Explanatory Considerations Guide Pursuit

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CogSci 2019

1 Inference to the Best Explanation and the pursuit of hypotheses


We are often searching
for explanations.

Inference to the Best Explanation

- **An epistemological principle:** When reasoning about explanations, we are warranted to infer to the truth of the best explanation (Lipton, 2004).

- **Empirical findings:** When deciding between two competing explanations, people's beliefs are best predicted by the absolute and relative quality of an explanation rather than by probability ratings (Douven & Mirabile, 2018; see also Lombrozo, 2016, Douven & Schupbach, 2015).

But is explanation quality a good guide to truth?

IBE can be an effective epistemic policy even if it doesn't necessarily guide us to truth:

Explaining for the Best Inference: Seeking good explanations improves learning, memory and reasoning processes (Wilkenfeld & Lombrozo, 2015).

Nyrup (2015) also argues for an application of IBE to pursuit rather than belief.

Why pursuit matters to reasoning

Decisions about pursuit are critical to any search for explanations: The investigation and testing of hypotheses is a defining aspect of science (Popper, 1959).

However, we cannot investigate every hypothesis: We need to decide which hypotheses are worthy of pursuit and which should be pursued first.

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Q4: Does explanation quality differentially affect pursuit versus belief?

2 Investigating pursuit decisions

Experiment 1 - Design

Within-subject (n = 72). Six vignettes describing a disruptive event and offering two possible, non-exhaustive, hypotheses, adapted from Douven & Mirabile (2018).

Difference in explanation quality was based on intuitions and previous norming study.

Experiment 1 – Materials

"Lady Windermere was found murdered in her castle. A police investigation is under way to find the culprit.

- Her sister had the following motive: not only did the two sisters hate each other since they were children, the sister would also inherit Lady Windermere's fortune of £5,000,000 *[...]*.

- Jeeves, Lady Windermere's butler, had the following motive: he owed Lady Windermere **£25,000**, which he had borrowed from her, and which he would be **able to reimburse** within the next two years *[...]*."

Experiment 1 – Measures

BLOCK A

Pursuit decision: The [experts] only have enough resources to investigate and test one of the two hypotheses before deciding on an explanation. They could also decide to save their resources and not investigate or test either of the two hypotheses. What do you think they should do? H1 – H2 – Neither.

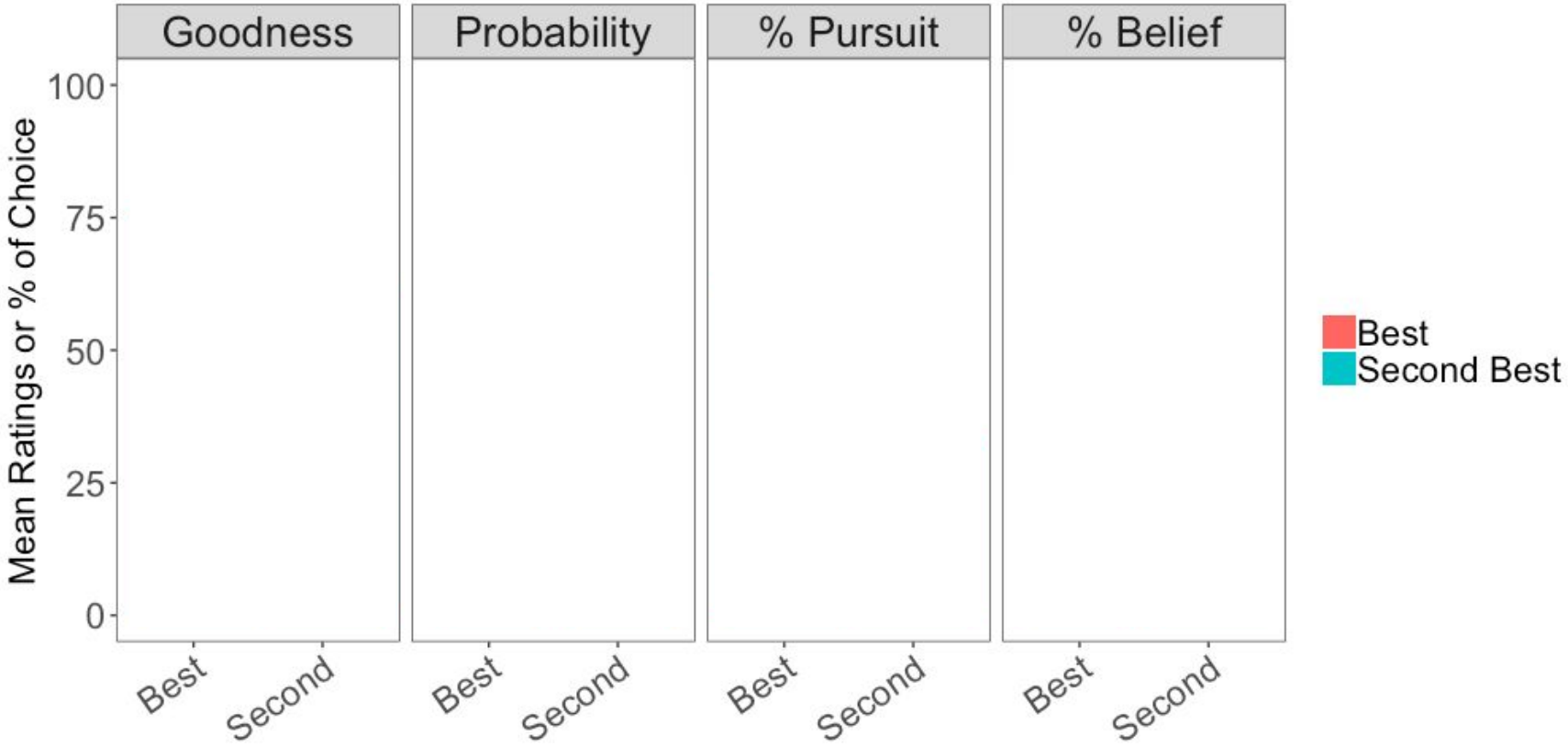
Belief decision: Which of the two hypotheses are you more inclined to believe is the true explanation of why? H1 – H2 – Neither.

