# Point process latent variable models of larval zebrafish behavior

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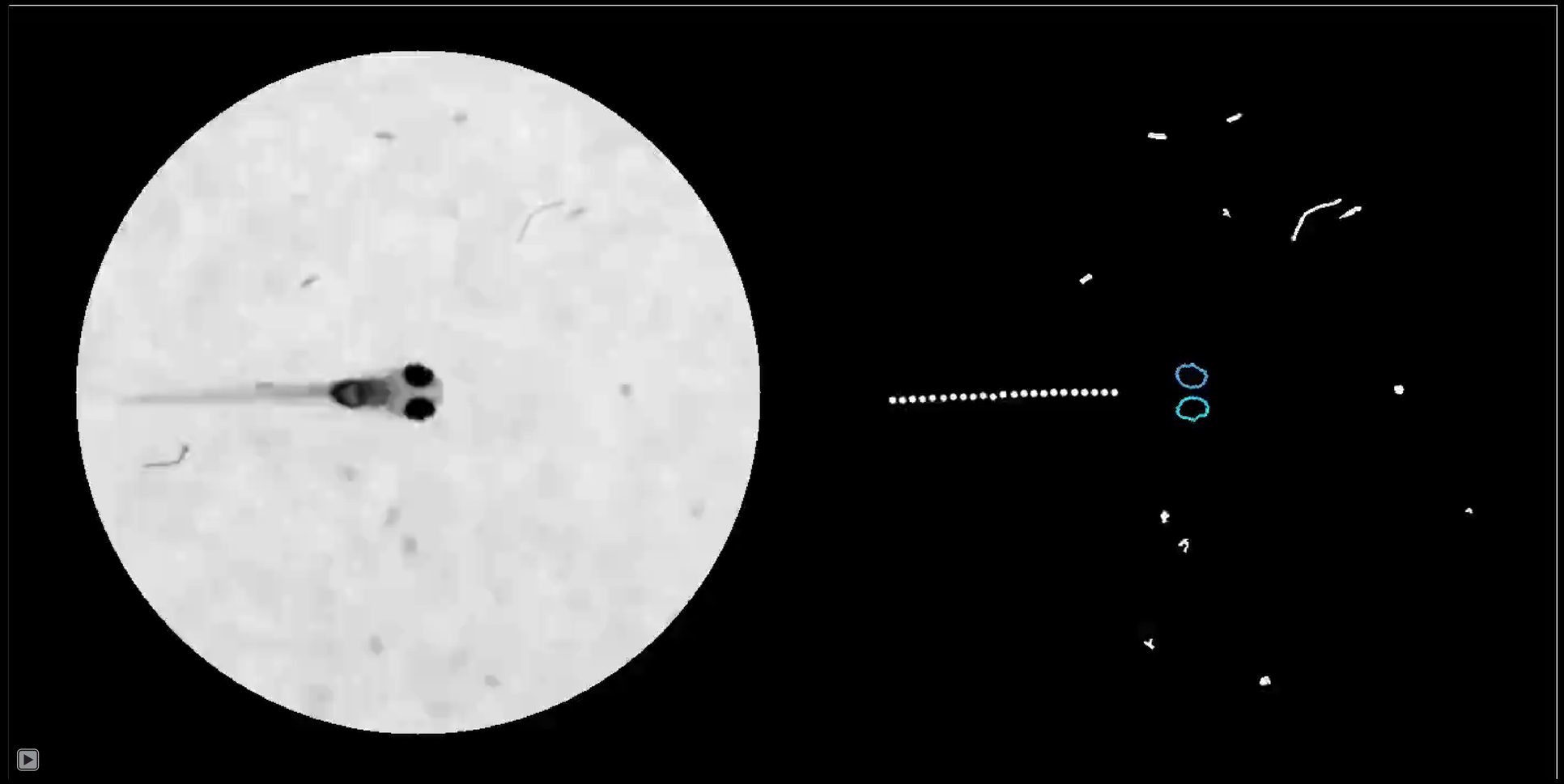
# Why larval zebrafish behavior?

To understand the computations of the nervous system, we need to understand its behavioral outputs.

