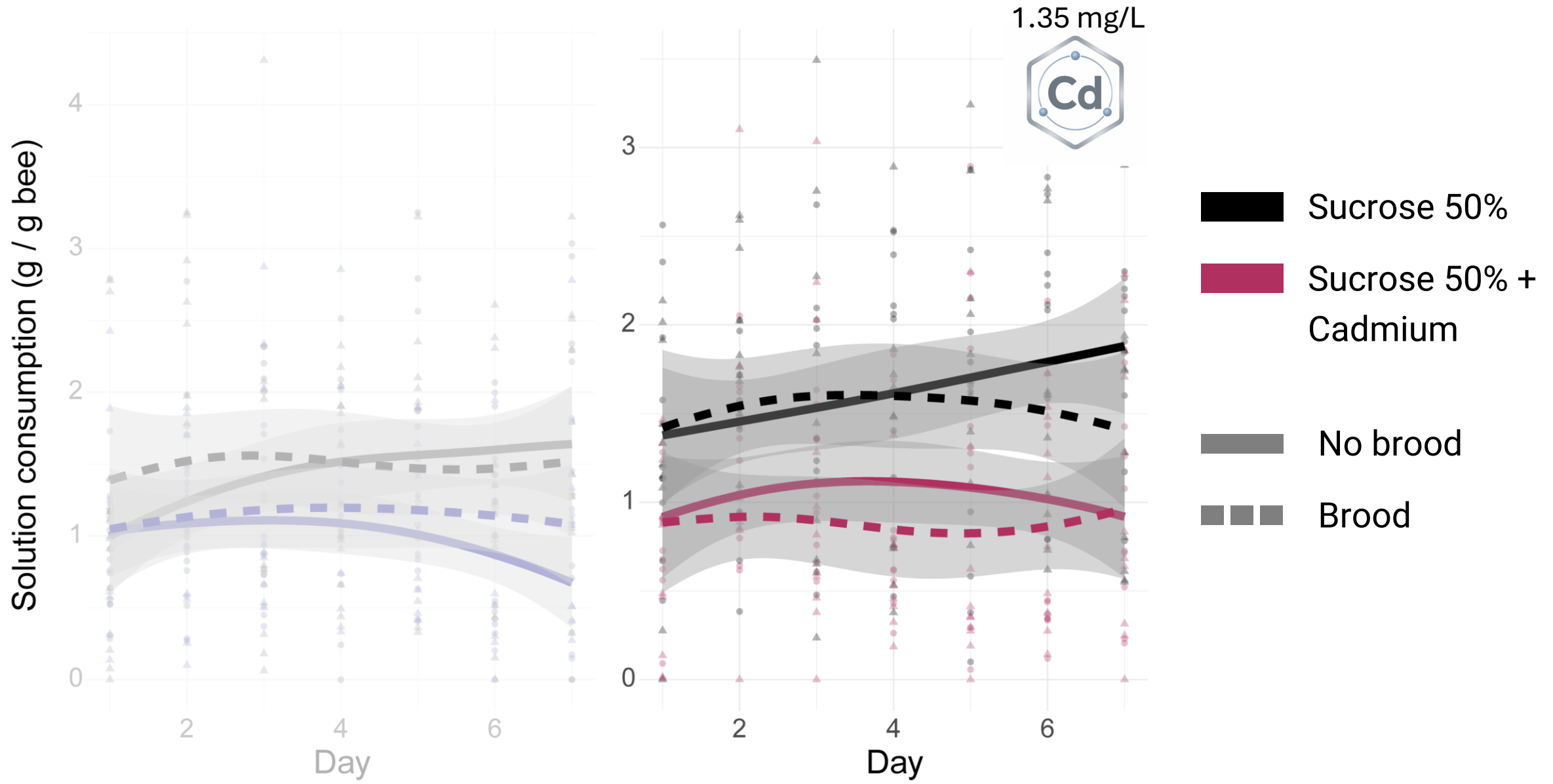
Do bumblebees avoid metals?



2

Do bumblebees avoid metals?