BLOCK B

Goodness rating: How good do you think each of these hypotheses is as an explanation for why *[X]*? 0–100.

Probability ratings: How likely do you think each of these hypotheses is? 0–100.

Experiment 1 – Data summary



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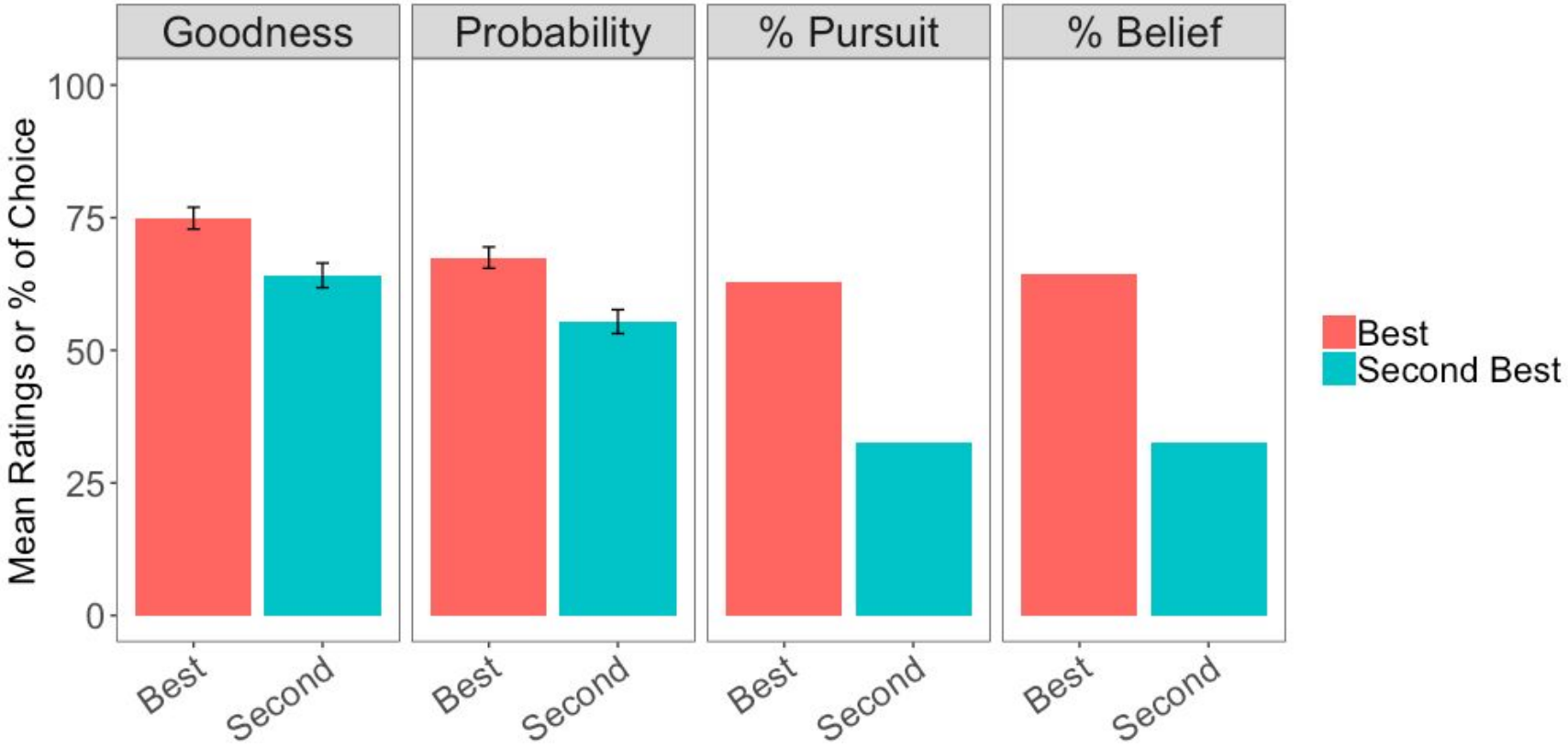

