Point process latent variable models of larval zebrafish behavior

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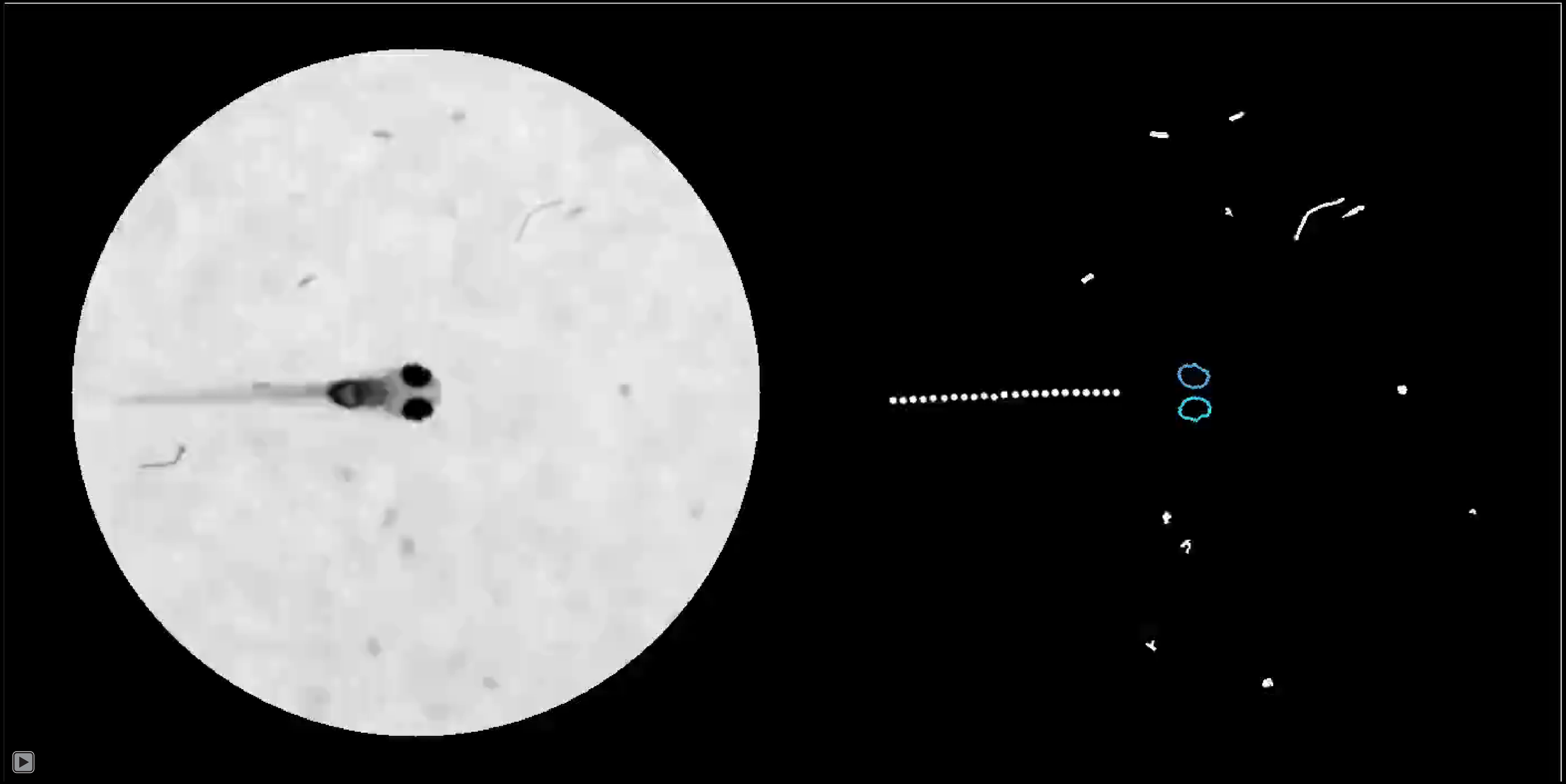
Why larval zebrafish behavior?

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?

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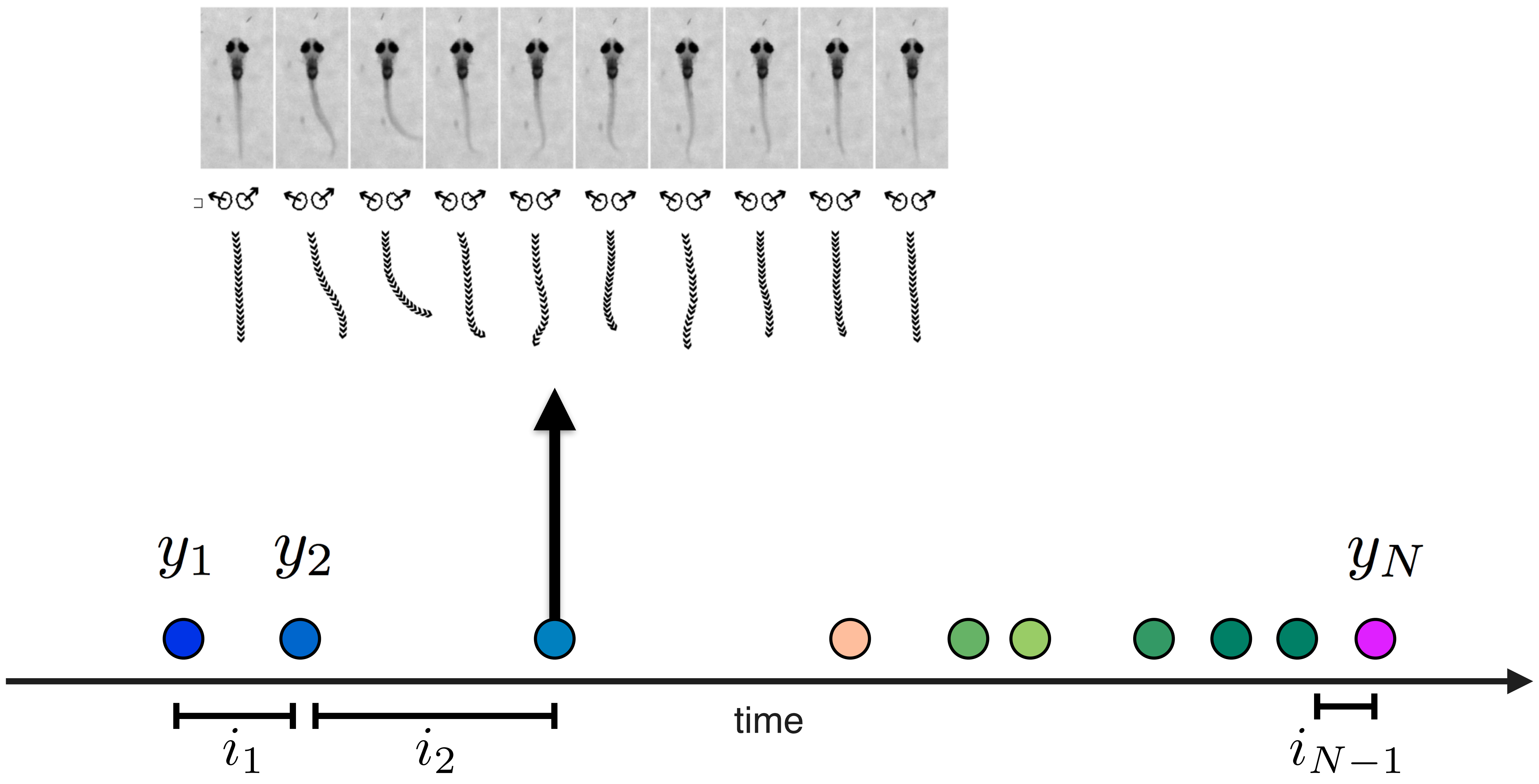
Q2: What dynamics govern how swim bouts are sequenced together over time?

