

No Effect of Working Memory Load on Conditional Reasoning

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Background

Working memory and reasoning

- Most psychological theories of reasoning assume that working memory plays a role in reasoning.
- Very few studies have actually examined the relationship of working memory and conditional reasoning by manipulating working memory load (WML).
- The results of these experiments are inconclusive; while some have found no or very little effect of WML, others found the expected impairment of reasoning in conditions with high WML (De Neys, Schaeken & D'Ydewalle 2005; Evans & Brooks, 1981).

Conditionals

For any conditional of the form "if A, then C", there are four inferences one can draw, two of which are valid while the other two are fallacies in classical logic:

$$\begin{array}{l} \text{MP: } A \rightarrow C \\ \quad A \\ \hline \therefore C \quad \checkmark \text{ valid} \end{array} \qquad \begin{array}{l} \text{AC: } A \rightarrow C \\ \quad C \\ \hline \therefore A \quad \times \text{ invalid} \end{array}$$

$$\begin{array}{l} \text{MT: } A \rightarrow C \\ \quad \neg C \\ \hline \therefore \neg A \quad \checkmark \text{ valid} \end{array} \qquad \begin{array}{l} \text{DA: } A \rightarrow C \\ \quad \neg A \\ \hline \therefore \neg C \quad \times \text{ invalid} \end{array}$$

Note. $\neg A$ means "not A" and \therefore is the abbreviation for "therefore", marking a conclusion.

Disablers and Alternatives

Availability of counterexamples for a given conditional (i.e., disablers and alternatives) affect endorsement of conditional inferences:

- Disablers lower the acceptance of MP and MT inferences;
- Alternatives lower acceptance of AC and DA inferences.

For example, for the conditional "If you drink coke, you gain weight":

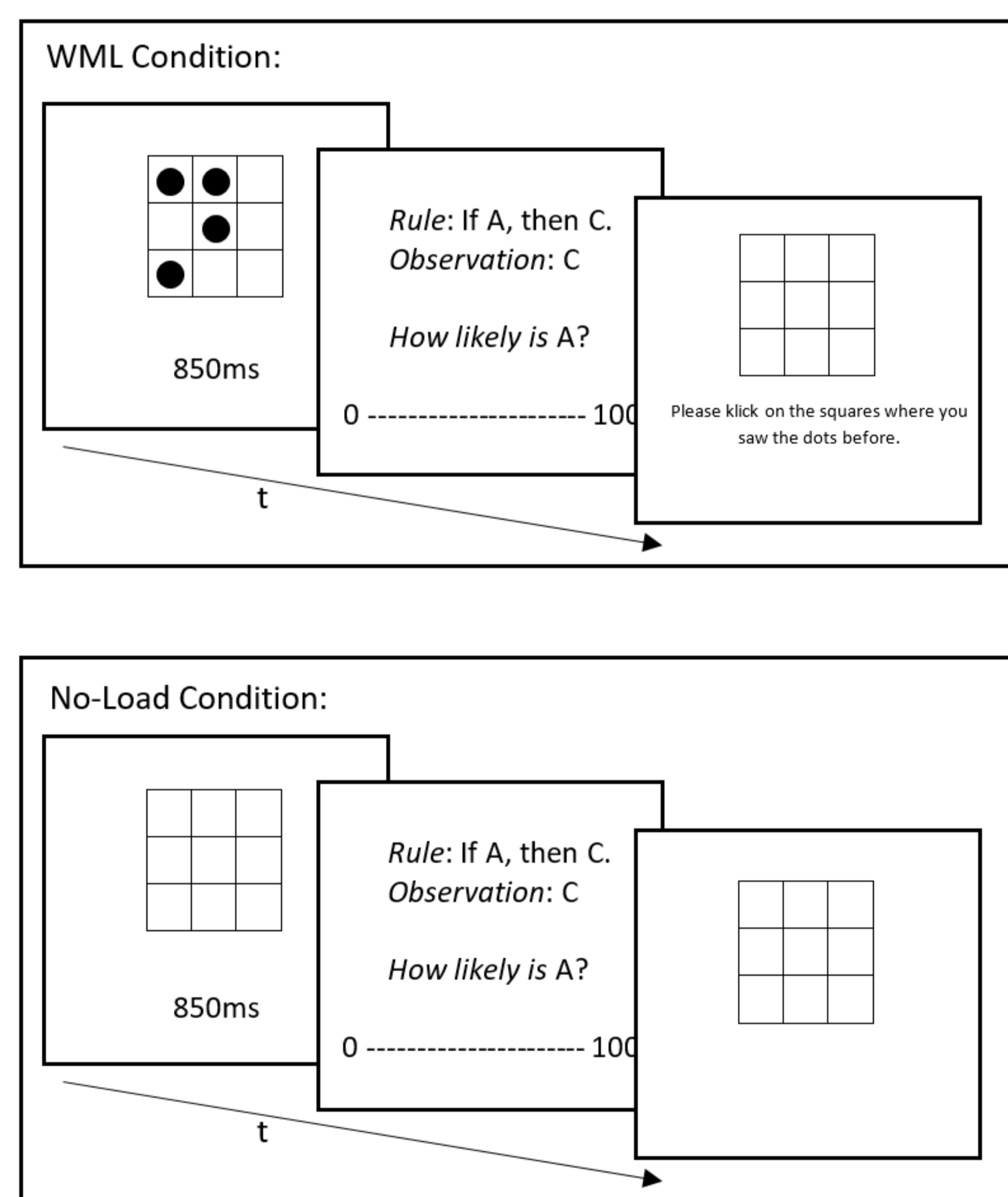
- Alternatives: Gain weight by eating lots of chocolate, side-effects of medication.
- Disablers: Exercising a lot, eating very healthy otherwise, having a great metabolism.