They do, after a few days, but
no effect of brood presence

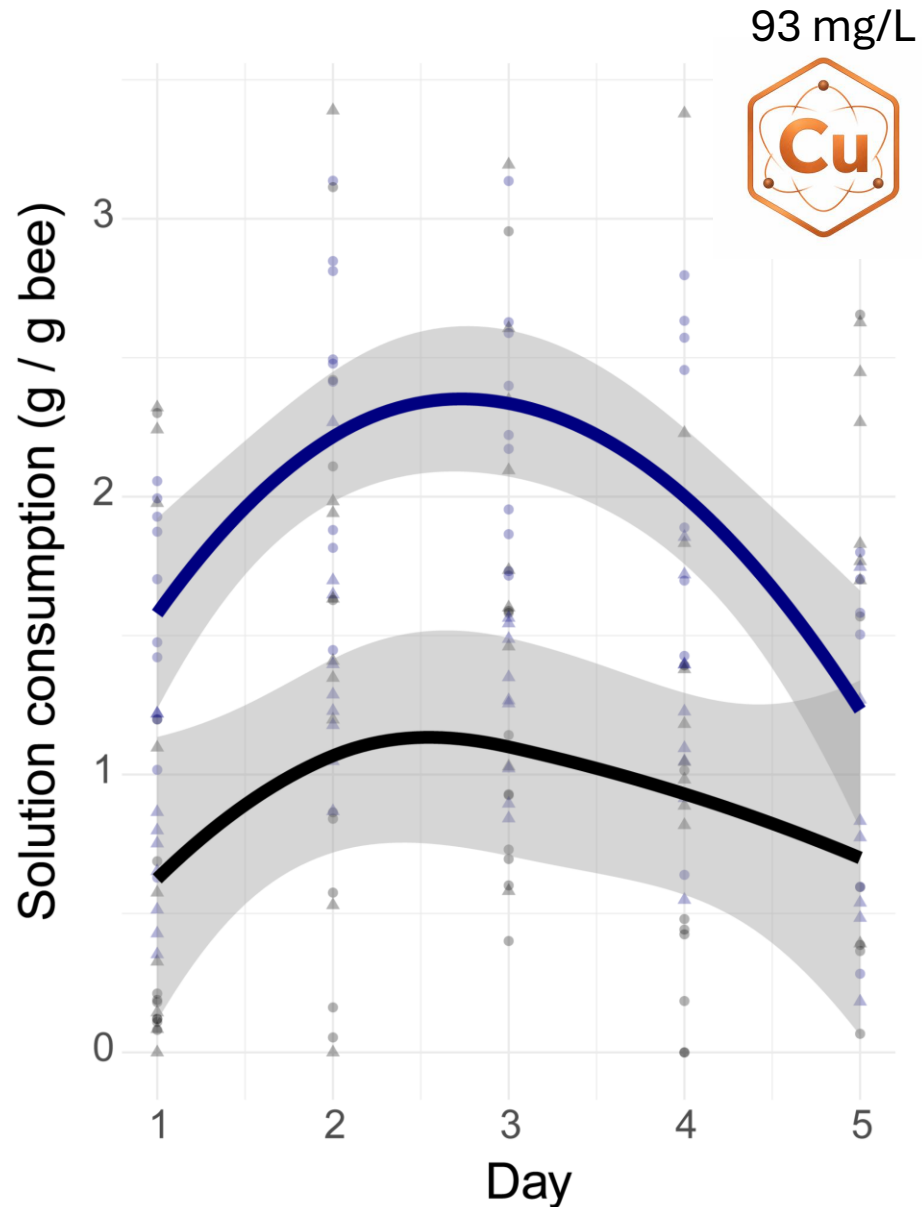


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Do bumblebees make tradeoffs?

