

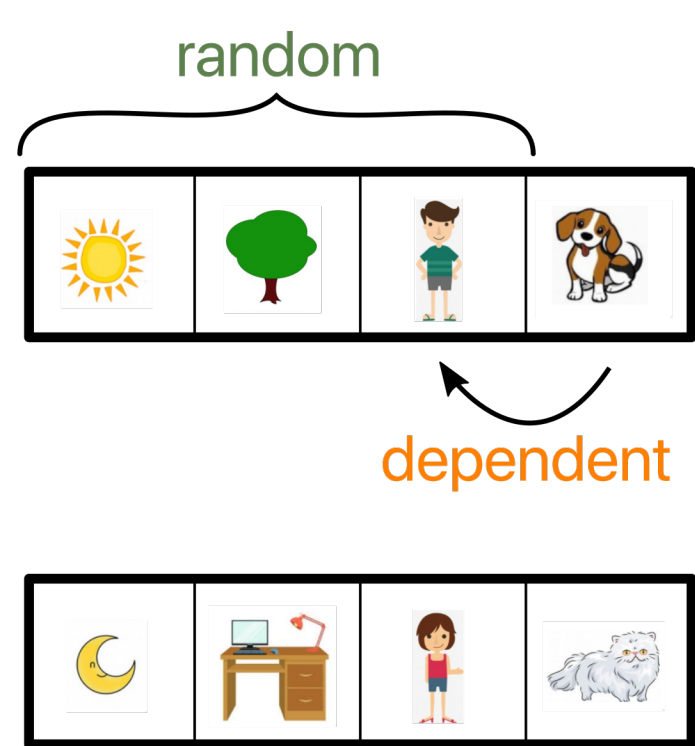
From episodic to semantic memory: A computational model

Introduction

- Multiple phenomenological theories for **systems memory consolidation** exist [1]
- It appears clear that **episodic memories undergo a semantization** over time, but there is no consensus on why and how this happens [1]
- The **mechanistic basis** on the level of neurons and synapses is largely **unresolved**

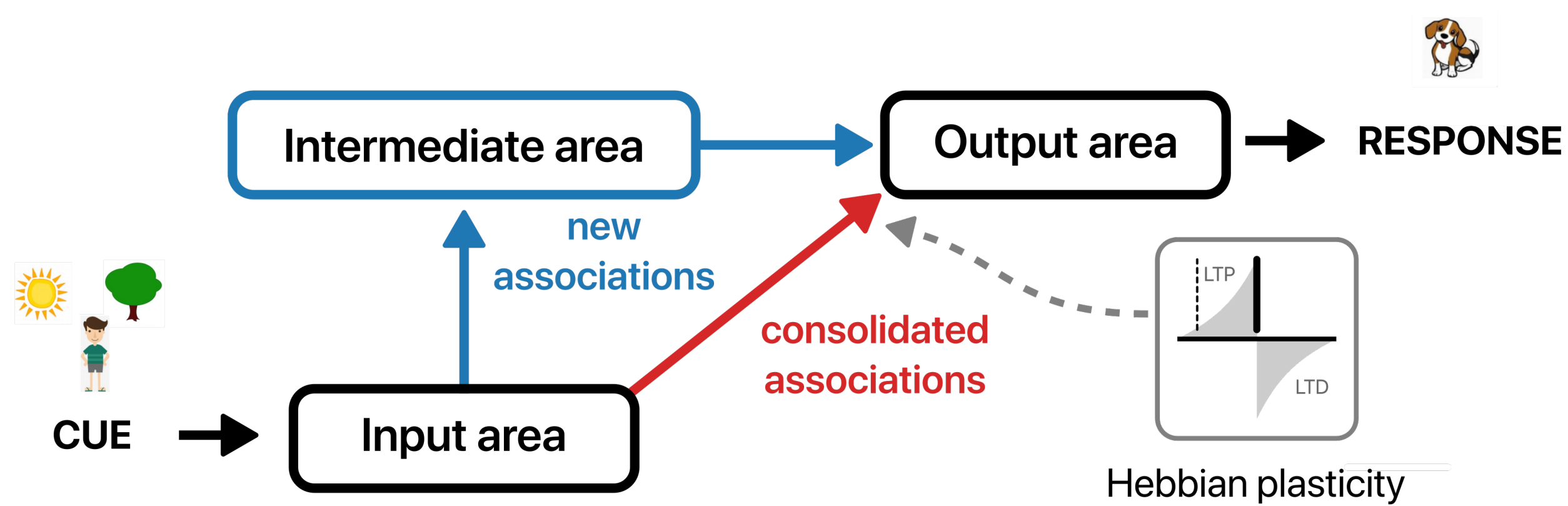
A mechanistic model for systems memory consolidation