Experiment 1 – Analyses & Results

Three logistic binomial mixed-effects models predicting variation in odds of deciding to select the (antecedently defined) best explanation

	Goodness of Best Explanation	***Goodness of Second Best***	***Proba of Best***	***Proba of Second***	***Response***
Q1/Q2 Model: Effect of Goodness on Pursuit	+5.2%, $p < .001$	-5.2%, $p < .001$	-	-	

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Q3 Model: Accounting for the effect of Probability on Pursuit	$p > .05$	$p > .05$	+4.8%, $p < .001$	−4.9%, $p < .001$	

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=> But high correlations between goodness and probability ratings.

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Q4 Model: Differential effect of Goodness on Pursuit vs Belief	+5.6% on pursuit, p < .001 +13.6% on belief, p<.001	-4.1% on pursuit, p < .001 -10.4% on belief, p < .01	-	-	

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Experiment 2 - Design

Between-subject (n = 135). Two new vignettes describing a disruptive event and offering two possible, non-exhaustive, hypotheses.

Difference of explanation quality was based on simplicity dimension: hypothesis was either simple (single cause) or complex (conjunction of independent causes).

Probability was explicitly manipulated.

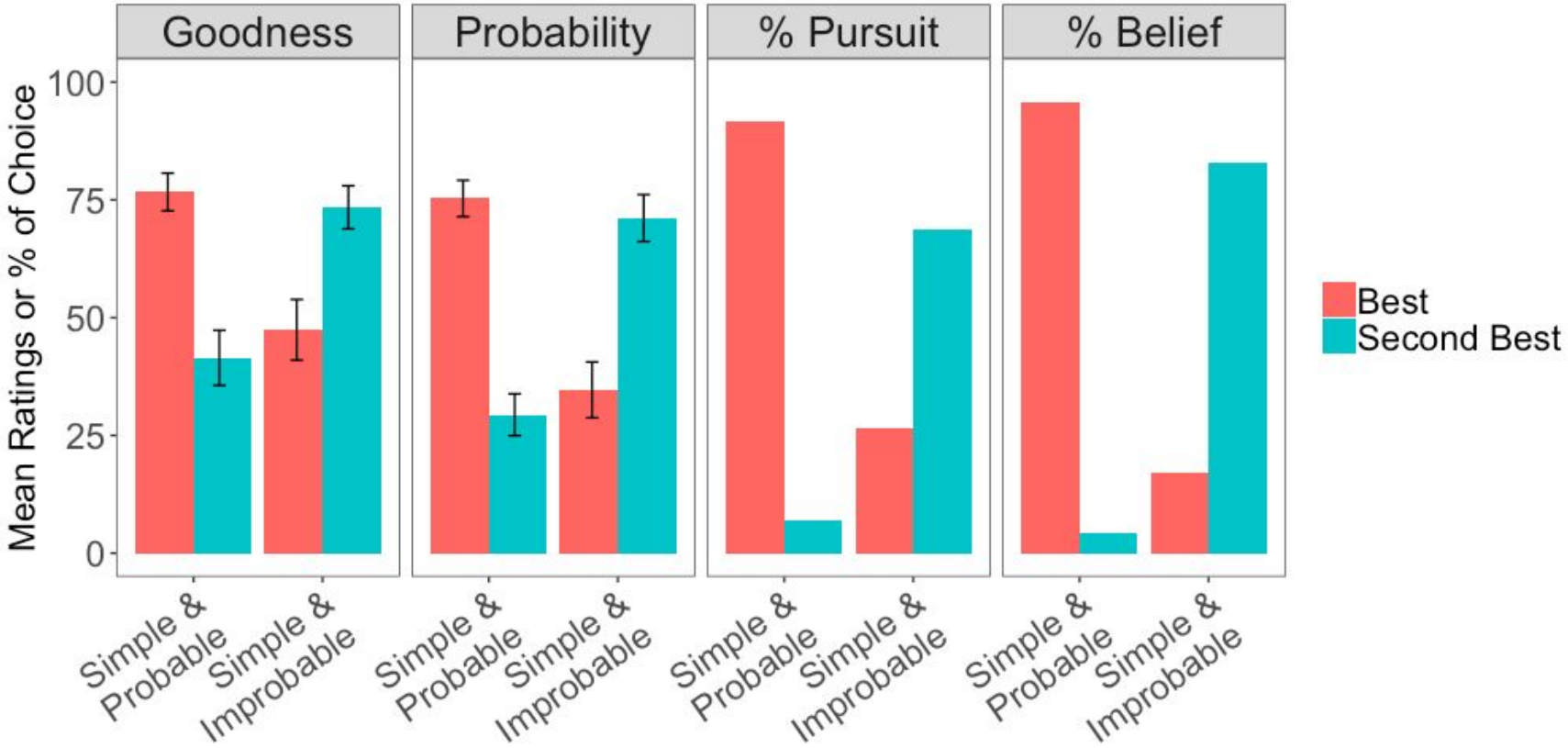
Experiment 2 – Materials

"The county of Sandhart's main agricultural activity is growing corn and barley. *[...]* In the past year, however, both corn and barley have yielded much smaller crops than usual. A group of experts has been called in to explain why the crop yields are unusually small this year. They have generated two possible hypotheses:

- According to this hypothesis, **red sand aphids**, which are a kind of pest, contaminated the fields in Sandhart county. *[...]* Based on the data available to them, experts estimate that this hypothesis is quite probable.

- According to this hypothesis, **nocturnal armyworms and cereal yellow dwarves**, which are two different types of pests, contaminated the fields in Sandhart county. Neither pest alone is harmful enough *[...]* However their **joint occurrence** can lead to reduced crop yields for barley and for corn. Based on the data available to them, experts estimate that this hypothesis is quite improbable."

Experiment 2 - Data



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Q1/Q2 Model: Effect of Goodness on Pursuit	+9.8%, p < .001	-8.1%, p < .001	-	-	

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Q3 Model: Accounting for the effect of Probability on Pursuit	+7.9, $p < .001$	-5%, $p < .001$	$p > .05$	$p > .05$	

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=> Can we extend these results along other explanatory dimensions?

Experiment 3 – Design

Between-subject (n = 875). Twelve vignettes describing a disruptive event and offering two possible, non-exhaustive, hypotheses.

Difference of explanation quality was based on four dimensions:

- **simplicity** with materials similar to Experiment 2;
- **actual scope**, explaining all aspects of the explanandum vs a subset;
- **latent scope**, accounting only for the explanandum or making additional unverified predictions;
- **Inherence**, invoking an inherent feature or an extrinsic feature of the explanandum (modified from Horne & Khemlani 2018).

