

# From Curiosity to Competence: How World Models Interact with the Dynamics of Exploration

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## Background: The two flavours of intrinsic motivation

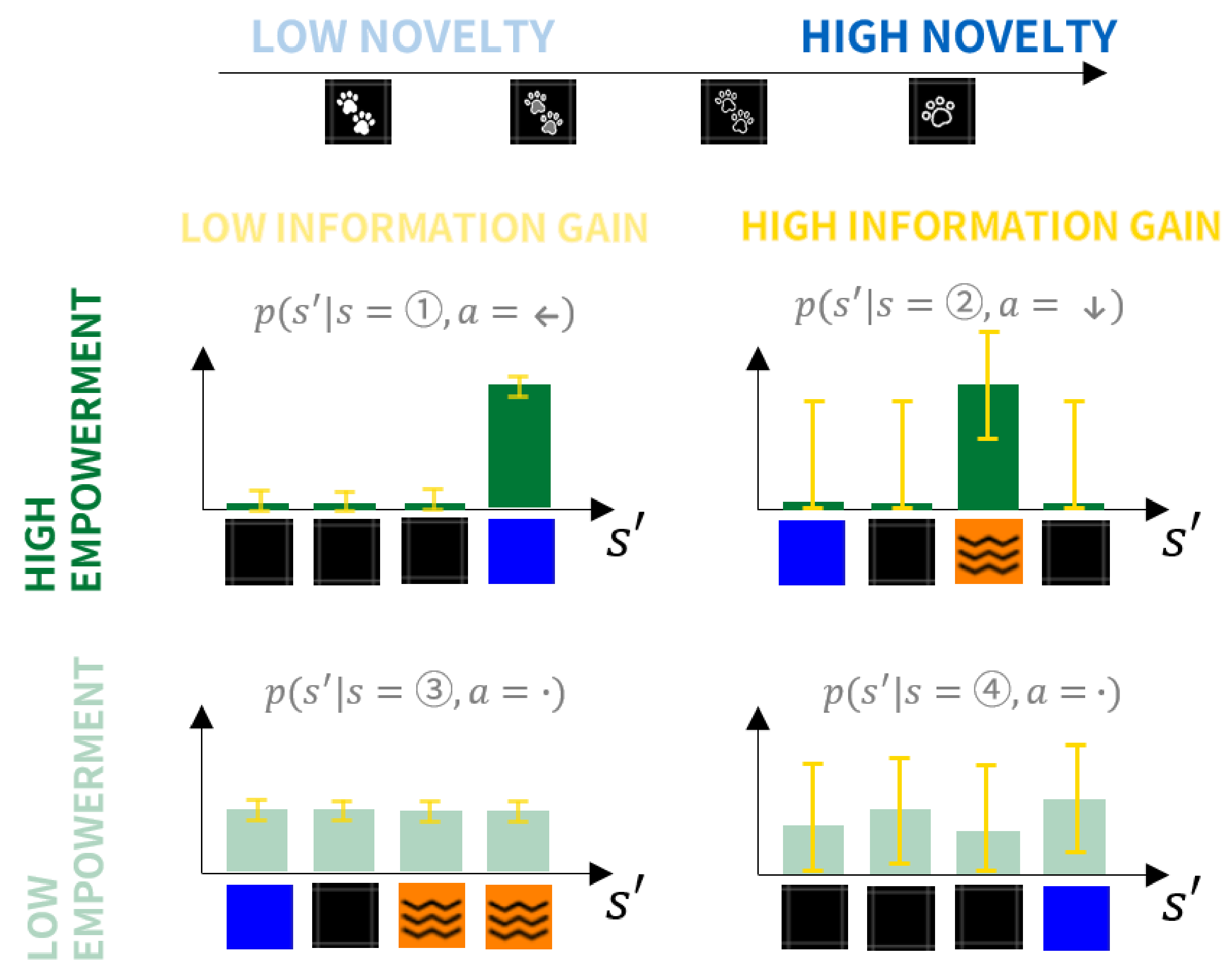
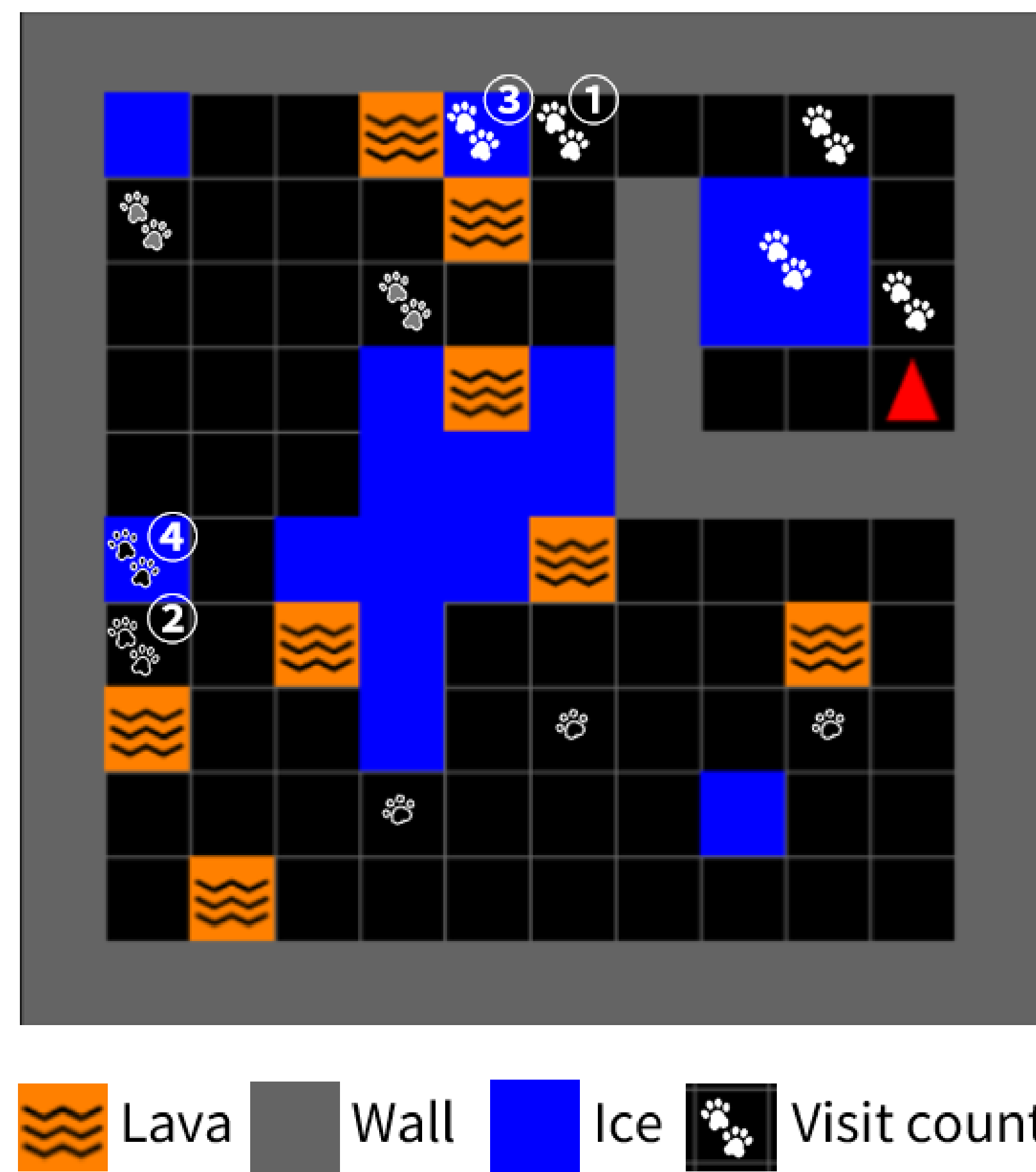
### Curiosity (Knowledge-seeking)