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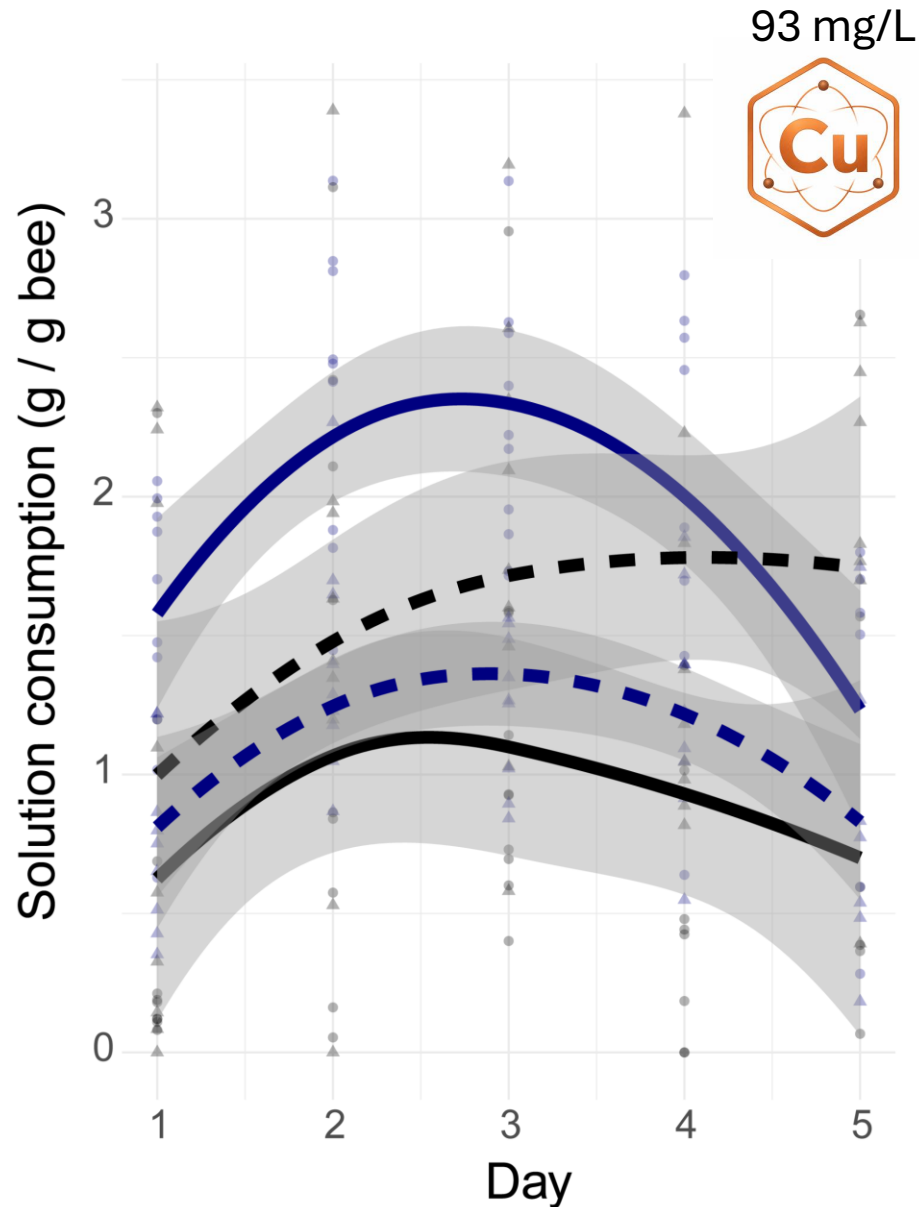
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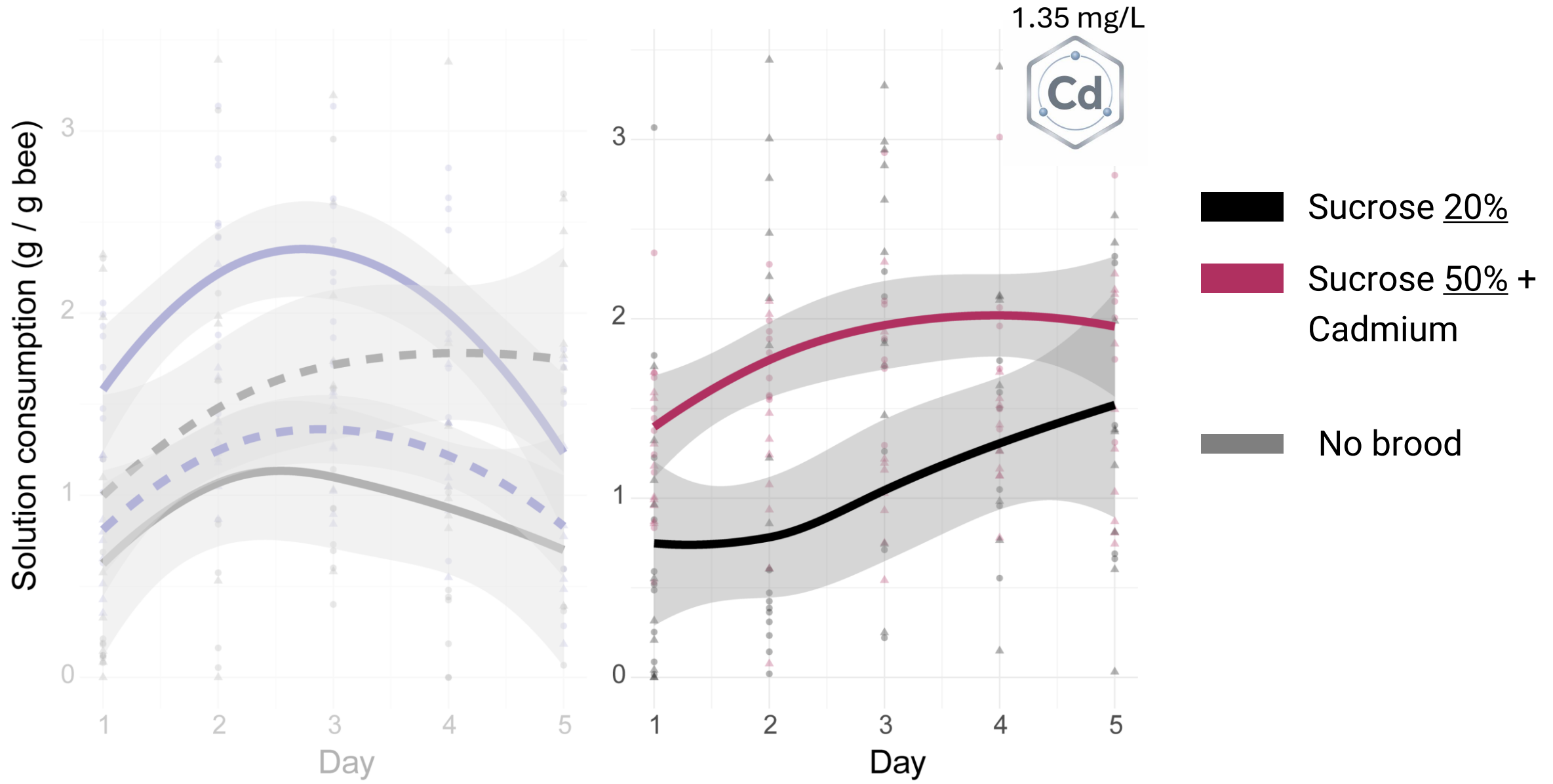
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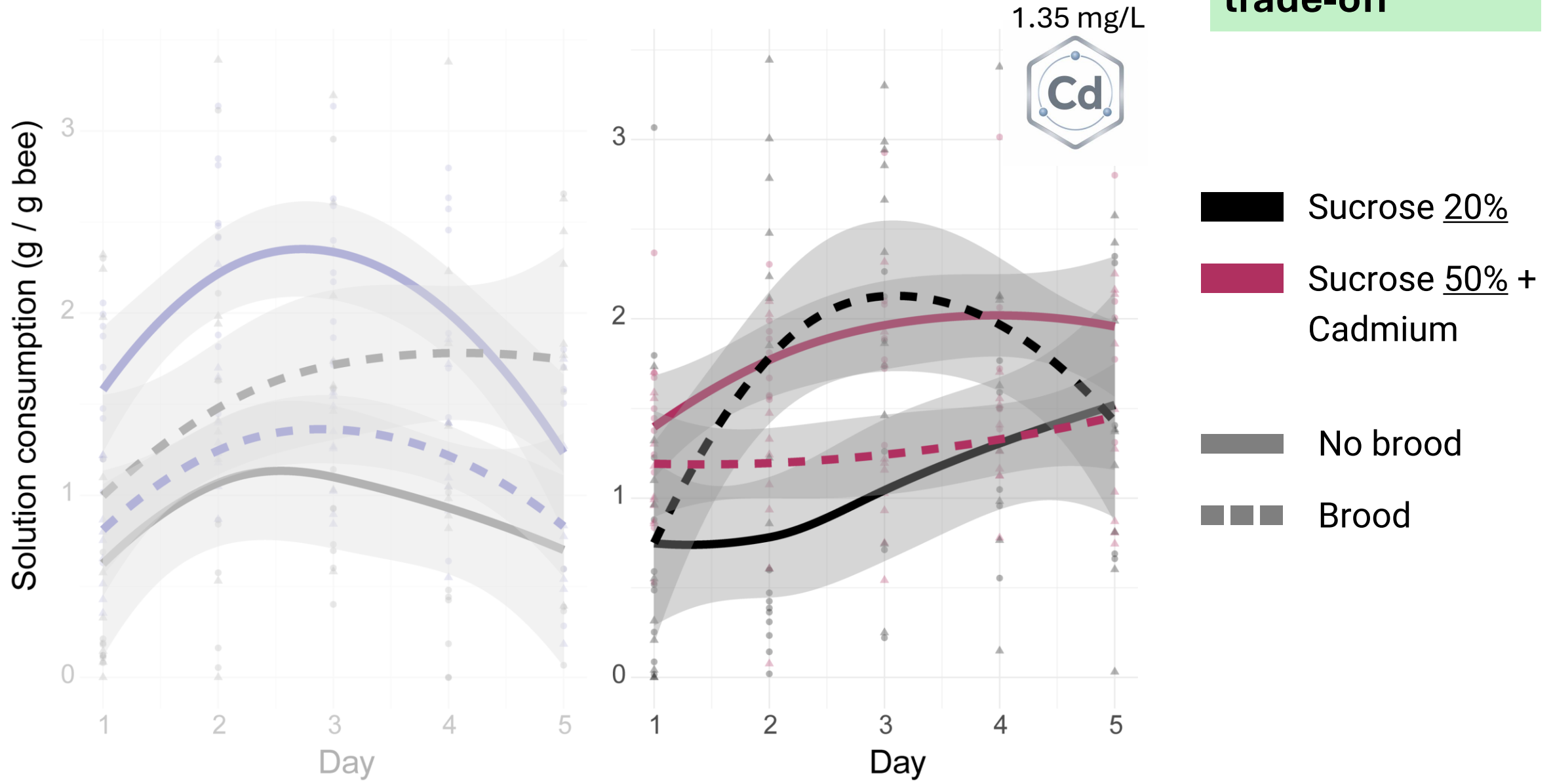
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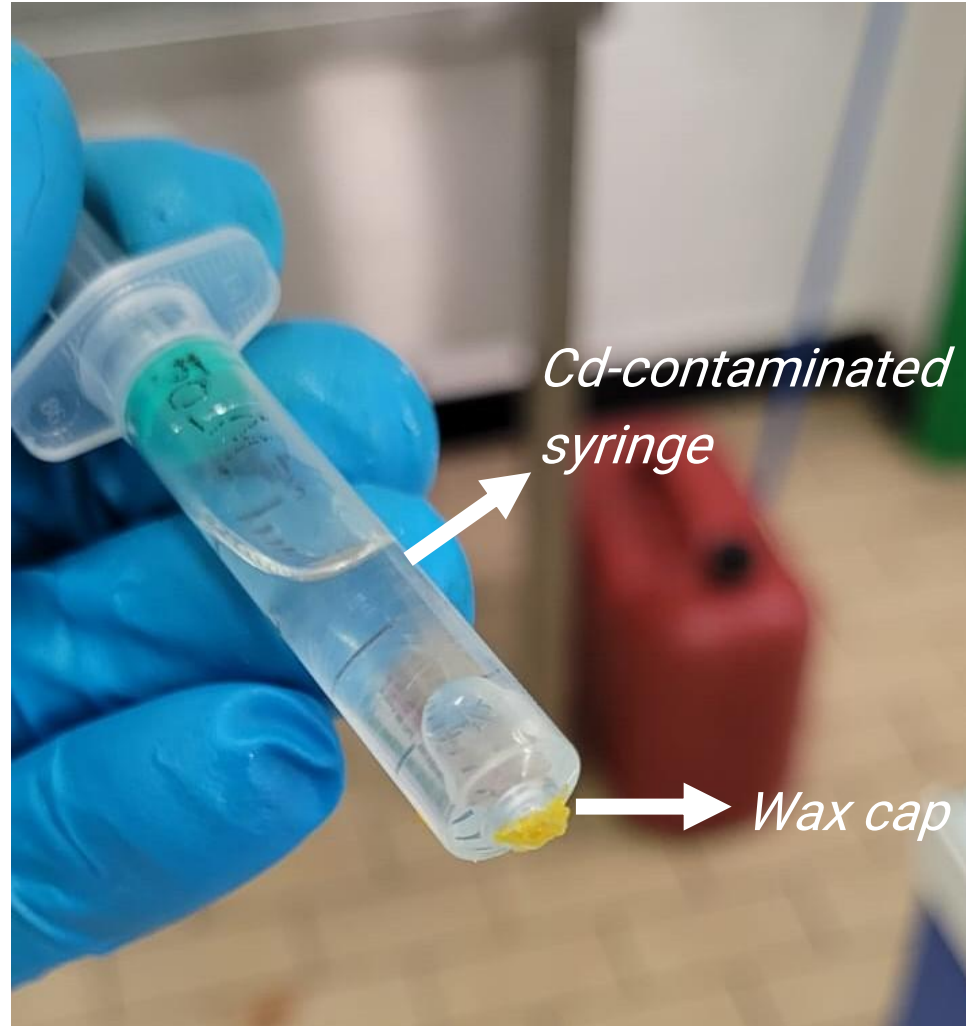
Brood presence
reverses the
trade-off



