# Intent Matters: Resolving the Intentional vs Incidental Learning Paradox in Episodic Long-term Memory

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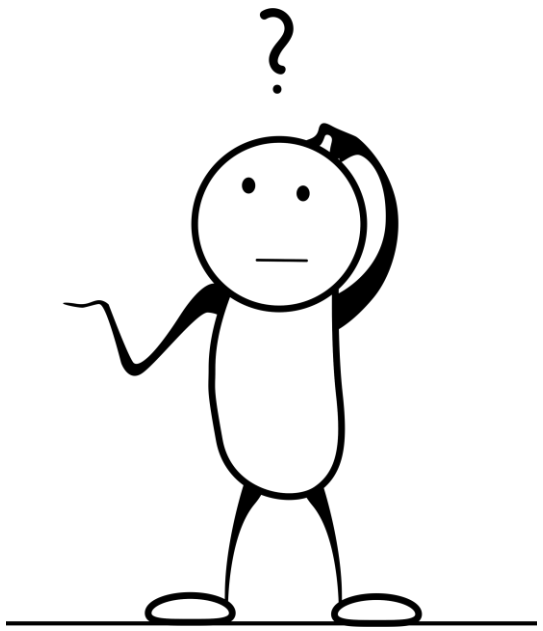
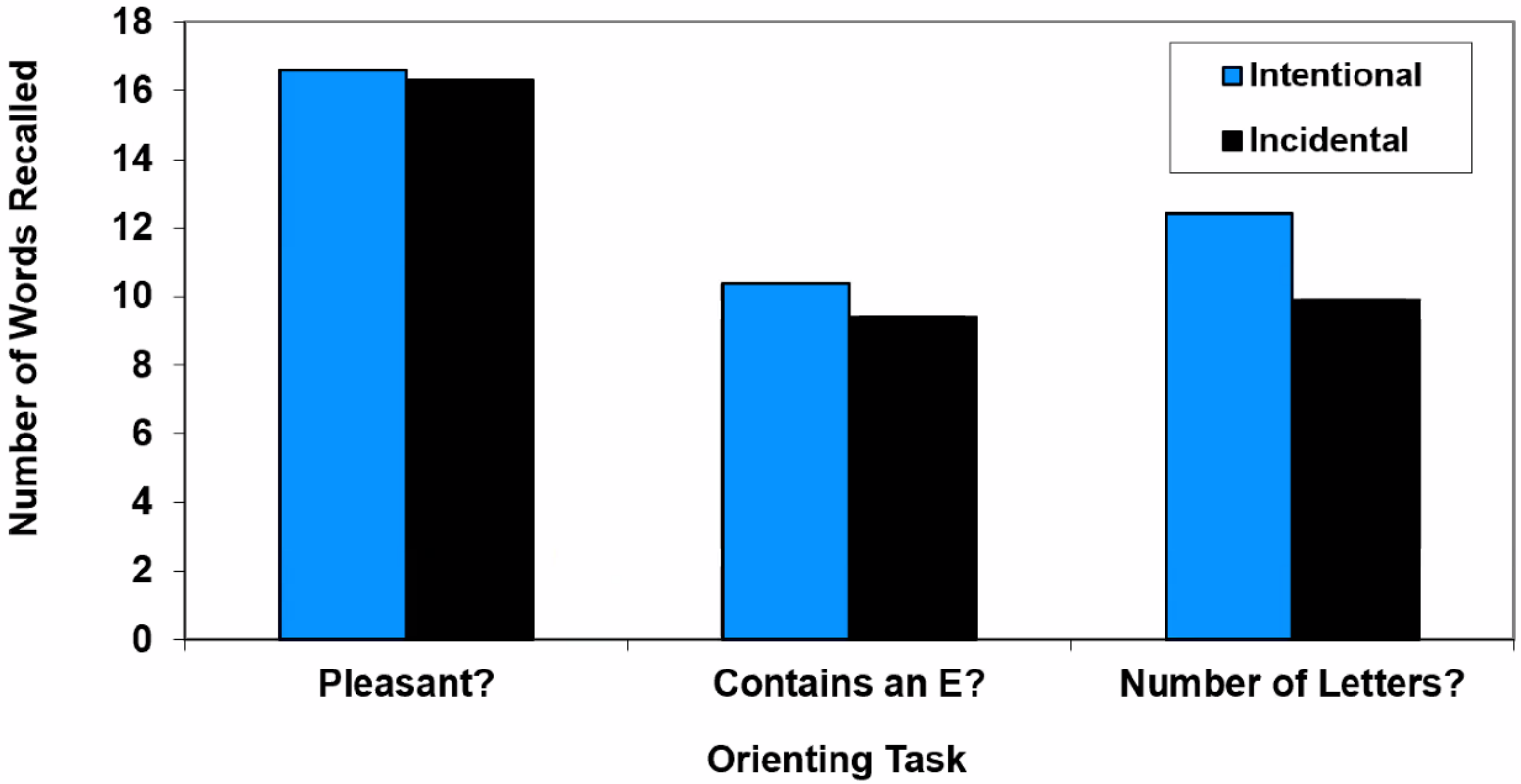


Try to remember your last birthday

# Does the intent to remember matter for long-term memory?

# Intentional and Incidental Episodic Memory

Hyde & Jenkins (1969)



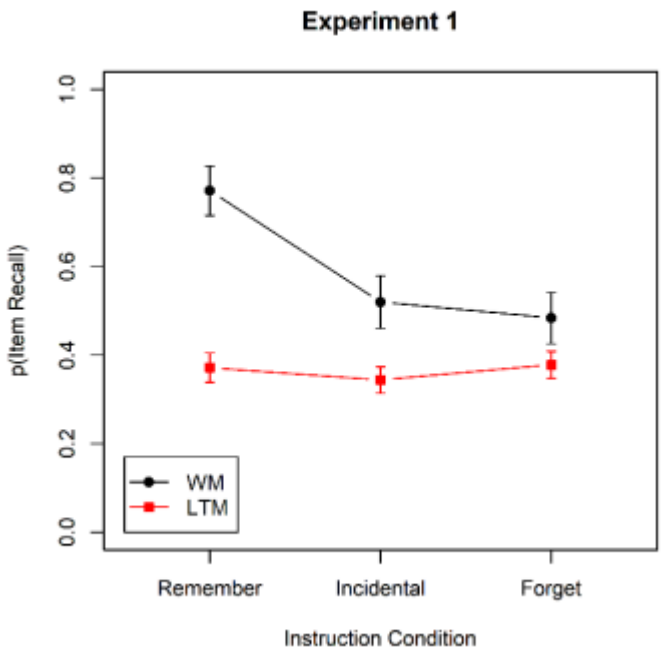
*“It is abundantly clear that what determines the level of recall or recognition of a word event is not intention to learn [...]; rather it is the kind of operations carried out on the items, that determines retention.”*

*– Craik and Tulving (1975)*

# Between-subject experiments

Given deep processing, long-term free recall and recognition of words are just as good under **incidental learning** instructions as they are under **intentional learning** instructions

(Craik & Tulving, 1975; Hyde & Jenkins, 1969, 1973; Johnston & Jenkins, 1971; Oberauer, submitted; Till, Johnston & Jenkins, 1975).




