Koriat, A; Bjork, R. A (2006).
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# Mending Metacognitive Illusions: A comparison of mnemonic-based and theory-based procedures

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## Introduction

- Learners experience an illusion of competence during learning: **Foresight bias**.
- Foresight bias derives from a characteristic that is inherent to the relationship between study and test sessions
  - Judgments of learning (JOLs) are made in the presence of information that will be absent at test.

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## Introduction

- "A priori" & "a posteriori" associations
  - A posteriori association is best measured by subjective judgments of the degree of relatedness between the cue and the target
  - A priori association is best measured by word-association norms (D. L. Nelson, McEvoy, & Schreiber, 1999).
    - Umbrella – Rain ⇒ Good JOL
    - Rain – Umbrella ⇒ Inflated JOL

Likelihood of:
"Umbrella" eliciting "Rain" = .70
"Rain" eliciting "Umbrella" = .04

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## Introduction

- Other types of pairs that yield inflated JOLs:
  - Purely a posteriori associations such as
    - Citizen – Tax
  - Unrelated words frequently used in other experiments
    - Pen – Clip
- JOLs are particularly inflated when the target word presented during study brings to the fore aspects of the cue word that are less likely to emerge during testing, when the cue word is presented alone

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## Focus of the Study

- This study focused on debiasing procedures that can help reduce the illusions of competence that derive from misleading "a posteriori" associations.

**Theory-Based & Mnemonic-Based Metacognitive Judgments**

- Theory-based judgments rely on a deliberate, explicit deduction from rules and theories retrieved from memory.
- Mnemonic-based JOLs rely on a variety of internal cues that are used automatically and unconsciously to give rise to subjective feelings. Such feelings are then used as the immediate basis for metacognitive judgments.

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## Aim of the Study

**How to mend faulty monitoring and overconfidence?**

- Mnemonic-based debiasing – increase tuning to the mnemonic cues that are pertinent to the retrieval of the response term during testing
  - Delayed JOL; Study-test practice
- Theory-based debiasing – help learners formulate an effective theory that can serve as an alternative basis for JOLs, replacing misleading mnemonic cues.

✓ This study aimed at comparing the effectiveness of theory-based and mnemonic-based procedures in mending metacognitive illusions.

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## Aims of the Experiments

- The experiments used both:
  - A mnemonic-debiasing procedure (study–test practice)
  - A theory-debiasing procedure
- The lists to be studied included:
  - Forward-associated pairs (yield good JOL-recall correspondence)
  - Backward-associated pairs (yield inflated JOL-recall correspondence)
  - Unrelated pairs with zero associative strength
- In order to examine transfer of training:
  - Second phase used the same list as in the first phase
  - Second phase used a new list

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## Hypothesis

- Both debiasing procedures are expected to be effective in increasing discrimination between the forward and backward pairs when the same list is used in the two phases, but only the effects of theory-based debiasing would transfer to a new list of items.

Experiment 1 – Focused on metacognitive monitoring (JOL judgments).

Experiment 2 – Focused on metacognitive control (allocation of study time).

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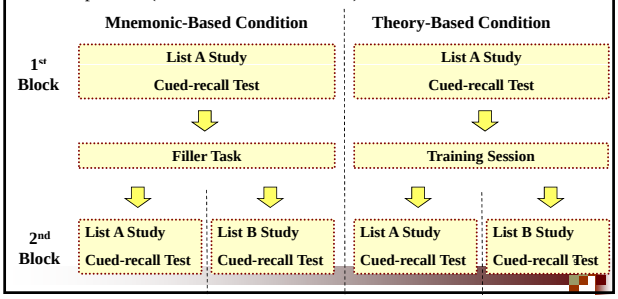
## Experiment 1 Flow

- Experimental design:
  - 2 Debiasing procedures (mnemonic-based vs. theory-based) X 2 List repetition (same list vs. different list) factorial.

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## Experiment 1

- Participants:
  - 96 Haifa University undergraduate students (61 women and 35 men).
- Materials:
  - Two lists of Hebrew paired-associates.
    - 36 word pairs composed of two sets of 18 pairs with forward and backward associations were matching
    - 18 asymmetrical pairs were included in each list with zero associative strength

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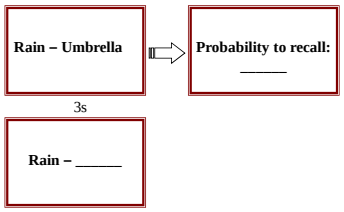
## Experiment 1

- Apparatus and Procedure:
  - The stimuli were displayed on the computer screen, and JOLs and recall, spoken by the participants, were entered by the experimenter on a keyboard.
- Study Phase:
- Test Phase: (random order)