Episodic memories



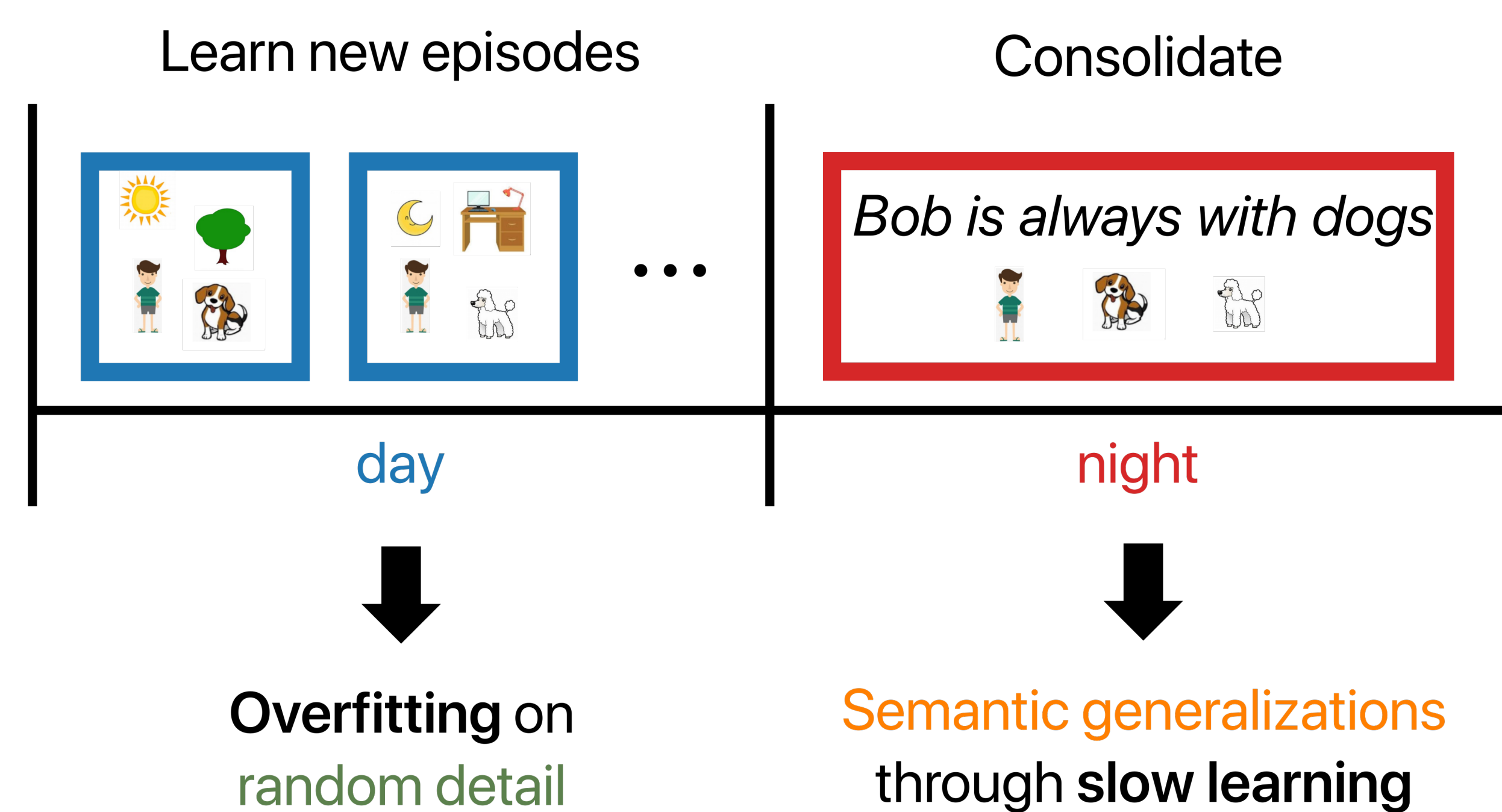
- Collection of **categorical variables**
- Some variables
 - are **random** (e.g. *weather*)
 - follow **semantic rules** (e.g. *Bob always with dogs*)