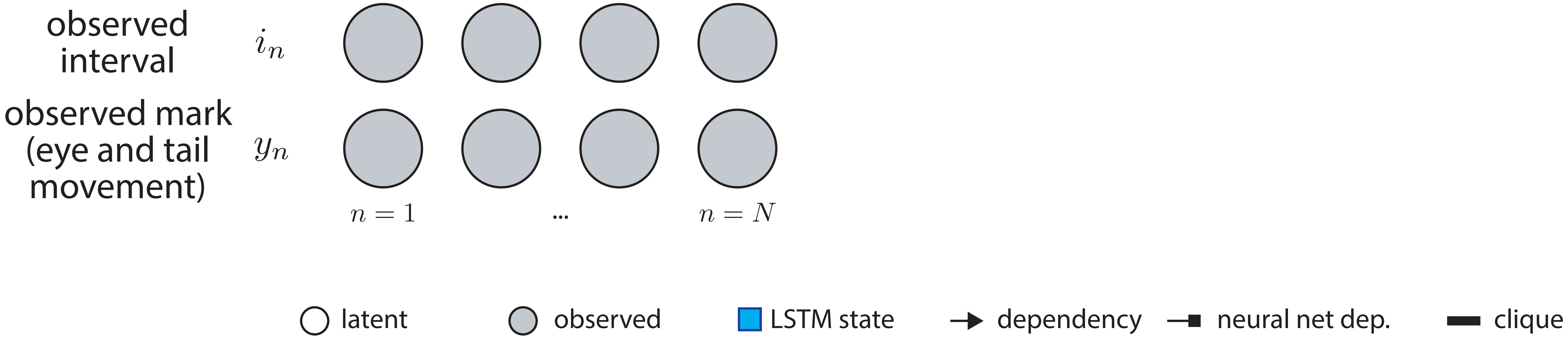
Q3: How are these dynamics modulated by internal states like hunger?

Modeling larval zebrafish behavior as a marked point process



Point process latent variable models

Full Generative Model



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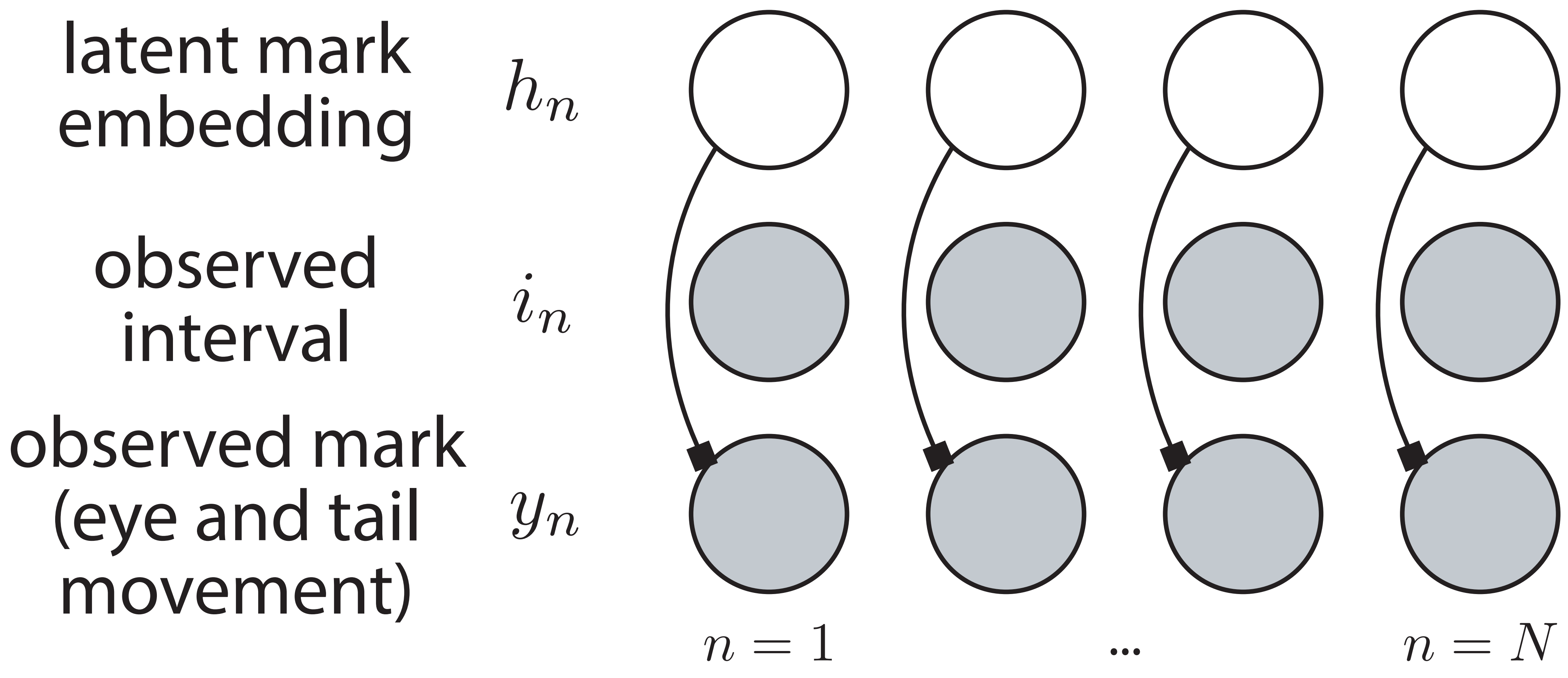

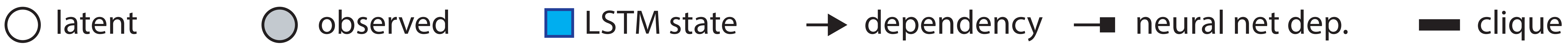

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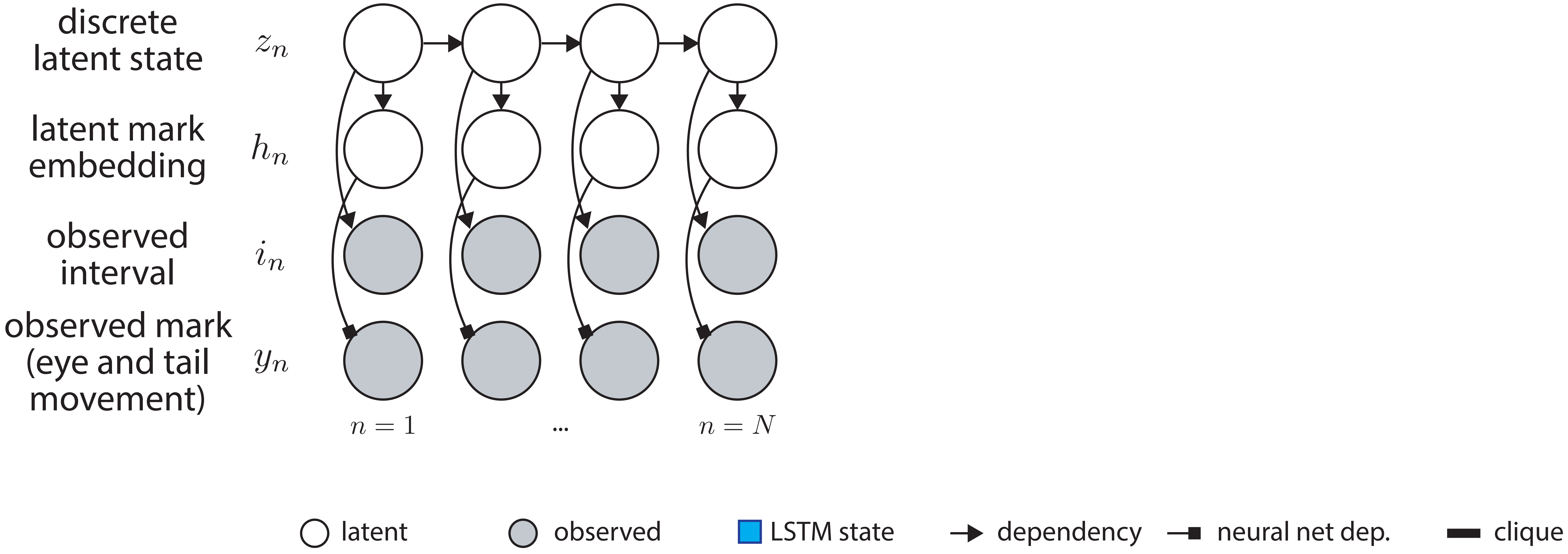