Method

All experiments were conducted online via the crowdflower platform (www.crowdflower.com).

Dual-task Procedure

- Conditional inference task: Participants rate how likely a conclusion is (*probabilistic reasoning instruction*)
- Dot-memory task imposing WML: Remember the location of four dots in a 3 x 3 matrix.



Experiment 1:

- N = 92
- Design: 2 (WML: load, no load, within-subj.) x 4 (Disablers/ Alternatives: few/many, within-subj.) x 2 (counterbalancing, between-subj.).
- Materials: Four conditionals with few/many disablers and alternatives.
- Half of trials with WML (random order).

Experiment 2: Probabilistic Instructions

- N = 95
- Design: 2 (inference: MP vs. AC, within-subj.) x 2 (Disablers: few vs. many, within-subj.) x 2 (WML: load vs. no load, within-subj.).
- Materials: 16 conditionals with few/many disablers.
- Half of trials with dot memory task (blocked, which condition first counterbalanced).

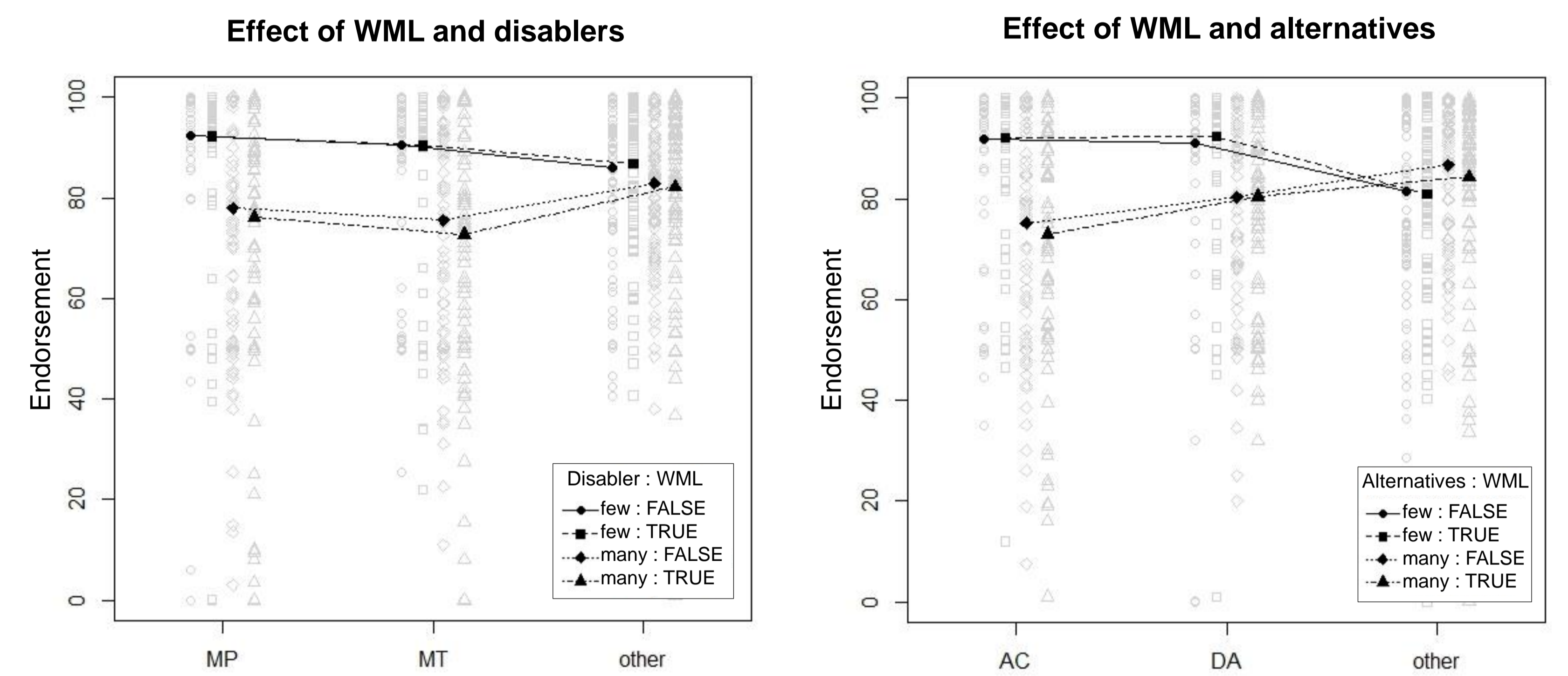
Experiment 3: Deductive Instructions

- N = 100
- Replication of Experiment 2 but with all four inference forms and with *deductive instructions* (reason according to logic)

Results

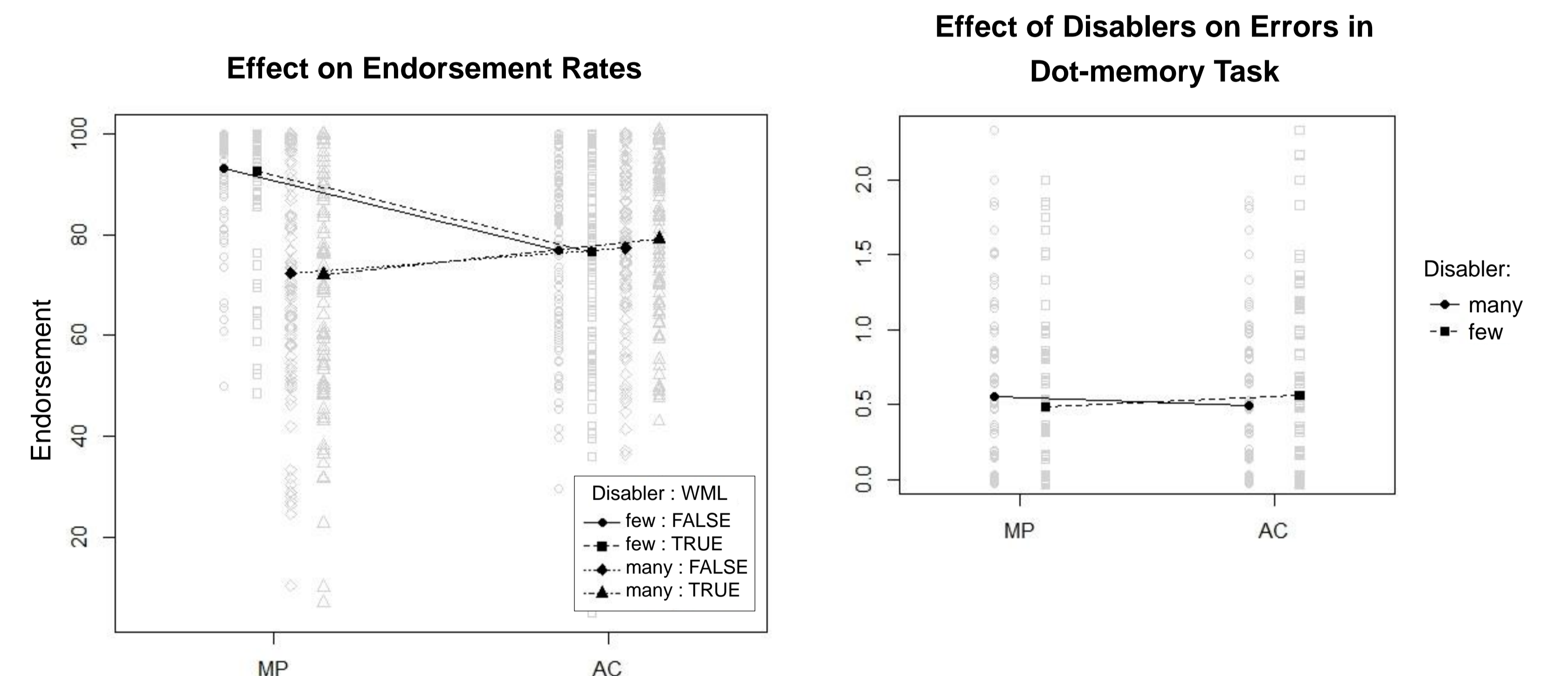
Experiment 1

- Disablers only affect MP and MT, alternatives only affect AC and DA.
- No effect of WML.