Oberauer and Greve (2021). JEP: General

# Oberauer & Greve (2021)

**Intent matters** for **WM** because WM is severely limited and needs a selection mechanism

**Intent does not matter** for **LTM,** because LTM has unlimited capacity and we cannot predict what information might be useful for the future

# Long-term memory is also limited

Limitations in rate of encoding

- Presentation rate effect (Criss & McClelland, 2006; Malmberg & Nelson, 2003; Murdock, 1960)
- Primacy effects (Murdock, 1962)
- List-length effects
- Sequential study effects (Popov & Reder, 2020; Popov et al., 2019)

A limited encoding resource (Popov & Reder, 2020)

# Main goal of experiments

The goal of these experiments was to determine **if** and **why** the intent to remember increases long-term episodic memory for items that are processed deeply.

Popov, V., & Dames, H. (2021). Intent Matters: Resolving the Intentional vs Incidental Learning Paradox in Episodic Long-term Memory. https://doi.org/10.31234/osf.io/jf2en

Answer: Intent matters a great deal in within-subject mixed-lists experiments.

Puzzle: Why intent matters in an item-wise manipulation, but not in a between-subject list-wise manipulation?

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- Selective strengthening of item-context associations for Remember items
- Inhibition of Process-only items
- Interrupted consolidation of Process-only items
- Output interference
- Selective relational encoding of Remember items

# Outline

- **Experiments 1-4:** Establish the basic finding
- **Experiments 5-7:** Discount various explanations
- **Experiments 8-10:** Evidence for winning explanation

today

# General method

- **Materials:** 180 high-frequency English words for concrete objects, selected from a stimulus pool used by Popov, So & Reder (under review). 3-7 letters in length.

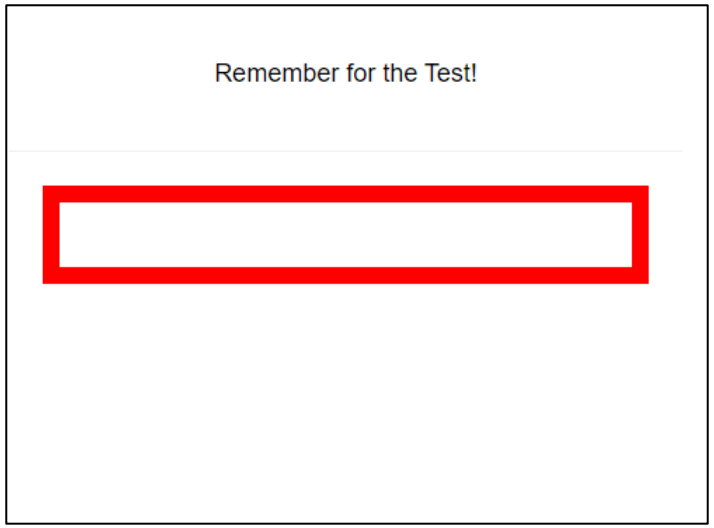
- **Study procedure:**
  - 1 to 3 different lists of 30 words or word pair
  - participants had to judge the size of the objects
  - the referent varied in different experiments – people had to respond whether 1) each item is larger or smaller than a soccer ball or 2) which of two items is larger than the other
  - The size judgement task was self-paced with no time limit.
  - The word disappeared immediately after response
  - In 8 of the 10 experiments, half of the items in each list had to be remembered, while the other half only had to be processed
  - The instruction for each item was cued by a change in the border color around the word – blue or red.
  - The timing of the instructions for each item was varied across experiments – simultaneous with word onset, immediately after size judgement or 5 seconds after size judgement.
  - One experiment used between-subject list-wise instructions, replicating Oberauer (submitted) LTM condition.
  - One experiment had color cues as in the other experiments, but participants had to remember all items, regardless of color. Random assignment of words and instructions for each trial. Color-instructions counter-balancing.
- **Distractor task:**
  - in all experiments, the memory test was delayed by 1 minute of solving algebraic equations
- **Test procedure:**
  - free recall, forced-choice recognition or cued-recall
  - In experiments with more than one list, all lists but the last tested memory only for Remember items. The last list always tested memory for all items.

# Experiment 1

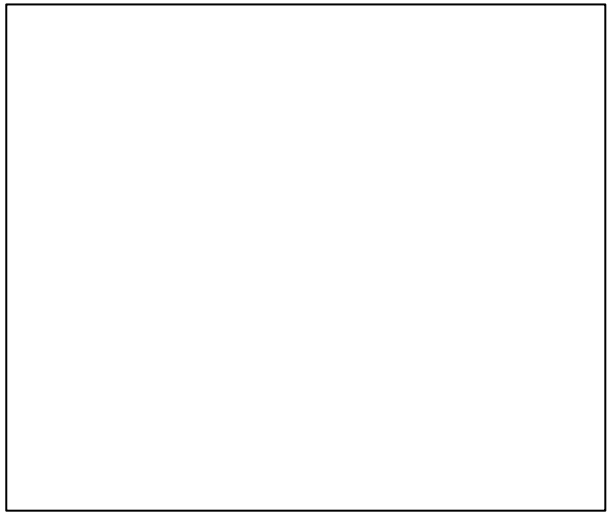
**Method:**

- 3 lists of 30 words or word pairs (between-subjects)
- If stimulus is a single word – “Is this larger than a football?”. If stimulus is a pair of words – “Which of the two objects is larger”?
- Border color appeared with word onset and remained on the screen for 3 seconds after the response and the word disappeared. After a blank interval of 250 ms, the next word appeared.
- Instructions to remember only the words in one color
- Delayed free recall after each list. Test for List1 and List2 asked recall only for “remember” words. Test 3 was a surprise test and asked participants to recall all words