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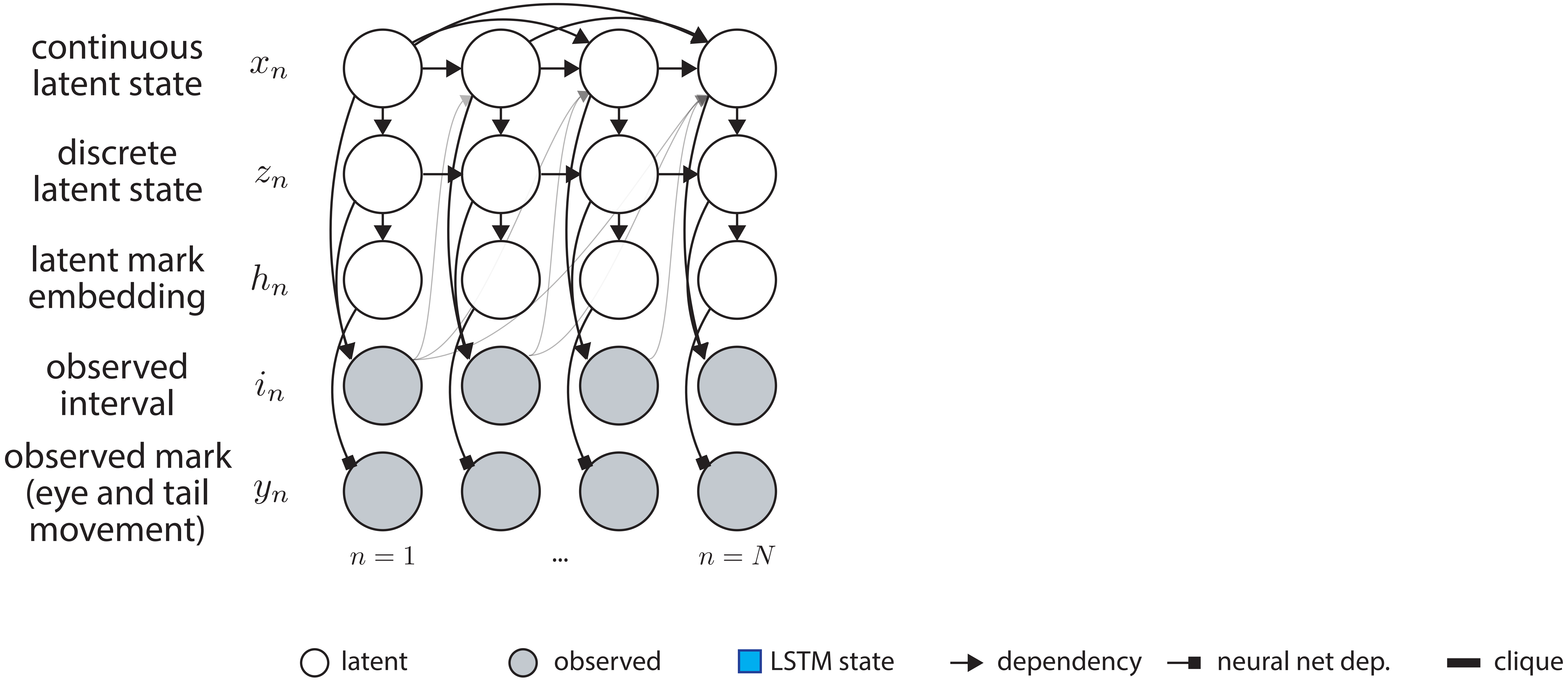

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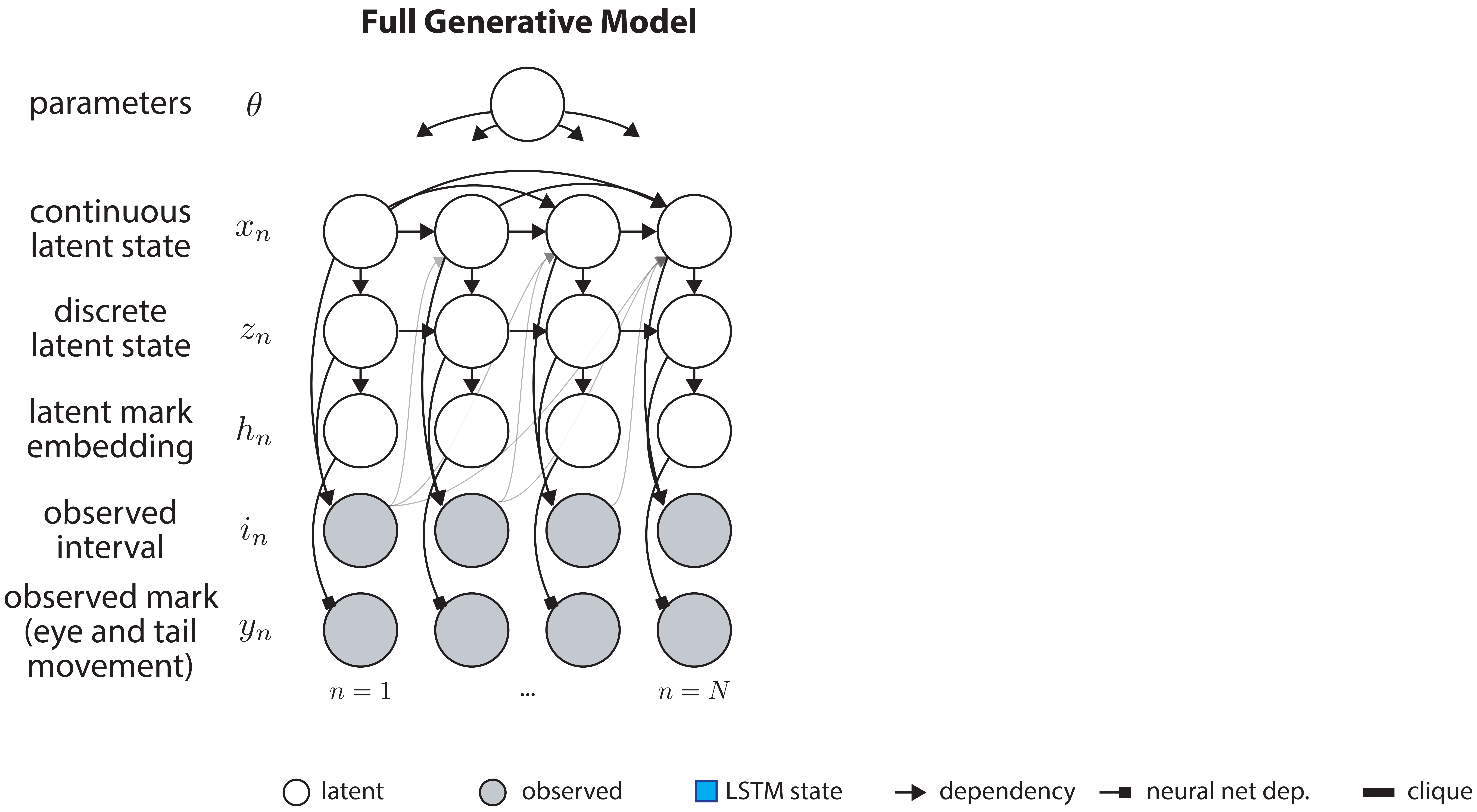