... is about improving predictions, reducing surprise, better knowledge.  
(e.g. **Novelty**, **Information Gain**)  
⇒ Builds world model

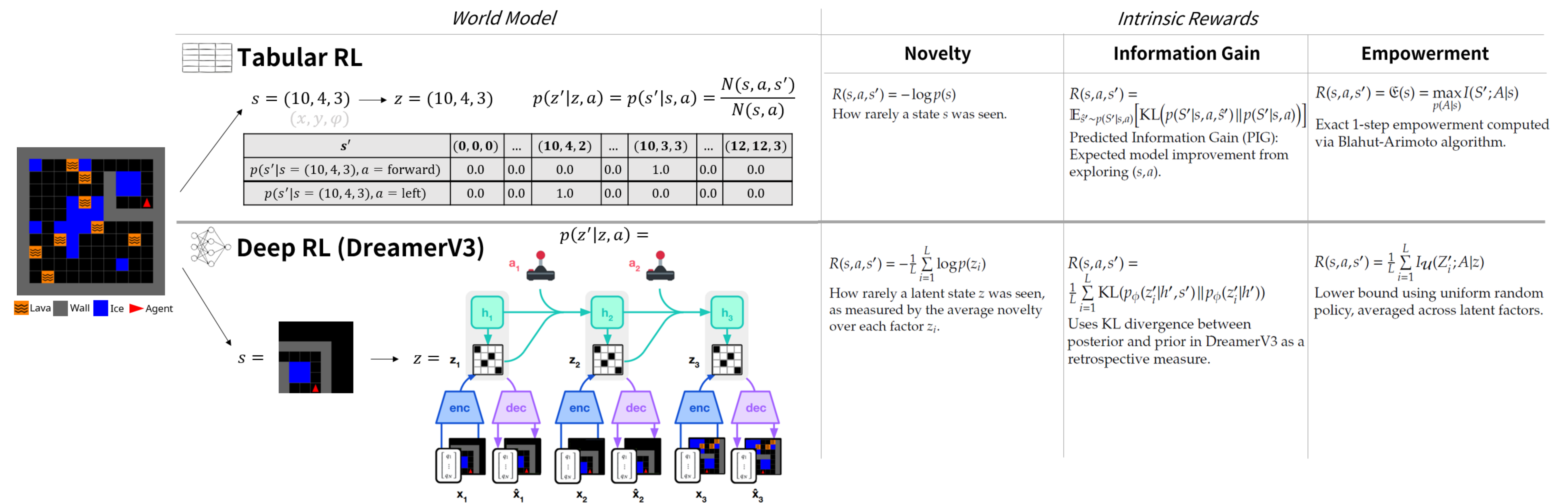
### Competence

... is about increasing control, mastery, skillfulness.  
(e.g. **Empowerment**)  
⇒ Needs world model

How do curiosity and competence co-evolve, as agents build and refine their understanding of the world?



## Simulation: Exploration shapes the world model, which in turn shapes exploration



- **Novelty/InfoGain** ↔ **Empowerment**: How do curiosity and competence balance efficient but safe exploration?
- **Tabular** ↔ **Deep RL**: Can curiosity and competence enable more human-like representation learning?