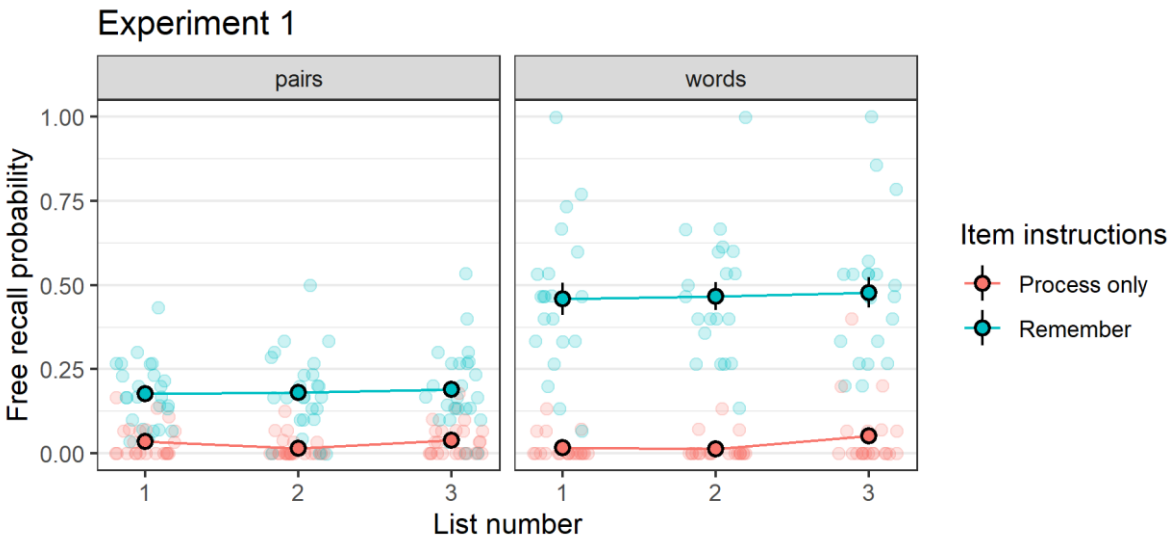

Until response

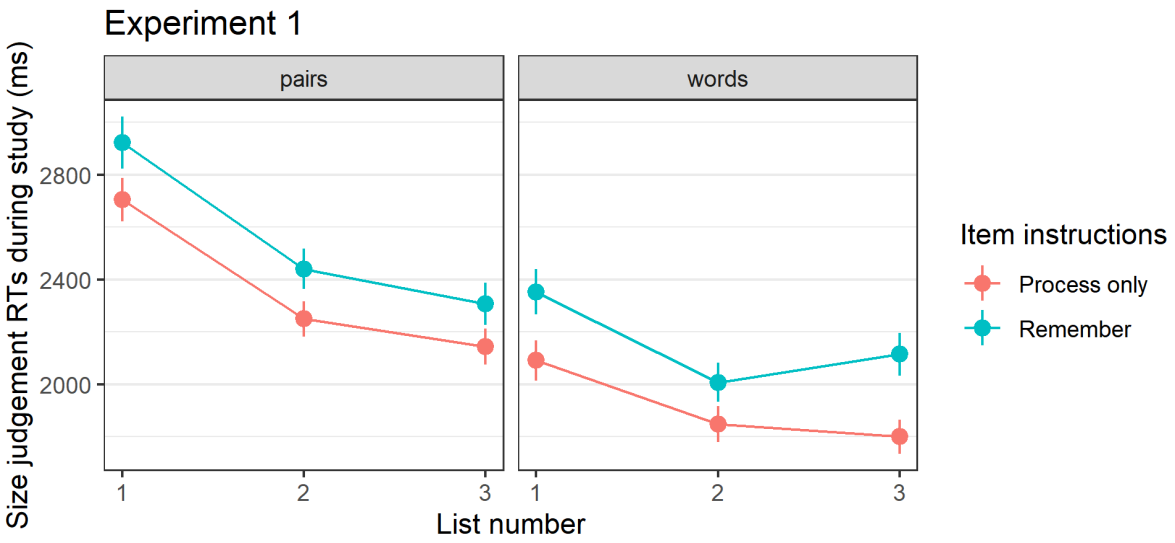


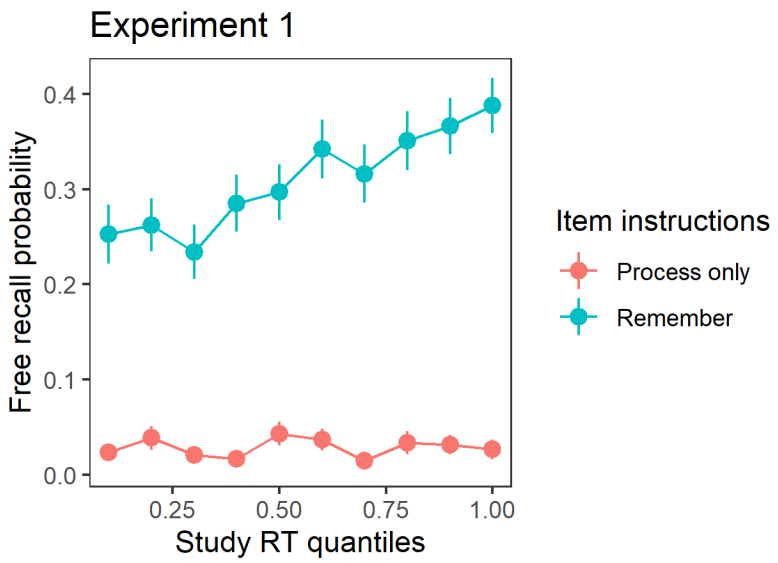

3000 ms

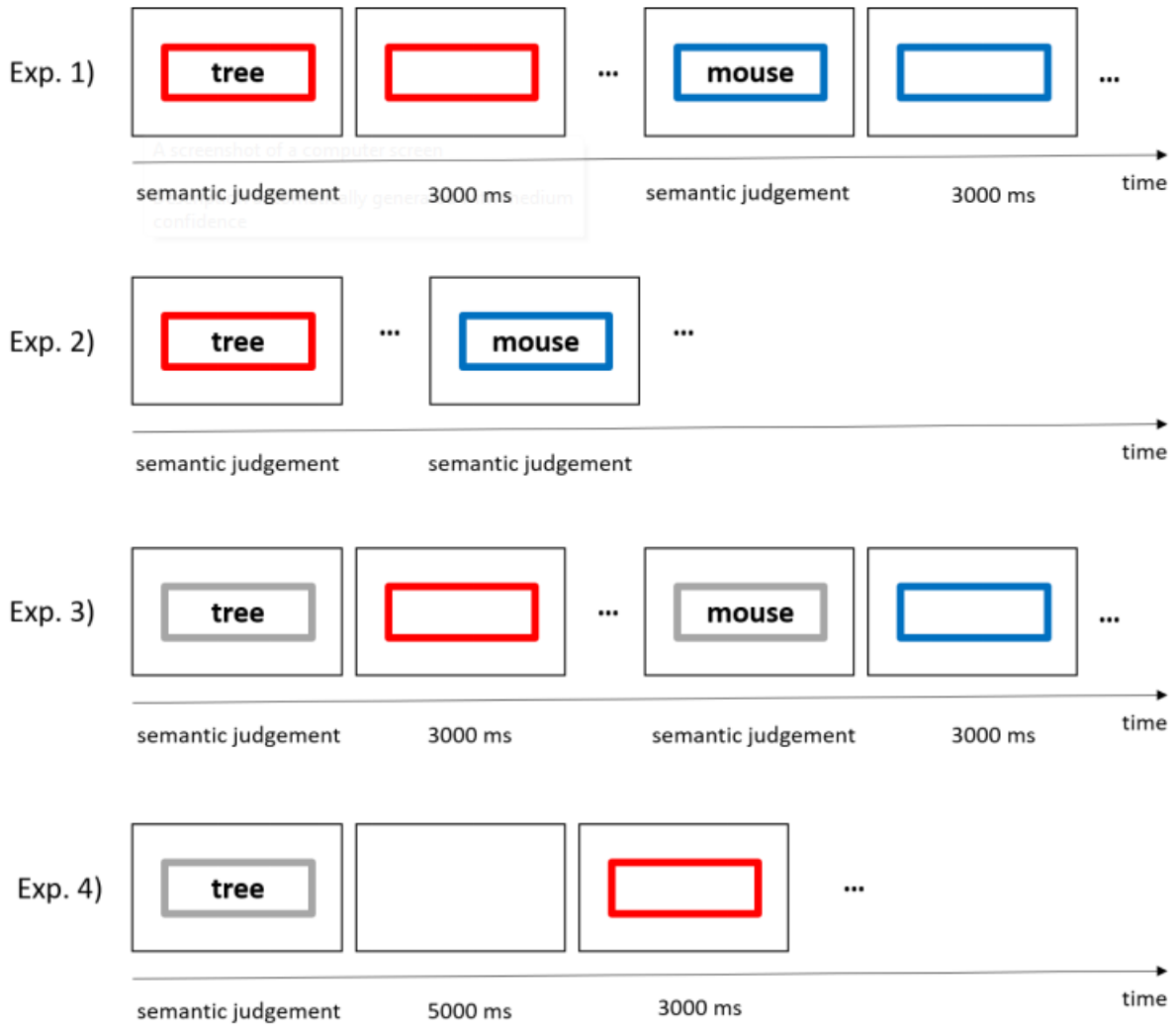