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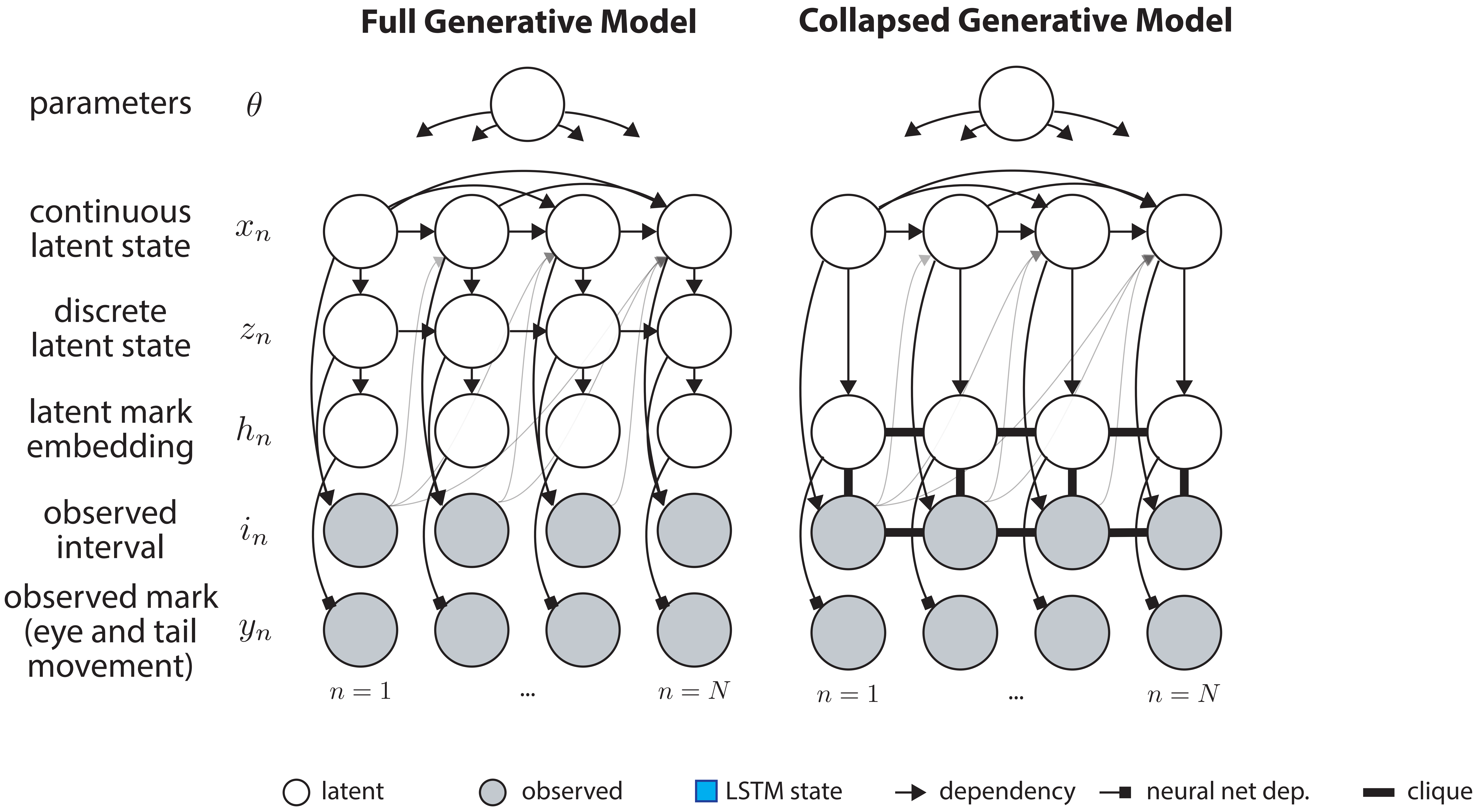

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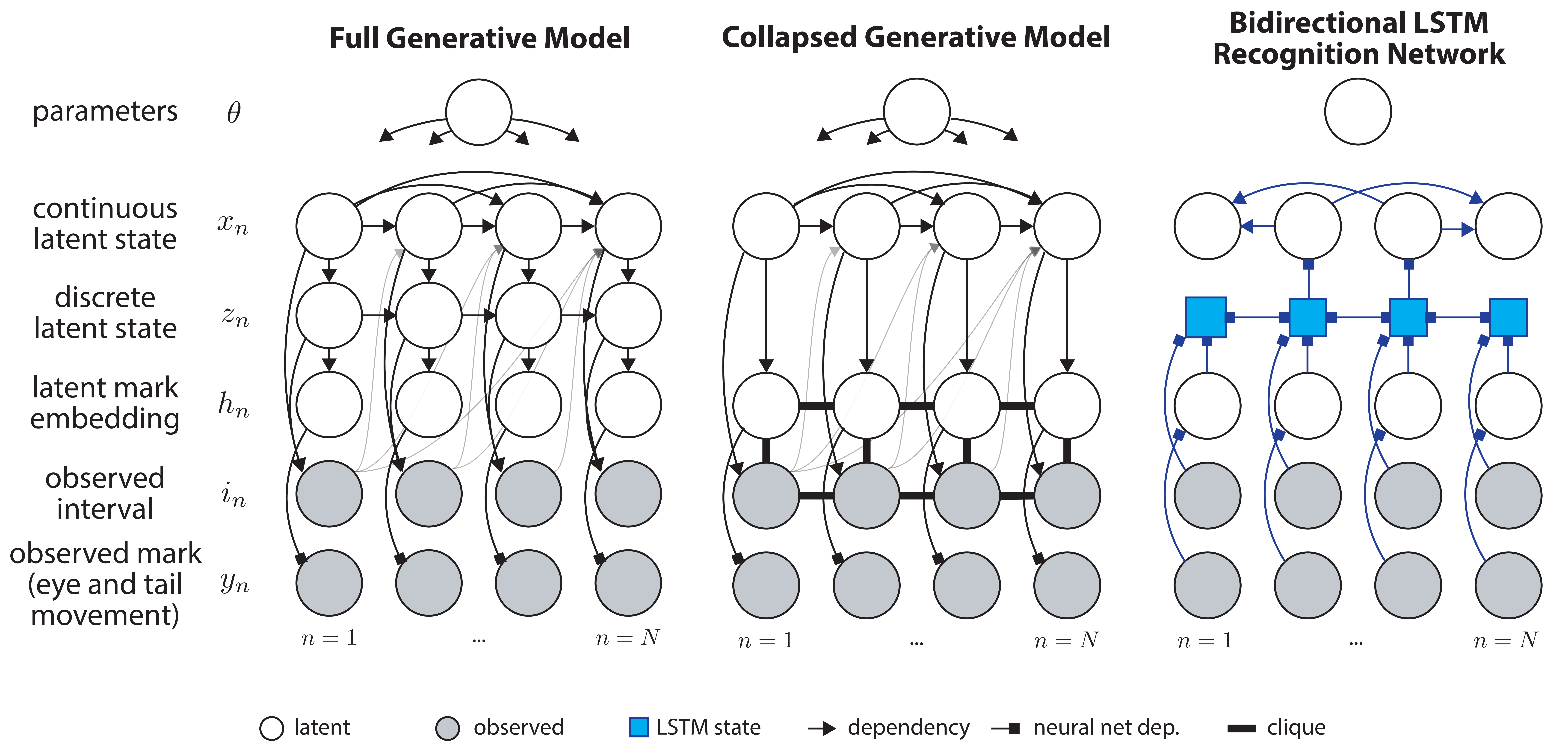
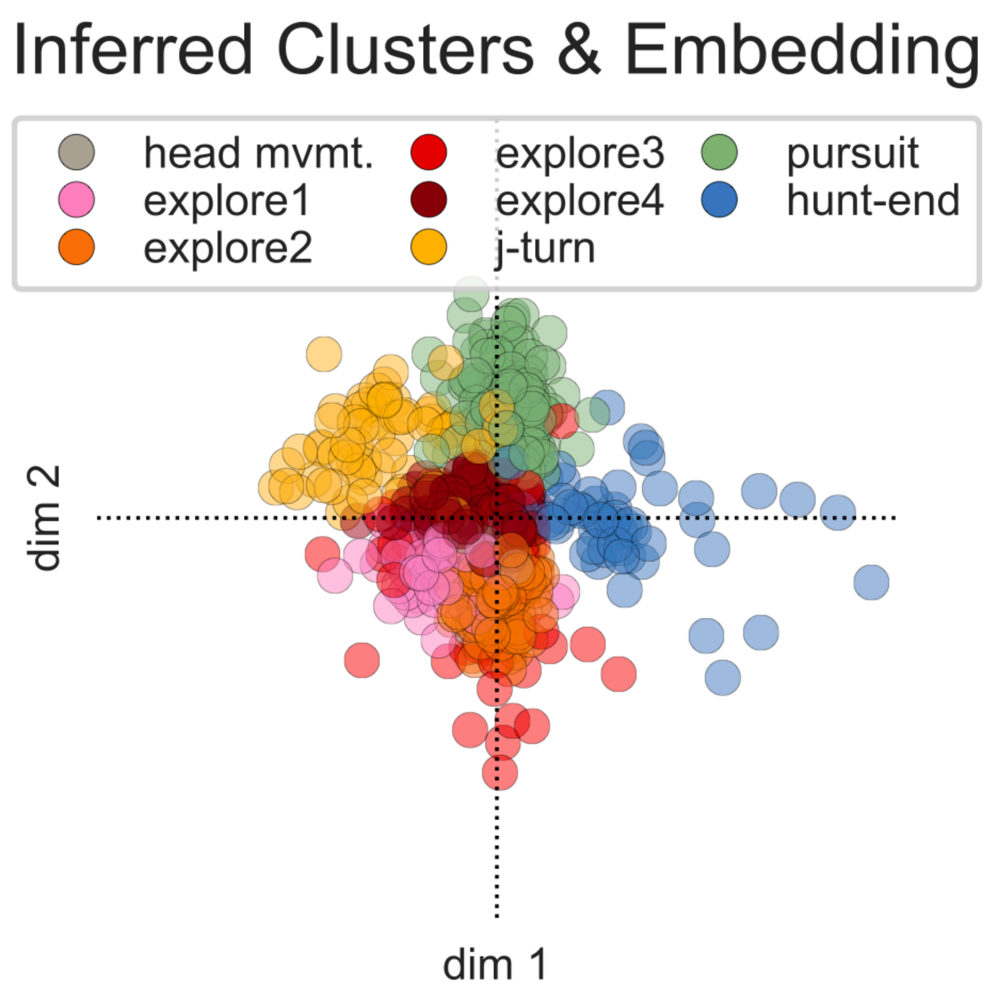
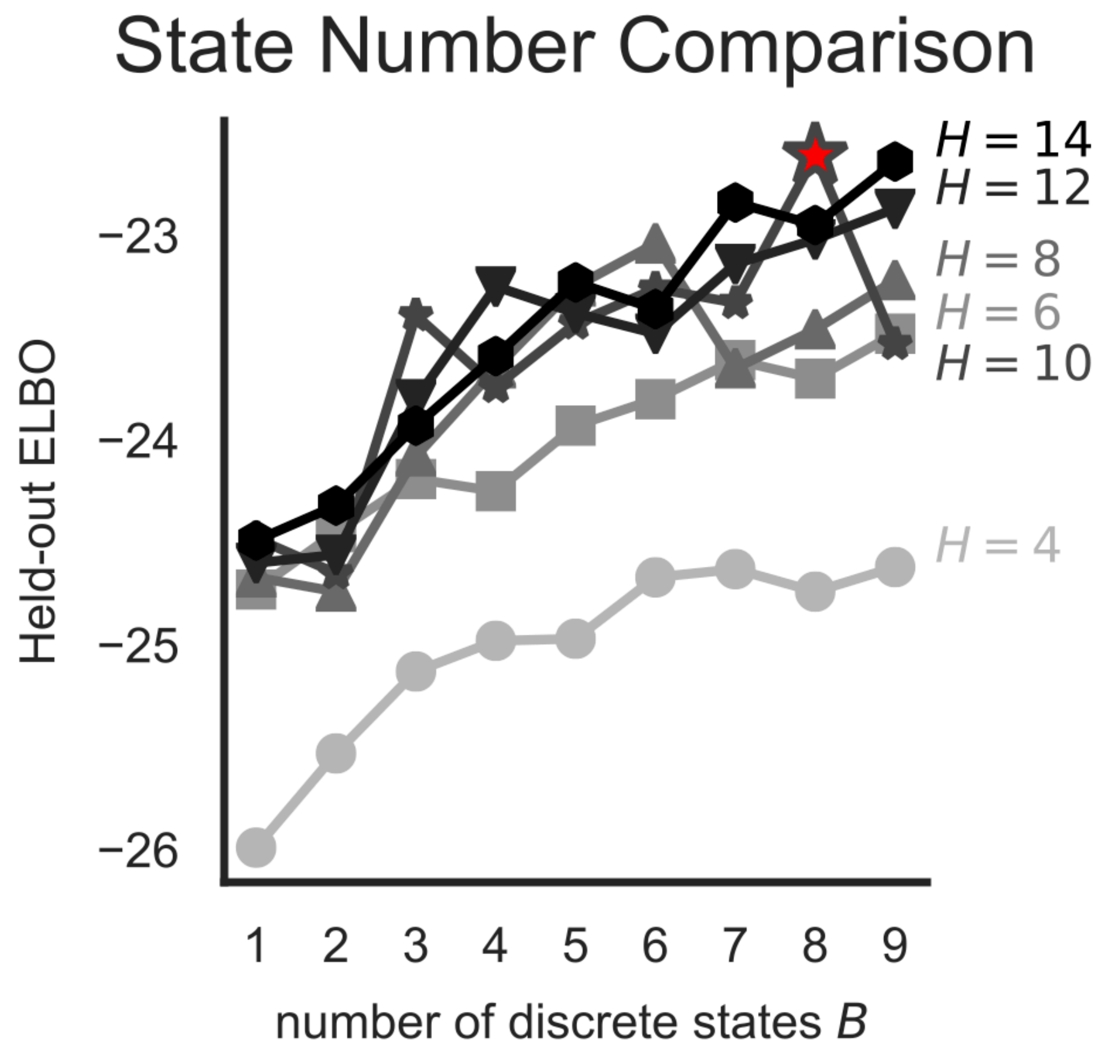