# Real recording of a freely behaving larval zebrafish



# Key questions

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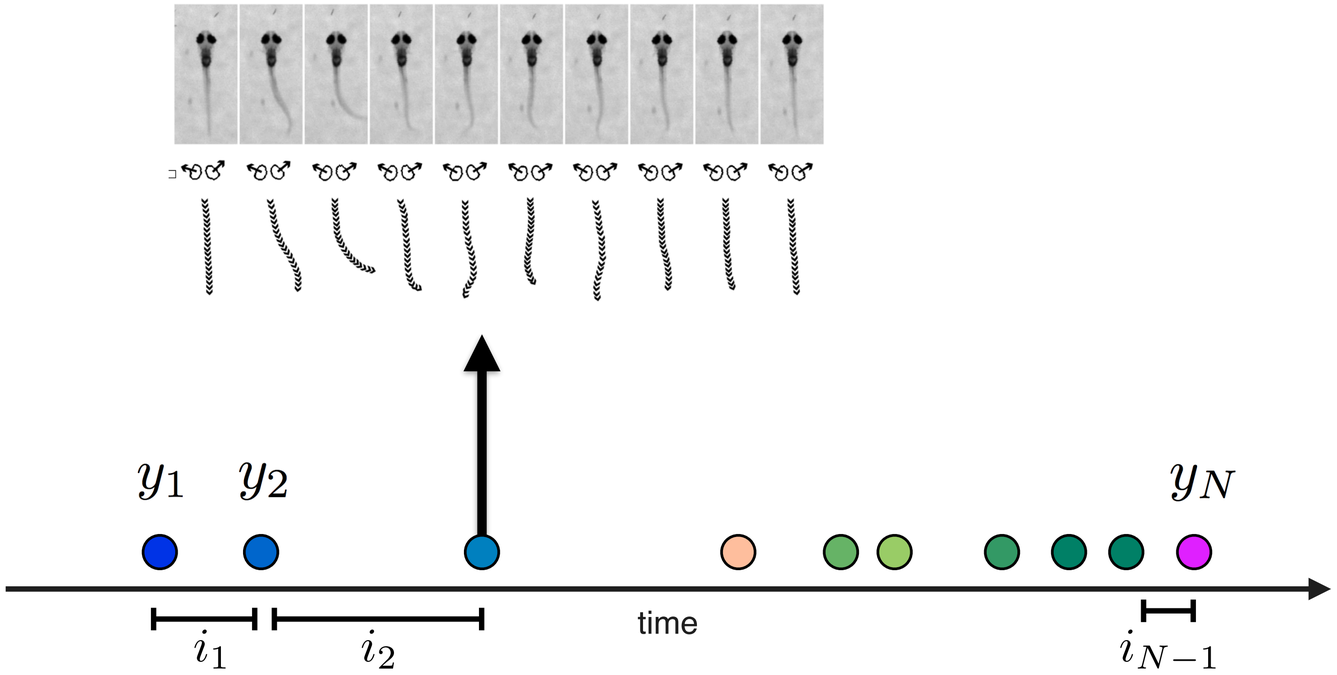
**Q2**: What dynamics govern how swim bouts are sequenced together over time?

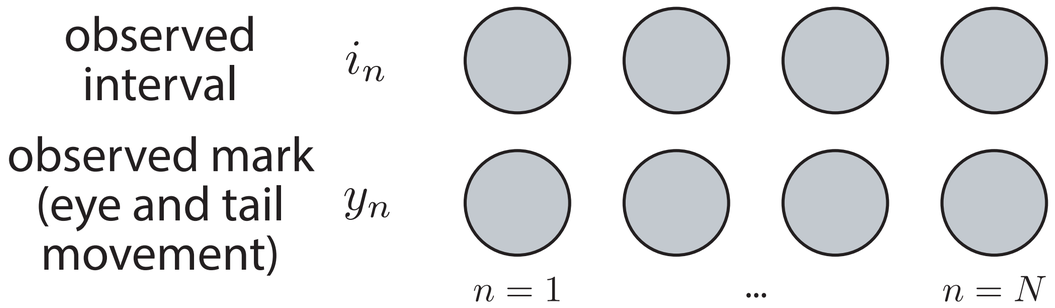
**Q3**: How are these dynamics modulated by internal states like hunger?

# Modeling larval zebrafish behavior as a marked point process



# Point process latent variable models

**Full Generative Model**




latent observed LSTM state dependency neural net dep. clique

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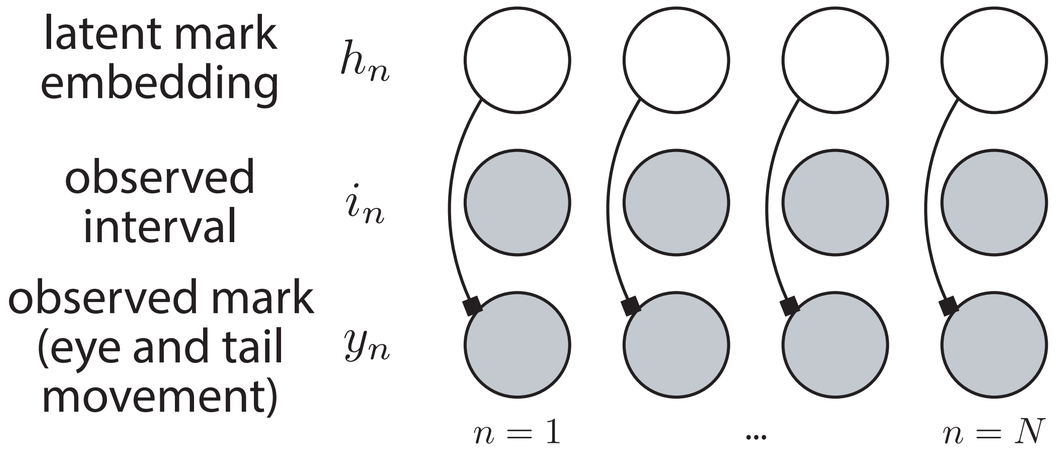


