Why two heads together are worse than apart: A context-based account of collaborative inhibition in memory search

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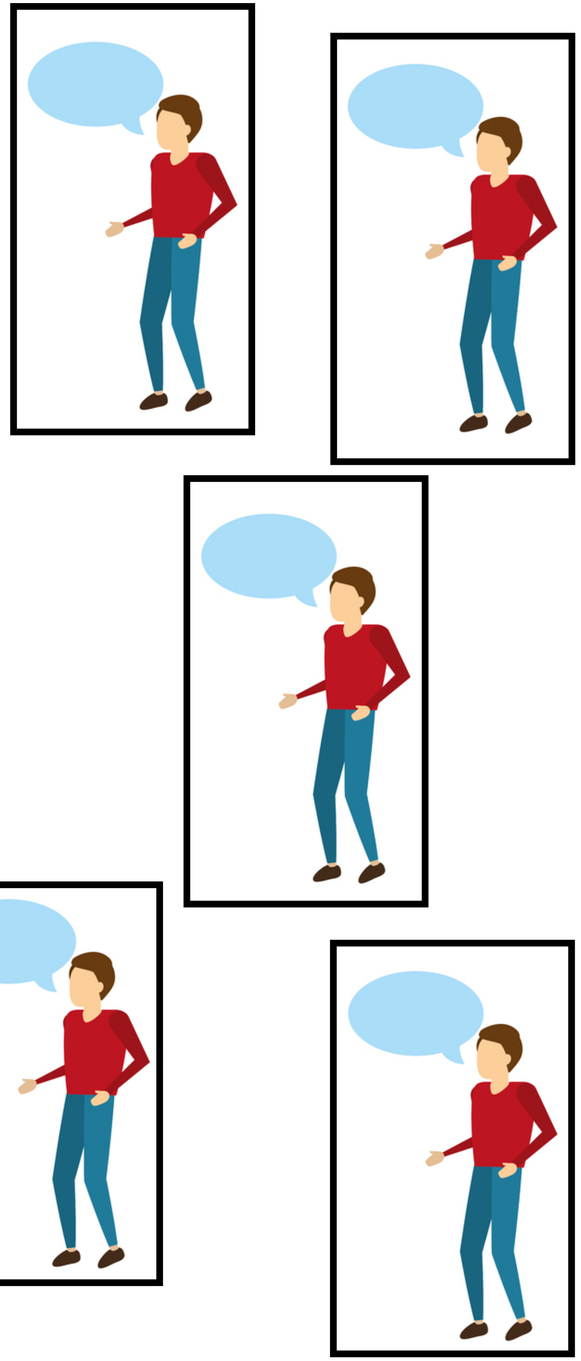
Memory search in daily life

We often recall information in a group instead of in isolation

Experiment design of collaborative memory studies



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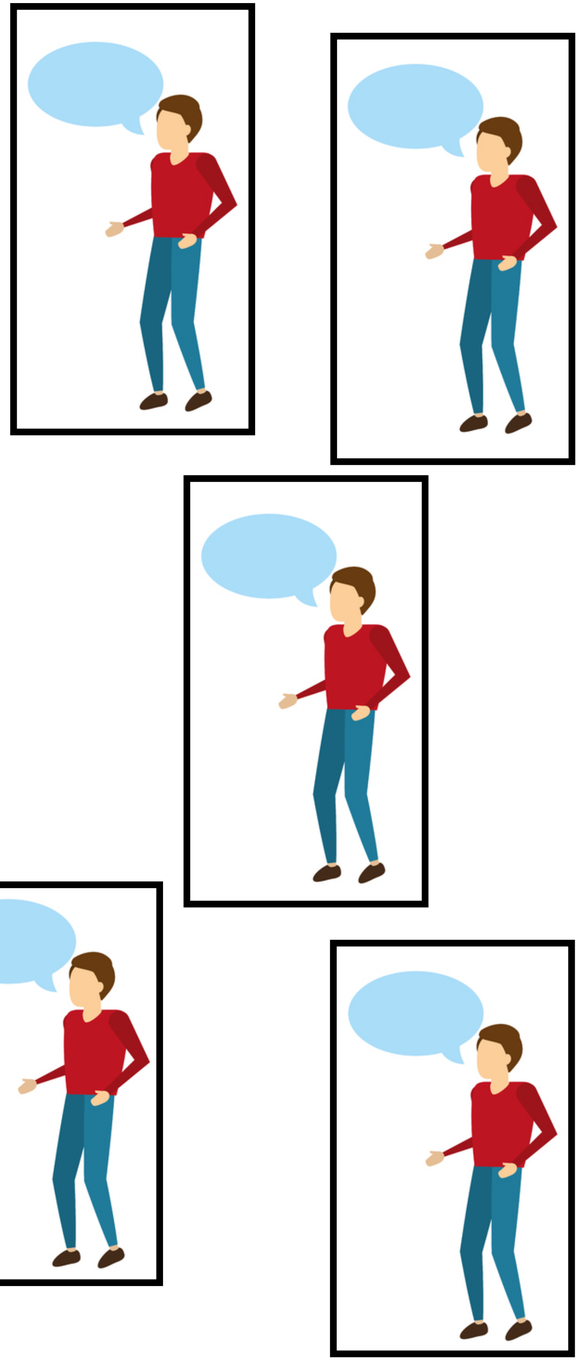


Experiment design of collaborative memory studies

Study Phase

Study List: A,B,C,D,E,F,G

Recall Phase

Nominal condition

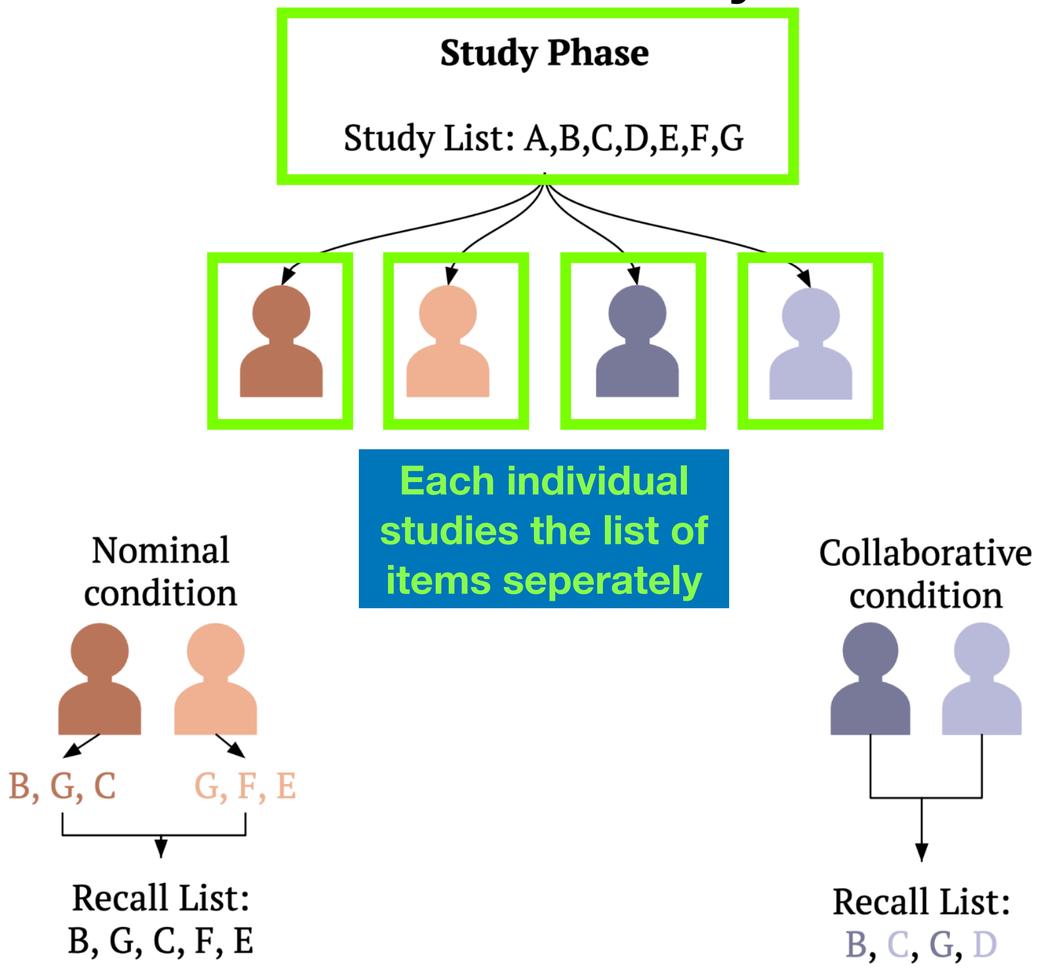
B, G, C G, F, E

Recall List:
B, G, C, F, E

Collaborative condition

Recall List:
B, C, G, D

Experiment design of collaborative memory studies



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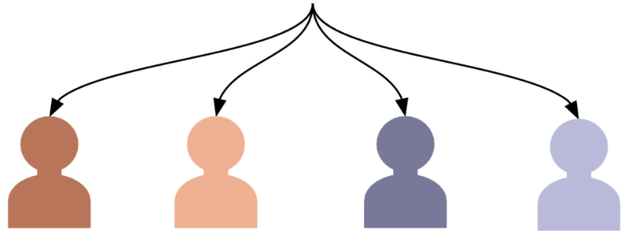
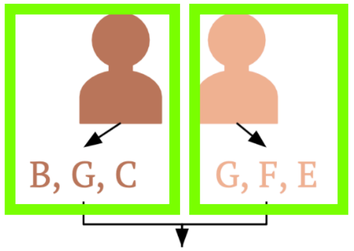


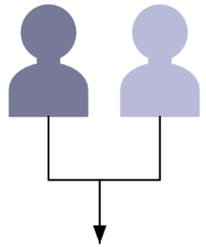
Recall Phase

Nominal condition



Recall List:
B, G, C, F, E

Collaborative condition



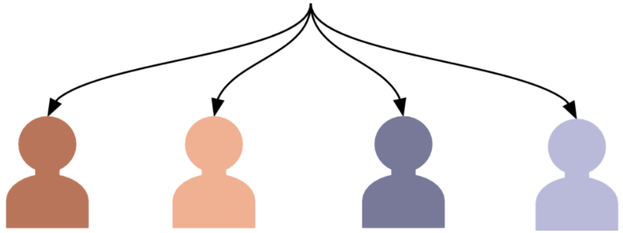
Recall List:
B, C, G, D

Recall alone

Experiment design of collaborative memory studies

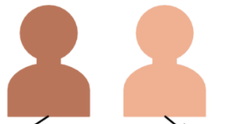
Study Phase

Study List: A,B,C,D,E,F,G



Recall Phase

Nominal condition



B, G, C G, F, E

Recall List:
B, G, C, F, E

Collaborative condition

Recall List:
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Recall in a group

Experiment design of collaborative memory studies

Study Phase

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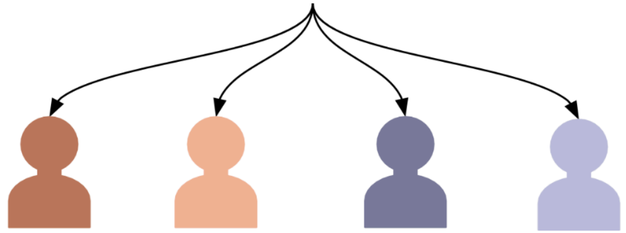