PPLVMs help answer key questions

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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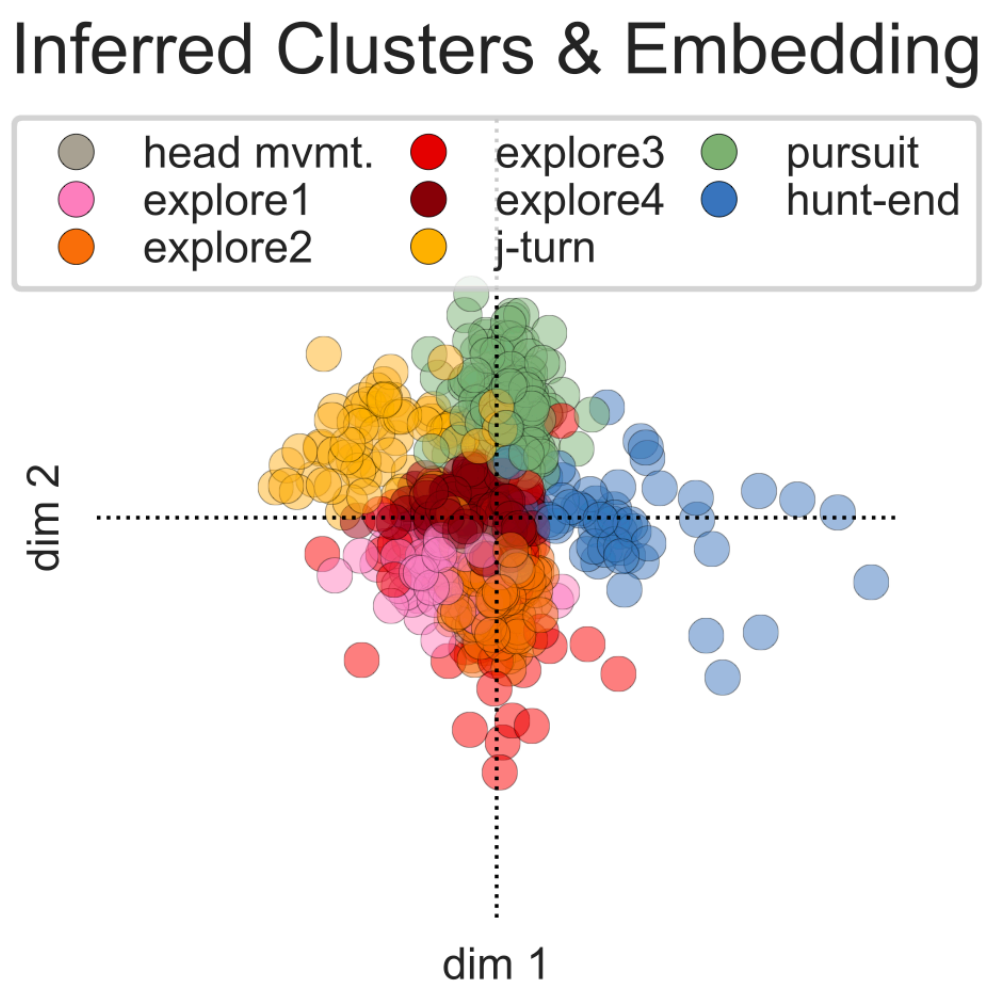