3

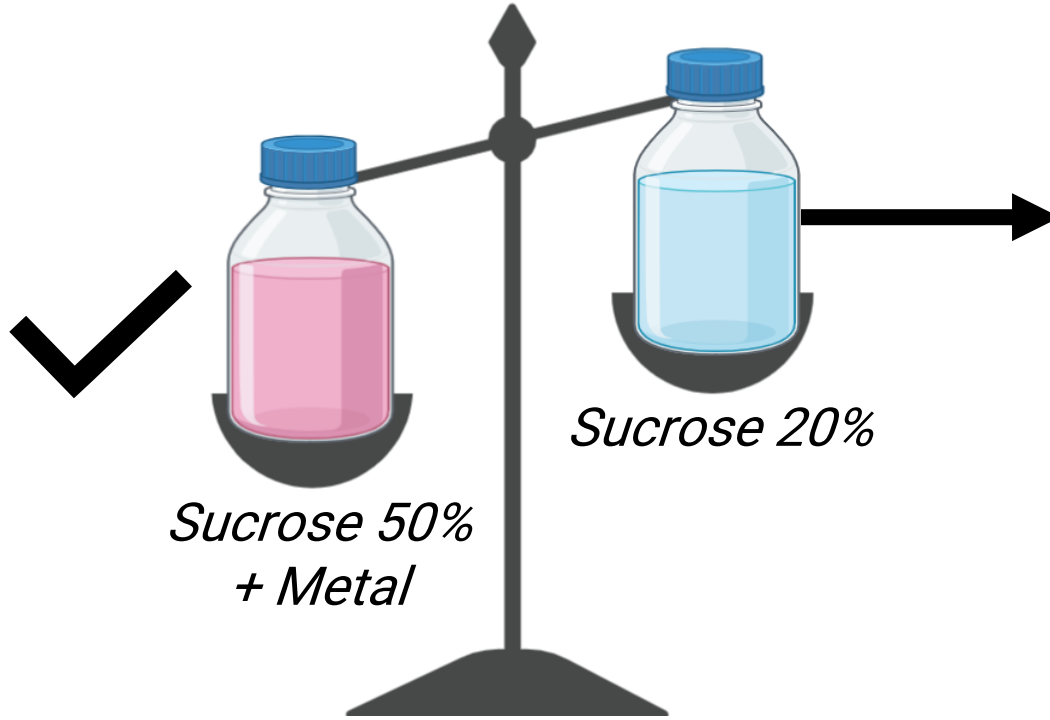
Do bumblebees make tradeoffs?

Observed on a few tested colonies exposed to trace metals in the presence of brood