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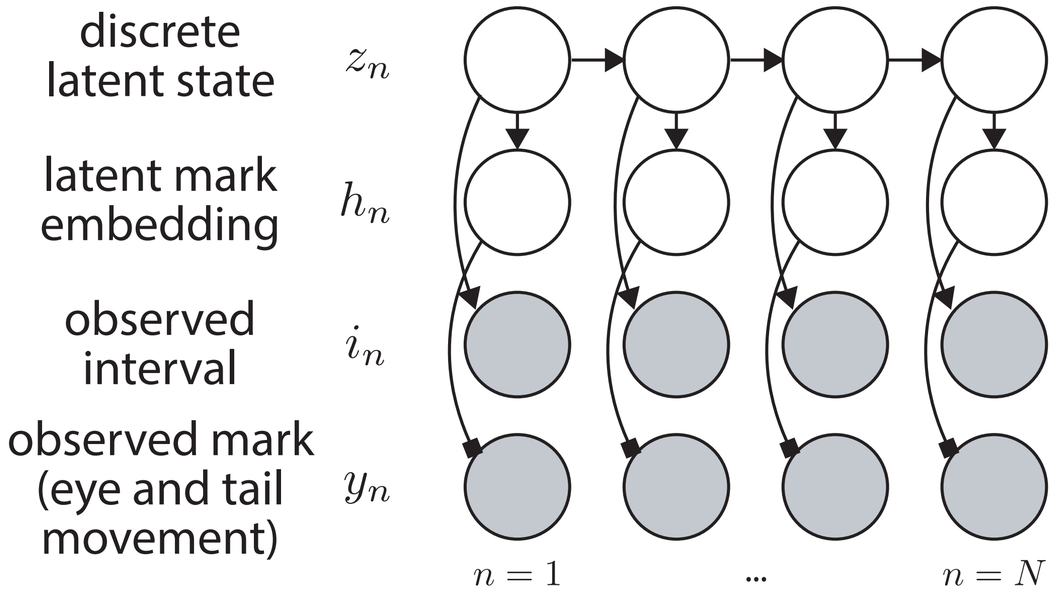


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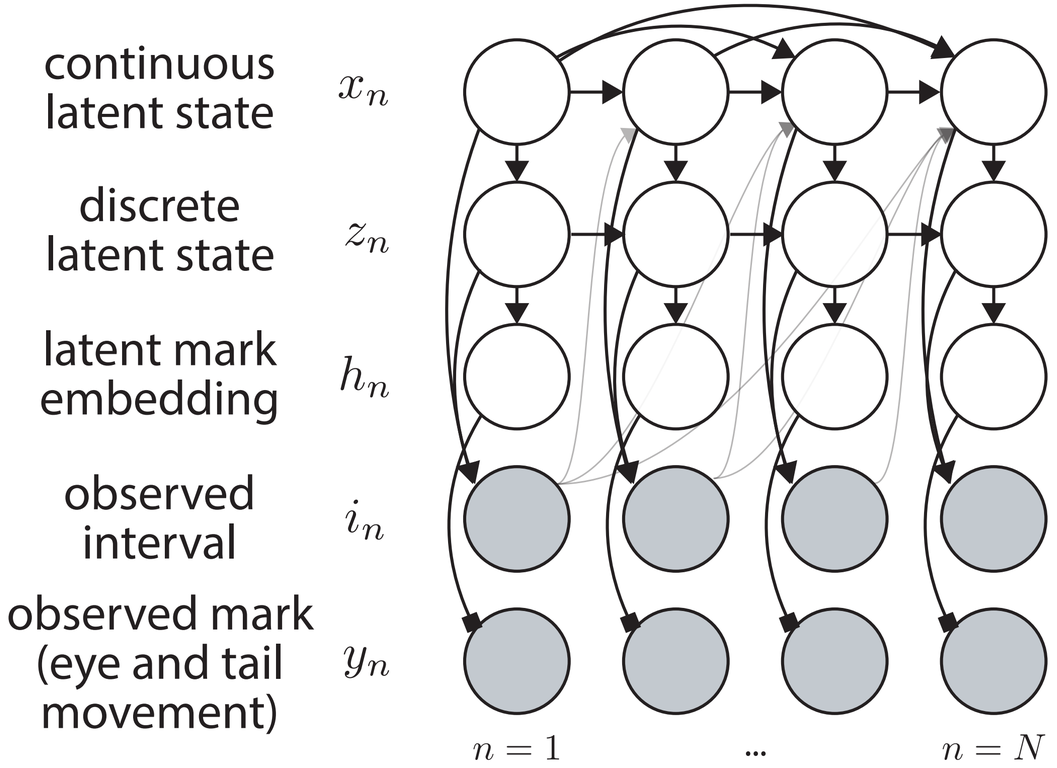