The shortcut mechanism [2]

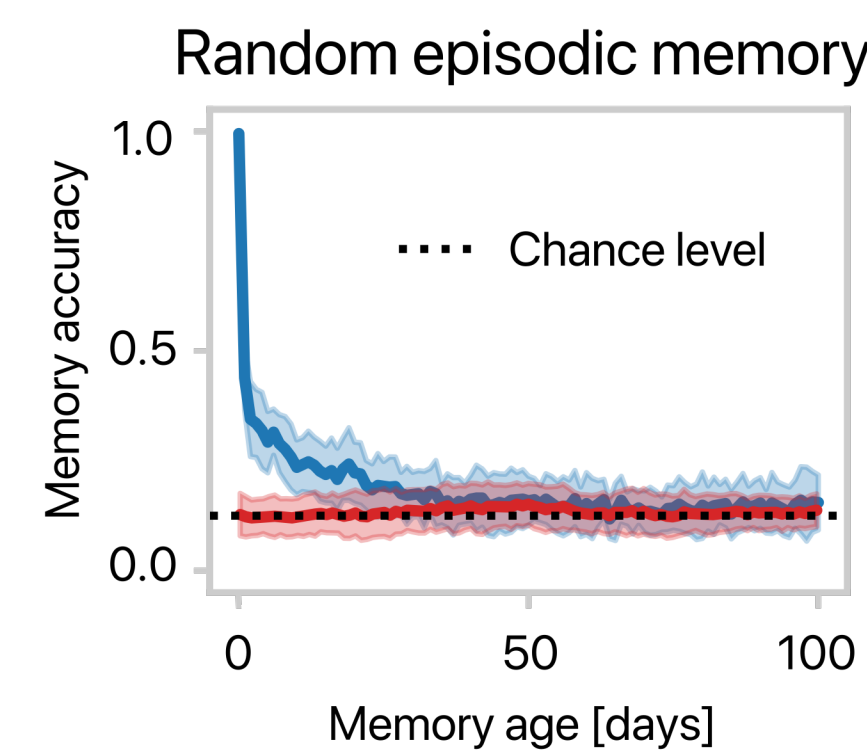


- New associations are stored in **multisynaptic path**
- During consolidation, **cues are reactivated** in input area
- **Multisynaptic path** acts as **supervisor** for learning in **shortcut**