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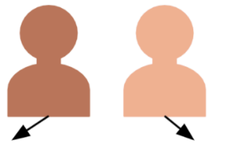

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Recall List:
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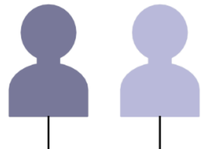


Recall List:
B, C, G, D

Non-overlapping sum of individual recalls

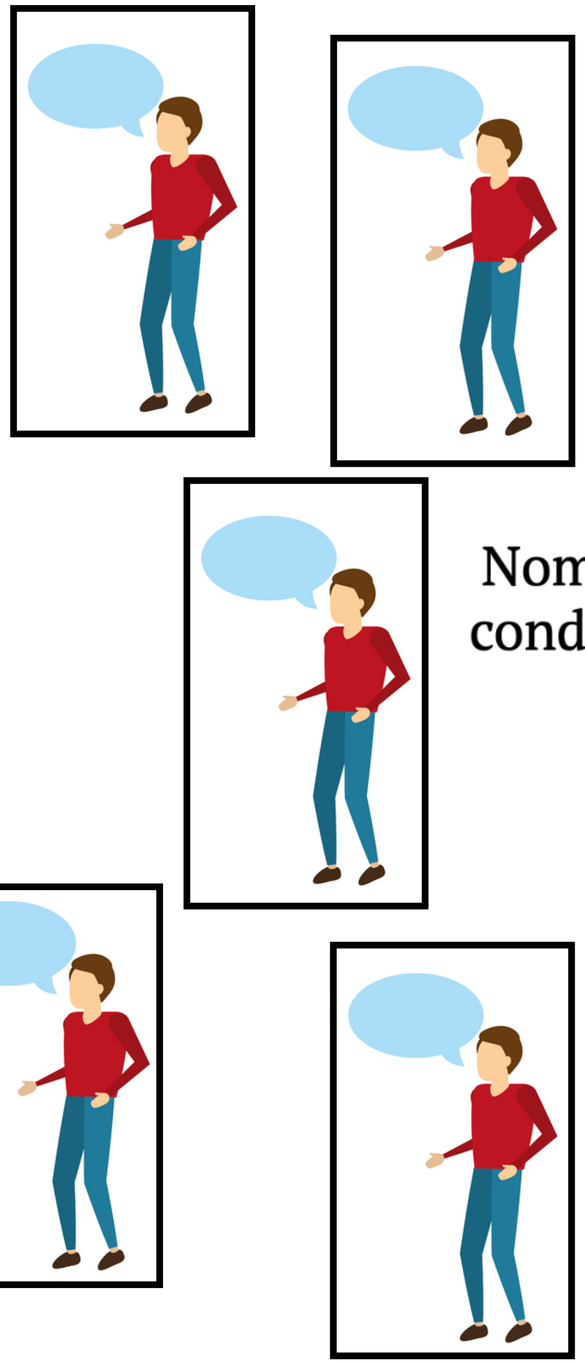
Recalls made in a group

Experiment design of collaborative memory studies

Nominal condition

Non-overlapping sum of individual recalls

Experiment design of collaborative memory studies



Nominal condition

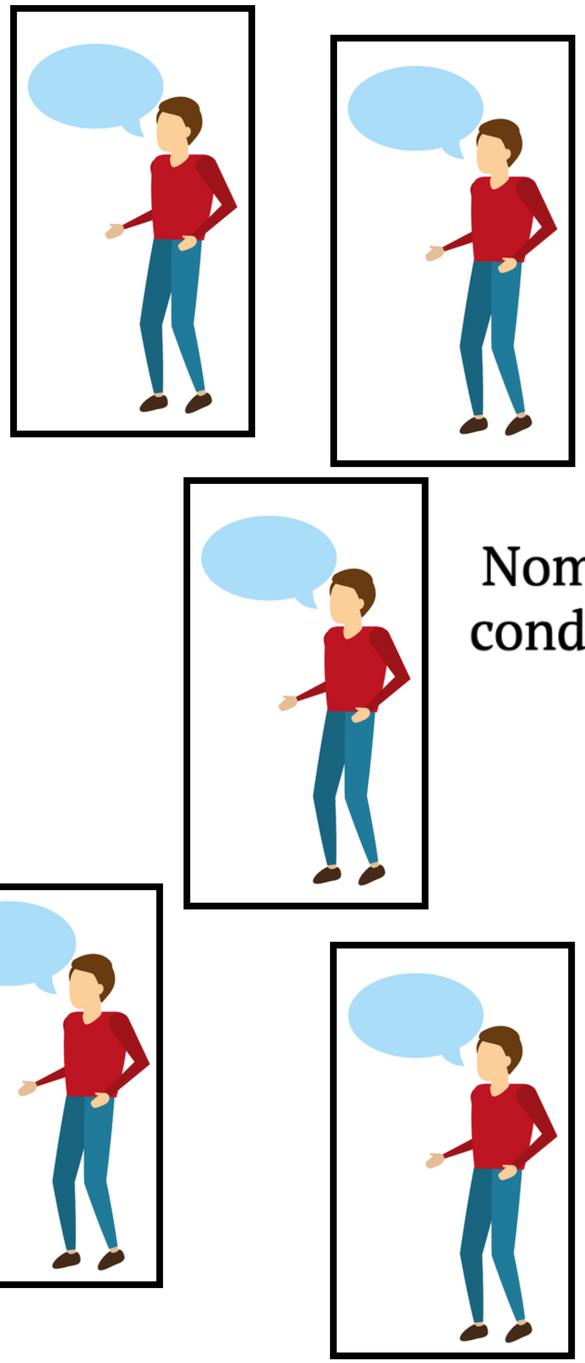
Collaborative condition

Non-overlapping sum of individual recalls

Recalls made in a group

Which condition do you think will recall more words?

Experiment design of collaborative memory studies



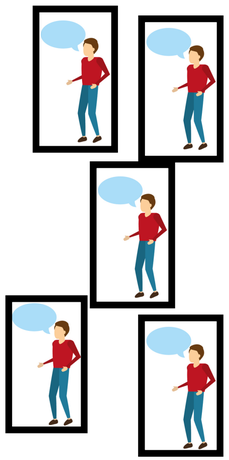
Nominal condition

Collaborative condition

Non-overlapping sum of individual recalls **>** Recalls made in a group

‘Collaborative Inhibition’

Non-overlapping sum of individual recalls



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Recalls made in a group

‘Collaborative Inhibition’

Our hypothesis:

A context-based account can explain collaborative inhibition

To test our hypothesis

1. We build a model of collaborative recall by extending a temporal context model*, the Context Maintainence and Retrieval model (CMR)**, previously developed to capture individual behavior in a free recall task.

2. We then compare our model's behavior to data from an existing online group recall study#, involving groups of sizes 2 to 16.

* Sederberg et al. (2008)
** Polyn et al. (2009)
# Gates et al. (2022)

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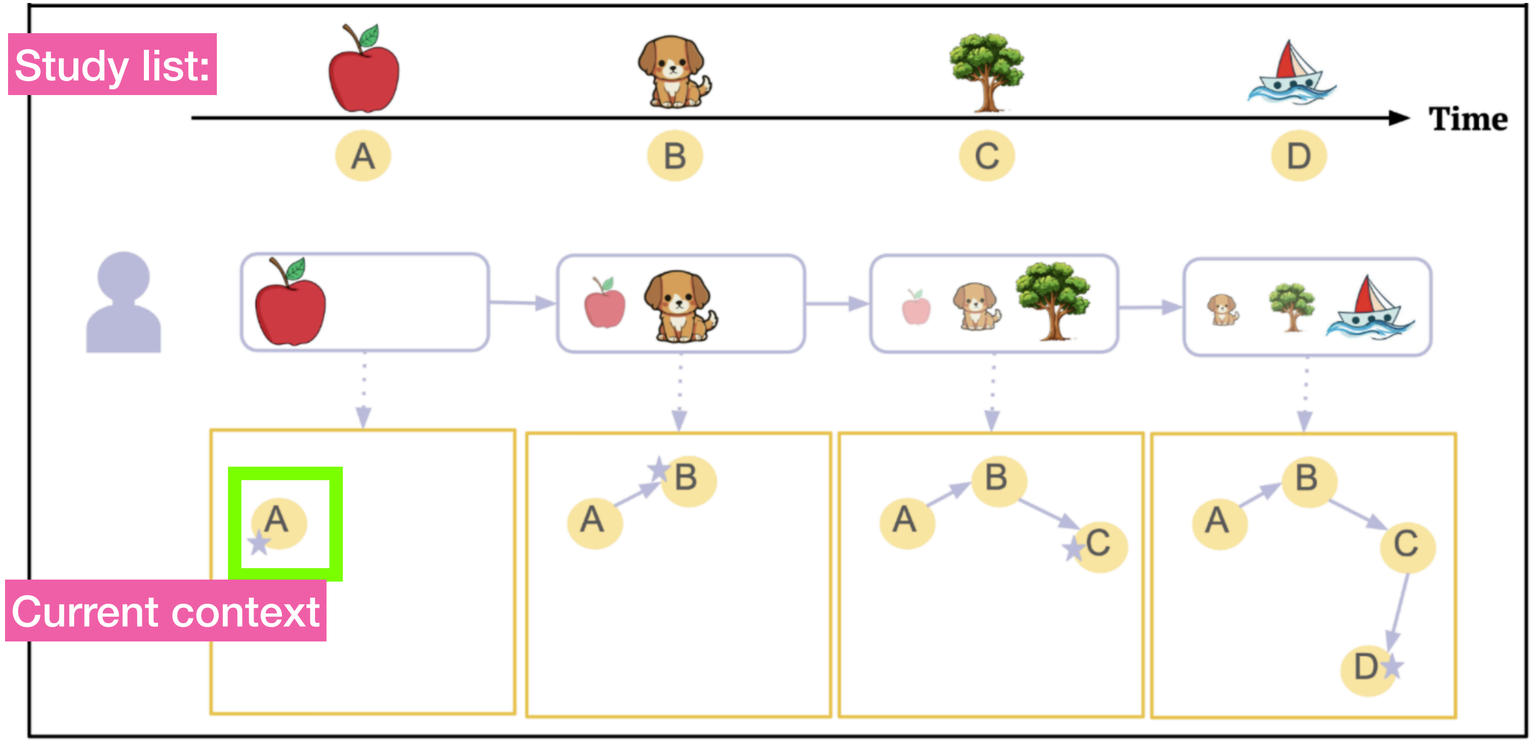
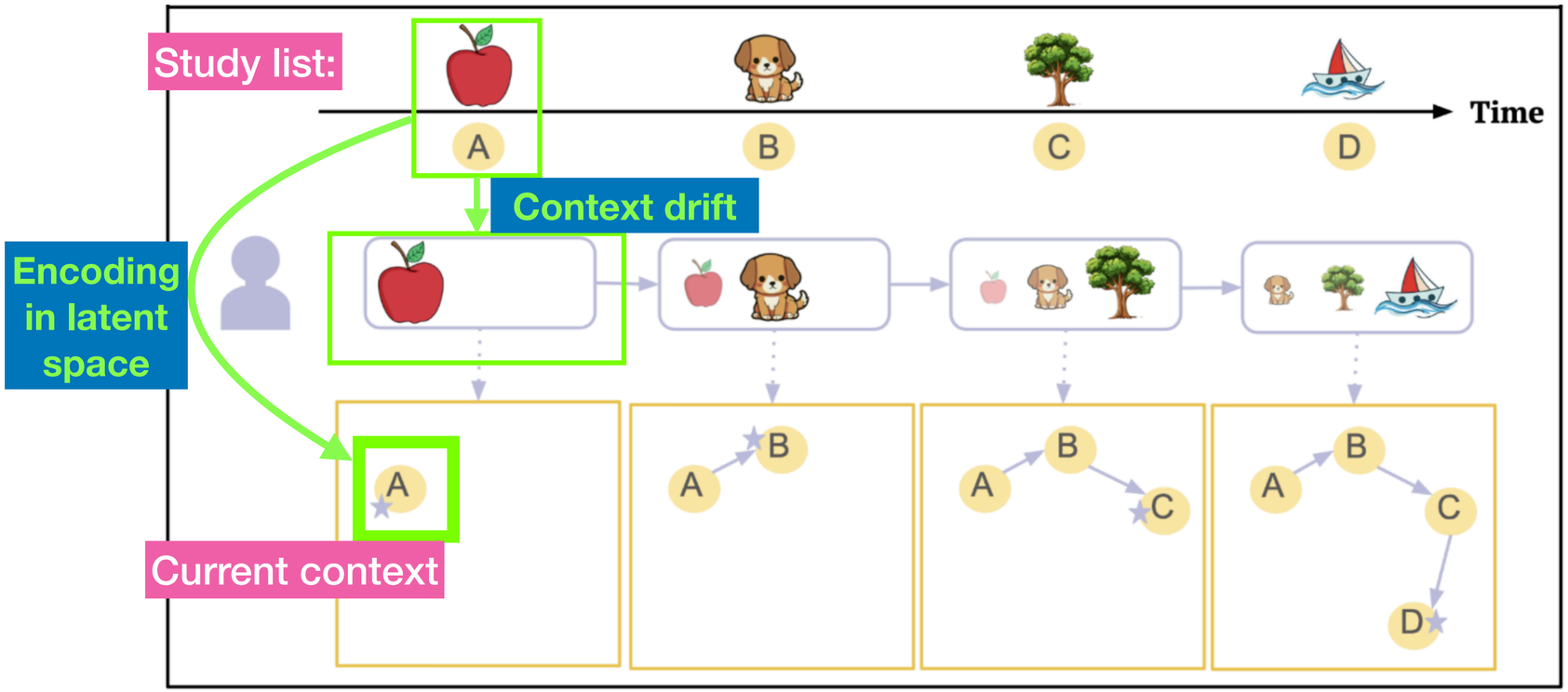
CMR Study Phase