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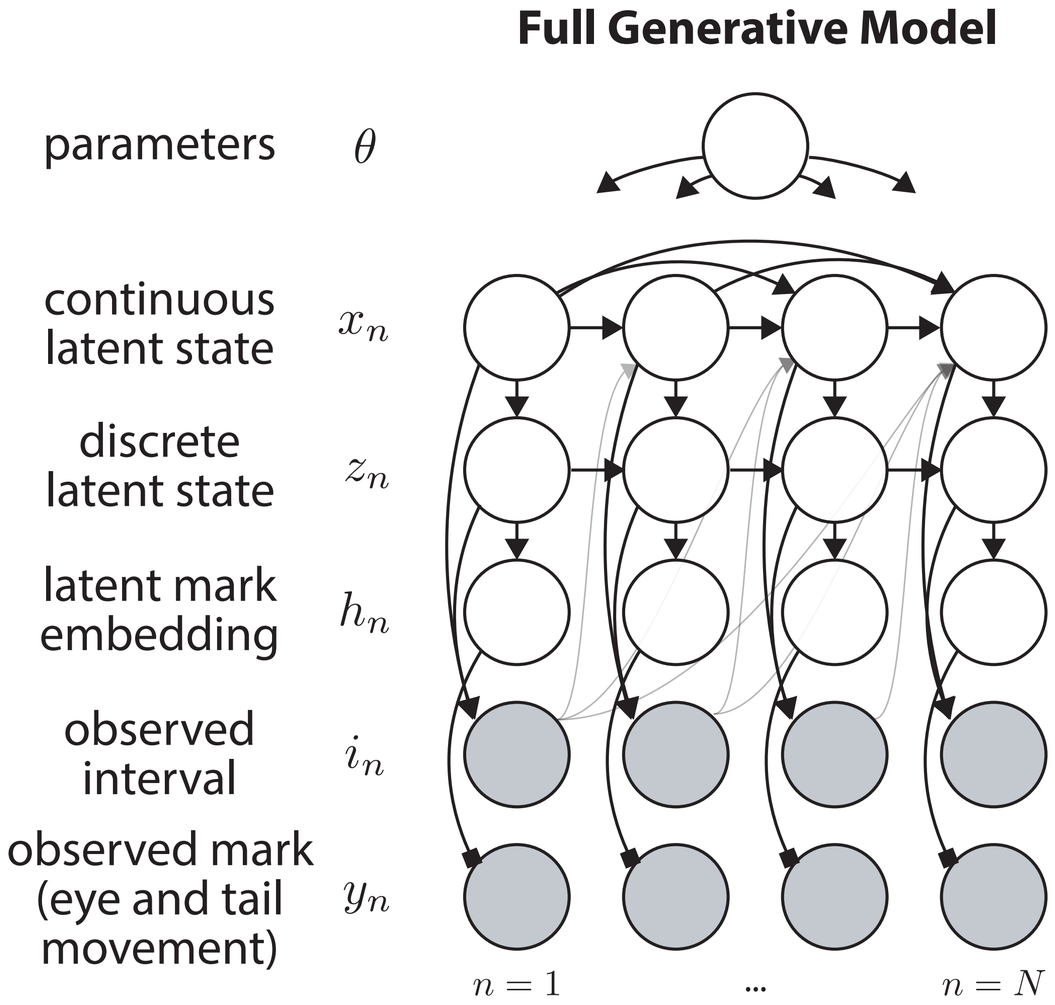