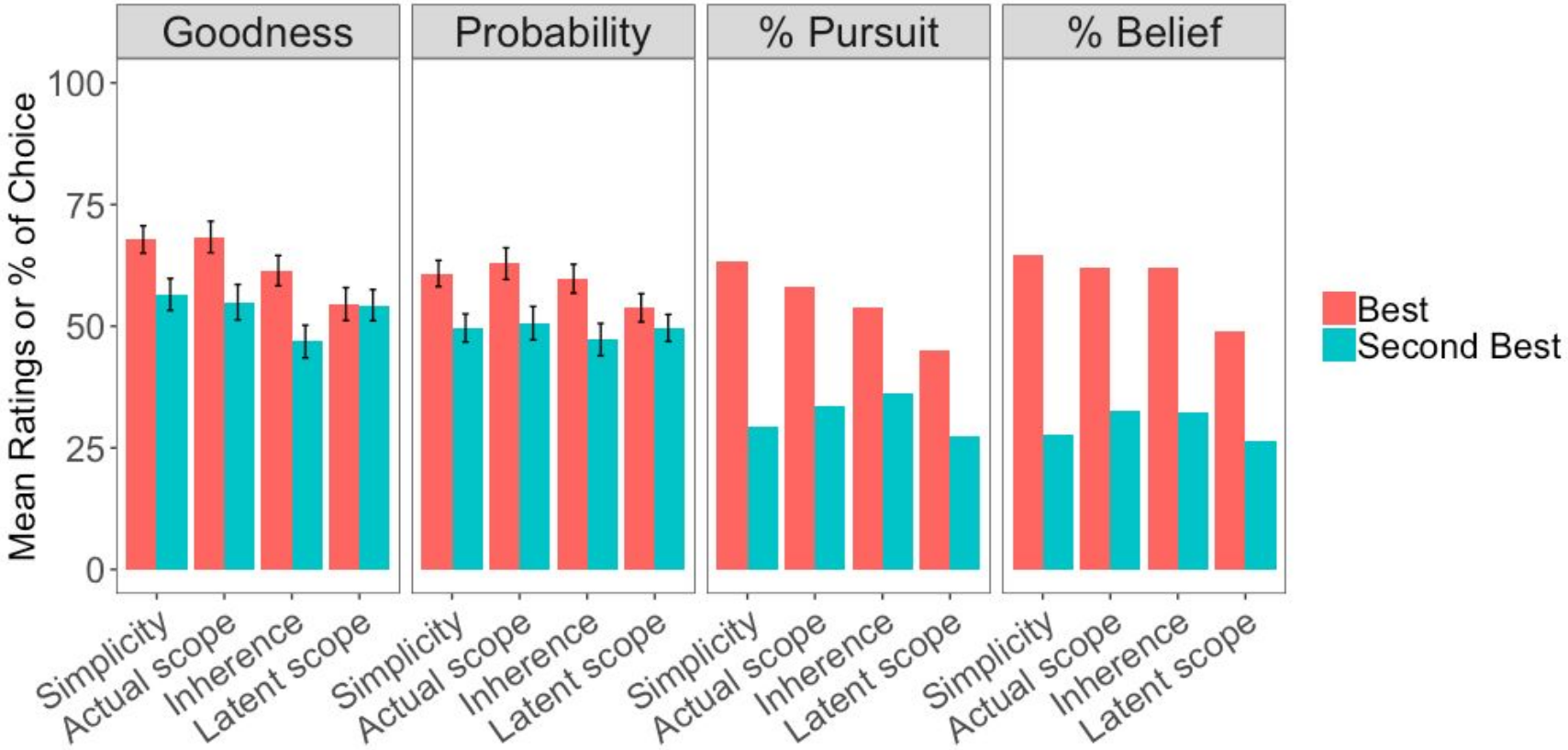
Experiment 3 – Materials for inherence

"[...] A group of biologists has been studying how *[Diphyllea flowers]* respond to moisture and have discovered that Diphylleia are able to wick 98% of water off of their petals. The scientists are trying to explain this unusual ability. They have generated two possible hypotheses:

- According to this hypothesis, the Diphylleia are able to wick 98% of water off of their petals because the petals from the flower are very narrow and thin.

- According to this hypothesis, the Diphylleia are able to wick 98% of water off of their petals because they grow in regions where the soil has high levels of carbon dioxide."

Experiment 3 – Data



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	Goodness of Best Explanation	*Goodness of Second Best*	*Proba of Best*	*Proba of Second*	*Response*
Q3 Model: Accounting for the effect of Probability on Pursuit	+2.7, $p < .001$	-1.8%, $p < .001$	+3.4%, $p < .001$	-2.9%, $p < .001$	

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Summary of results

	Exp 1 **n = 72**	**Exp 2** **n = 135**	**Exp 3** **n = 875**
Q1/Q2. Does explanation goodness predict pursuit?	Yes	Yes	Yes
Q3. Is this effect of explanation goodness reducible to subjective probabilities?	No	Yes	Yes
Q4. Does explanation goodness impact pursuit and belief differentially?	Yes	No	Yes

Take home message

- In three experiments, we varied explanation quality along different dimensions in order to investigate whether explanatory considerations guide pursuit. We also wanted to find out if this impact is not reducible to the impact of subjective probability, and if it is different from the way explanation affects belief.

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- Inconsistent results suggest that these effects might be moderated by external factors (e.g. explanatory dimension, materials, pragmatic constraints on belief and pursuit).

Limitations and open questions

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- Why did different explanatory dimensions behave differently with regards to pursuit?

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- Why did different explanatory dimensions behave differently with regards to pursuit?

- These results suggest the value of thinking about the role of IBE and explanation as guides for our epistemic behavior, construed to include not only belief but also judgements and behaviors such as information seeking, question asking, exploration, etc.

Thanks!

Any questions ?