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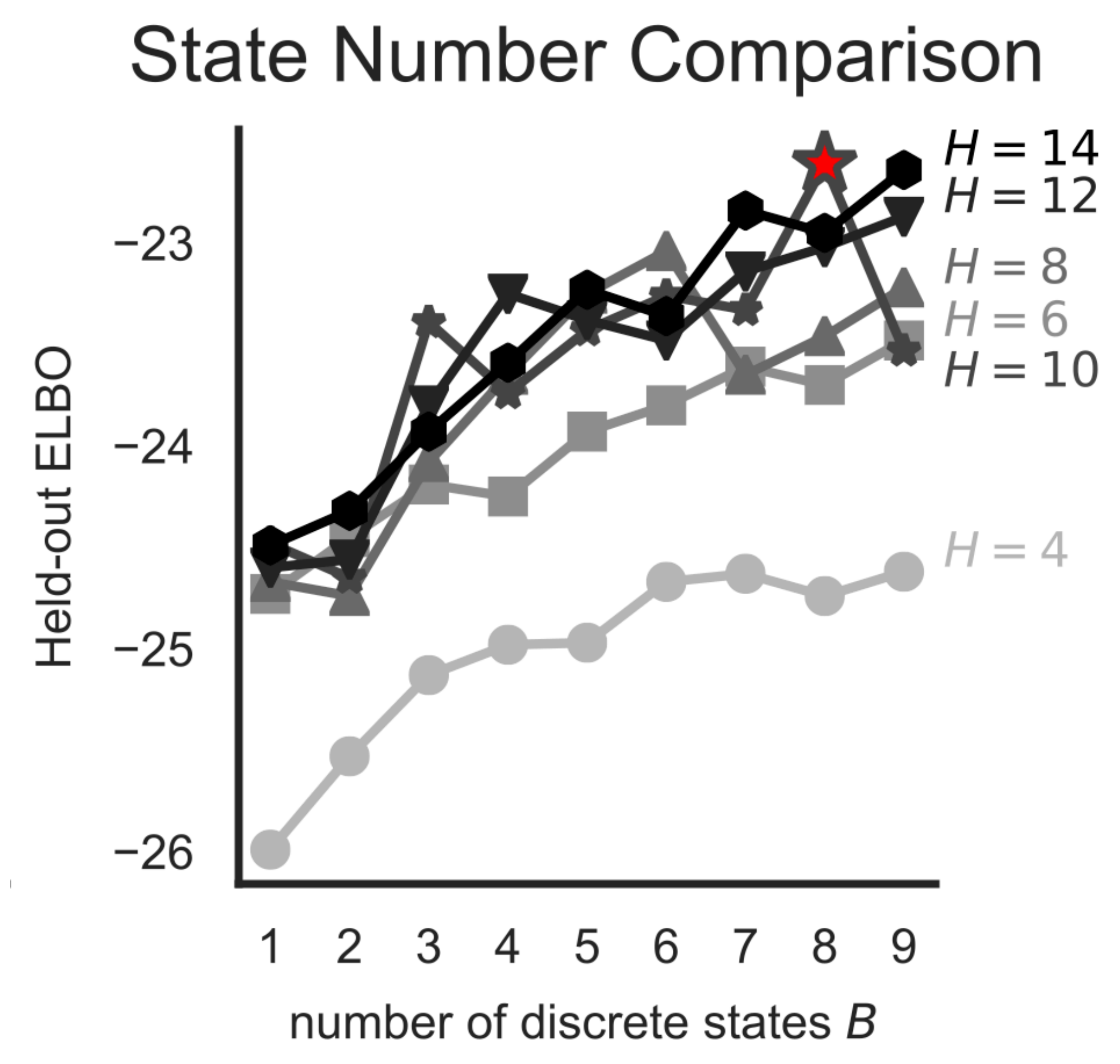
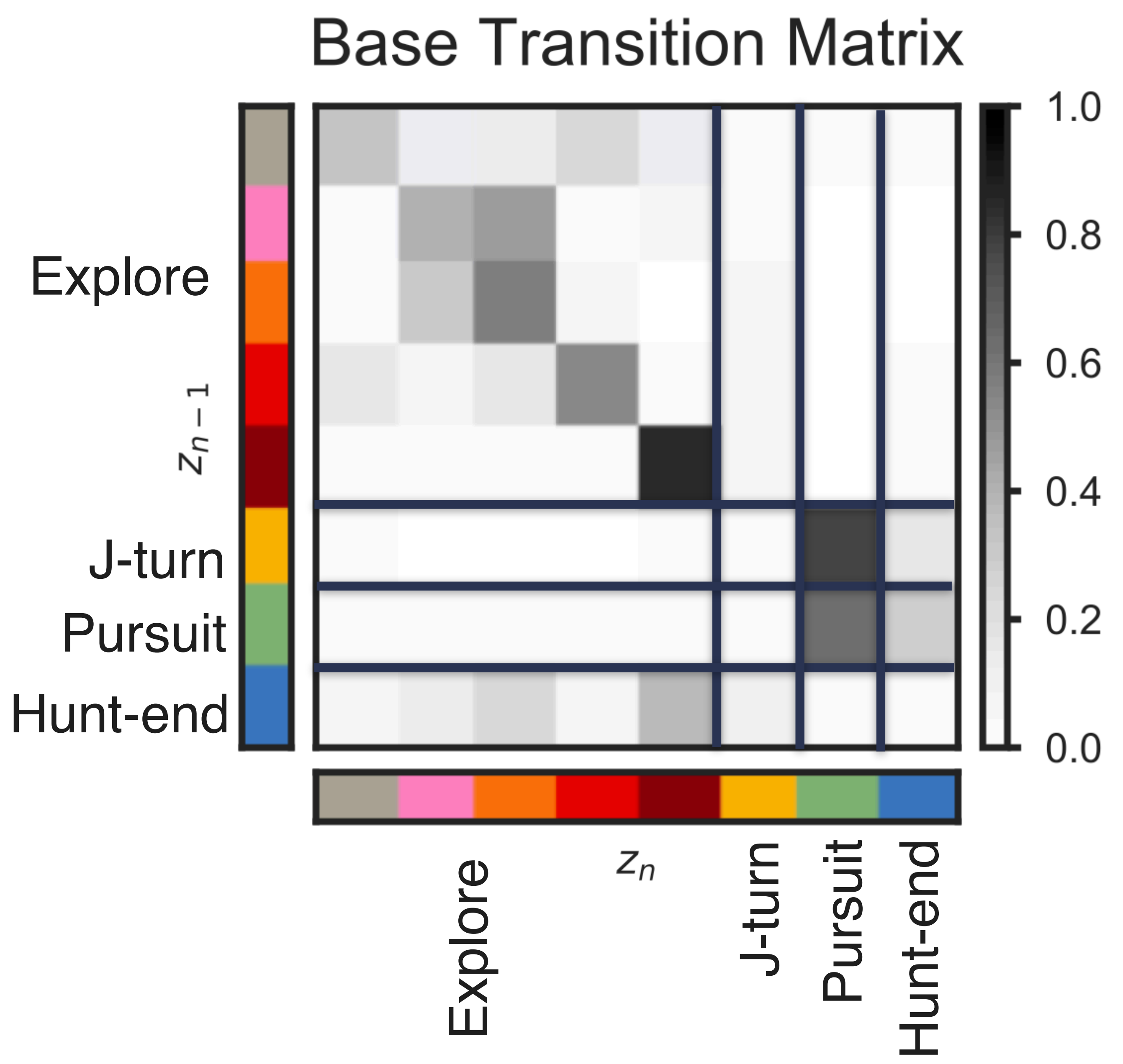


A2: Bout types follow characteristic transition patterns between hunting and exploring.



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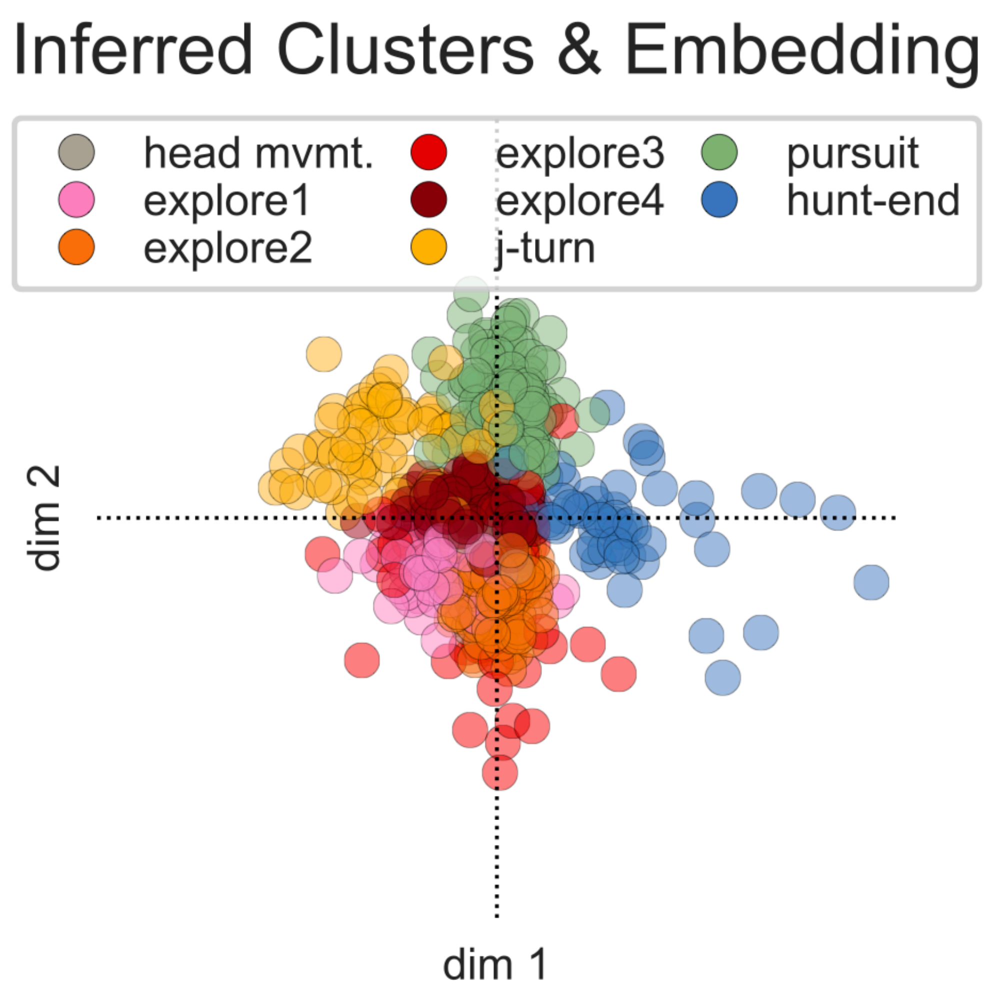