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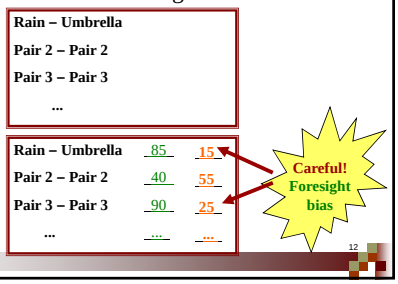
## Experiment 1

- Theory-debiasing group:
  - Training session: intended to make participants aware of the conditions that lead to a foresight bias.
- Show list of 10 asymmetric pairs:
- Estimation Task:

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## Results of Experiment 1

- The JOL-recall correspondence – 1st Study-Test Block:

| | Previous Experiments | This Experiment |
|---|---|---|
| Forward Pairs | Well calibrated / Small overconfidence bias | Underconfidence bias |
| Backward Pairs | Overconfidence bias | Overconfidence bias |
| Unrelated Pairs | Overconfidence bias | Overconfidence bias |

- Discrimination between Forward and Backward pairs

| | JOL | Recall |
|---|---|---|
| Forward-Backward difference | (78.3% - 72.8%) 5.5% | (87.8% - 65.8%) 22.0% |

  - Both the mnemonic and theory groups were susceptible to foresight bias.

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## Results of Experiment 1

- The UWP effect for the same-list conditions:
  - Underconfidence-With-Practice (UWP) – when judging the same list of pairs more than once, participants tend to become underconfident in their JOLs.

| | 1st Block | 2nd Block |
|---|---|---|
| Forward Pairs | Small overconfidence bias | Not clear |
| Backward Pairs | Small overconfidence bias | Underconfidence bias |
| Unrelated Pairs | Small overconfidence bias | Underconfidence bias |

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## Results of Experiment 1

- Comparing the two debiasing procedures (same-list groups):
  - Although practice studying the same list intensified an underconfidence bias, it helped increase sensitivity to the effects of associative direction (forward/backward).
- Difference between forward and backward pairs' JOL:

| | 1st Block | 2nd Block |
|---|---|---|
| Mnemonic-debiasing | 4.2% | 8.1% |
| Theory-debiasing | 4.5% | 13.2% |

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## Results of Experiment 1

✓In sum, practice studying the same list seems to increase sensitivity to associative direction (forward/backward), and there was no significant difference in this respect between the mnemonic- and theory-debiasing conditions.

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## Results of Experiment 1

- Comparing the two debiasing procedures (different-lists):

Difference between forward and backward pairs' JOL:

| | 1st Block | 2nd Block |
|---|---|---|
| Mnemonic-debiasing | 7.0% | 7.1% |
| Theory-debiasing | 6.5% | 19.0% |

  - Whereas in the theory-debiasing condition the effects of associative direction increased for the different-list group as it did for the same-list groups, mnemonic-debiasing failed to yield such increase.

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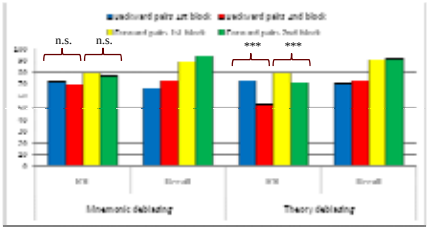
## Results of Experiment 1

- Comparing the two debiasing procedures (different-lists):




  - Only the theory debiasing increased sensitivity to the forward–backward distinction, whereas the mnemonic debiasing yielded no such effect.

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## Results of Experiment 1

- Comparing the same-list and different-list conditions:
  - Theory debiasing exerted a similar beneficial effect whether the same list or a different list was used in the second block.
  - Mnemonic debiasing, in contrast, exerted different effects when the same list was repeated and when a different list was used in the second block. The beneficial effects were observed only when the same list was used twice.

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## Results of Experiment 1

- Changes in monitoring resolution:
  - Resolution refers to the extent to which participants' JOLs discriminate between items that are eventually recalled and those that are not.

Improvement in the same-list condition

| | 1st Block | 2nd Block |
|---|---|---|
| Mnemonic-debiasing | .62 | .81 |
| Theory-debiasing | .62 | .82 |

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- Consistent with previous findings that practice studying the same list improves resolution

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## Results of Experiment 1

- Changes in monitoring resolution:

Improvement in the different-list condition

| | 1st Block | 2nd Block |
|---|---|---|
| Mnemonic-debiasing | .66 | .68 |
| Theory-debiasing | .72 | .70 |

n.s.

- There was no improvement in resolution from the first to the second list. The improvement in resolution that occurs with practice appears to be item specific and does not transfer to a new list.

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## Experiment 2

Experimental 2 focused on metacognitive control

- Differences from Experiment 1:
  - Study time was self-paced
  - No JOLs were required
- Hypotheses:
  - Foresight bias will have detrimental effects on the allocation of study time, causing learners to allocate relatively less study time to items with inflated a posteriori associations.
  - The two debiasing procedures used in Experiment 1 are expected to mend the allocation of study time when the same list is used in the 2nd block.
  - When studying a new list in the 2nd block, only the theory debiasing is expected to produce beneficial effects.