CMR Study Phase



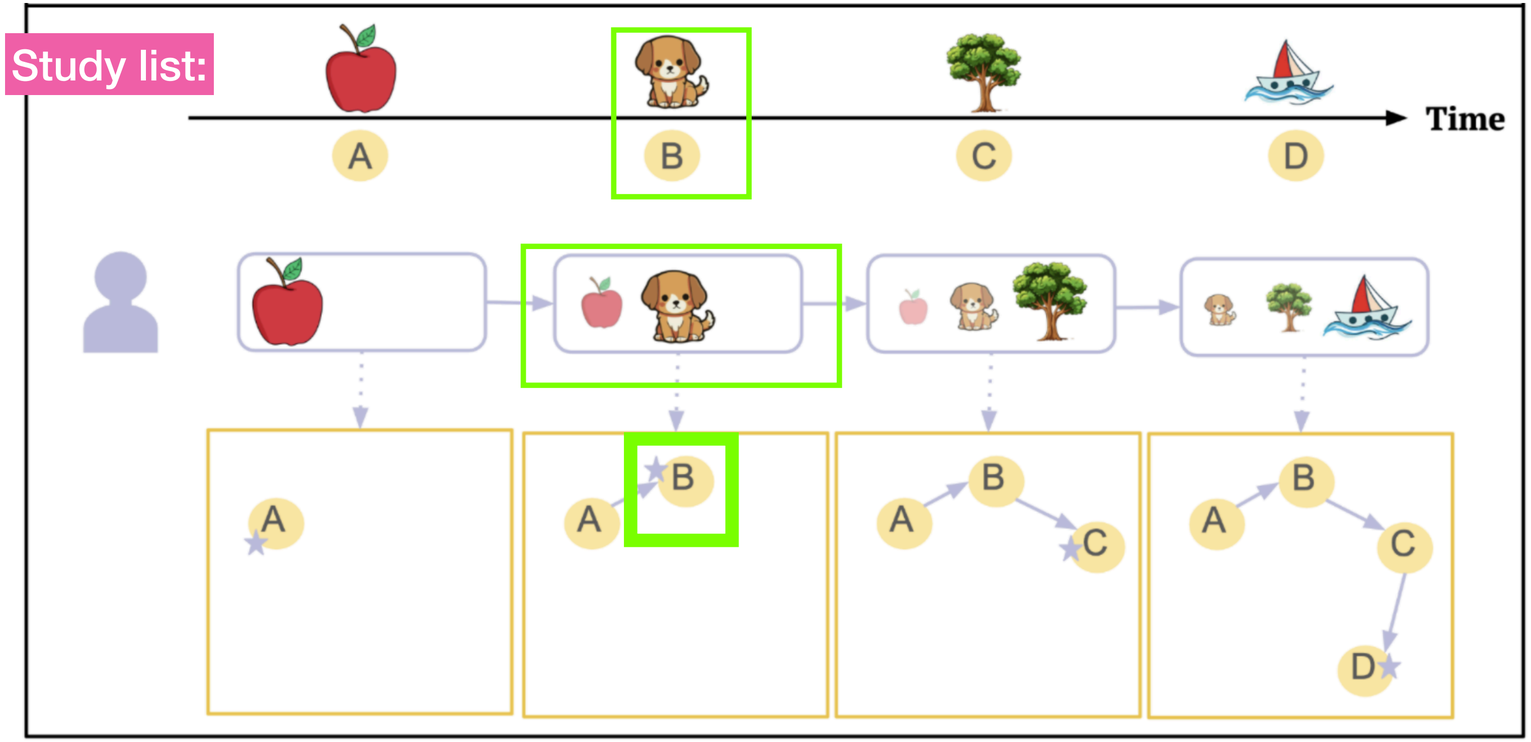
Incoming context containing semantic representation of item:

$$c^{IN} = M^{FC}_{pre} f_t$$

Context drifts towards incoming context:

$$c_t = \rho c_{t-1} + \beta_{enc} c^{IN}$$

CMR Study Phase



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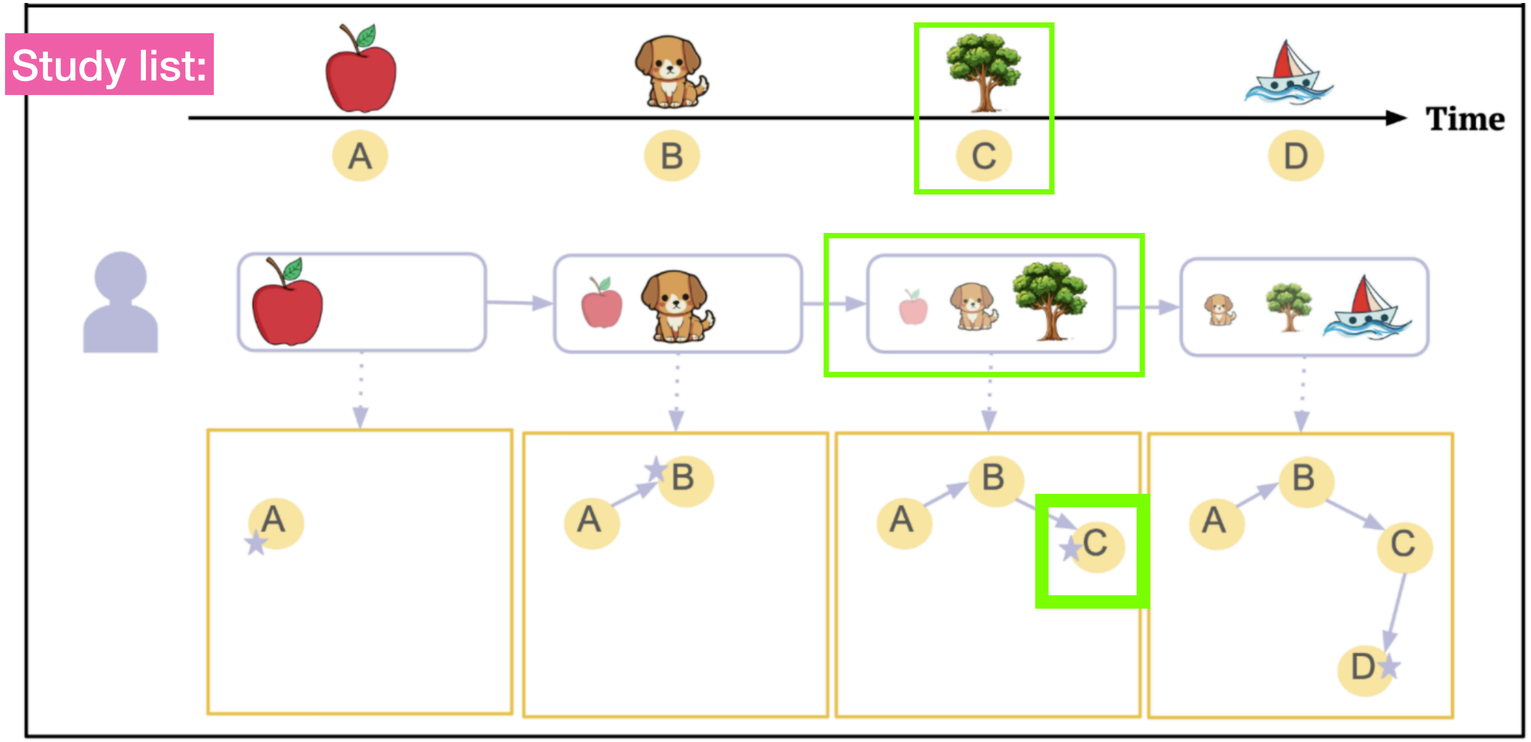