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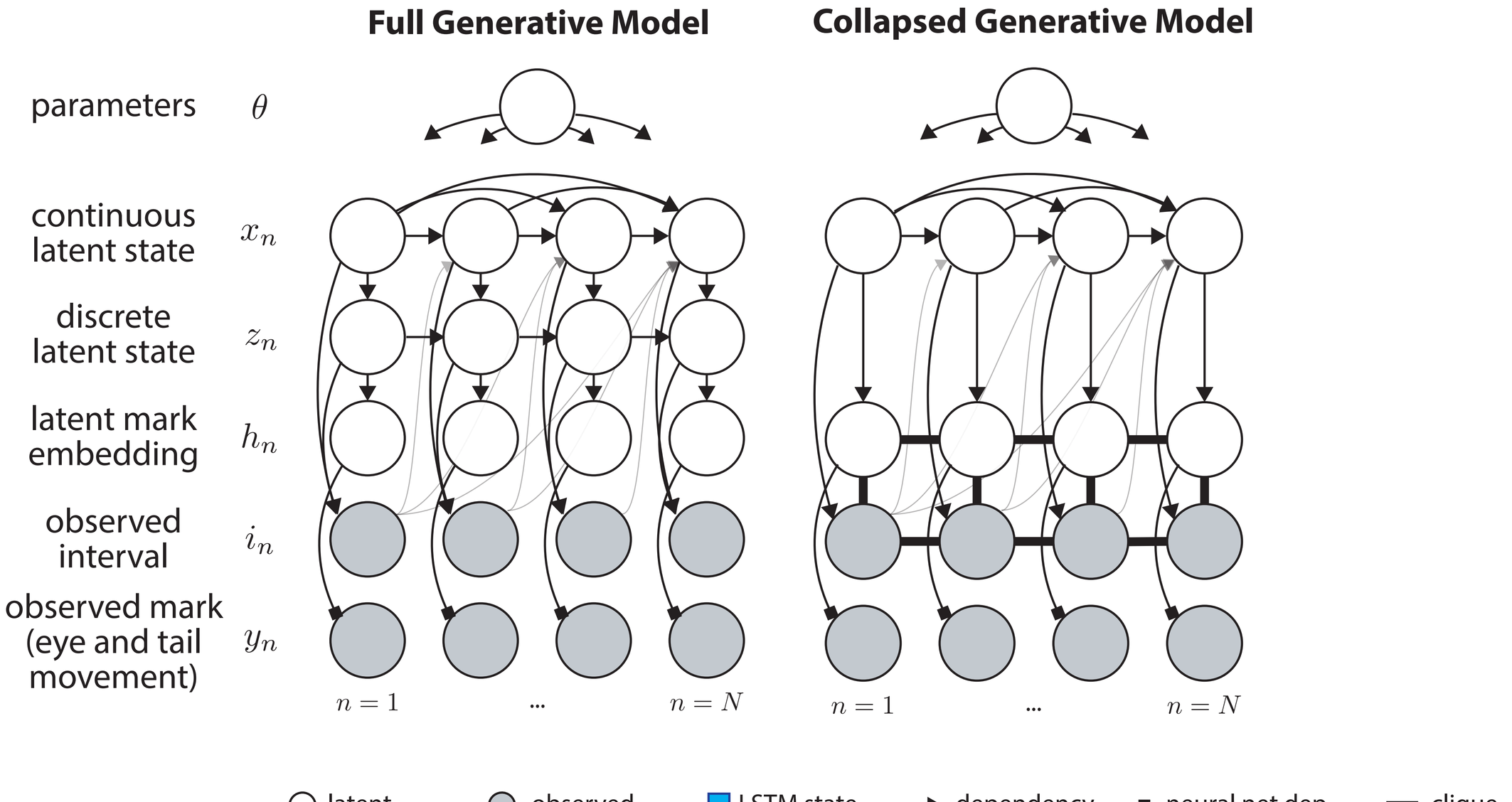