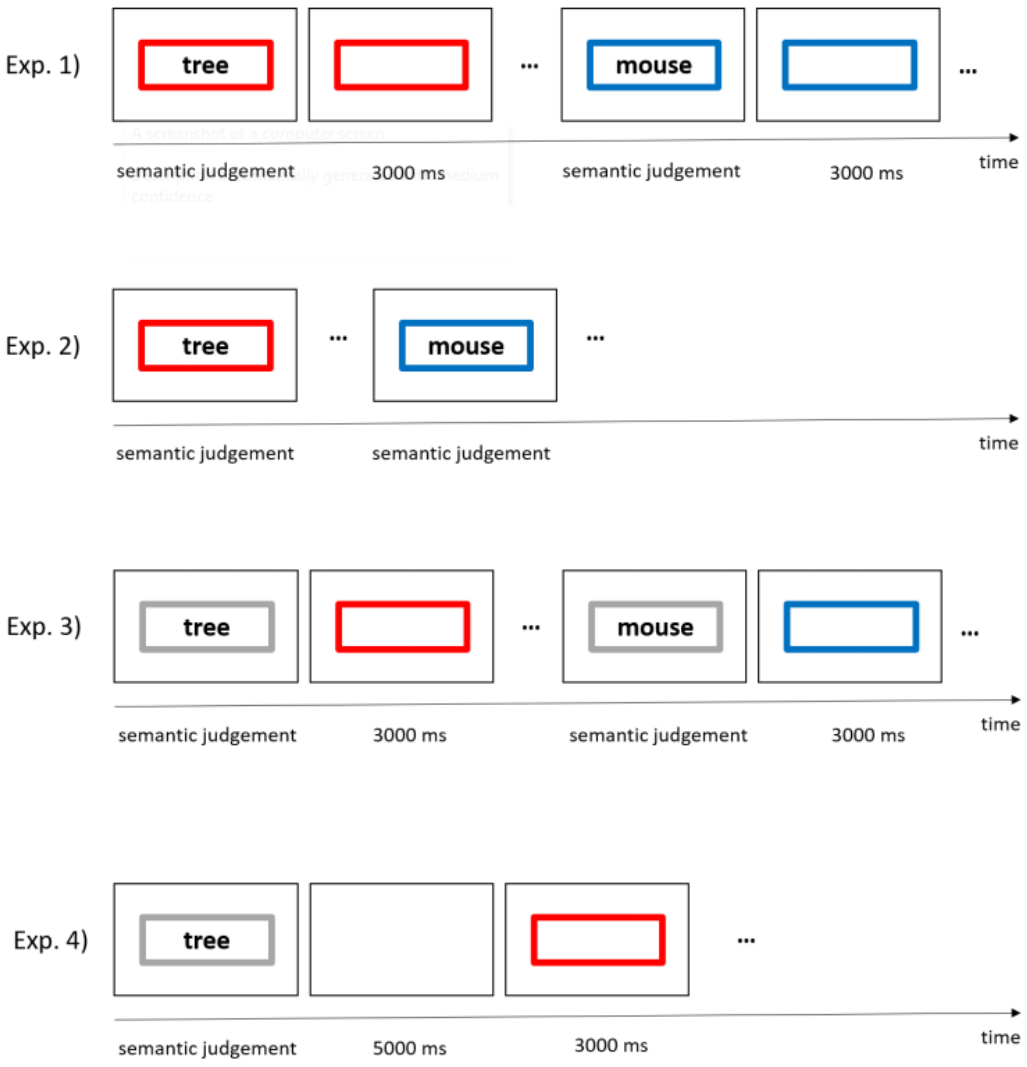
250 ms

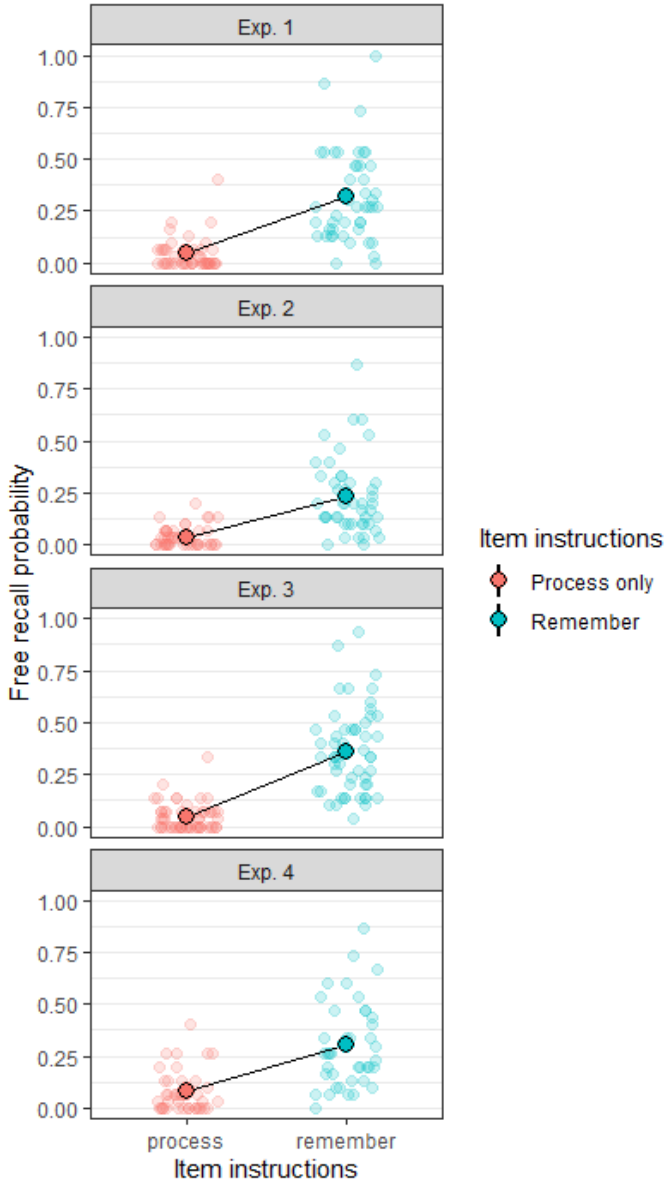

Experiment 1
pairs
words
Free recall probability
1.00
0.75
0.50
0.25
0.00
1
2
3
1
2
3
List number
Item instructions
Process only
Remember