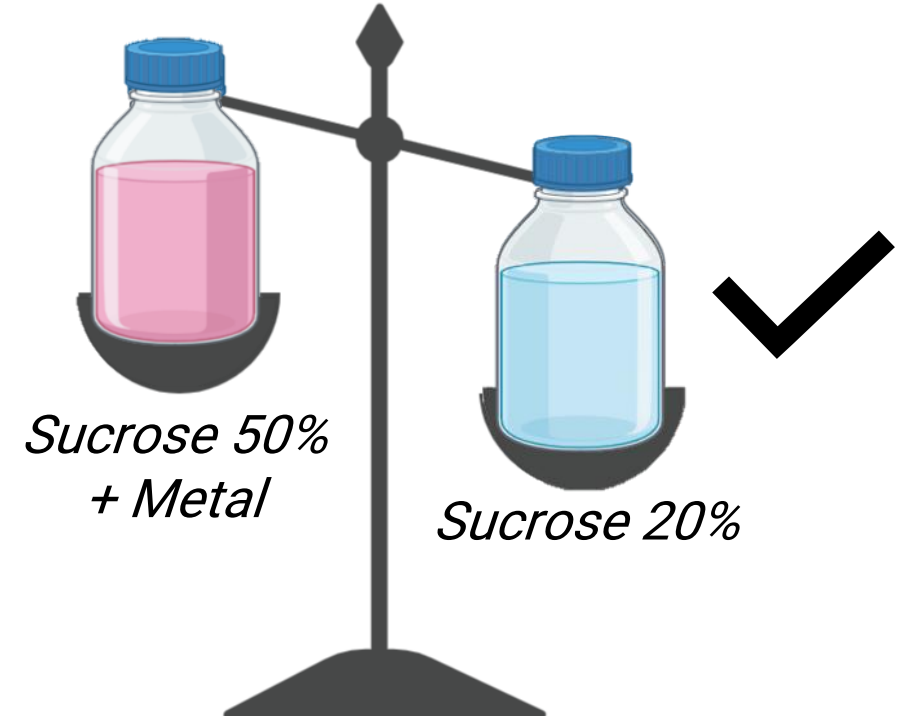
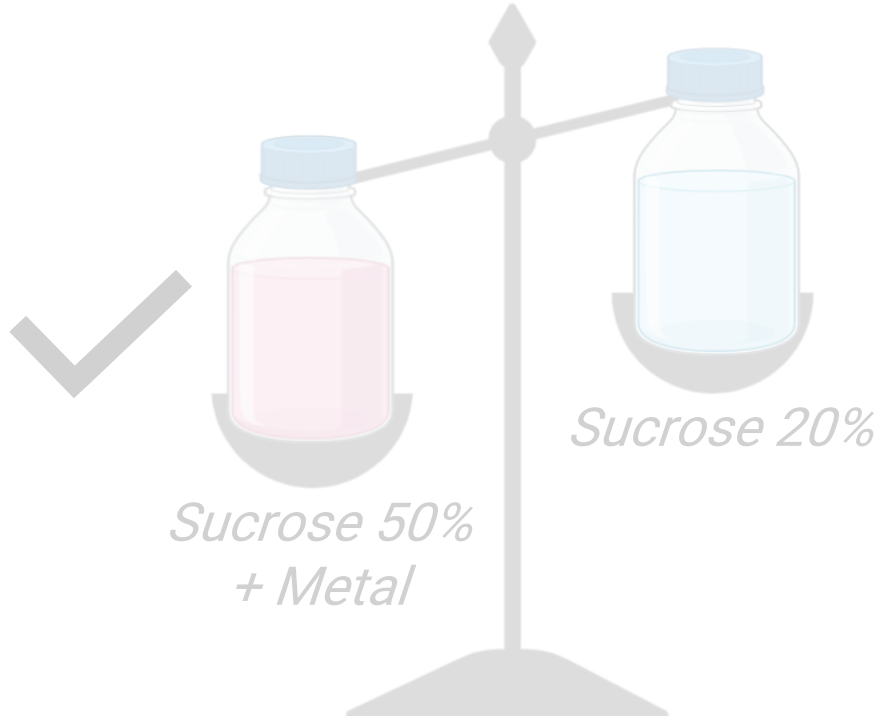
Why do bumblebees make brood-dependent tradeoffs?

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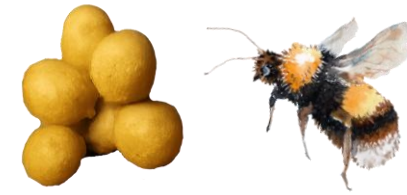


Low energetic gain rate and
excessive water intake

Why do bumblebees make brood-dependent tradeoffs?

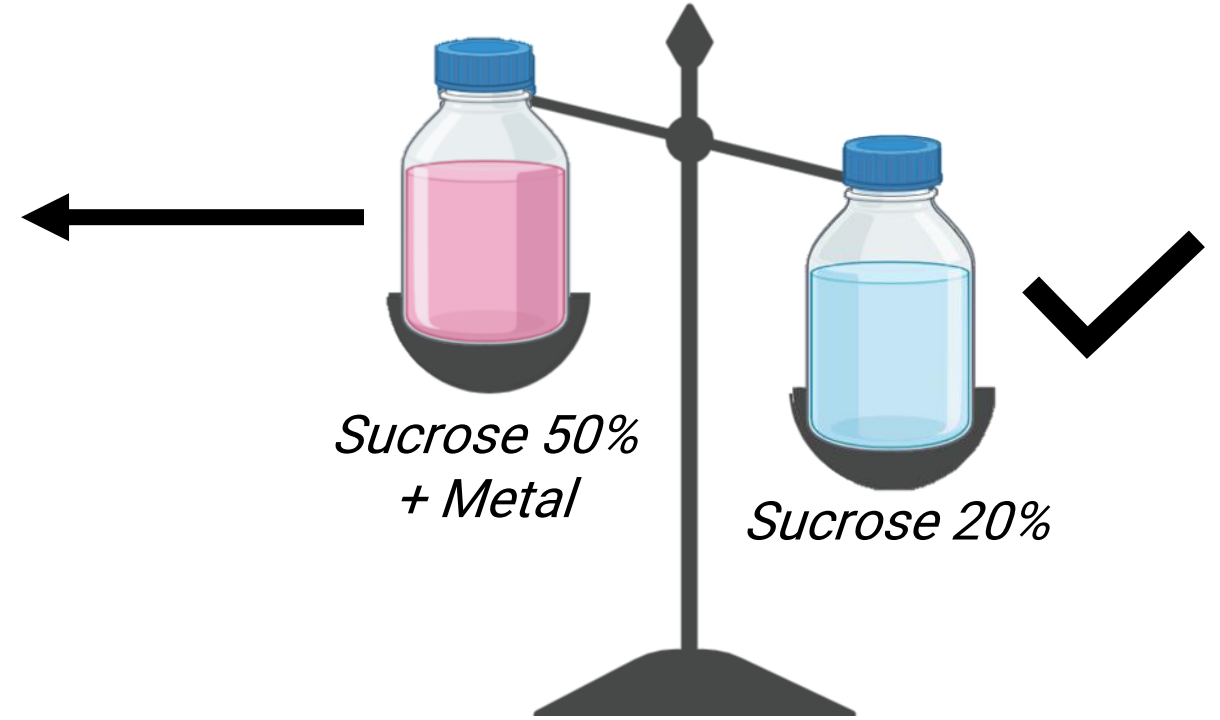


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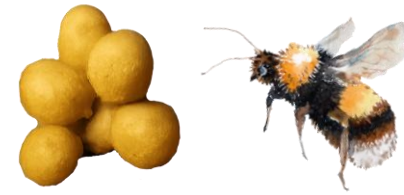
Safeguarding the brood:

- Larvae express fewer detoxification genes



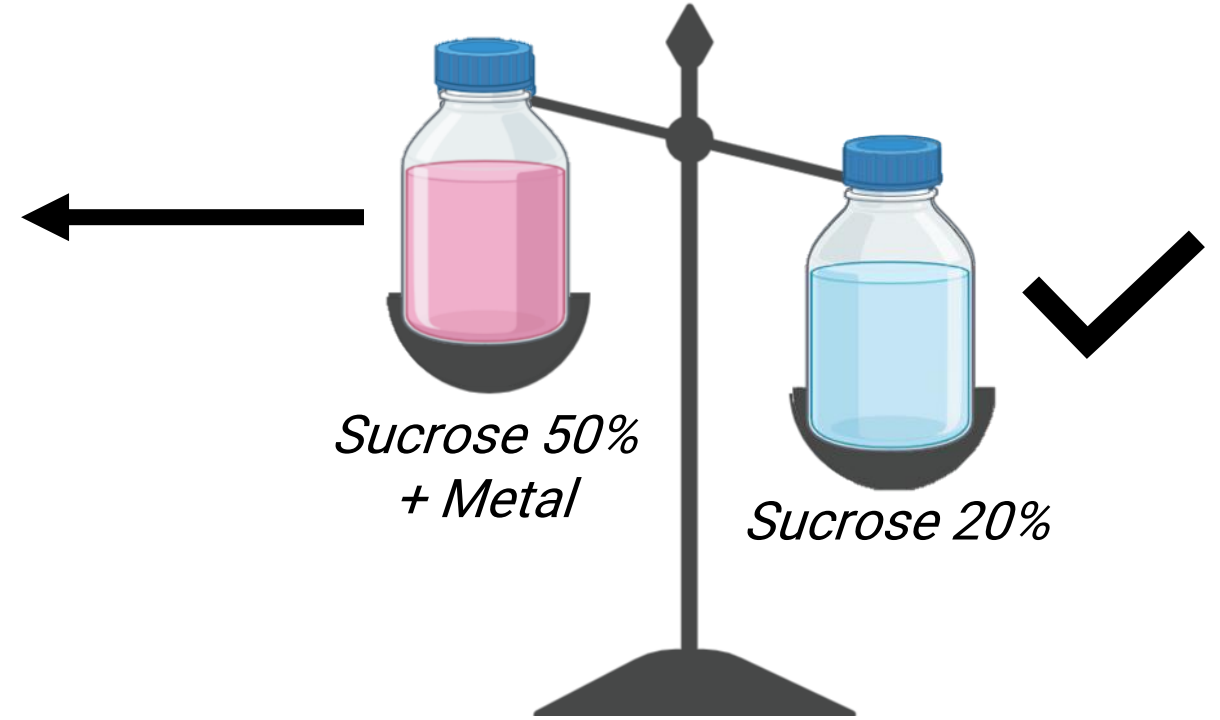
Why do bumblebees make brood-dependent tradeoffs?

A protective strategy against colony-level developmental costs?



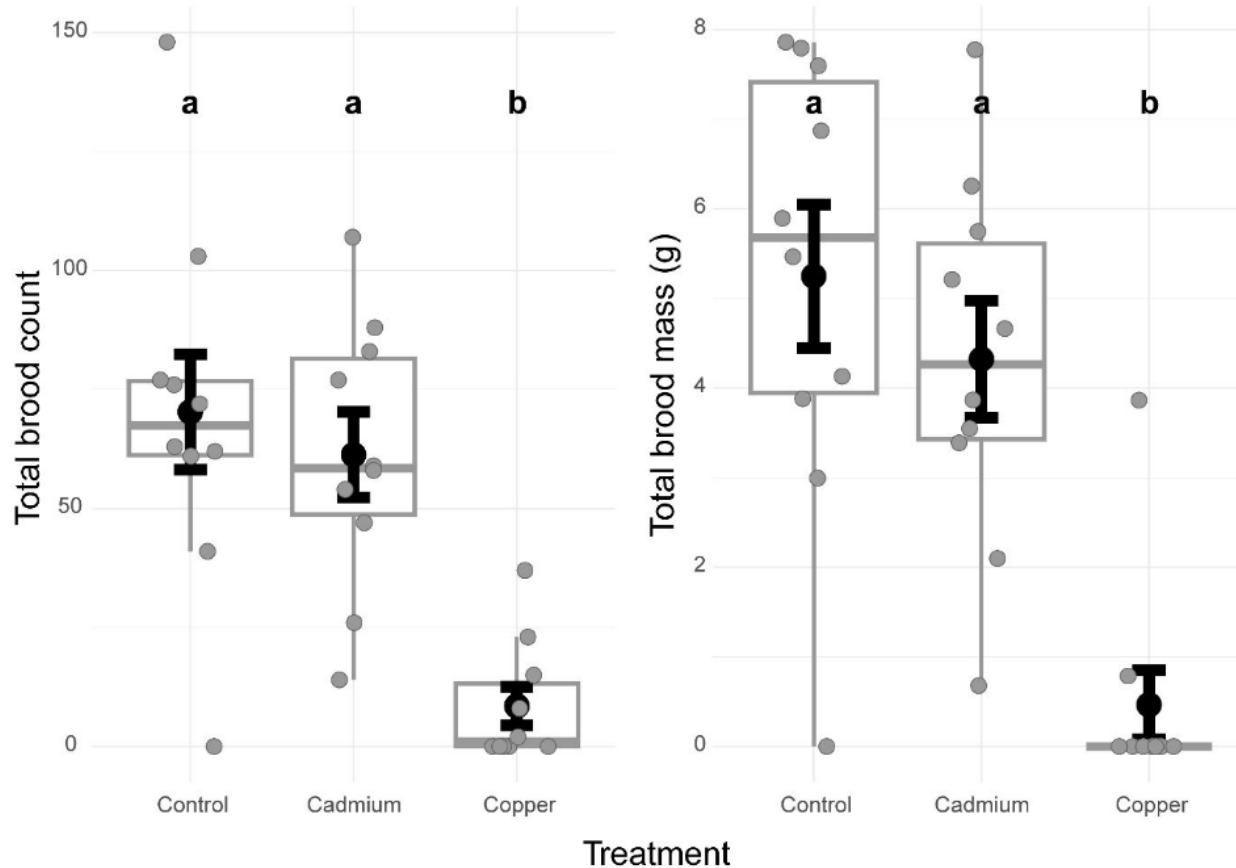
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Why do bumblebees make brood-dependent tradeoffs?