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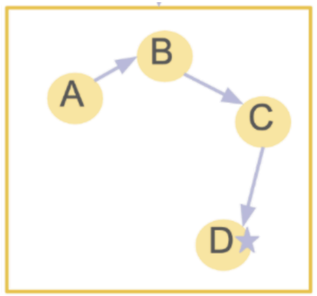
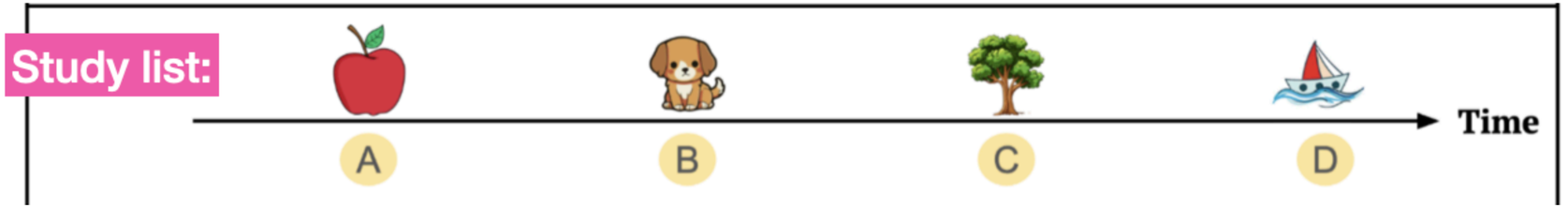
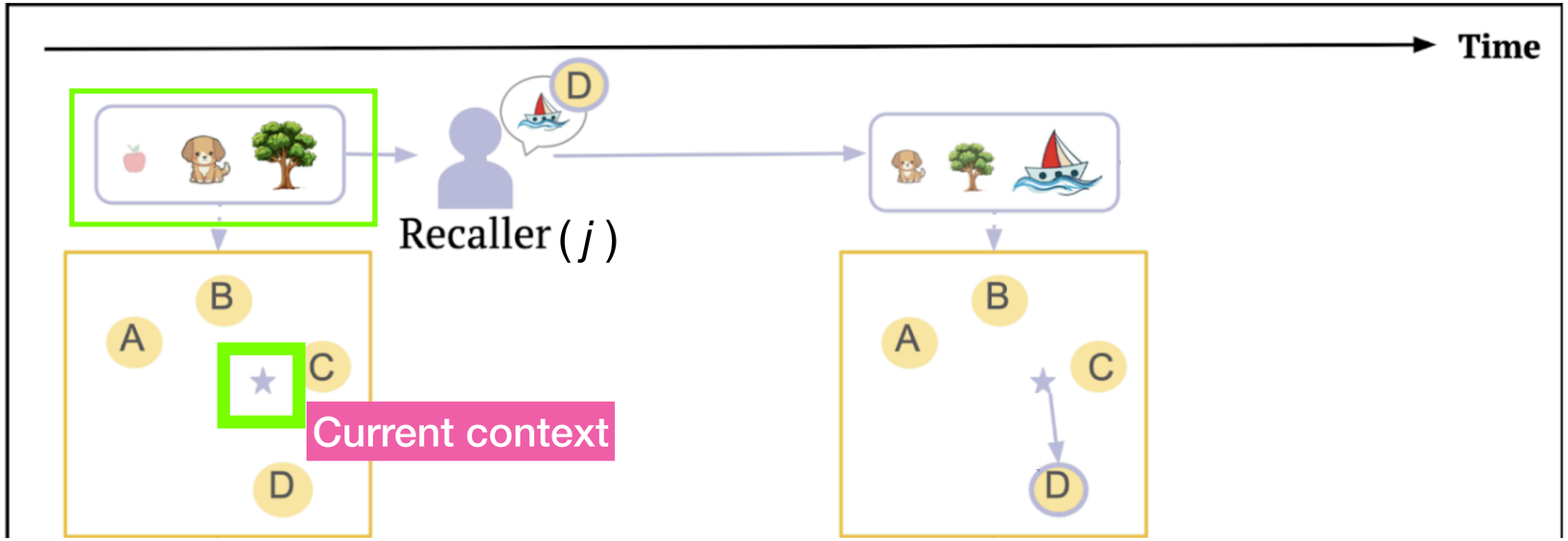
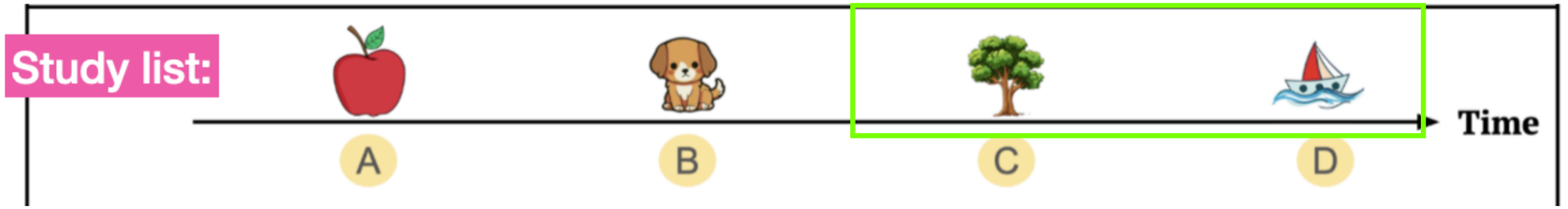
CMR Recall Phase





CMR Recall Phase: A snapshot





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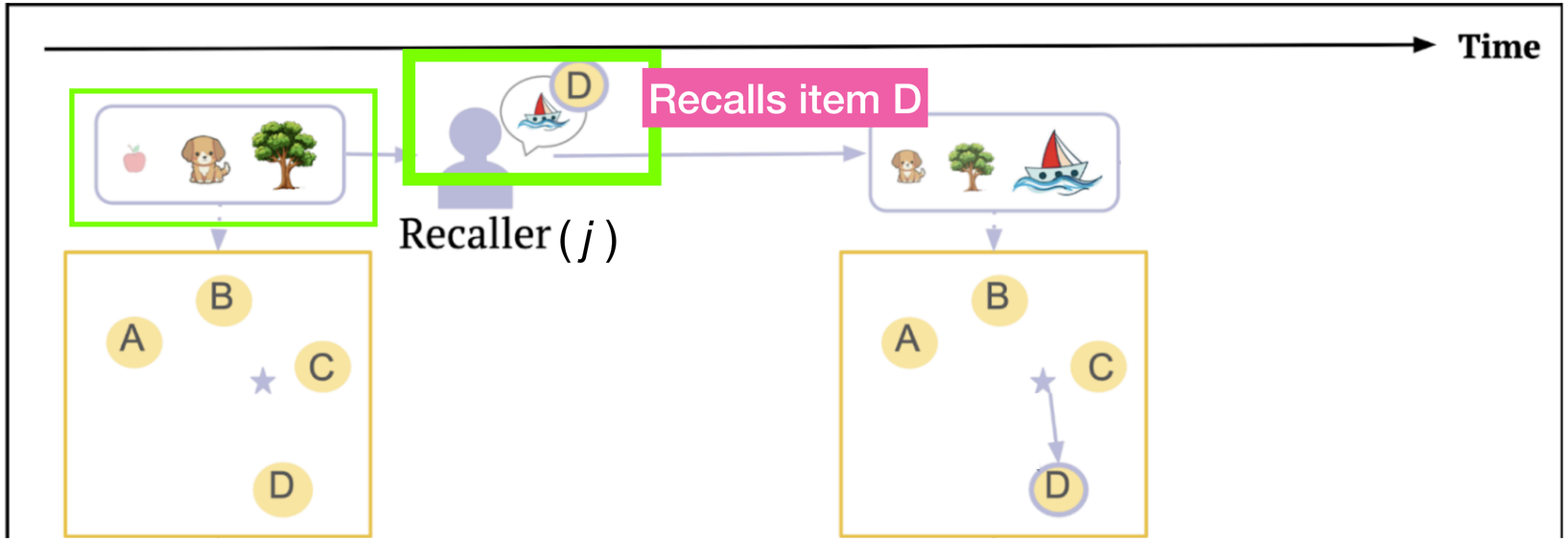

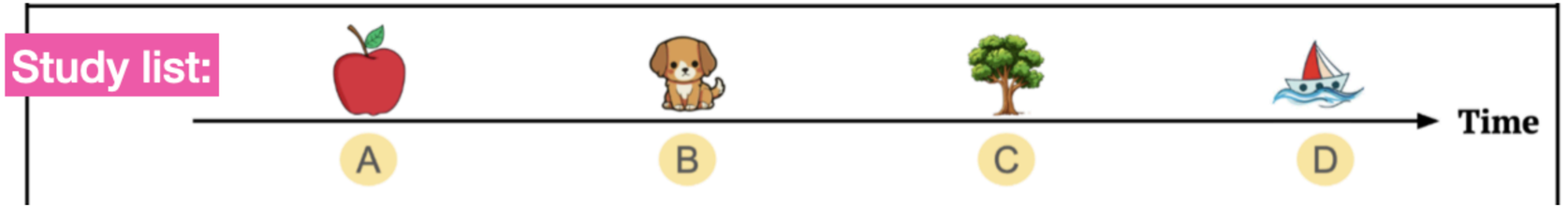

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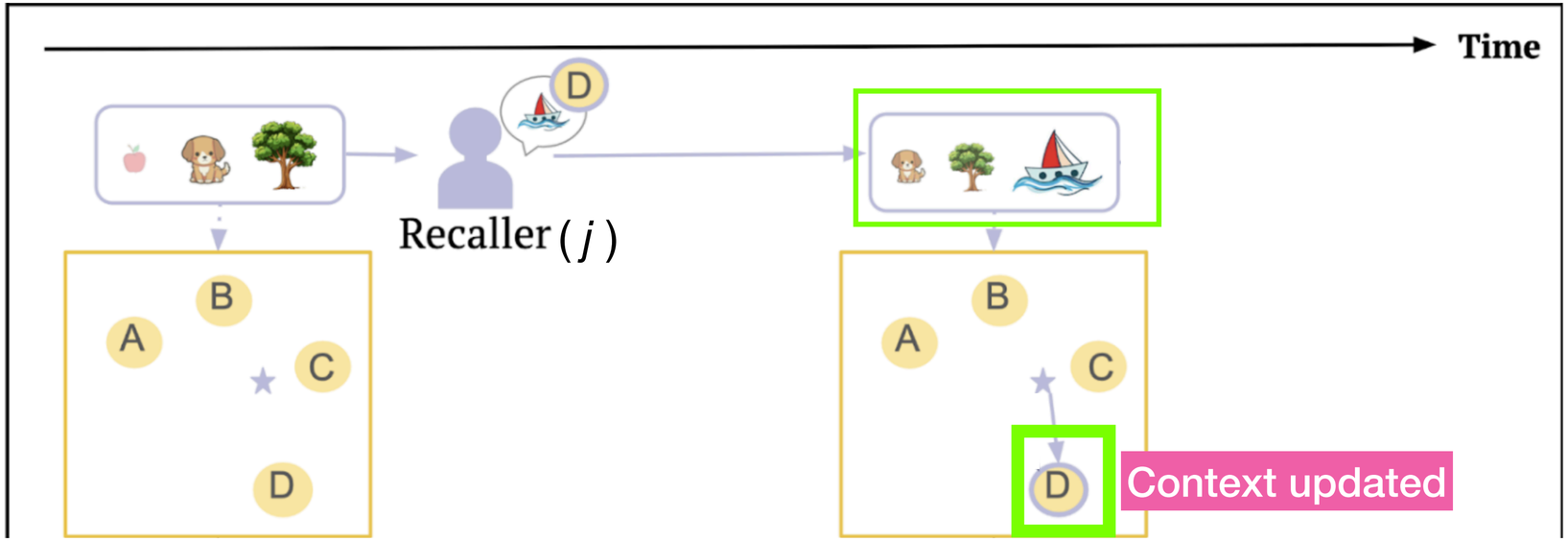
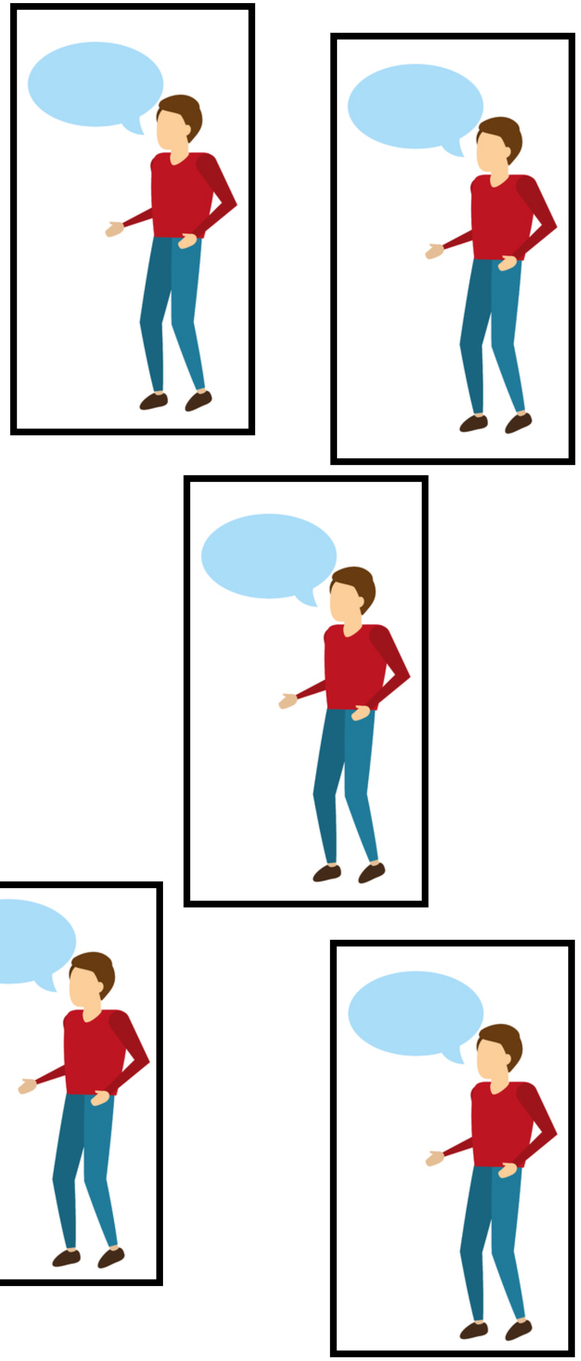