Experiment 1
pairs
words
Size judgement RTs during study (ms)
2800
2400
2000
1
2
3
1
2
3
List number
Item instructions
Process only
Remember


Experiment 1
Free recall probability
0.4
0.3
0.2
0.1
0.0
0.25
0.50
0.75
1.00
Study RT quantiles
Item instructions
Process only
Remember


Exp. 1)
tree
...
mouse
...
semantic judgement
3000 ms
semantic judgement
3000 ms
time
Exp. 2)
tree
...
mouse
...
semantic judgement
semantic judgement
time
Exp. 3)
tree
...
mouse
...
semantic judgement
3000 ms
semantic judgement
3000 ms
time
Exp. 4)
tree
...
semantic judgement
5000 ms
3000 ms
time


Exp. 1)
tree
mouse
semantic judgement
3000 ms
semantic judgement
3000 ms
time
Exp. 2)
tree
mouse
semantic judgement
semantic judgement
time
Exp. 3)
tree
mouse
semantic judgement
3000 ms
semantic judgement
3000 ms
time
Exp. 4)
tree
semantic judgement
5000 ms
3000 ms
time

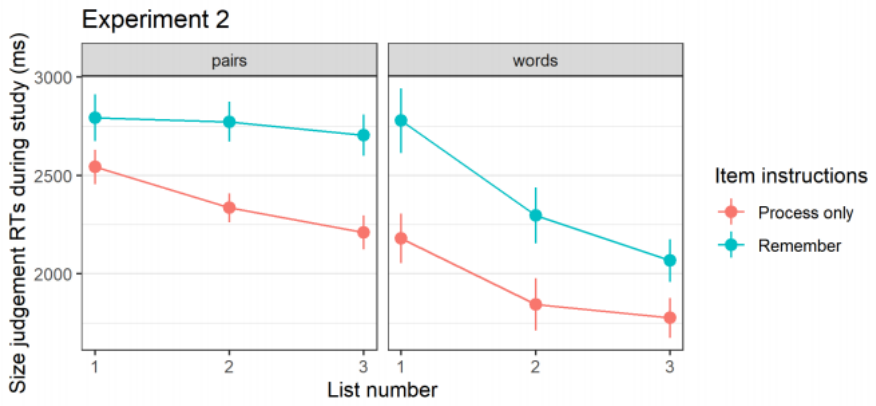

Exp. 1
Exp. 2
Exp. 3
Exp. 4
1.00
0.75
0.50
0.25
0.00
Free recall probability
process
remember
Item instructions
Item instructions
Process only
Remember

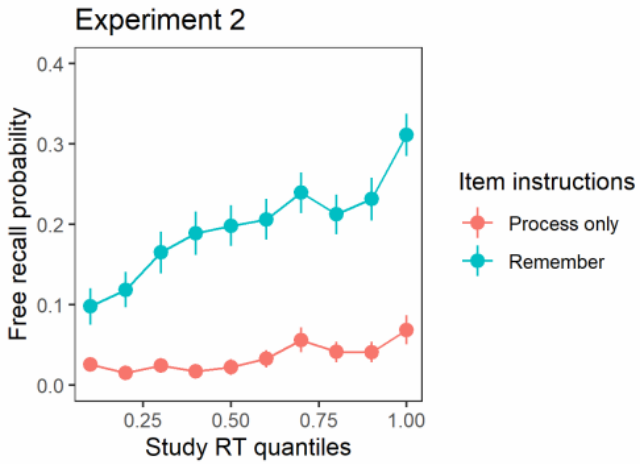
# Discussion of E1-E4

- Despite the fact that semantic processing is sufficient to produce equivalent LTM free recall under intentional and incidental learning in a list-method paradigm, I find that in the item-method version **process only words have free recall performance near floor**

- The timing of the cue (with word onset, after judgement response, both) doesn't matter much.

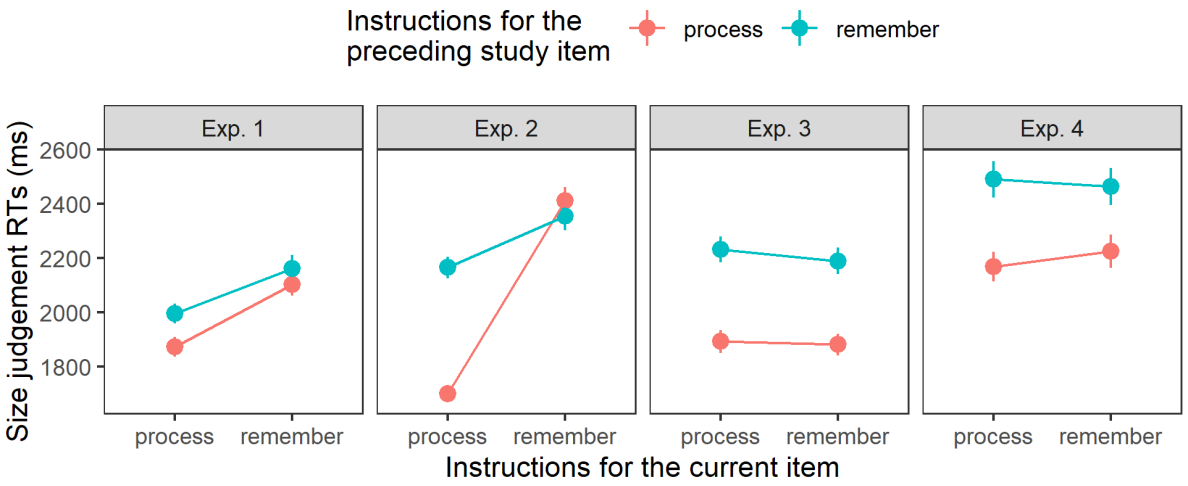
- Analysis of how accuracy improves as a function of study RTs across the three experiments revealed that:
  - People perform extra processing operations for R words, and the increased judgement time leads to better memory for R words
  - This increase in study time cannot explain the whole effect
  - Since processing of the R words continues when the subsequent word appears, it might be the case that total processing time could explain the entire effect
  - Not a satisfying explanation

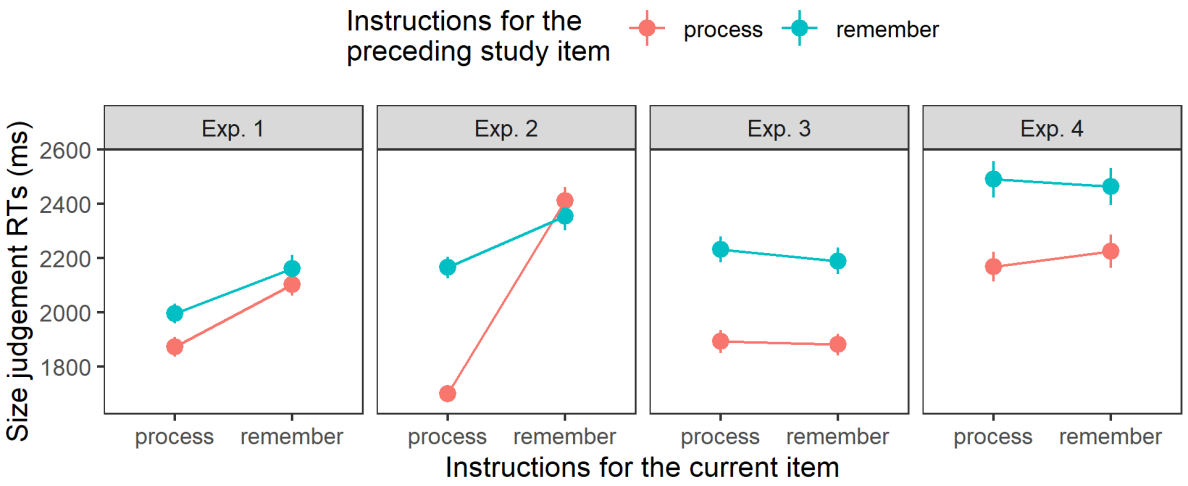


- However, this still doesn’t explain why memory for the process-only words is so bad, compared to list-wise experiments.
  - It could be:
    - inhibition during study of P-only words
    - output interference/response competition
    - relational encoding of R words with each other, so that each R word cues only other R words