A protective strategy against colony-level developmental costs



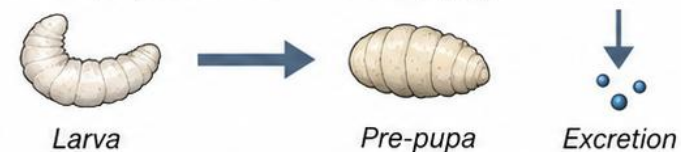
Copper exposure strongly impaired microcolony performance:

- larval **survival** and **development**
- reduced **brood production** and brood biomass
- delayed **egg laying**
- increased worker **mortality**
- reduced syrup and pollen **consumption**

No effect of cadmium, although it accumulated in larvae

Excretion during pre-pupation; larval development is a key stage in metal management

Larvae: $1.95 \pm 0.67 \mu\text{g/g}$
Pre-pupae: $0.68 \pm 0.56 \mu\text{g/g}$



Take-home messages



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- Bumblebees are able to detect and avoid metals
- **Without brood** → Favour sugar intake over metal avoidance
- **With brood** → Favour metal avoidance over sugar intake

PROCEEDINGS
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RESEARCH ARTICLES | 03 SEP 2025

Risk-averse parenting: bumble bees prioritize metal avoidance over sugar intake to safeguard offspring 🛒

Antoine Gekière ✉️ ; Timothy Snowden; Théau Masson; Mark J. F. Brown ; Kévin Tougeron 

+ Author & article information

Proc Biol Sci (2025) 292 (2054): 20251598 .



Thank you!



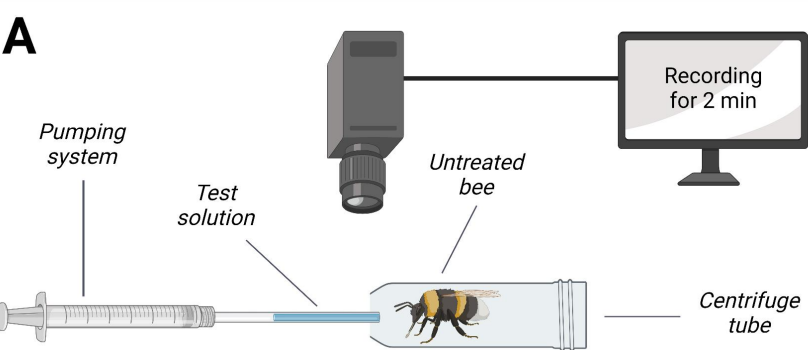
Experimental design and concentrations used in this study

EXPERIMENT 1				
Metal	Presence of brood	Choice #1	Choice #2	N boxes
Copper	No	Sucrose 50%	Sucrose 50% + Cu 692 μ M	10
Copper	Yes	Sucrose 50%	Sucrose 50% + Cu 692 μ M	10
Cadmium	No	Sucrose 50%	Sucrose 50% + Cd 7.38 μ M	10
Cadmium	Yes	Sucrose 50%	Sucrose 50% + Cd 7.38 μ M	10
EXPERIMENT 2				
Metal	Presence of brood	Choice #1	Choice #2	N boxes
Copper	No	Sucrose 20%	Sucrose 50% + Cu 692 μ M	10
Copper	Yes	Sucrose 20%	Sucrose 50% + Cu 692 μ M	10
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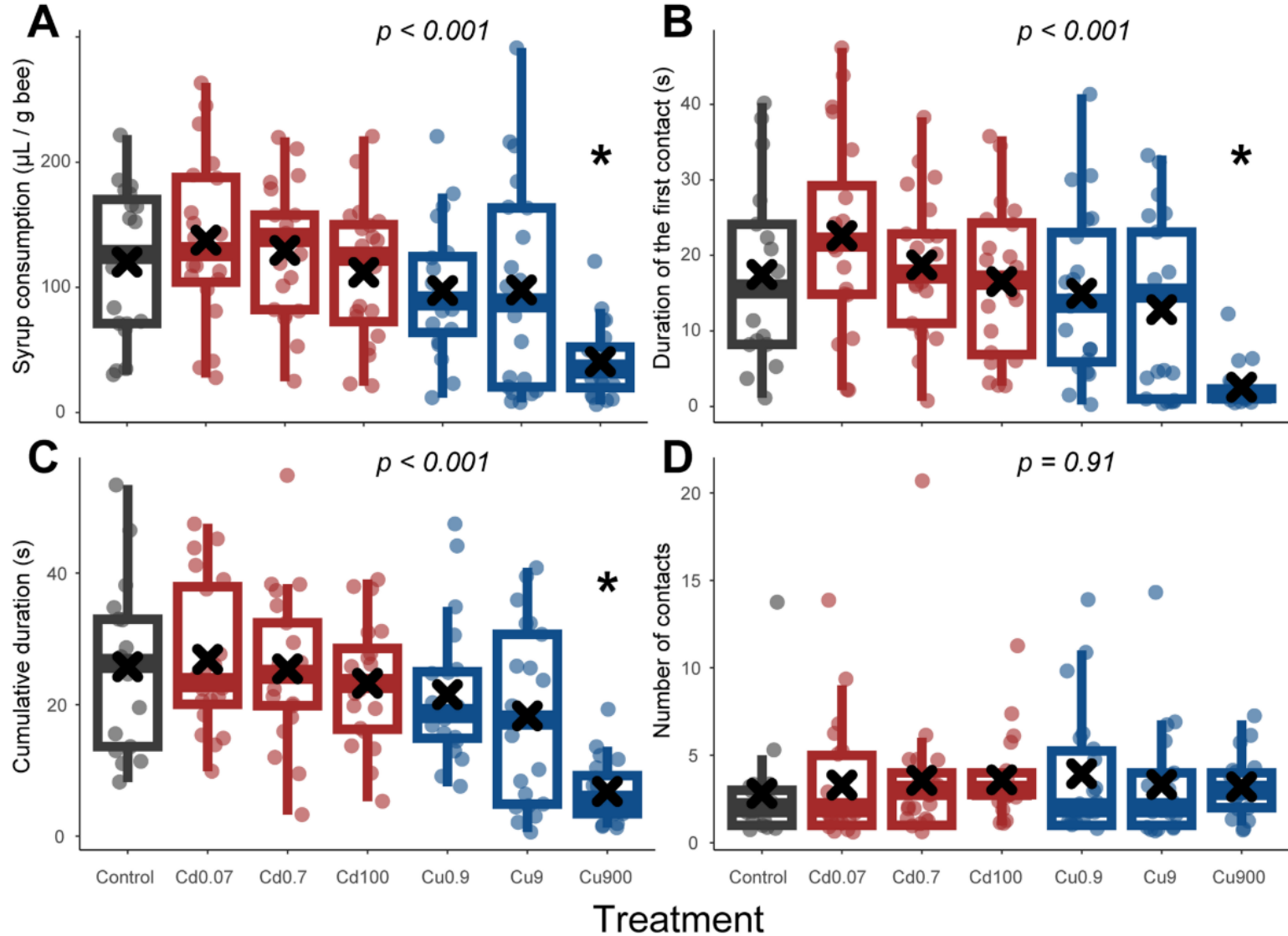
Cu 44 mg/L