Context drifts towards context of recalled item:

$$c_{t,j} = \rho c_{t-1,j} + \beta_{rec} c_{rec}^{IN}$$

How can CMR be extended to not only capture individual free recall but also collaborative recall?



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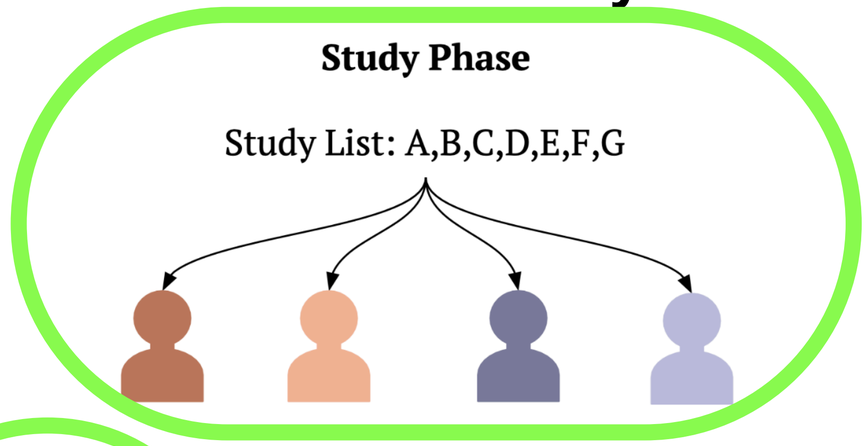

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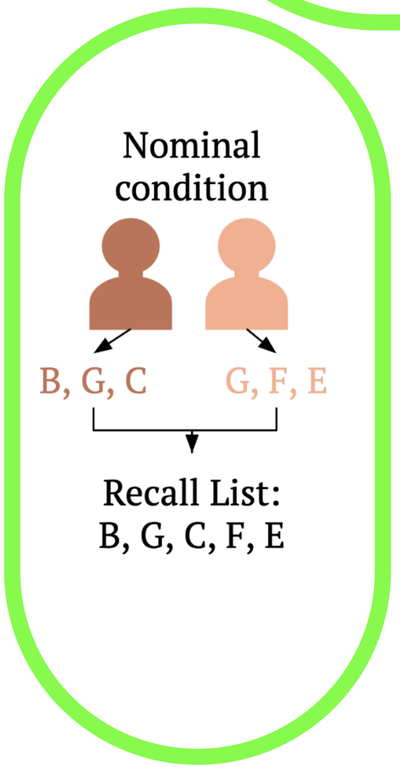

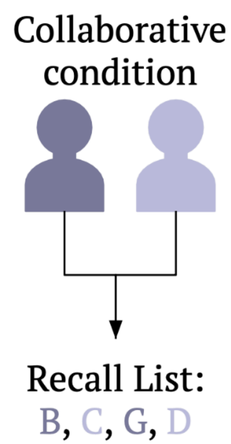

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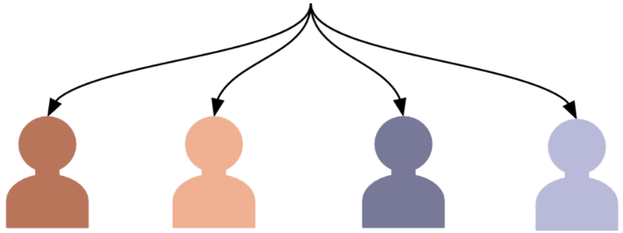

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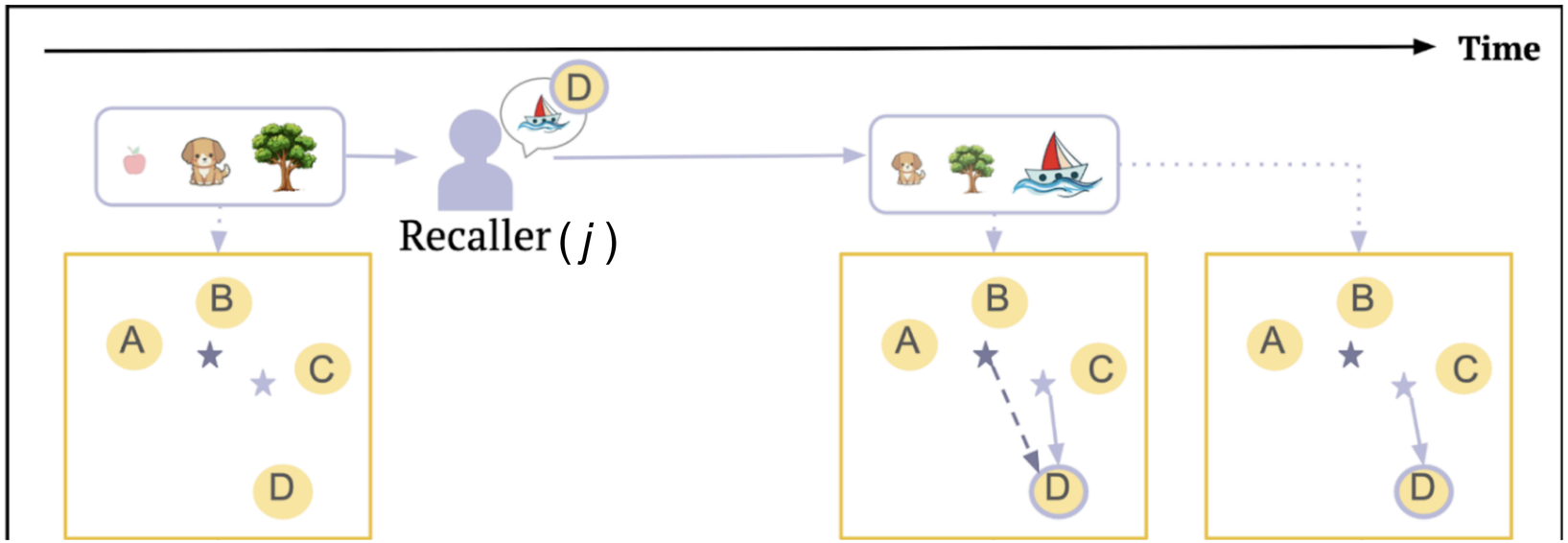
Recall Phase: Collaborative condition Interaction mechanism added to CMR



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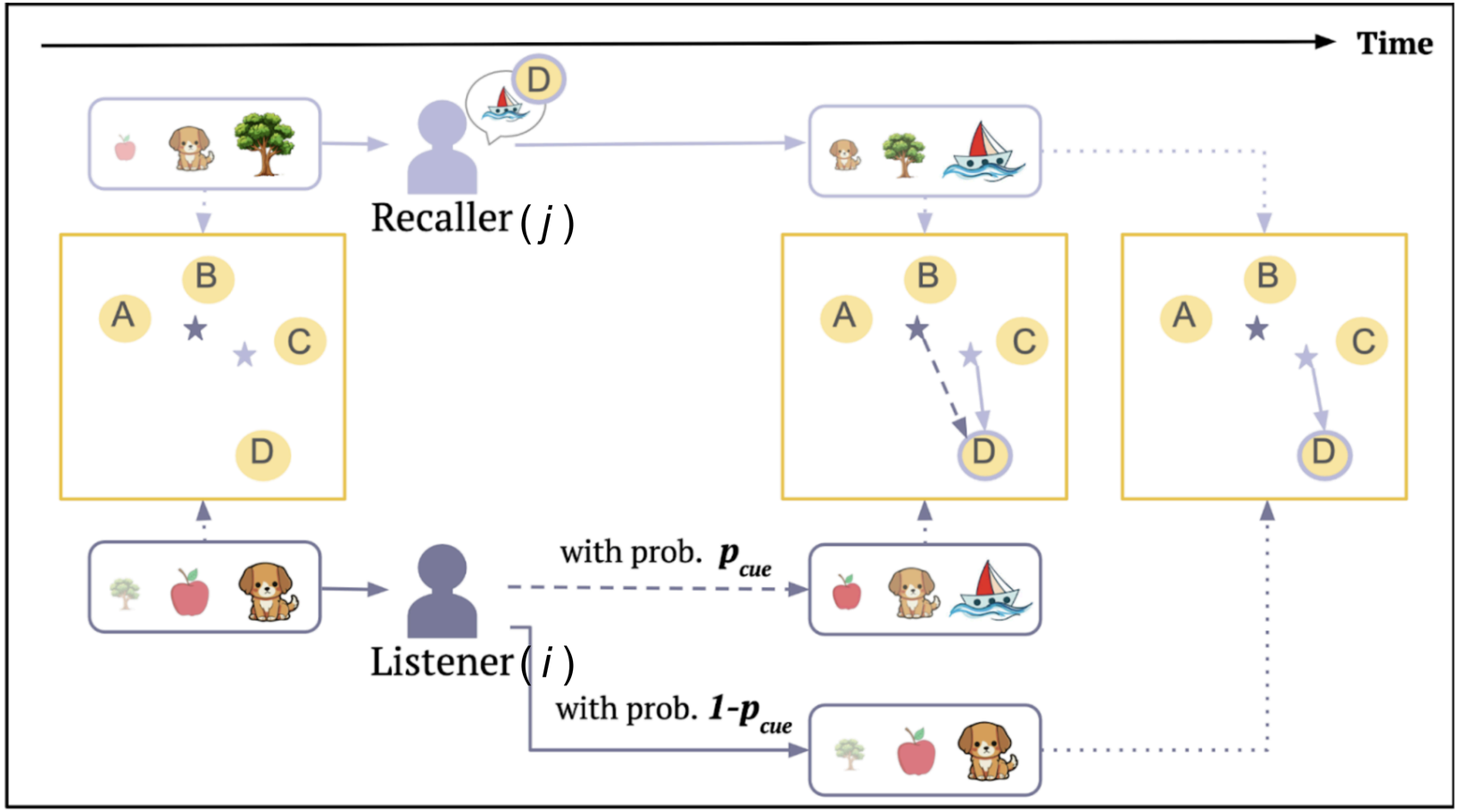