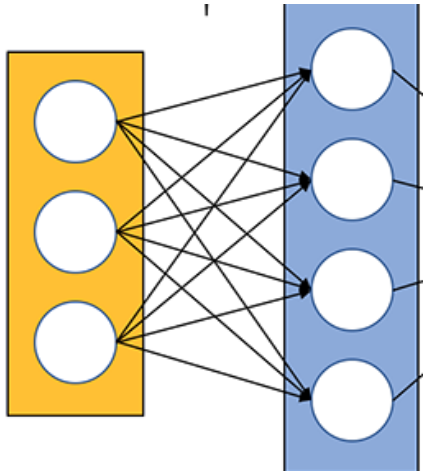
Active inhibition of Process-only words during encoding?

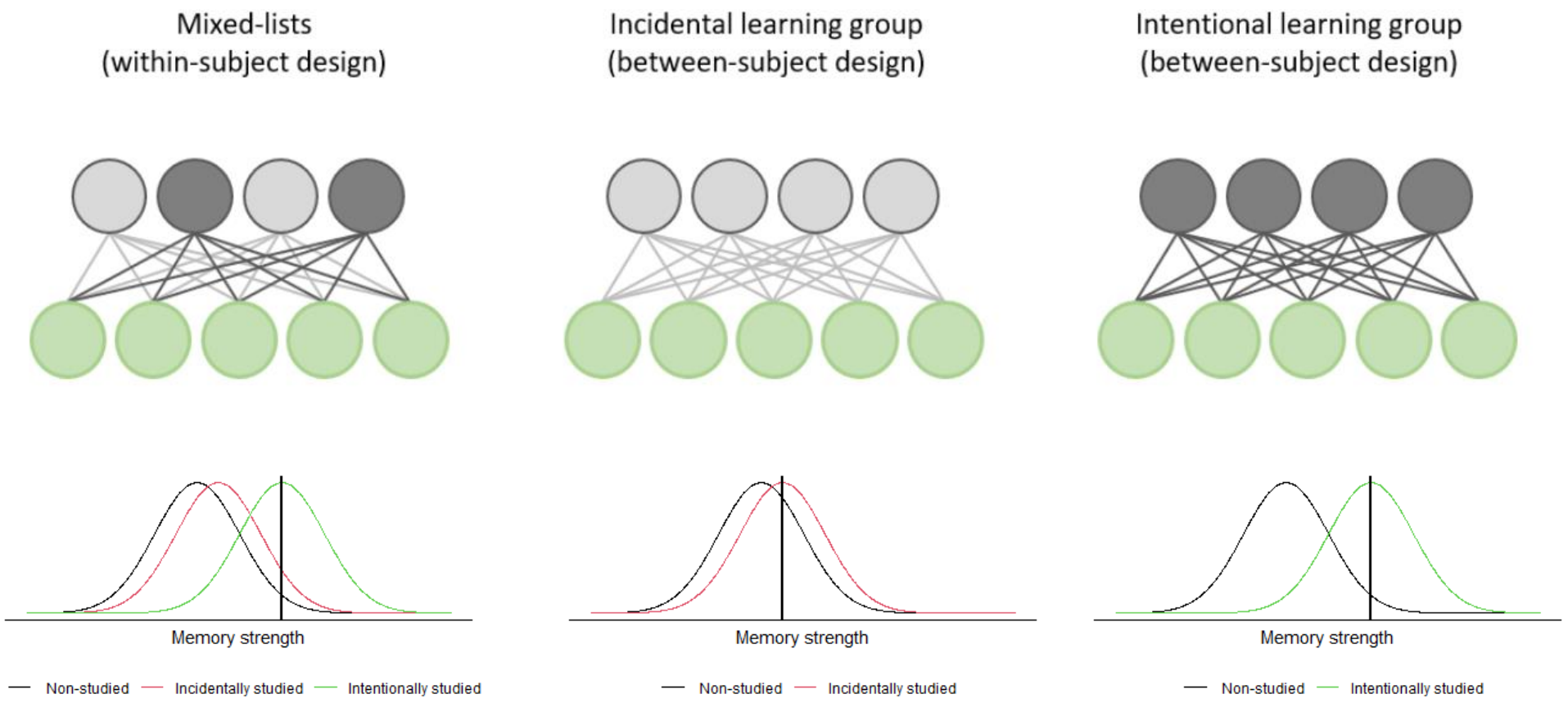

Instructions for the preceding study item
process
remember
Exp. 1
Exp. 2
Exp. 3
Exp. 4
Size judgement RTs (ms)
2600
2400
2200
2000
1800
process
remember
Instructions for the current item


Instructions for the preceding study item
process
remember
Exp. 1
Exp. 2
Exp. 3
Exp. 4
Size judgement RTs (ms)
2600
2400
2200
2000
1800
process
remember
Instructions for the current item

# So, what are we left with?

- Successfully free recall depends on 1) item memory and 2) item-context bindings
- Deep semantic processing boosts item memory, but not item-context bindings
- The intent to remember strengthens item-context bindings
- In between-subject experiments, the incidental learning group uses a lower retrieval threshold
- In within-subject experiments, the same retrieval threshold must be used




Mixed-lists
(within-subject design)
Incidental learning group
(between-subject design)
Intentional learning group
(between-subject design)
Memory strength
Memory strength
Memory strength
Non-studied
Incidentally studied
Intentionally studied
Non-studied
Incidentally studied
Non-studied
Intentionally studied

