Simplicity beyond probability:

Simplicity's role in evaluating explanations goes beyond providing cues to priors and likelihoods

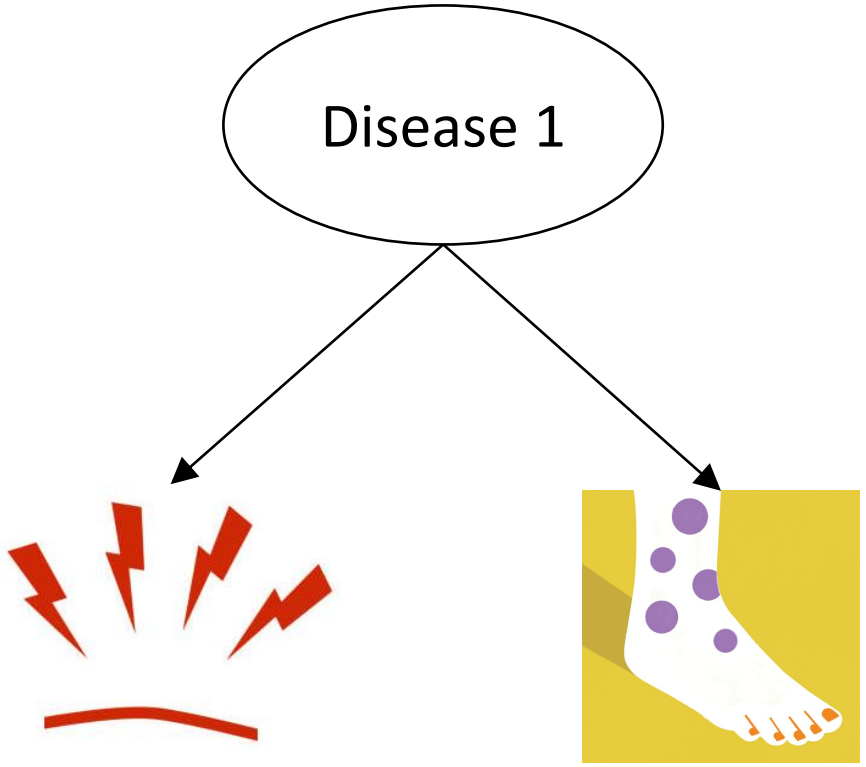
Thalia Vrantsidis, Tania Lombrozo

Princeton University

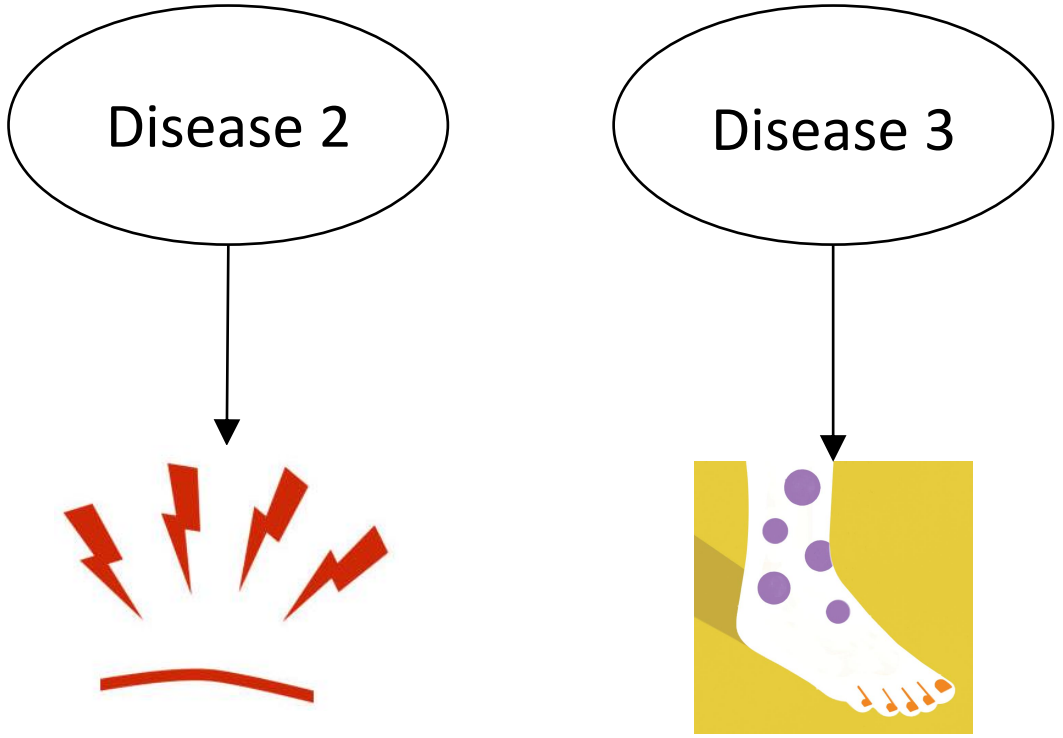
How do we evaluate competing explanations?

