

Disentangling suppression effects with the dual-source model of probabilistic conditional reasoning

Henrik Singmann, Sieghard Beller, and Christoph Klauer

Paper presented at the Workshop "Rationality frameworks for conditionals", Munich, 2012

Introduction

- According to the probabilistic model of conditional reasoning (Oaksford, Chater & Larkin, 2000), responses to conditional inferences are based on *background knowledge* and reflect the subjective conditional probability of the conclusion given the minor premise (e.g., For rule "If p , then q ", MP should be $P(q|p)$).
- Given findings that the presence or absence of the rule influences responses to conditional problems, the question arises: What is the effect of the rule?
- Several results (Klauer, Beller, & Hütter, 2010; Liu, 2003) indicate that the presence of the rule increases endorsement to conditional inferences, especially for MP and MT inferences.
- Klauer, Beller and Hütter (2010) assume that the effect of the rule is to provide information in addition to background knowledge: *form-based evidence* (i.e., the subjective probability to which an inference is seen as logically warranted)
- The dual-source model is a mathematical measurement model describing probabilistic conditional reasoning with three parameters:
 - ξ (**xsi**): quantifies the **knowledge-based** component (formalized as in Oaksford et al.'s, 2000, model)
 - τ (**tau**): **form-based evidence**
 - λ (**lambda**): **weighting factor**

Experimental Design

- Participants work on conditional reasoning tasks with different contents on two sessions:
 1. Session: Problems without conditional rule
 2. Session: Problems with conditional rule
- Four contents cross disablers and alternatives:
 - If a *predator* is hungry, then it will search for prey.
(few disablers, few alternatives)
 - If a *balloon* is pricked with a needle, then it will quickly lose air.
(few disablers, many alternatives)
 - If a *girl* has sexual intercourse, then she will be pregnant.
(many disablers, few alternatives)
 - If a person drinks a lot of *coke*, then the person will gain weight.
(many disablers, many alternatives)
- In both sessions participants work on all 4 contents and all four conditional inferences (MP, MT, AC, DA)
- To obtain better estimates of the perceived probability with which a conclusion holds, participants work on two versions of each inference, the original conclusion and the converse conclusion:
 - MP (Original): $p \rightarrow q; p : q$
 - MP' (Converse): $p \rightarrow q; p : \neg q$
- Dependent Variable: How likely does the conclusion hold given minor premise (Session 1) or given conditional rule and minor premise (Session 2)?
Response on scale from 0% to 100%.

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Parameter Validation (Klauer et al. 2010, Experiments 1 & 3)

- The parameters of the dual-source model are estimated by fitting individual data from both sessions to one set of parameters.
- The knowledge parameter ξ reflects the pattern of responses in the knowledge phase (i.e., session without rule).
- Changing the rule from "If p, then q" to "p only if q" only affects the form parameter τ and not the weighting parameter λ .

Research Question and Procedure

- Which type of information (background knowledge or perceived validity) is affected by suppression effects (Byrne, 1989)?
- Participants work on original and converse conditional inferences (same 4 contents) in two phases:
 1. Session (knowledge phase): without conditional rule
 2. Session (rule phase): with conditional rule (e.g., "If a predator is hungry, then it will search for prey.")
- Three experimental conditions:
 - baseline (no explicit counterexamples), $n = 29$
 - disablers (three additional disablers), $n = 31$ (e.g., "A predator will only search for prey, if it is physically fit.")
 - alternatives (three additional alternatives), $n = 31$ (e.g., "A predator will also search for prey, if it needs to feed its offspring.")

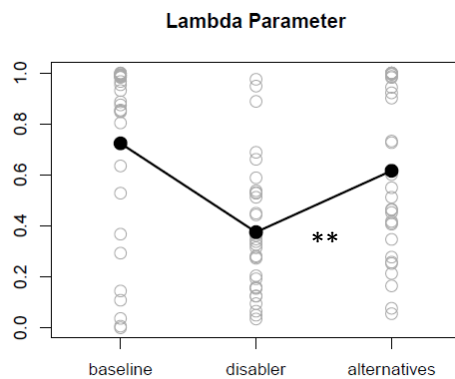
Results

- The dual-source model shows a dissociation for different suppression effects (results replicate from a prestudy).
- Explicit disabling conditions:
 - undermine the credibility of the rule: lower λ
 - undermine the perceived form-based evidence for the valid conditional inferences: lower $\tau(\text{MP})$ and $\tau(\text{MT})$
 - slight effects on knowledge parameter for MP: lower $\xi(\text{predator, MP})$ and $\xi(\text{balloon, MP})$
- Explicit alternative conditions
 - undermine the perceived form-based evidence for the invalid conditional problems: lower $\tau(\text{AC})$ and $\tau(\text{DA})$
 - undermine the perceived knowledge-based evidence for all contents on the invalid inferences: lower $\xi(\text{C, AC})$ and $\xi(\text{C, DA})$

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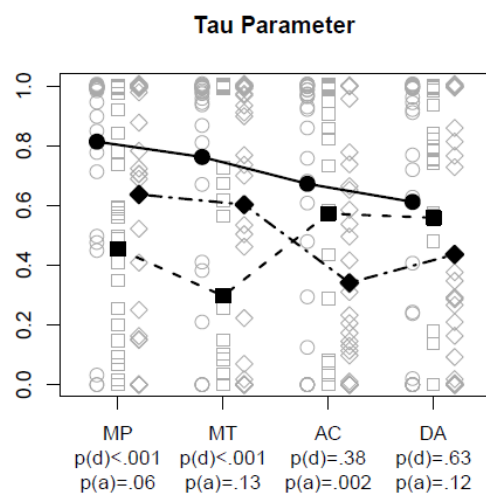
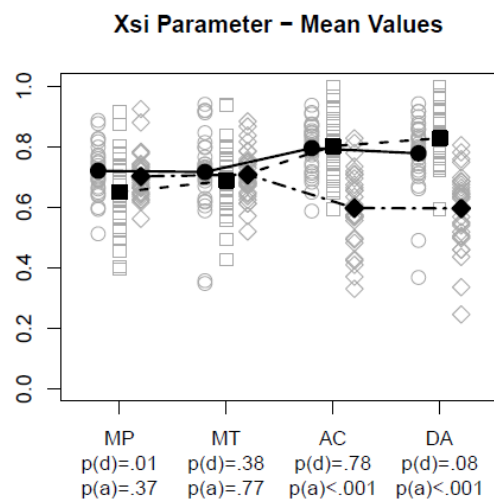
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● baseline
■ disabler
◆ alternatives

Note that the p -values below the plots compare the baseline with the disablers condition, $p(d)$, and with the alternatives condition, $p(a)$.



Summary

- Modeling suppression effects with the dual-source model shows that both disabling conditions and alternative conditions suppress the subjective probability with which the relevant inferences seem warranted by the logical form of the inference (i.e., lower τ parameters).
- Disabling conditions suppress the credibility of the conditional rule (i.e., lower λ parameters).
- Alternative antecedents suppress the subjective certainty that an inference seems warranted by background knowledge (i.e., lower ξ parameters).

References

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