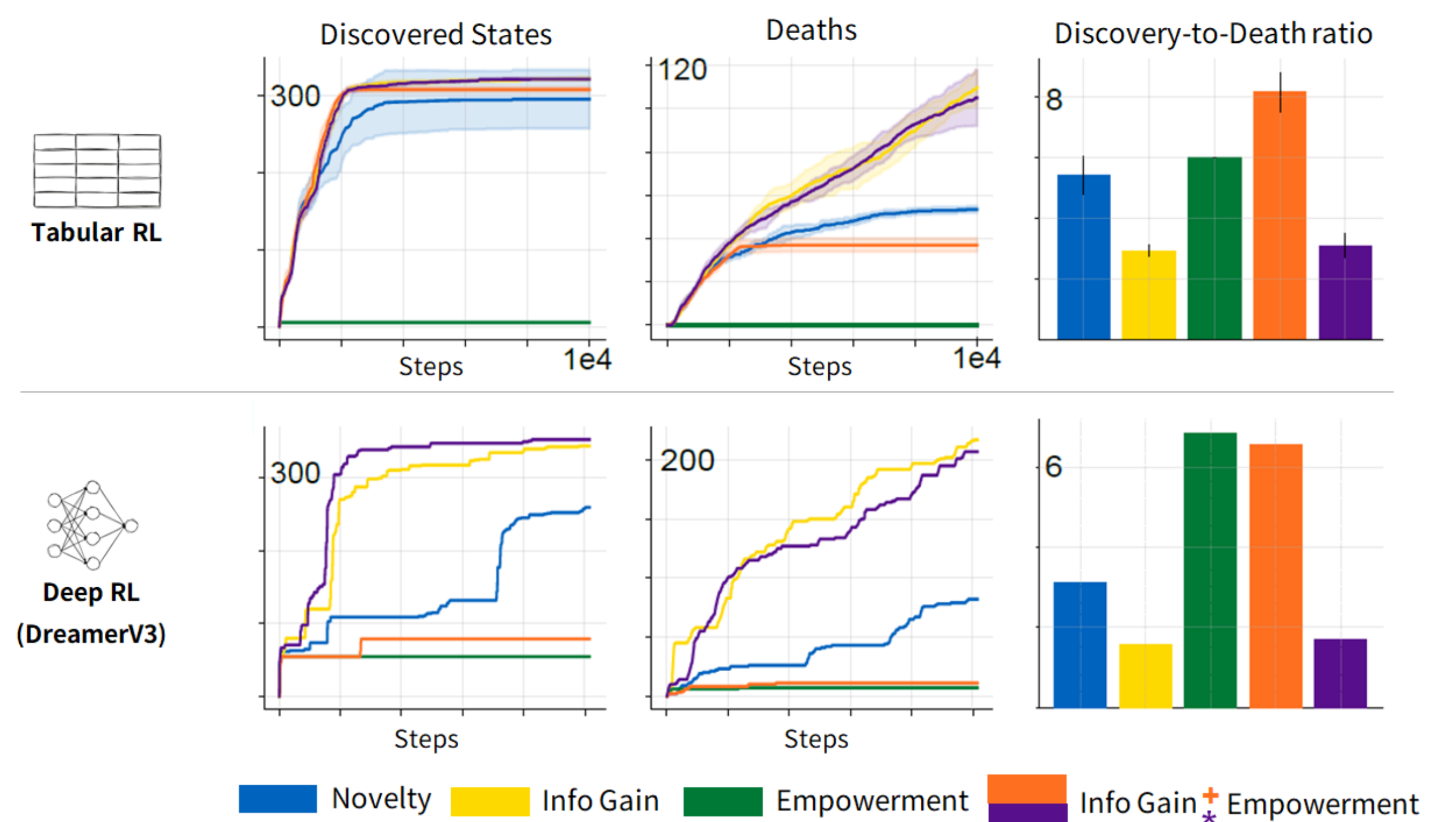
## Results: Complementarity of curiosity and competence allows safer exploration

### Competence-driven agents favor “comfort zone of control”

Satisfied with knowing they can control their immediate actions in the starting corner, **empowerment**-driven agents don't venture beyond, preferring safety over exploration.

### Curiosity-driven agents get distracted by the uncontrollable

Rewarding agents purely for **information gain** can make them explore thoroughly, but also chase useless stochasticity – the “noisy TV problem”. Even worse: losing control can be fatal!



### Striving for both curiosity and competence can be optimal!

⇒ **Combining Empowerment & Information Gain**  
= **Better exploration** (than Empowerment alone)  
= **Safer exploration** (than Information Gain alone)  
*Curiosity enables Competence, which unlocks more Curiosity.*

### Future directions

- Scale to more naturalistic environments (e.g. Crafter)
- Investigate interplay with representation learning
- Fill the gap between these simulations and being able to model human exploration on the same tasks