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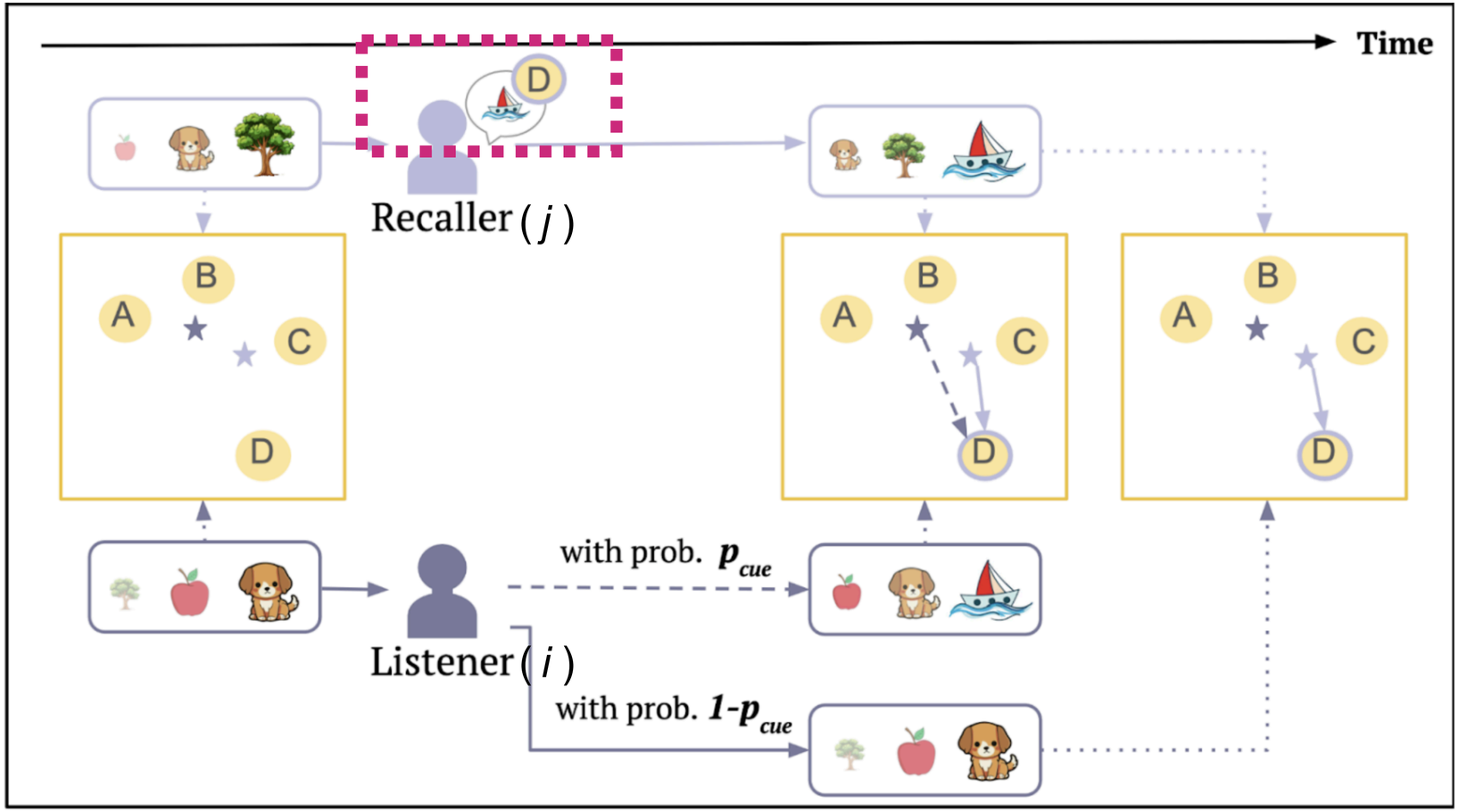

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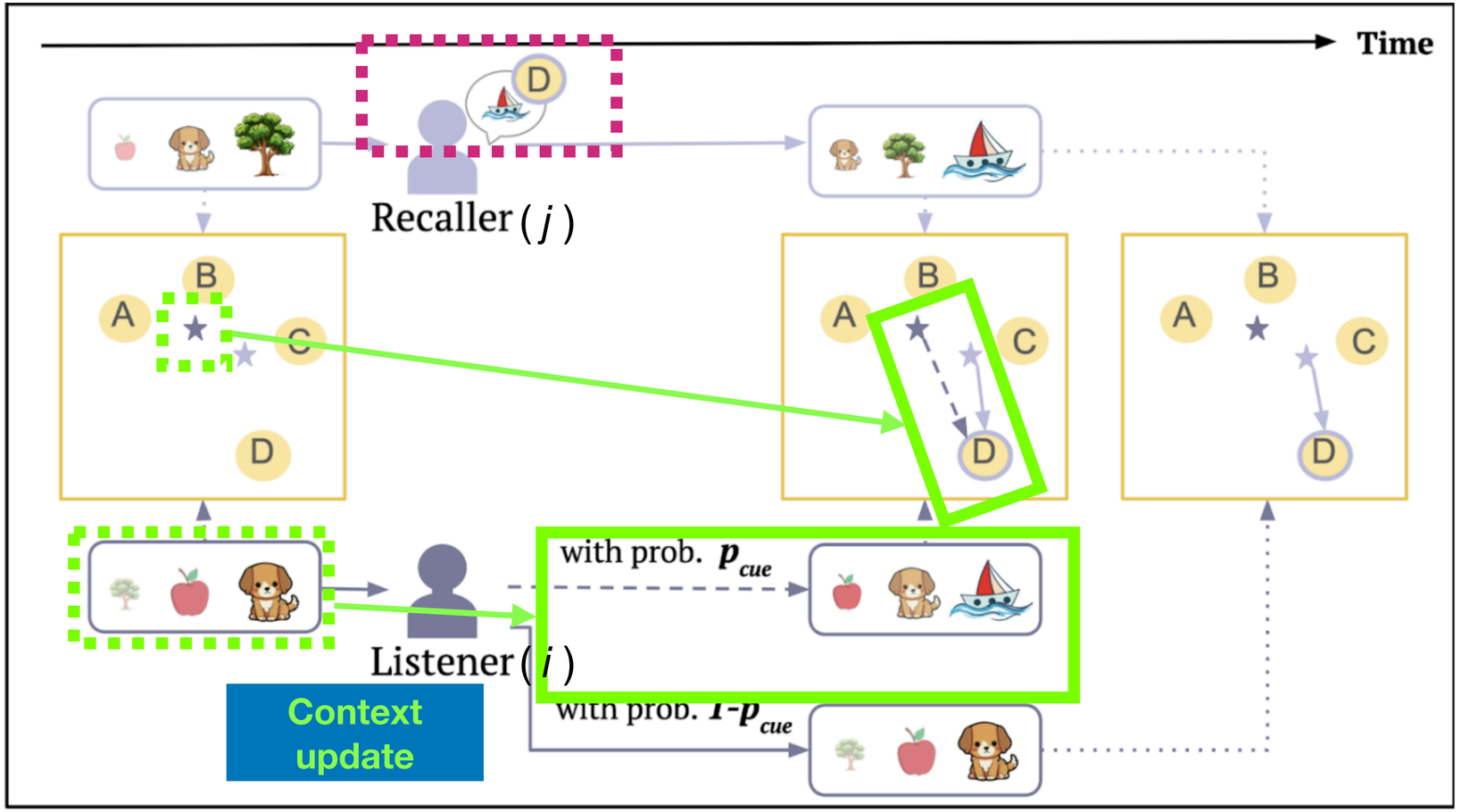
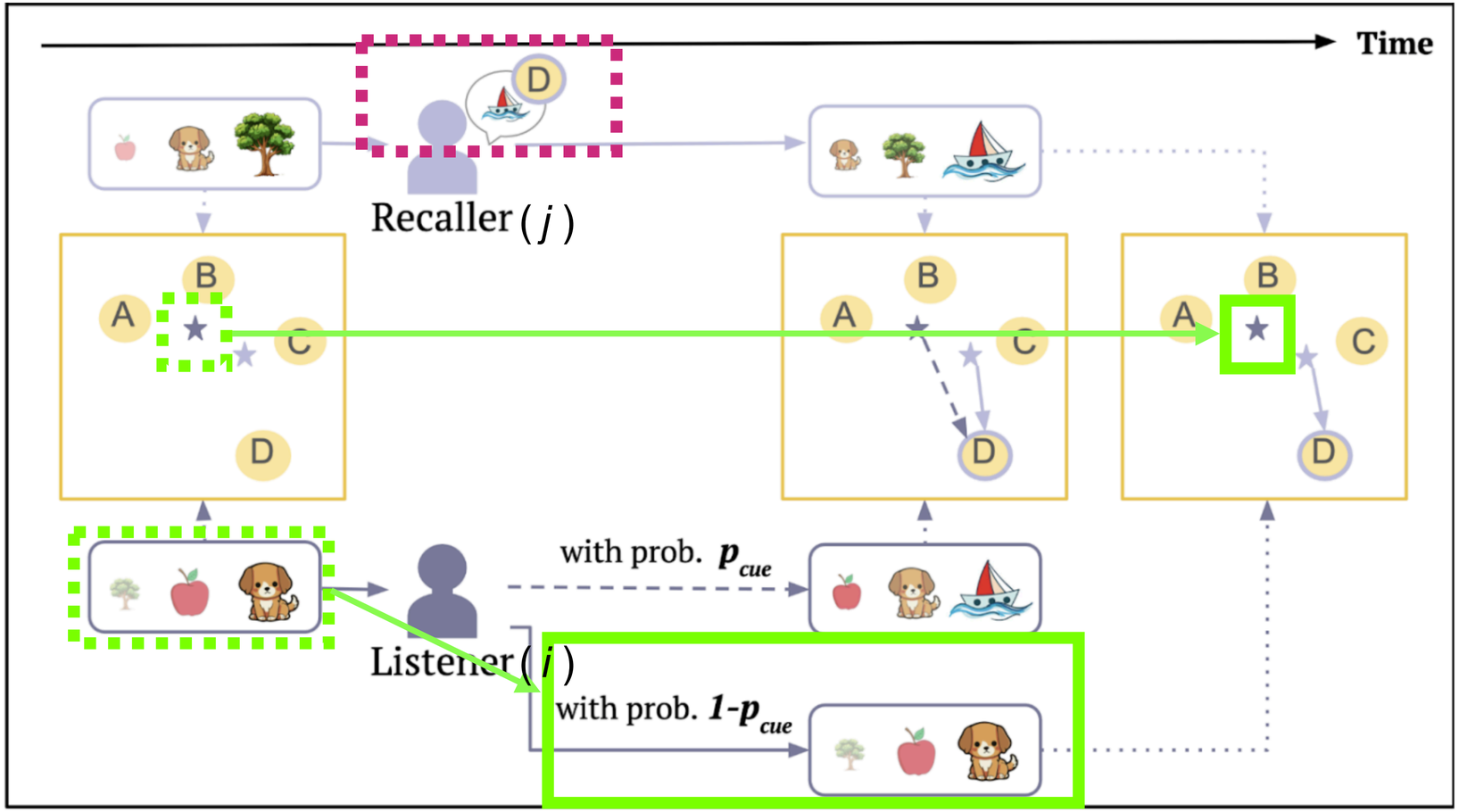