How do we evaluate competing explanations?

How do we evaluate competing explanations?



One disease causes both symptoms

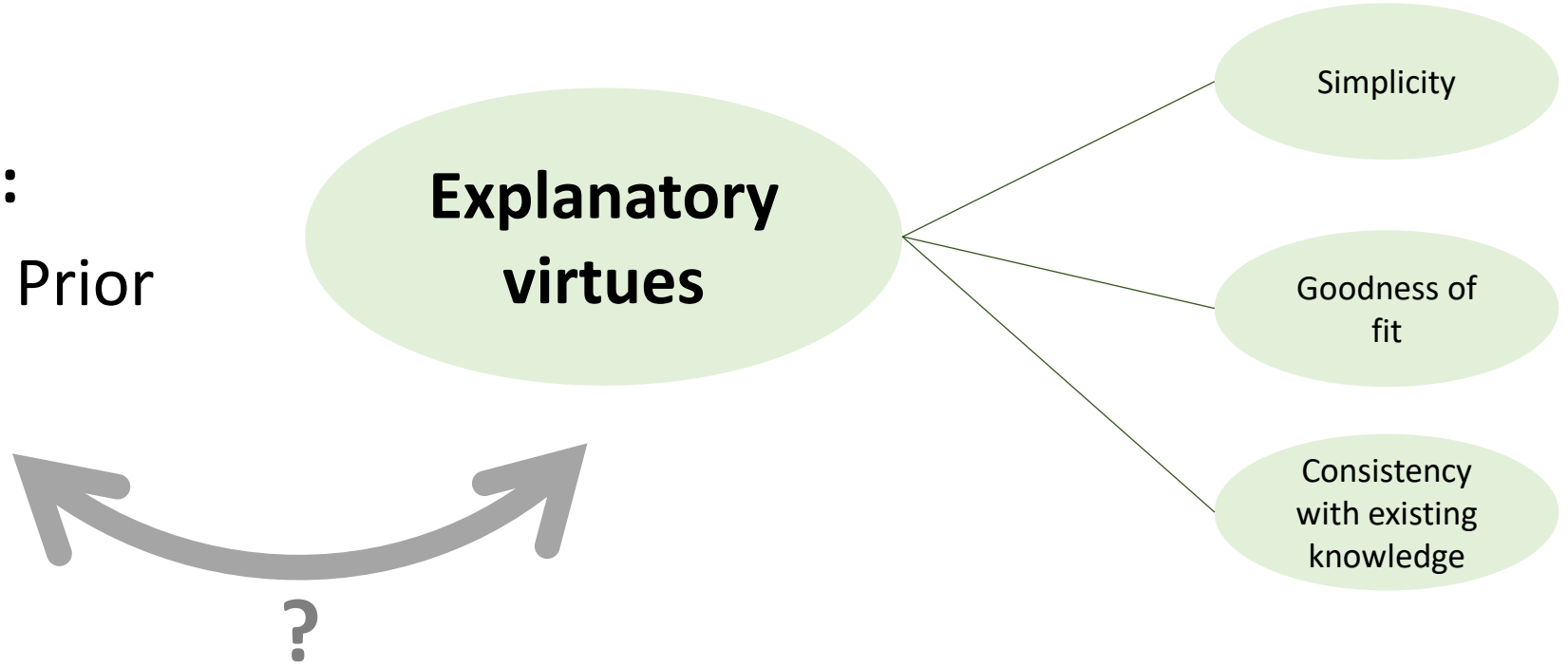


Two diseases each cause one symptom

How do we evaluate competing explanations?