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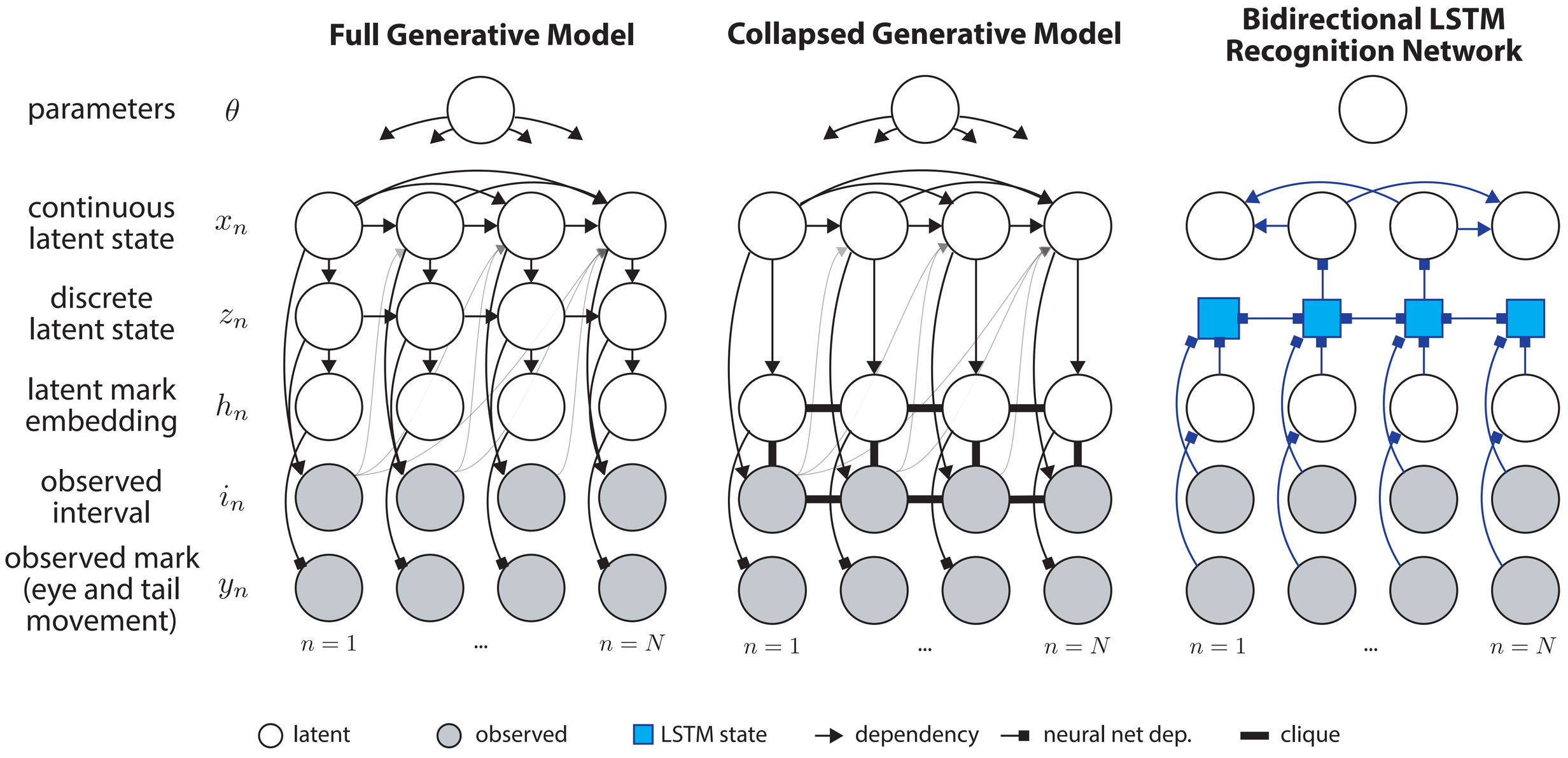
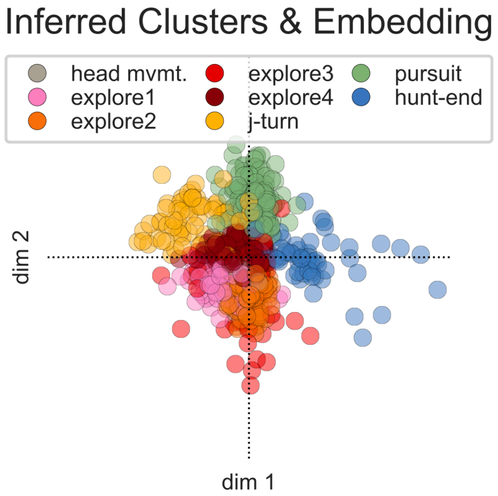
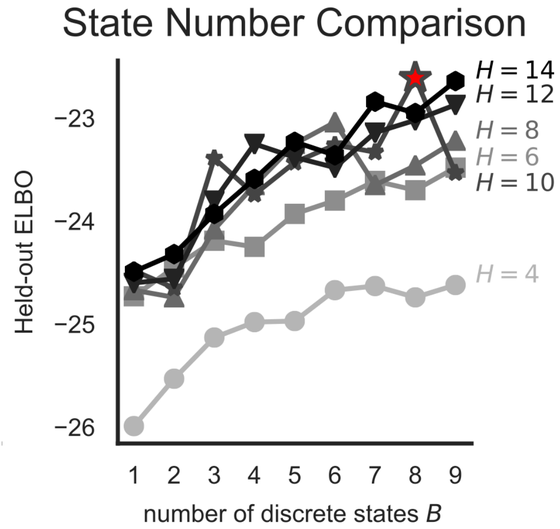


# PPLVMs help answer key questions

**A1:** Bouts cluster into discrete types in low-d latent space.




**A1':** Held-out likelihood offers a quantitative metric for comparing representations.



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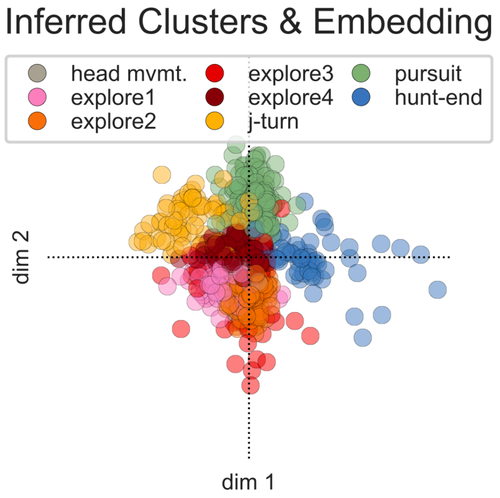