Implementation in artificial neural networks



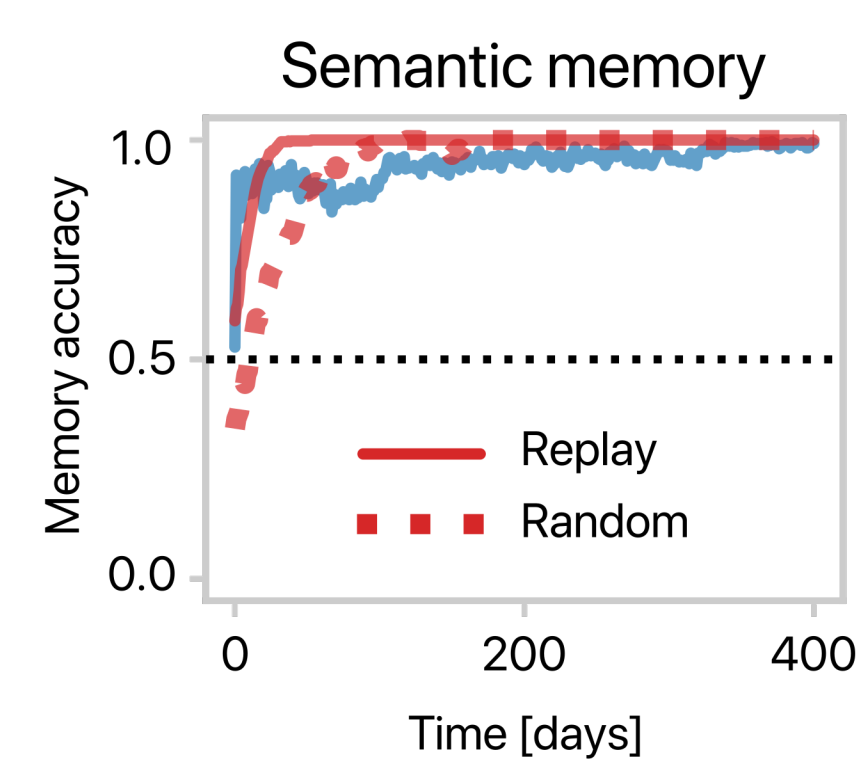
Random detail in episodic memories is forgotten over time



- **Multisynaptic path** initially **overfits** on random detail
- **Shortcut** does not learn specific episodic memories

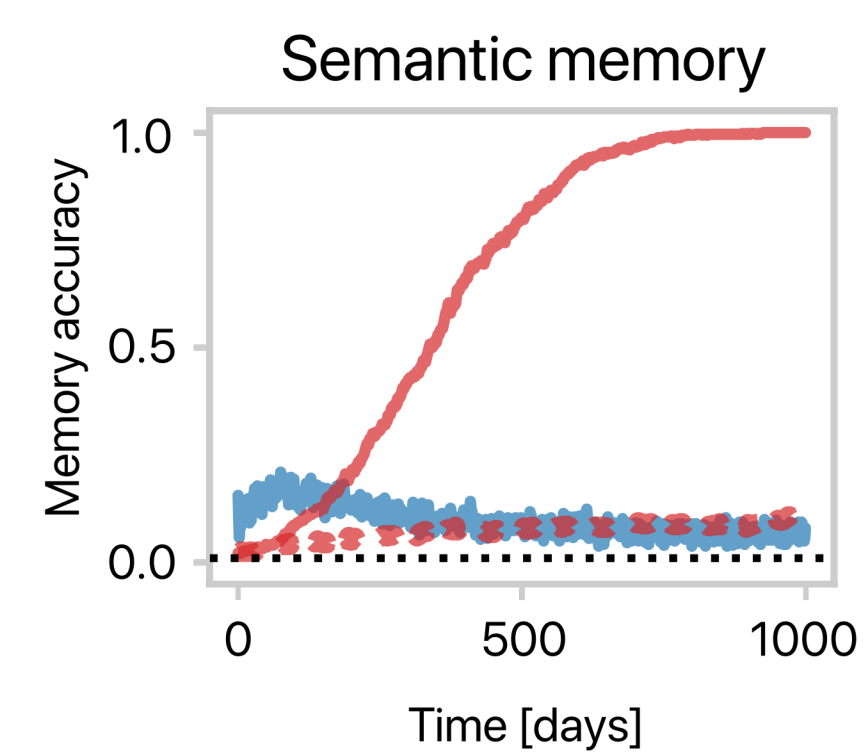
Neural replay is necessary for the consolidation of complex semantics