Listener attends to recall and updates context

$$c_{t,i} = \rho c_{t-1,i} + \beta_{rec} c_{cue,i}$$

Recall Phase: Collaborative condition Interaction mechanism added to CMR

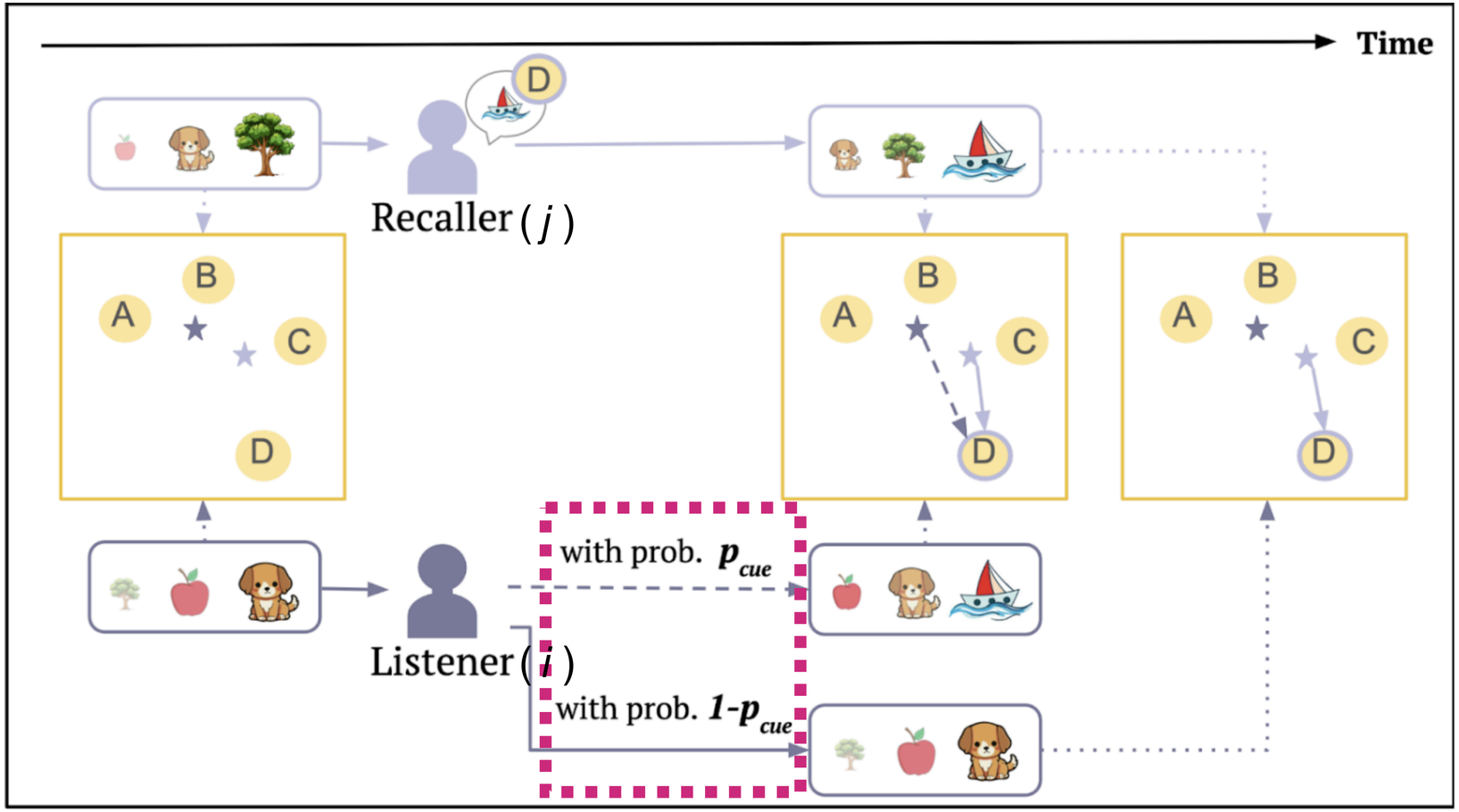


Listener attends to recall and updates context

$$c_{t,i} = c_{t-1,i}$$

Or Listener ignores recall and maintains their current context

Recall Phase: Collaborative condition Interaction mechanism added to CMR



Context drifts probabilistically towards cue:

with probability p_{cue}

$$c_{t,i} = \begin{cases} \rho c_{t-1,i} + \beta_{rec} c_{cue,i} \\ c_{t-1,i}, \end{cases}$$

with probability $1 - p_{cue}$

Assumption: Fundamental memory processes of how one searches their memories remain the same across individuals for whichever condition they are in

So, collaborative recall inherits parameter values from individual recall.

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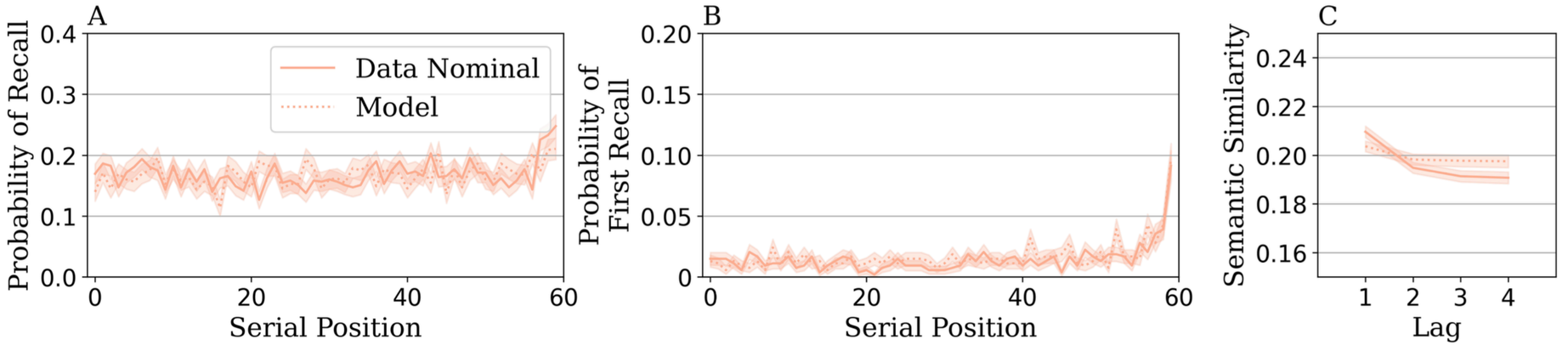
So, collaborative recall inherits parameter values from individual recall.

Existing modeling works*# on collaborative inhibition support retrieval inhibition and retrieval disruption accounts.

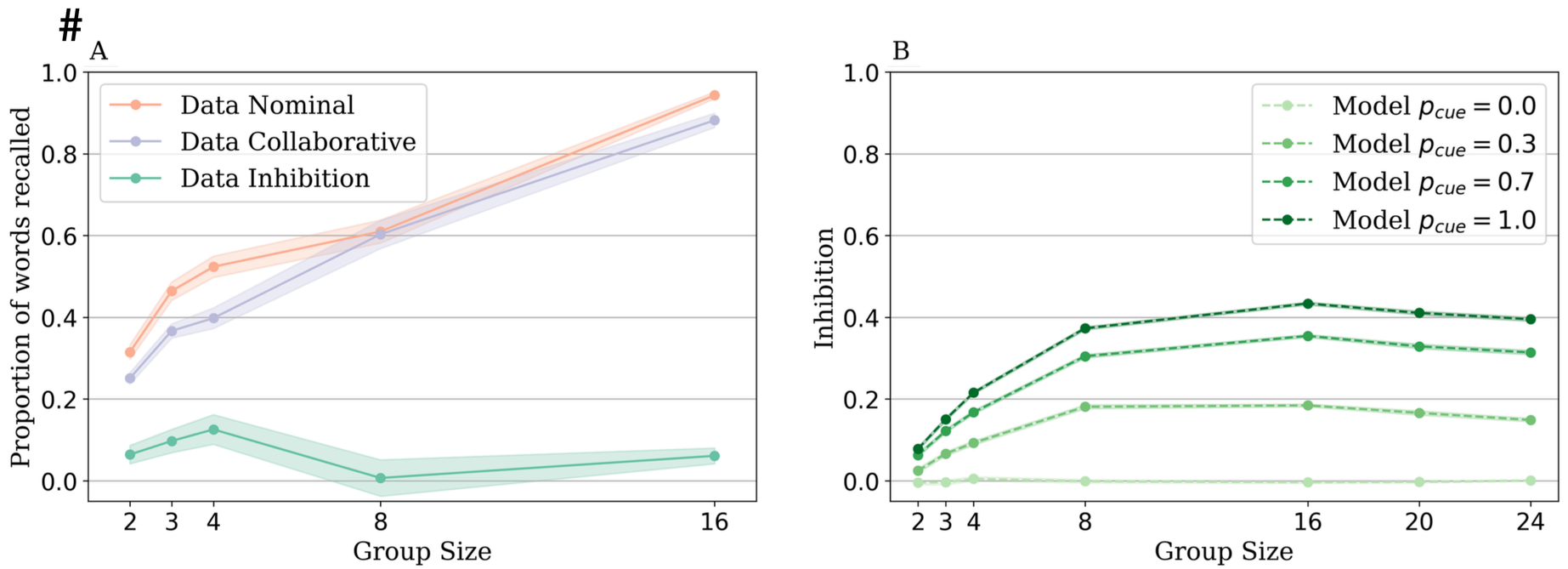
* Luhmann et al. (2015)
# Mannering et al. (2021)

Result 1: Our model captures free recall behavior of individuals



- Model fit to the free recall behavior of individuals in the nominal condition.

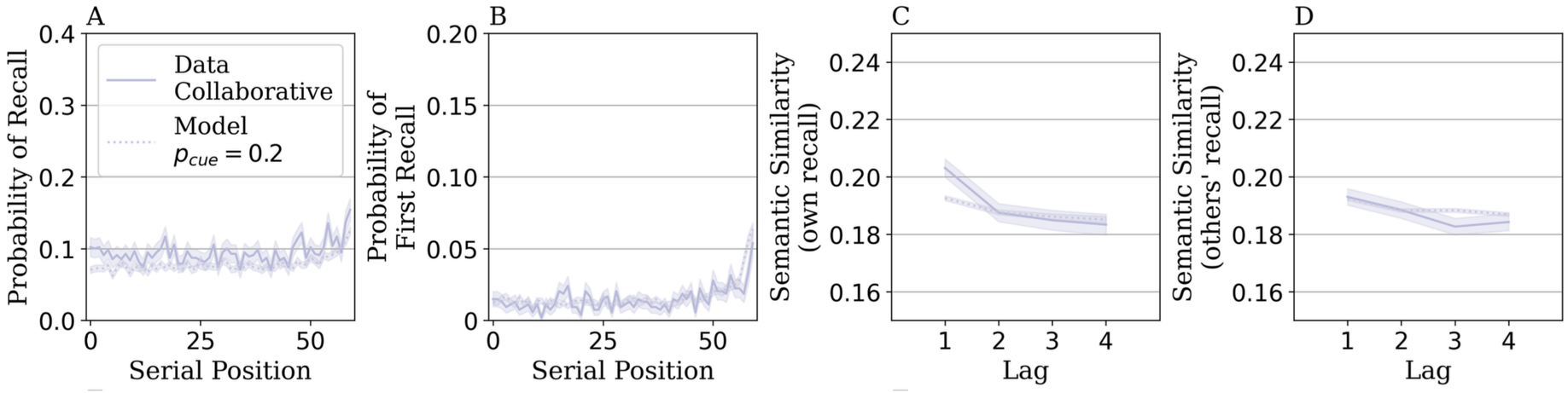
Result 2.1: Collaborative inhibition is an emergent property of the context-based account



- Collaborative inhibition first increased and then decreased as the group size grew from 2 to 16 (Gates et al. 2022).
- Our model captured this qualitative trend under different values of $p_{cue} > 0$.
- The collaborative condition inherited its parameter set from the nominal condition.