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## Experiment 2

- Participants:
  - 48 Haifa University undergraduate students (36 women and 12 men).
- Materials:
  - Two lists of Hebrew paired-associates.
    - 36 word pairs composed of two sets of 18 pairs with forward and backward associations were matching
    - 18 asymmetrical pairs were included in each list with zero associative strength

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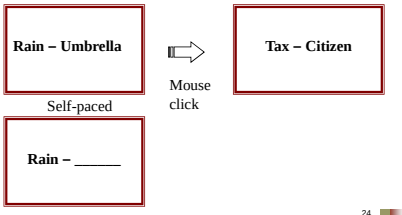
## Experiment 2

- Apparatus and Procedure:
  - The stimuli were displayed on the computer screen, and JOLs and recall, spoken by the participants, were entered by the experimenter on a keyboard.
- Study Phase:
- Test Phase: (random order)

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## Experiment 2

- Theory-debiasing group:
  - Training session: intended to make participants aware of the conditions that lead to a foresight bias.

1. Show list of 10 asymmetric pairs
2. Explanation about foresight bias

Rain – Umbrella
Pair 2 – Pair 2
Pair 3 – Pair 3
...

Careful! Foresight bias

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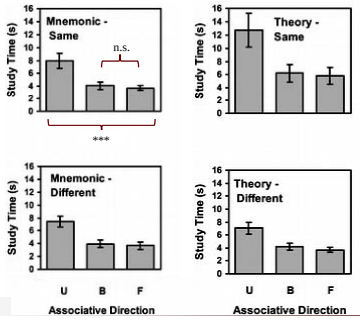
## Results of Experiment 2

- Effects of associative direction on study time in the 1st block:

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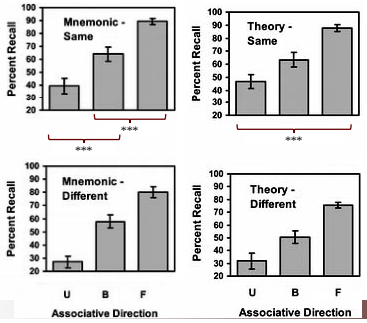
## Results of Experiment 2

- Effects of associative direction on recall in the 1st block:

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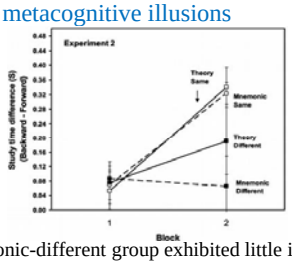
## Results of Experiment 2

- Mending metacognitive illusions




- The mnemonic-different group exhibited little increase in the time allocated to the backward pairs relative to the forward pairs.
- In contrast, such an increase was greater for the theory-different group.

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## Results of Experiment 2

Did the changes in study time affect recall?

| | 1st Block | 2nd Block |
|---|---|---|
| Mnemonic-debiasing | 68.9% | 75.0% |
| Theory-debiasing | 62.9% | 76.2% |

**, **, n.s.

- There was a significant effect of Block on recall.
- There is no indication that the increased investment of study time in the backward pairs reduced the forward–backward difference in recall.

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## General Discussion

- Metacognitive training procedures that capitalize on mnemonic cues produce their effects without learners being able to spell out the principle that cuts across different items.
  - Therefore, the effects of mnemonic debiasing do not transfer to new materials.
- In contrast, the theory-debiasing procedure induced participants to discover and articulate a general rule and to apply that rule in a subsequent study–test cycle.
  - This procedure was found to foster transfer beyond the original learning context.

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## Conclusion

The results have two broad and related implications:

- First, they demonstrate that metacognitive training that helps educate subjective experience need not ensure generalization to new situations.
- Second, that a good theory that helps replace faulty metacognitions does tend to generalize.

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## Extras

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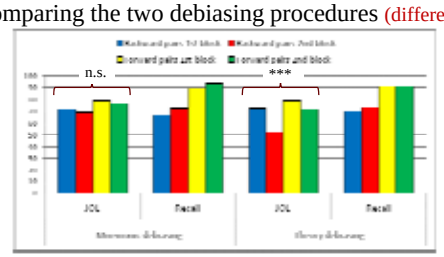
## Results of Experiment 1

- Comparing the two debiasing procedures (different-lists):




- Whereas in the mnemonic-debiasing group, JOLs on the second block did not differ significantly from those made for the first block in the theory-debiasing condition, JOLs were significantly lower (by 13.8%) on the second block, and even lower for the backward pairs.

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## General Discussion

Did the changes in study time affect recall?

- Clearly, one way in which metacognition can be trained is by providing people with valid knowledge about the operation of the cognitive system and inducing them to apply that knowledge in forming metacognitive judgments.
- These results not only demonstrate the benefits of explicit metacognitive training but also indicate its potential usefulness in fostering transfer to new situations.

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