Cd 0.83 mg/L

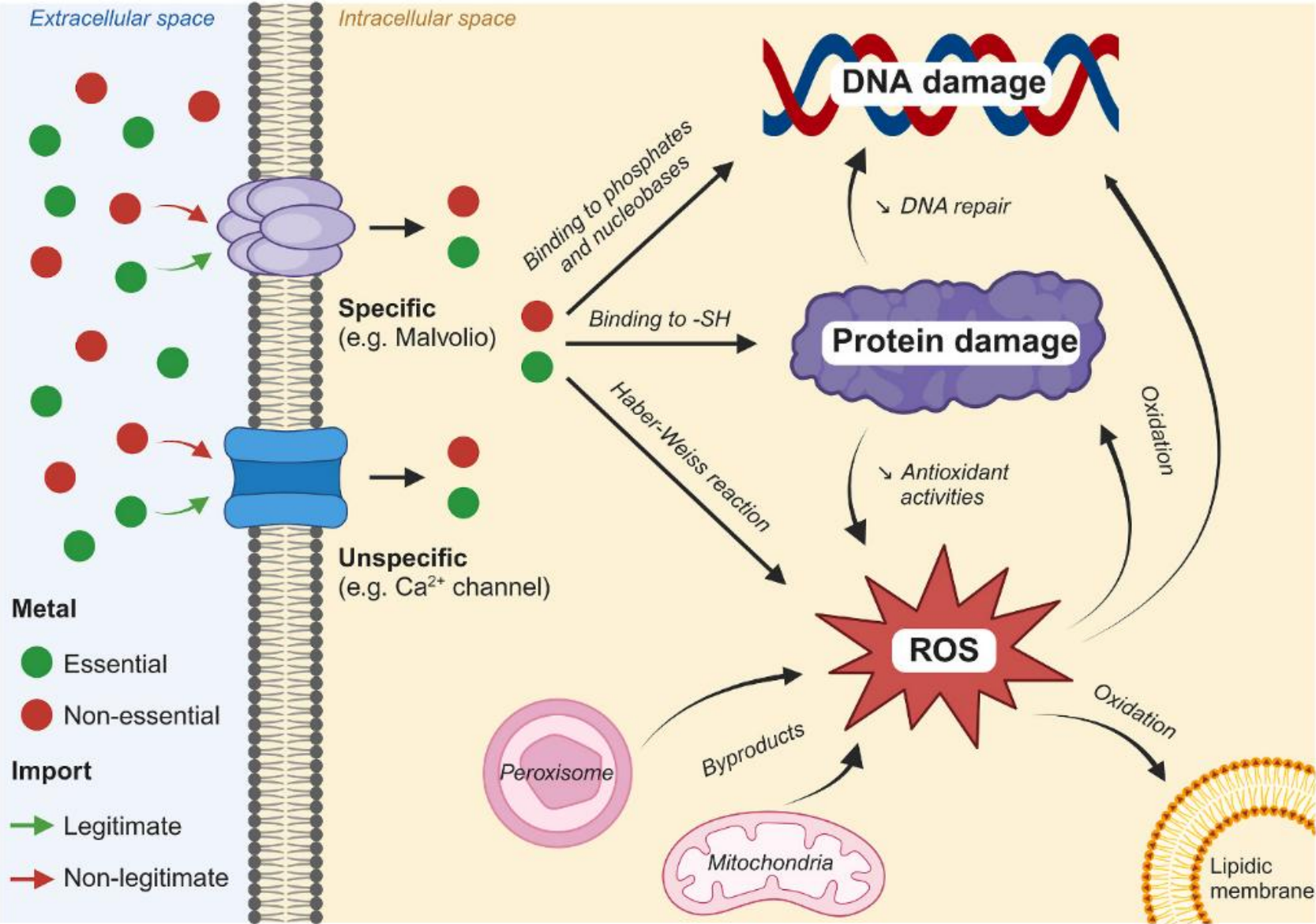
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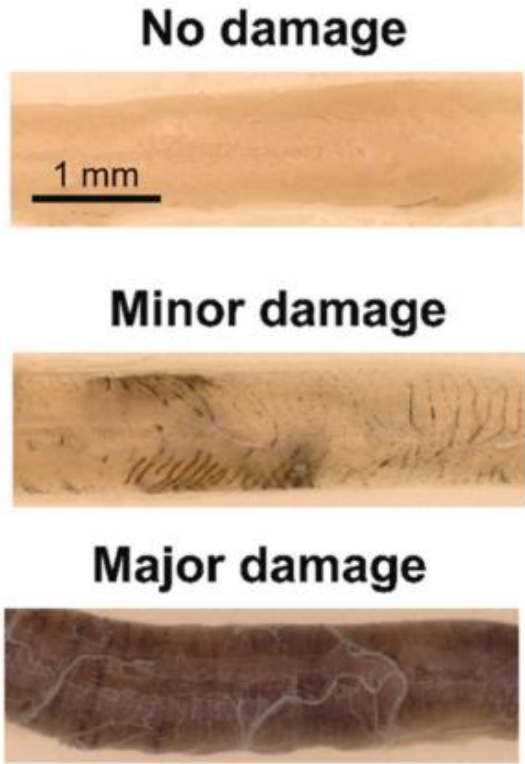
Gekière *et al.* (2024) *Ecotoxicology*



Heavy metals – Mechanisms of action



Heavy metals cause damage in the gut



Gekièrè *et al.* (2024)
Env. Toxicol. Pharmacol.