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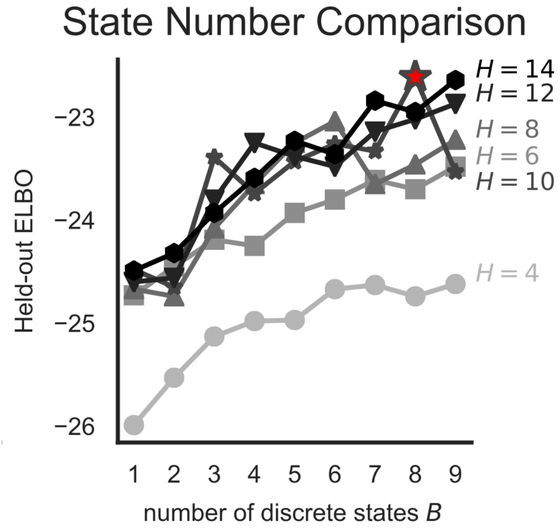
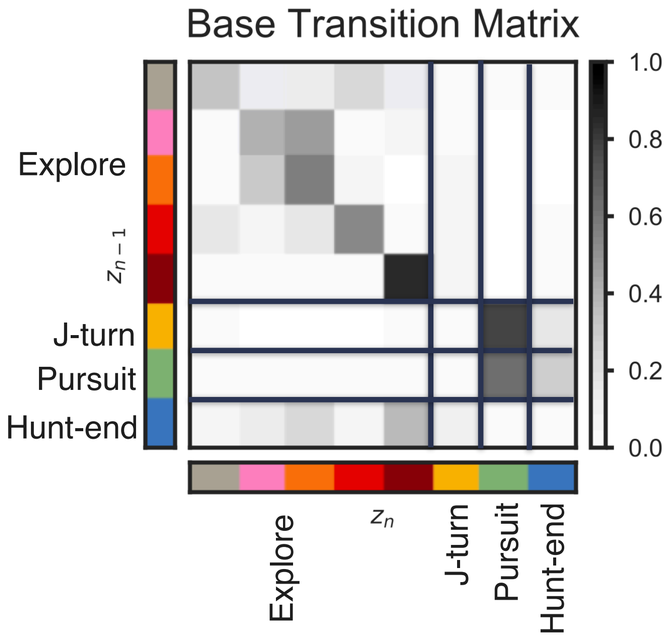



**A2:** Bout types follow characteristic transition patterns between hunting and exploring.



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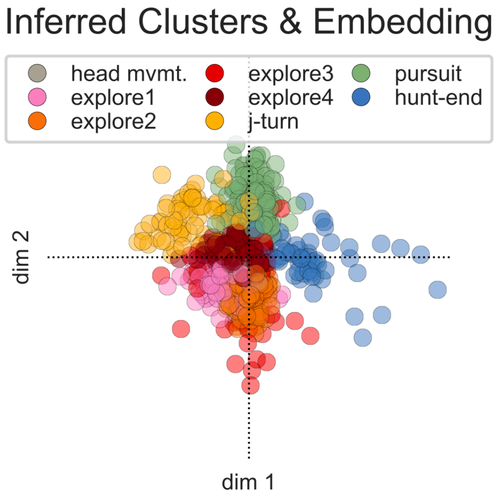


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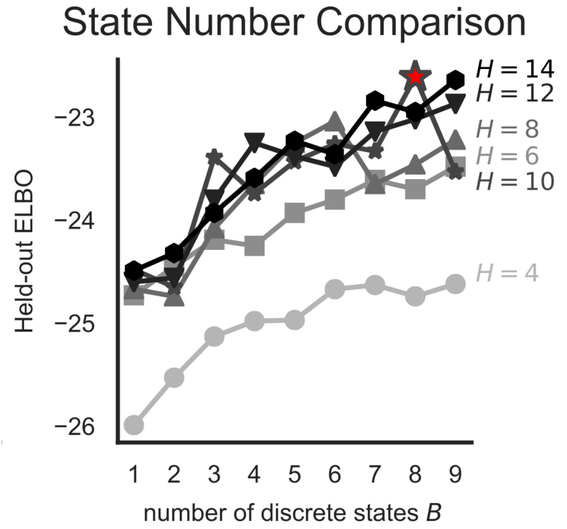