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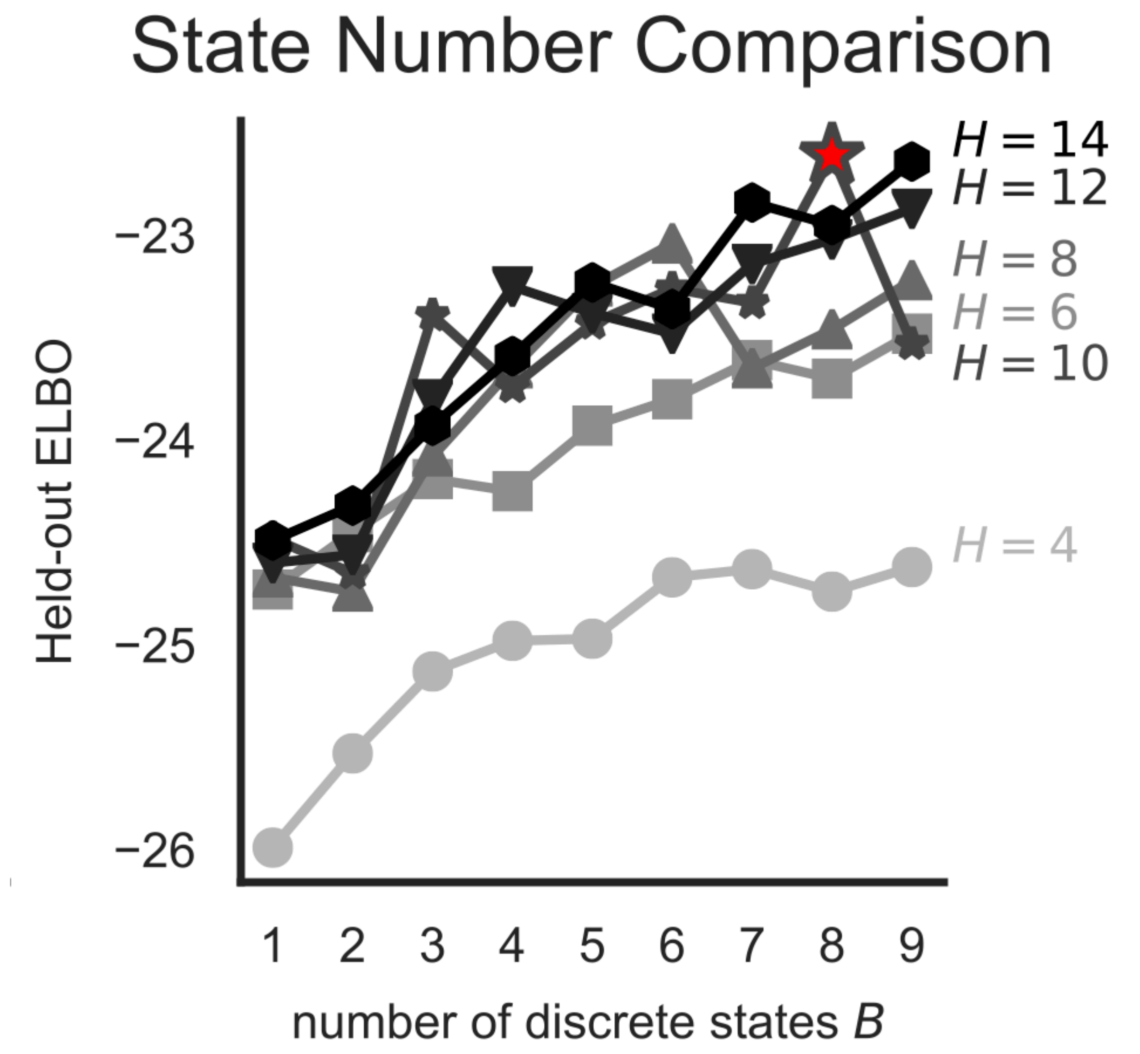