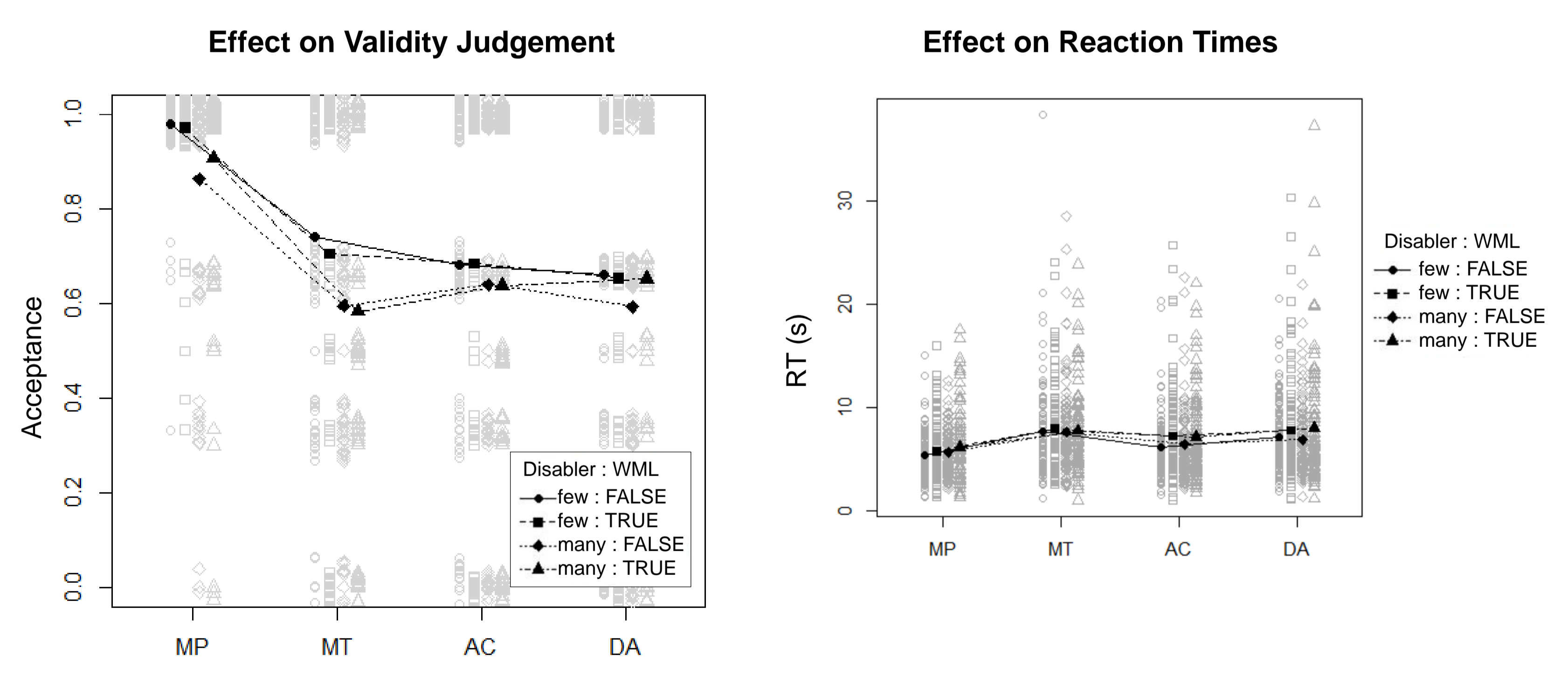
Experiment 2

- Effect of number of disablers as expected (only on MP, not on AC)
- No effect of WML.



Experiment 3

- Effect of number of disablers as expected (only on MP and MT, not on AC and DA)
- No effect of WML, neither on validity judgement nor on reaction time.



Conclusion

- WML has no effect whatsoever.
- The dot memory task clearly does not impose enough working memory load to affect reasoning.
- The results do not replicate the findings of De Neys and colleagues (De Neys, 2006; De Neys et al., 2005).

References

- Evans, J. S. B., & Brooks, P. G. (1981). Competing with reasoning: A test of the working memory hypothesis. *Current Psychological Research*, 1(2), 139–147.
- De Neys, W. (2006). Dual Processing in Reasoning Two Systems but One Reasoner. *Psychological Science*, 17(5), 428–433. <https://doi.org/10.1111/j.1467-9280.2006.01723.x>
- De Neys, W., Schaeken, W., & D'Ydewalle, G. (2005). Working memory and counterexample retrieval for causal conditionals. *Thinking & Reasoning*, 11(2), 123–150. <https://doi.org/10.1080/13546780442000105>