Simple semantics



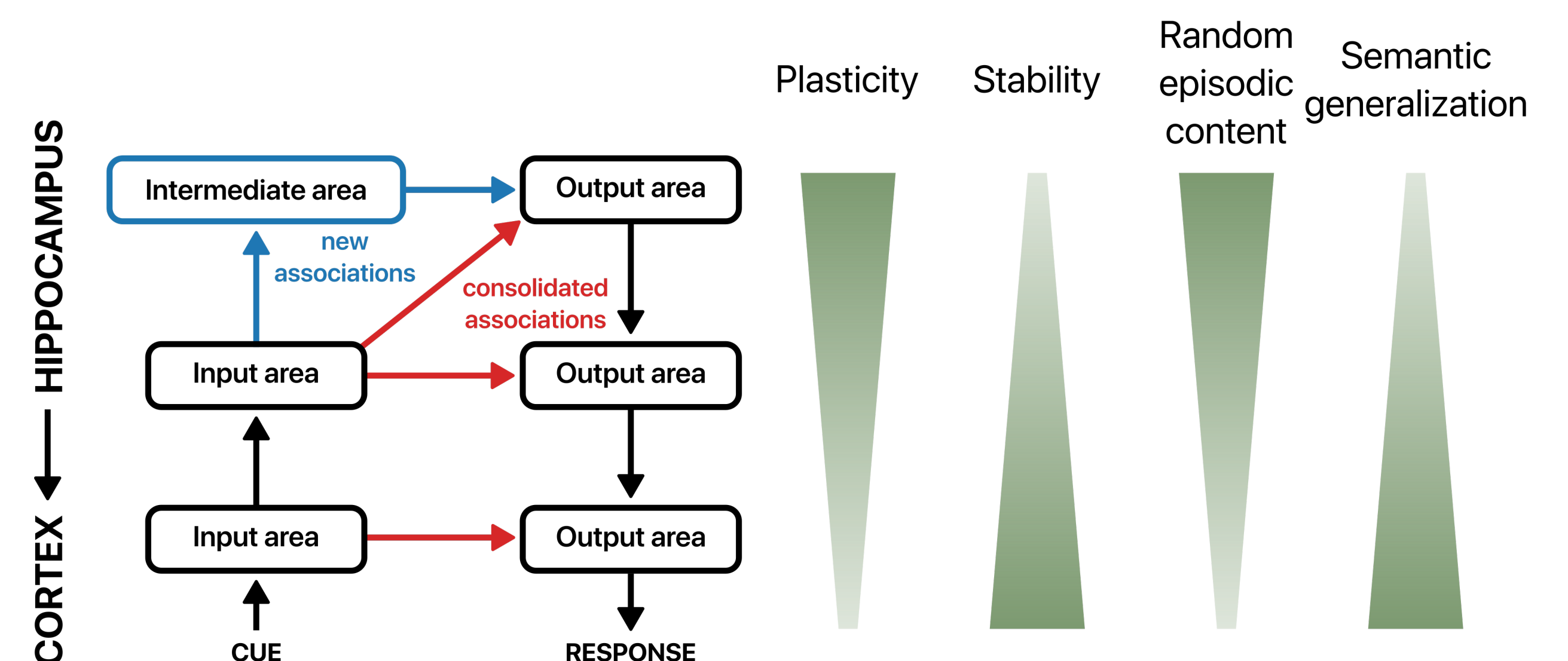
- **Multisynaptic path** learns semantic generalizations
- **Random reactivation** sufficient for consolidation into **shortcut**
- **Replay** speeds up consolidation

Complex semantics



- **Multisynaptic path** cannot learn generalizations
- **Replay** is necessary for consolidation into **shortcut**

Outlook: Spatial gradients of episodic and semantic memories



References and acknowledgments

[1] Dudai, Y., Karni, A., & Born, J. (2015). The Consolidation and Transformation of Memory. *Neuron*, 88(1), 20–32.

[2] Remme, M., Bergmann, U., Schreiber, S., Sprekeler, H., & Kempster, R. (2019). A circuit mechanism for systems memory consolidation. *Unpublished manuscript*.

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