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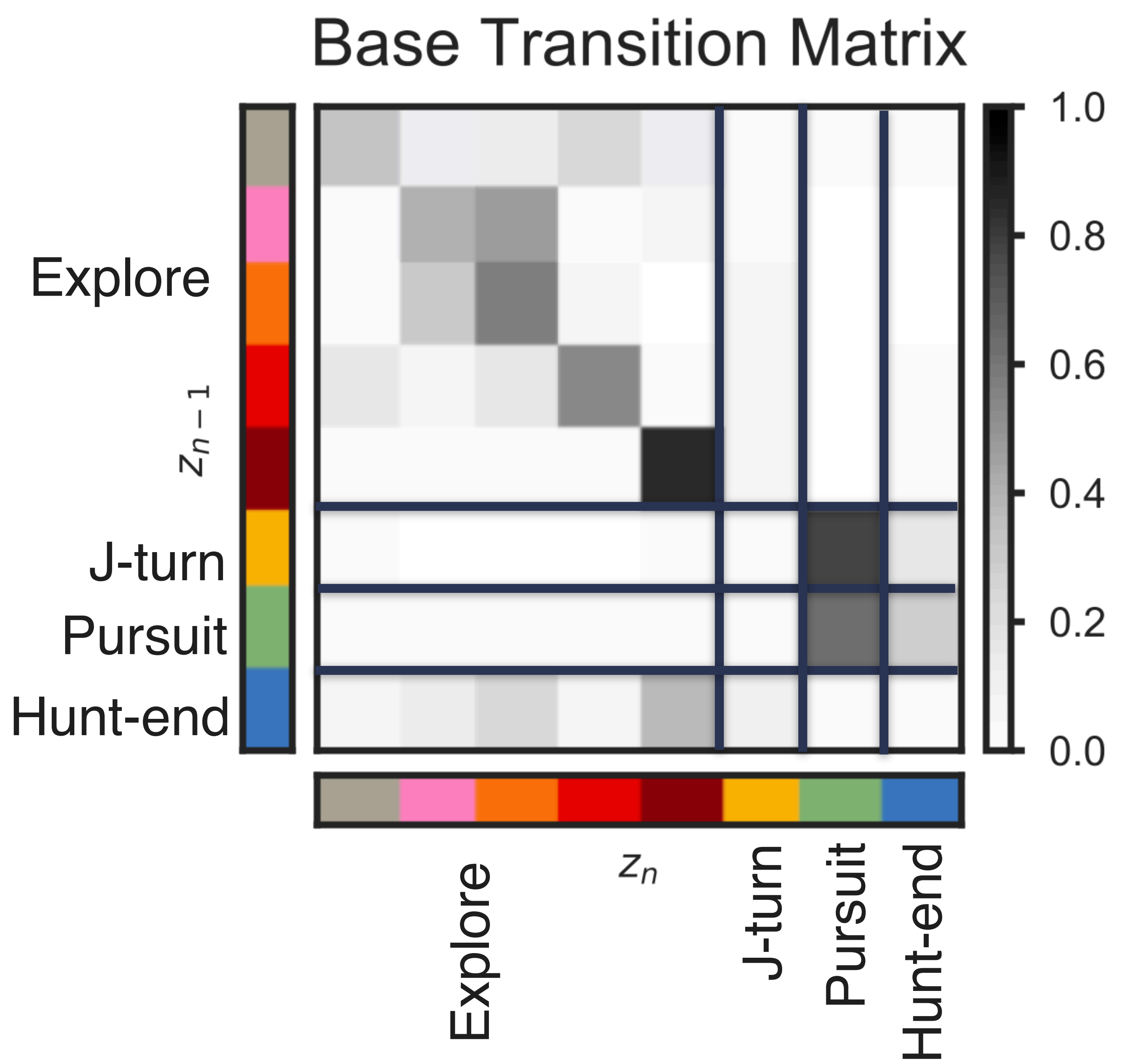
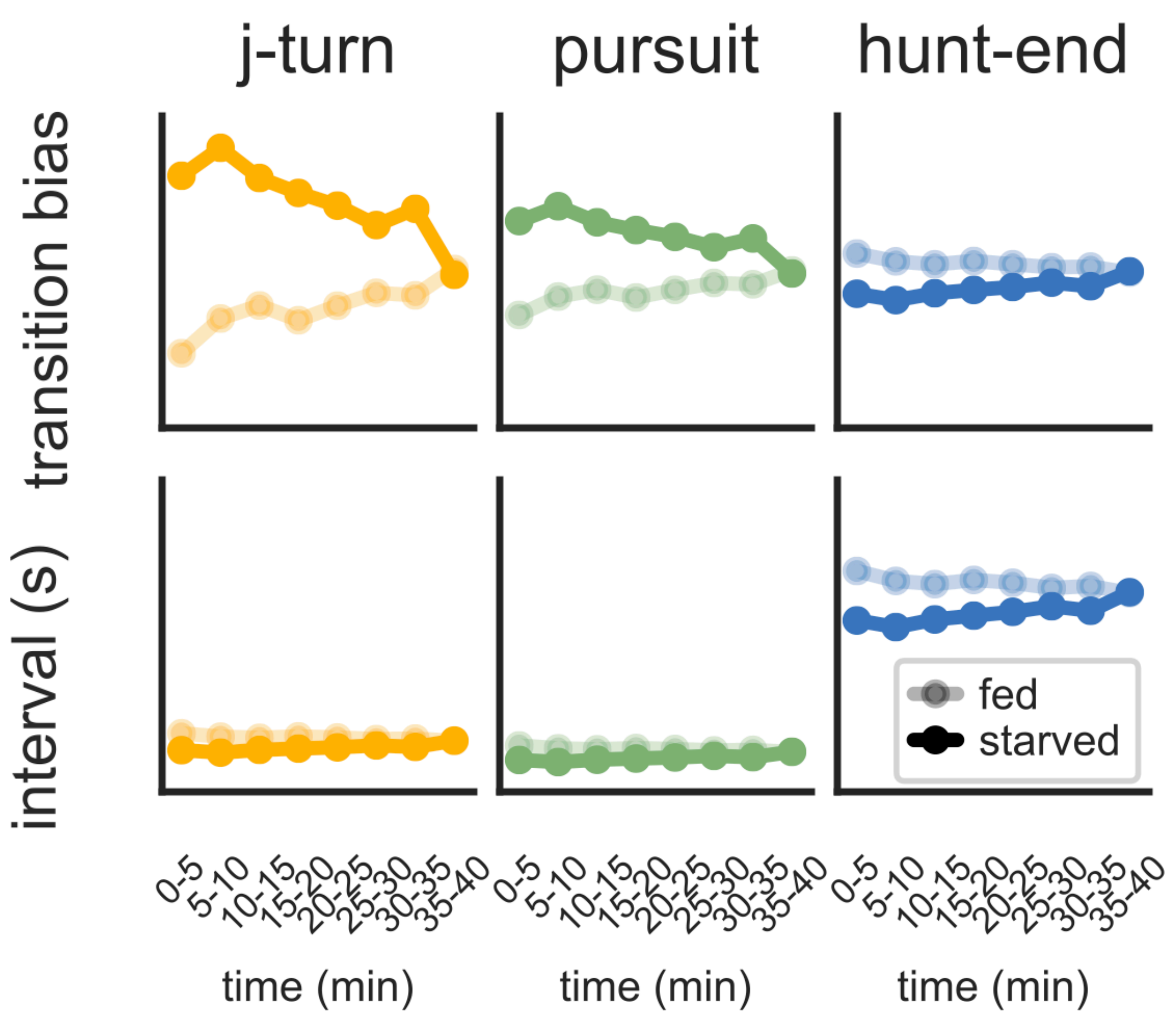


A3: These transition patterns change over time as a function of hunger.



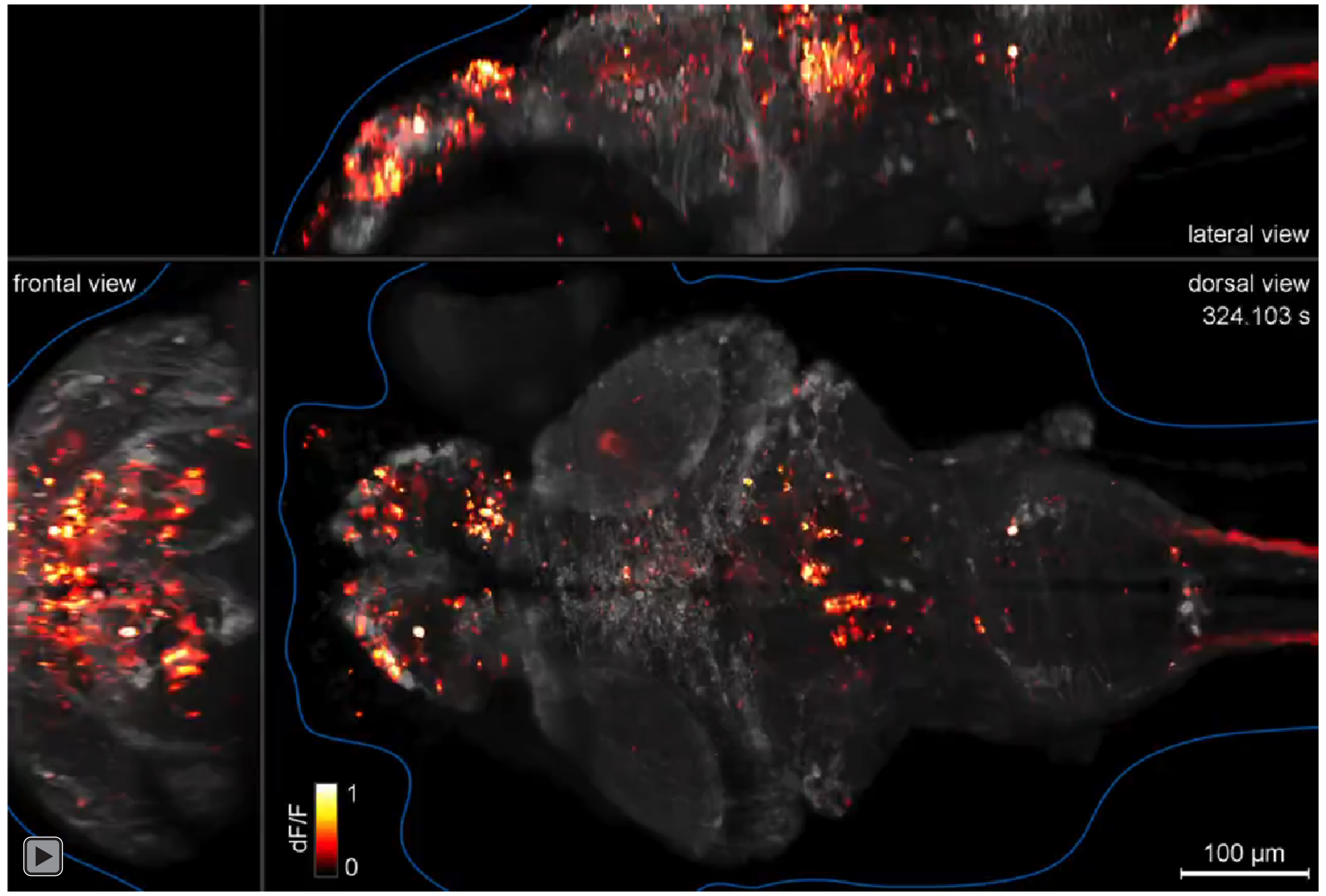
Come to our poster!

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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