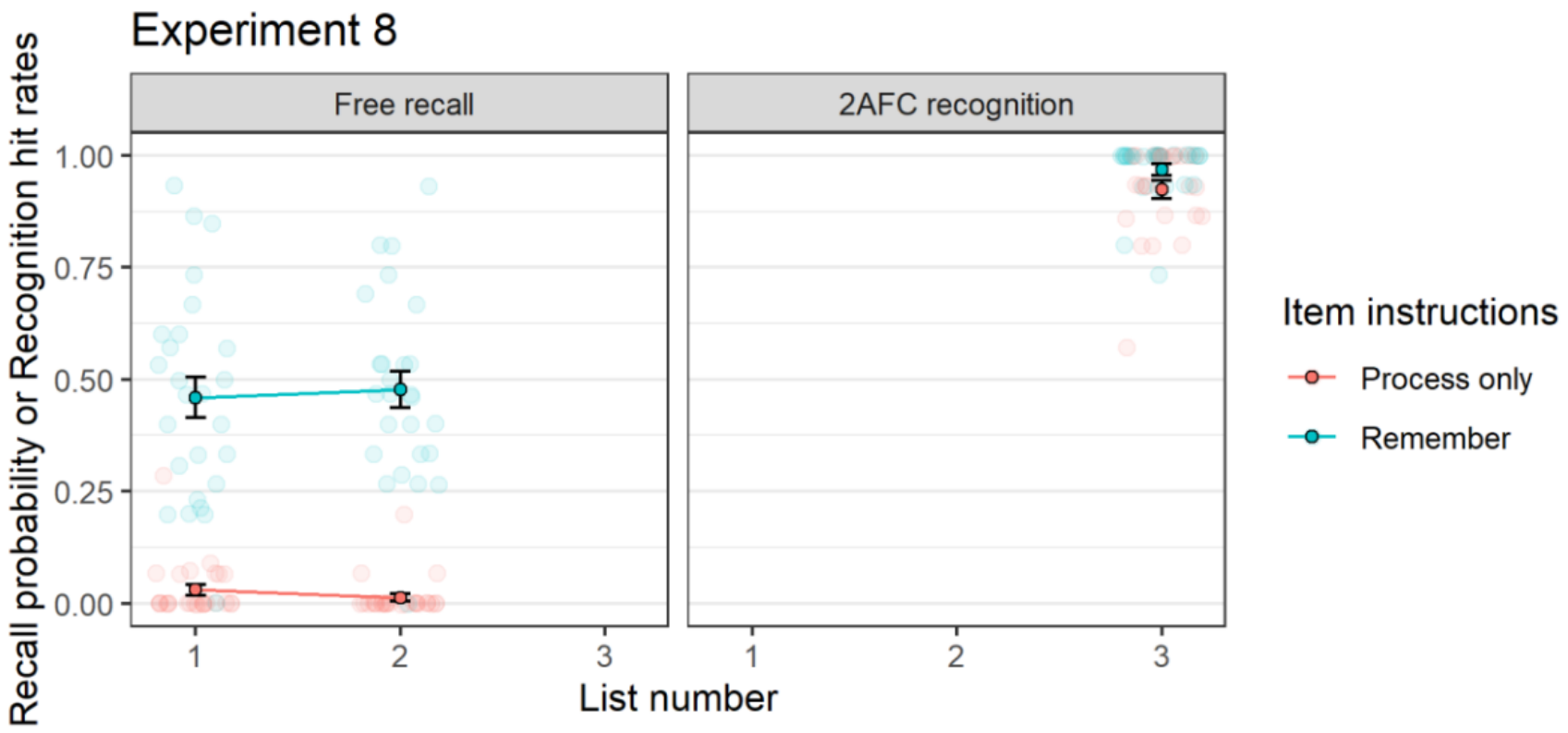
# Overview of Experiments 8-10

**Experiment 8** – surprise item-recognition test

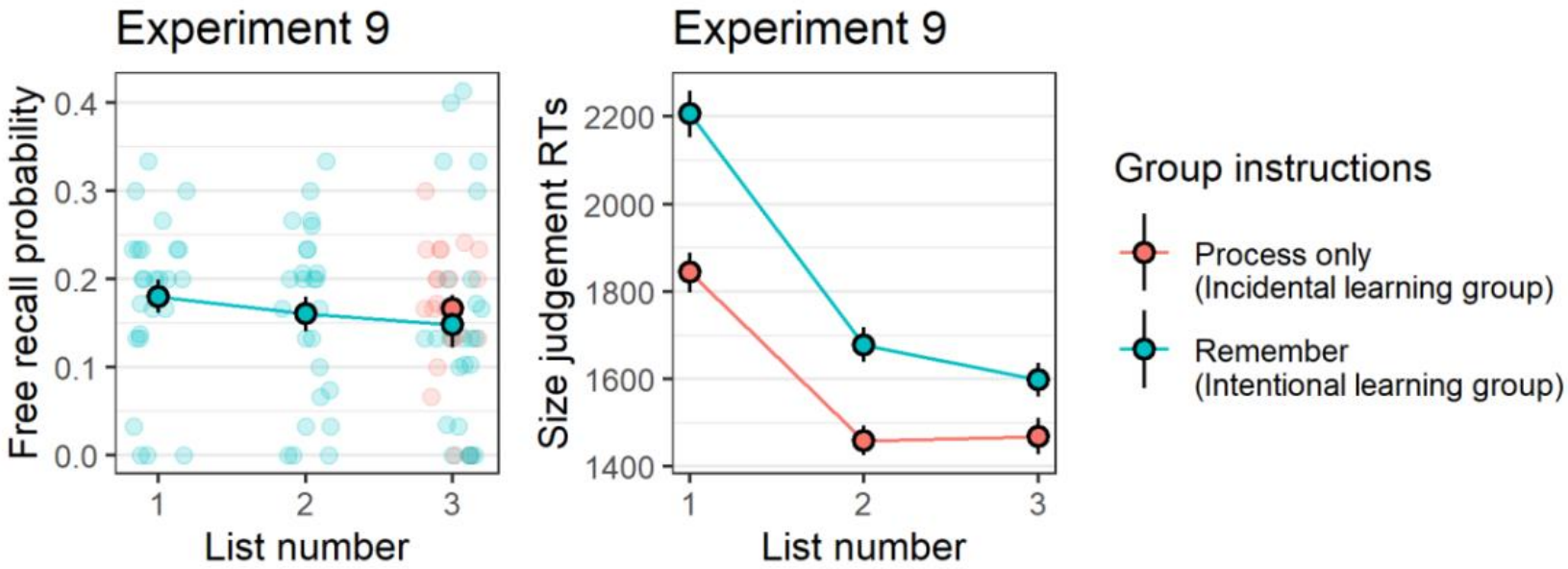
**Experiment 9** – replication of between-subject findings and test of predictions