Gates et al. (2022)

Result 2.2: Our model also captures behavior of individuals in the collaborative condition



- The collaborative condition has one additional parameter p_{cue}. The model with p_{cue} = 0.2 fit the collaborative data behavioral patterns

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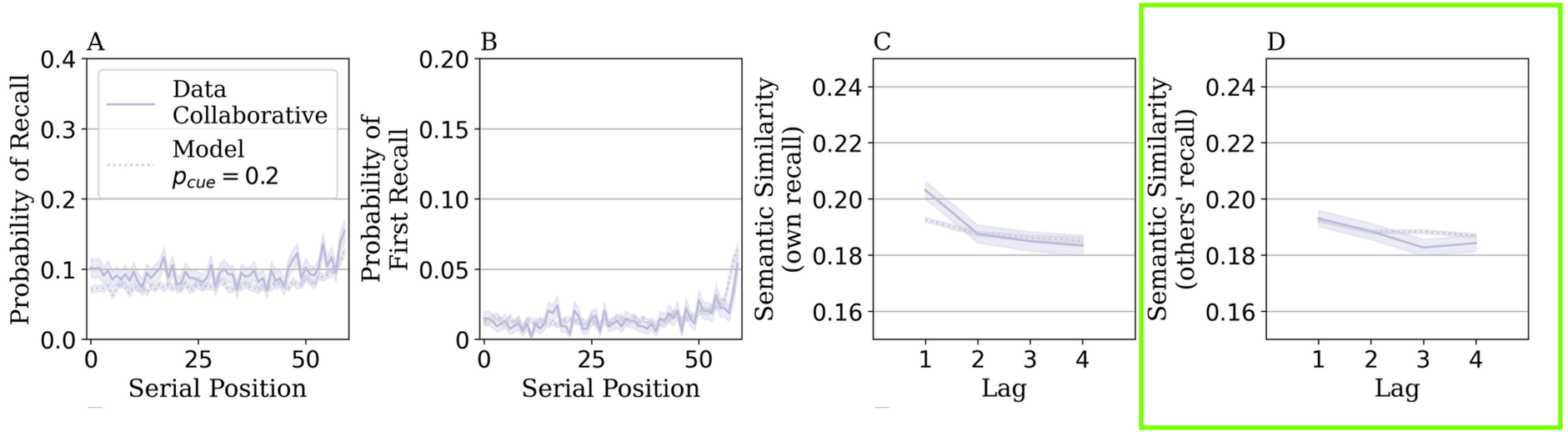

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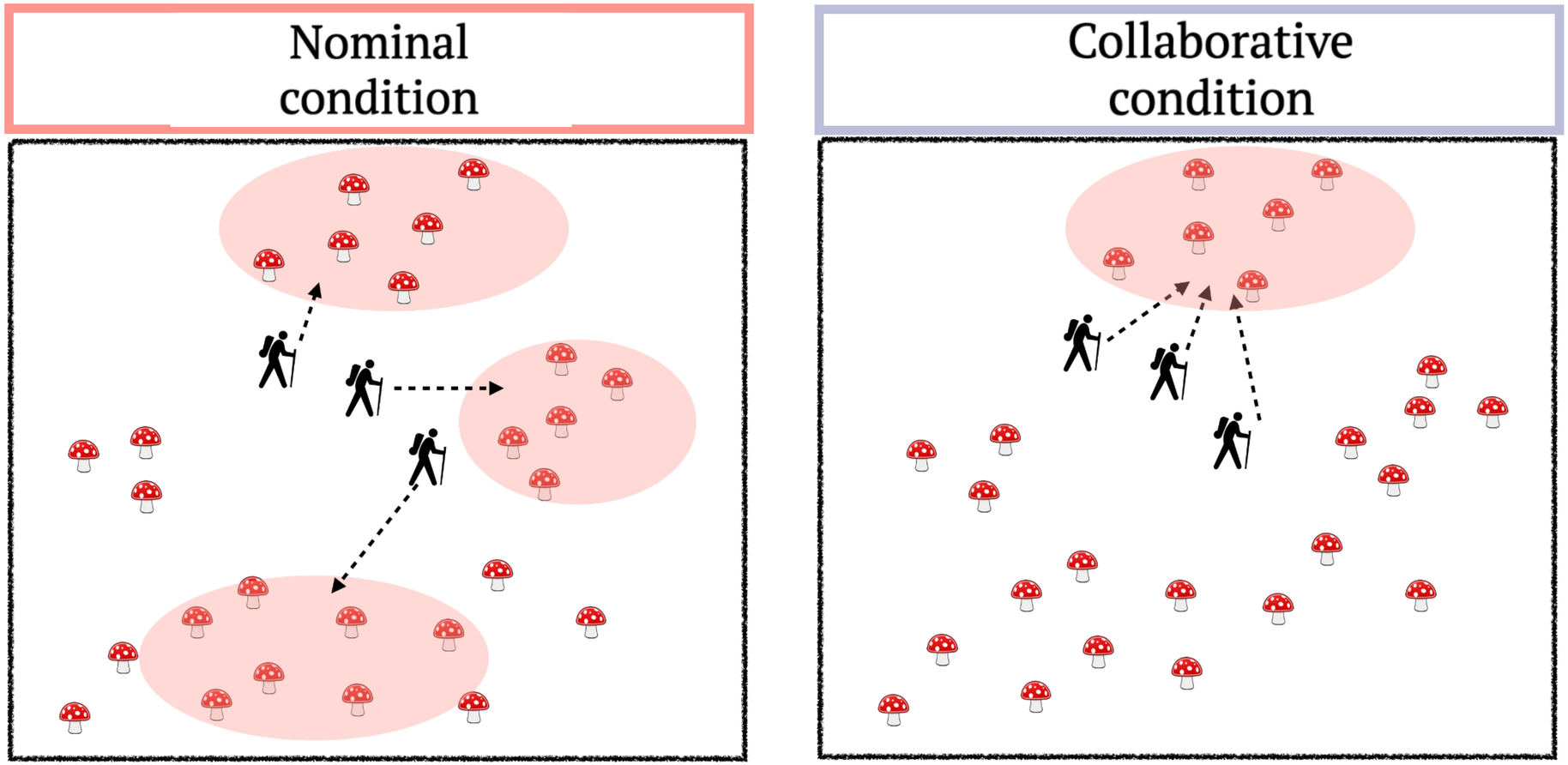
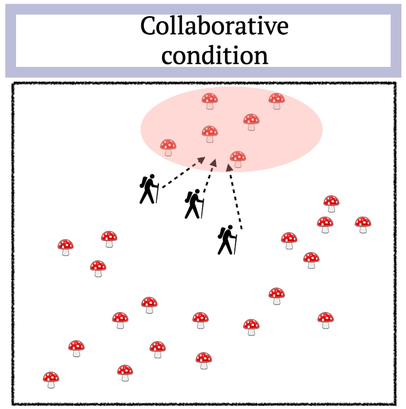
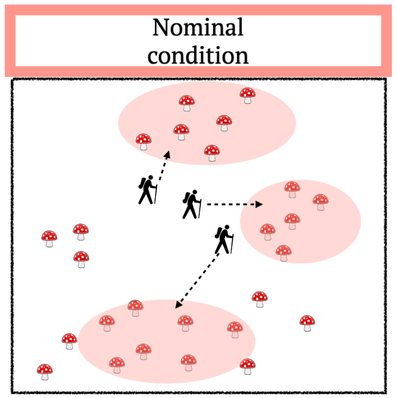
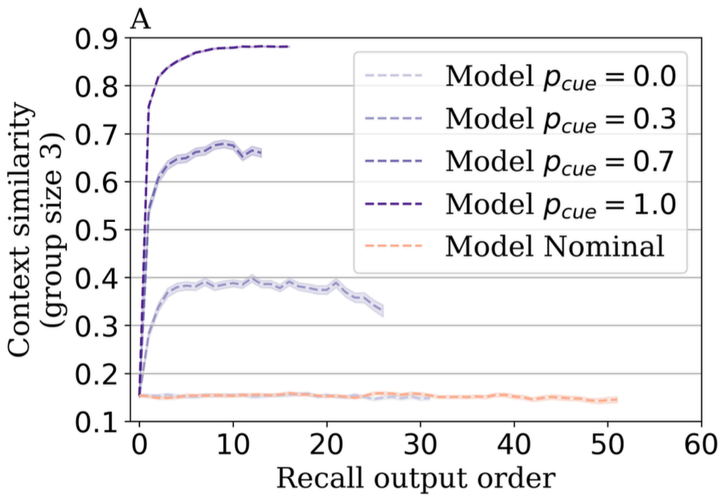
Intuition for why collaborative inhibition arises in our model

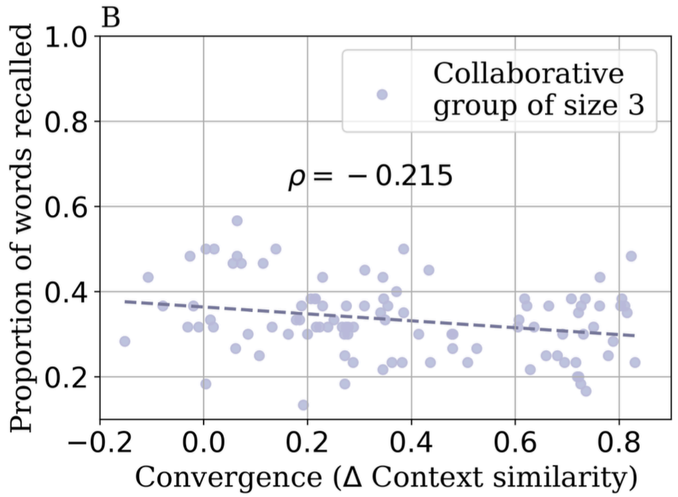


Result 3: Minds within a collaborative group become aligned with each other









- Context convergence in collaborative condition in group size 3. This convergence negatively correlates with performance.

Takeaways

1. Our model captures recall patterns and collaborative inhibtion observed in data.
2. We show that collaborative inhibtion emerges naturally from individuals' mental contexts interacting as they recall information without fitting any parameters to the collaboartive data.
3. Our study provides support for the important role of context in memory phenomenon across individuals and groups.

Acknowledgements

Qiong Zhang

Charlotte Cornell

> MEM0RY
0PTIMIZATI0N
LAB

Thank you!