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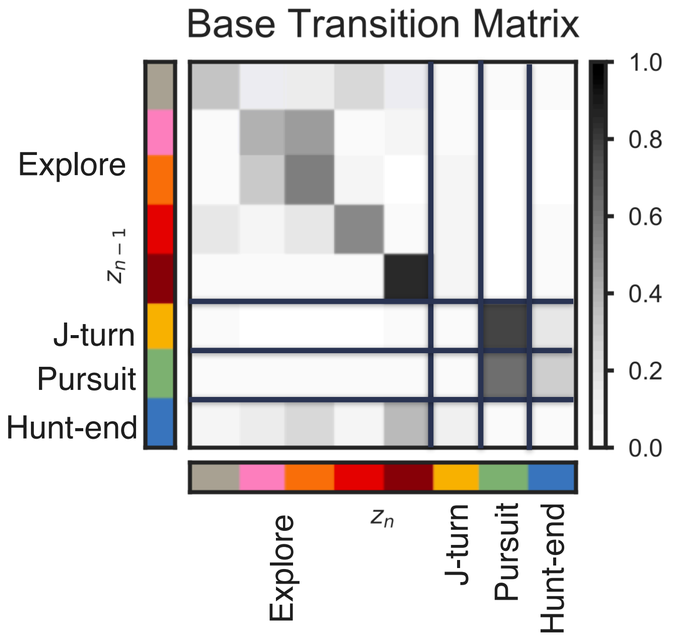
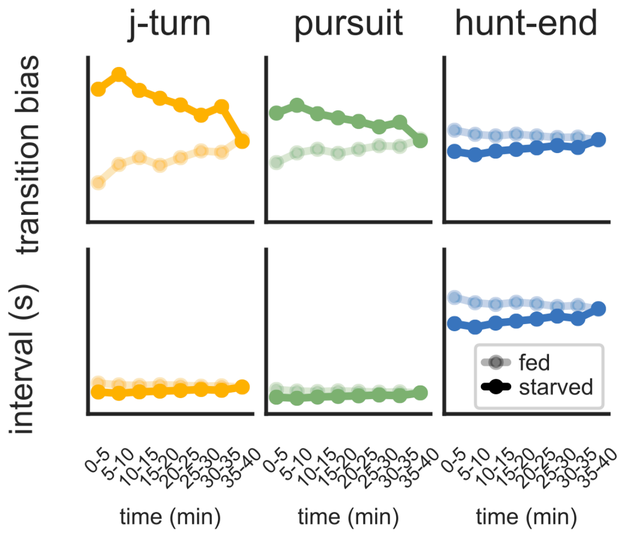



**A3:** These transition patterns change over time as a function of hunger.



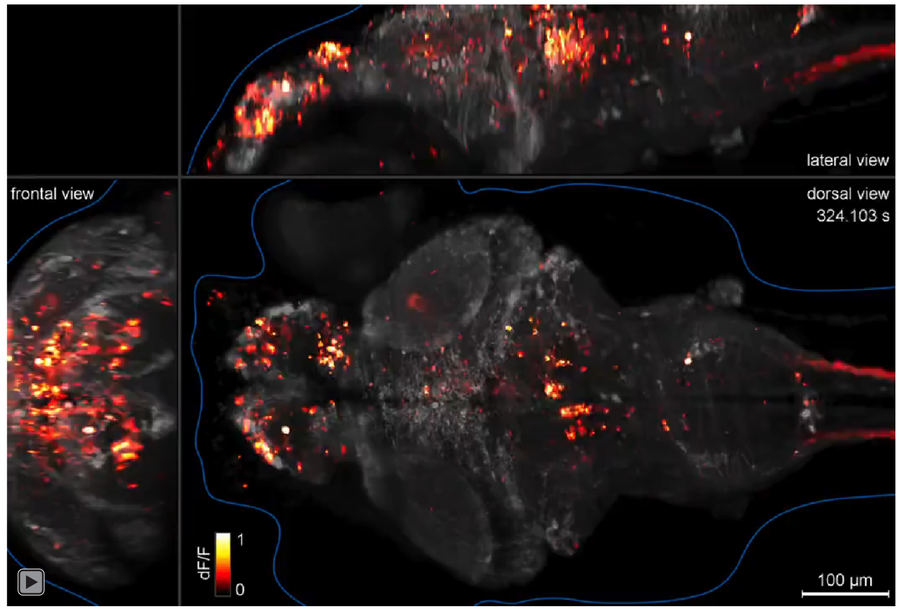
# Come to our poster!

Extend our model to include

- Environmental dependencies (prey locations, sizes, dynamics)
- Whole brain neural activity dynamics

Apply PPLVMs to other domains:

- Healthcare
- Social media
- Consumer behavior




Ahrens et al (Nature Methods, 2013)

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