**Experiment 10 –** a source-memory task to directly test for item-context binding strength

# Experiment 8 – Surprise item recontion test



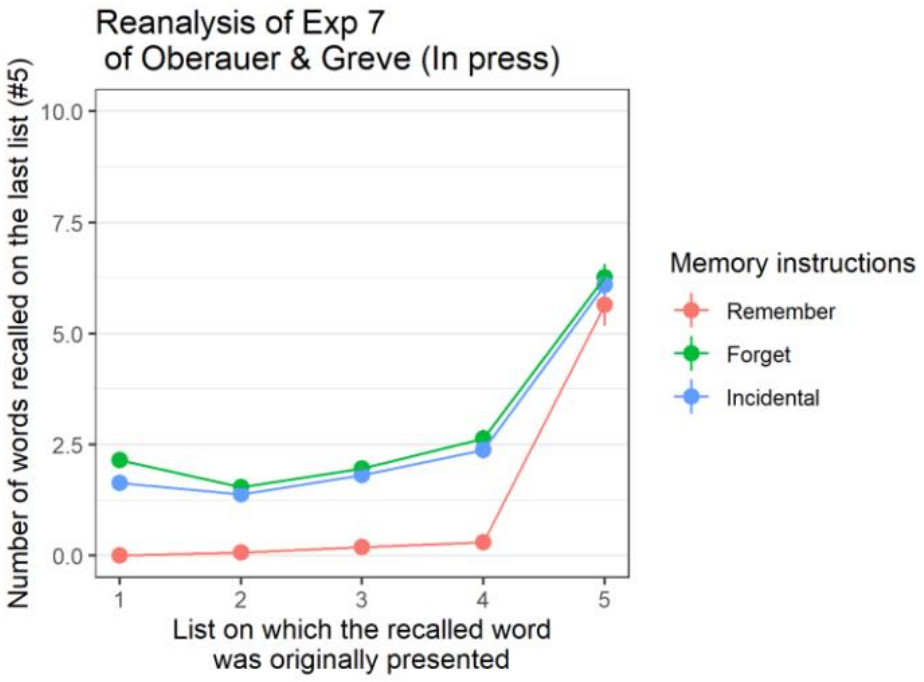
# Experiment 9 – between-subject design


Experiment 9
Free recall probability
0.4
0.3
0.2
0.1
0.0
1
2
3
List number
Experiment 9
Size judgement RTs
2200
2000
1800
1600
1400
1
2
3
List number
Group instructions
Process only
(Incidental learning group)
Remember
(Intentional learning group)

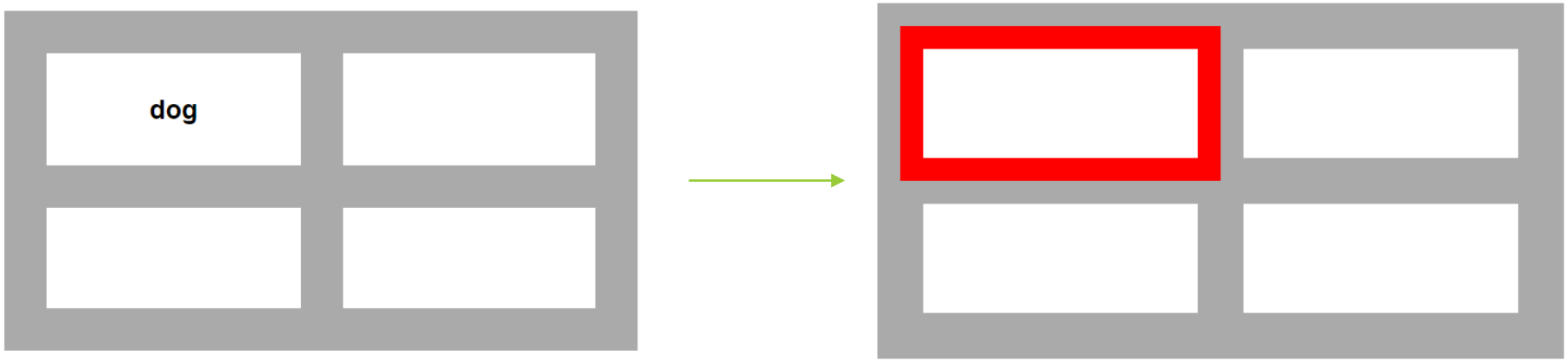
# Predictions of threshold-shift account

- In the incidental learning group performance is driven mostly by item activation rather than item-context bindings
- More extra-list intrusions from previous lists

- > x2 times more intrusions in List 3 recall for Process group (1.77 words, 27% of responses) relative to Remember group (0.71 words, 13% of responses)
- Also replicated in a reanalysis of Oberauer & Greve



# Experiment 10 - Is any item-context information stored without intent?




Is this object larger than a football?

For **yes** please press ↑ and for

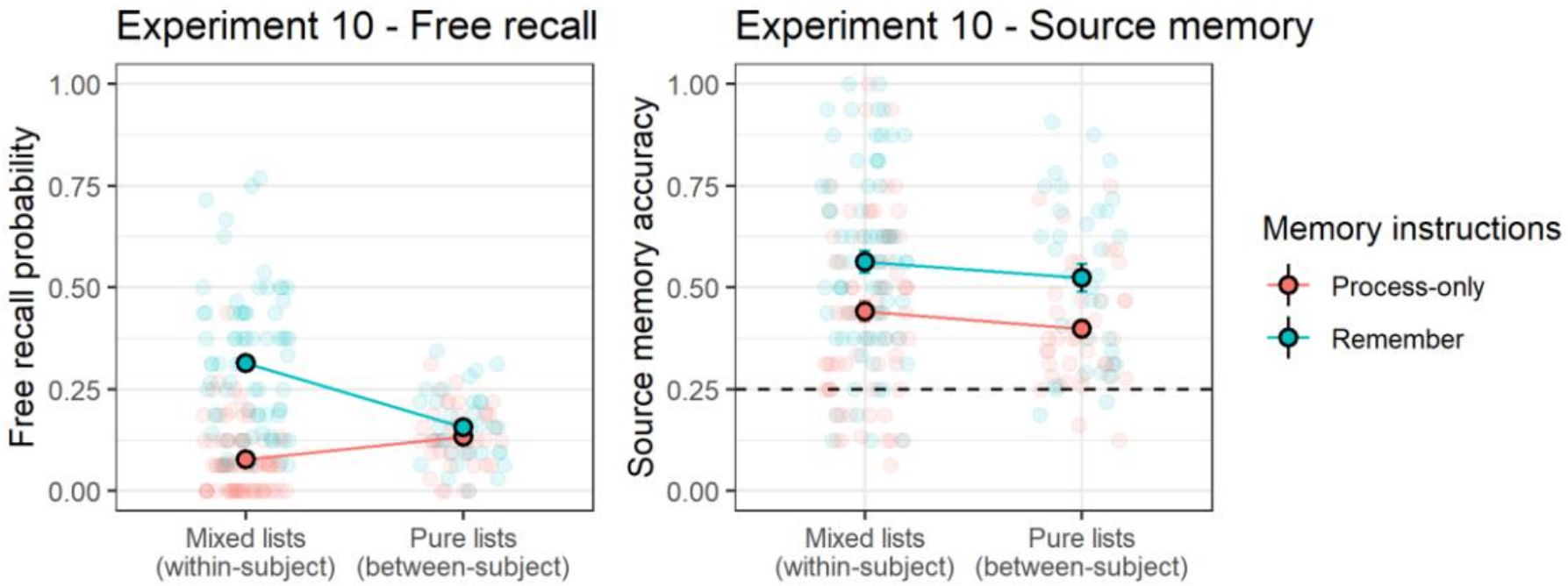
**no** please press ↓.

3000 ms.

Three groups

- Between-subject (Incidental learning)
- Between-subject (Intentional learning)
- Within-subject (Remember vs Process-only based on color)

# A clear effect of intent on source memory



# Summary

**Intentional vs incidental learning paradox:**

- Intent does not matter in between-subject experiments
- Intent matters in within-subject experiments

**A threshold-shift account:**

- Successful free recall depends on 1) item memory and 2) item-context bindings
- Deep semantic processing boosts item memory, but not item-context bindings
- The intent to remember strengthens item-context bindings
- In between-subject experiments, the incidental learning group uses a lower retrieval threshold
- In within-subject experiments, the same retrieval threshold must be used