Bayesian inference:

Posterior ∝ Likelihood * Prior



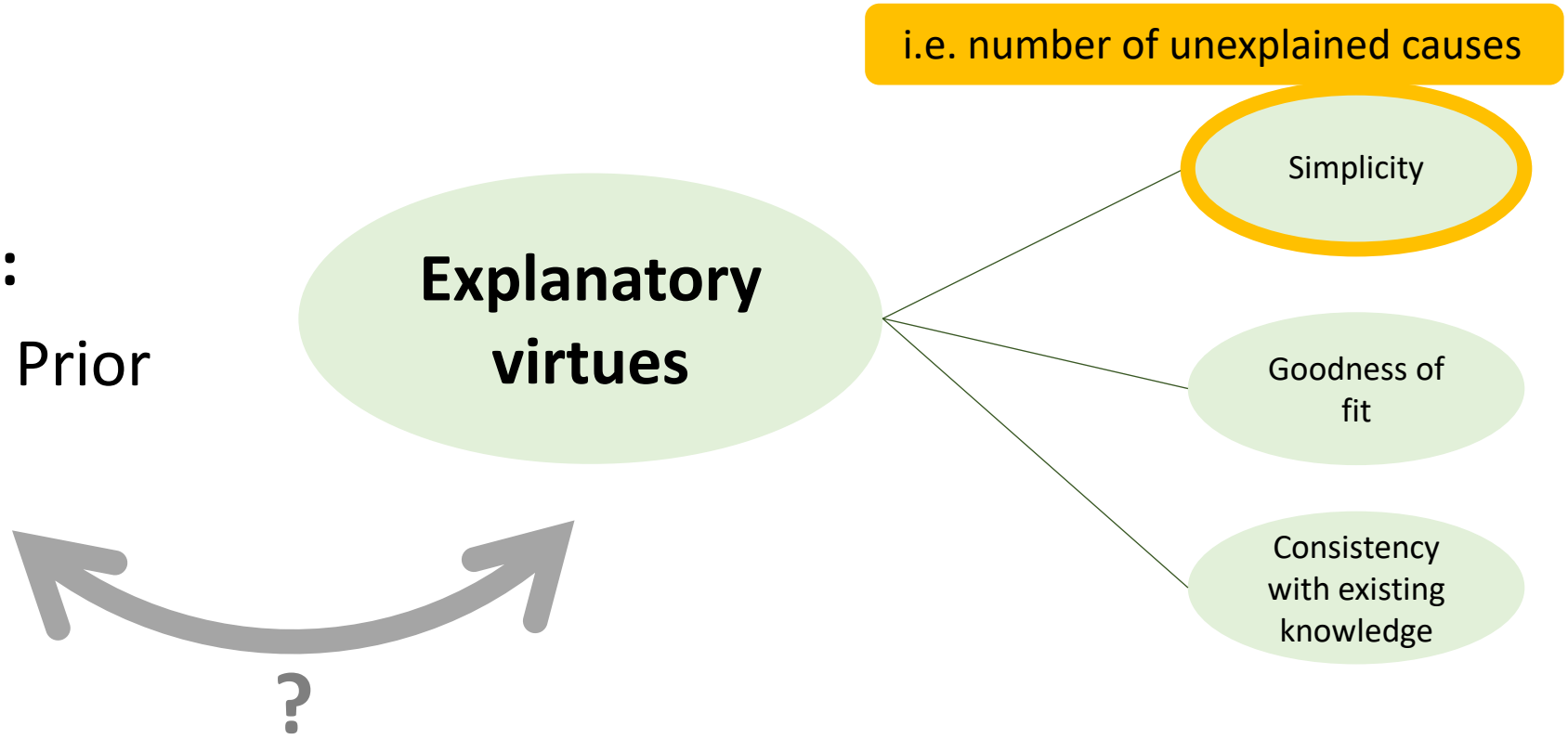
Might explanatory virtues help us overcome the challenges faced in using Bayesian inference to evaluate explanations? If so, how?

Wilkenfeld, 2019; Johnson et al., 2019; Dellsen, 2018; Lombrozo, 2007; Lipton, 2004; McGrew, 2003

How do we evaluate competing explanations?

Bayesian inference:

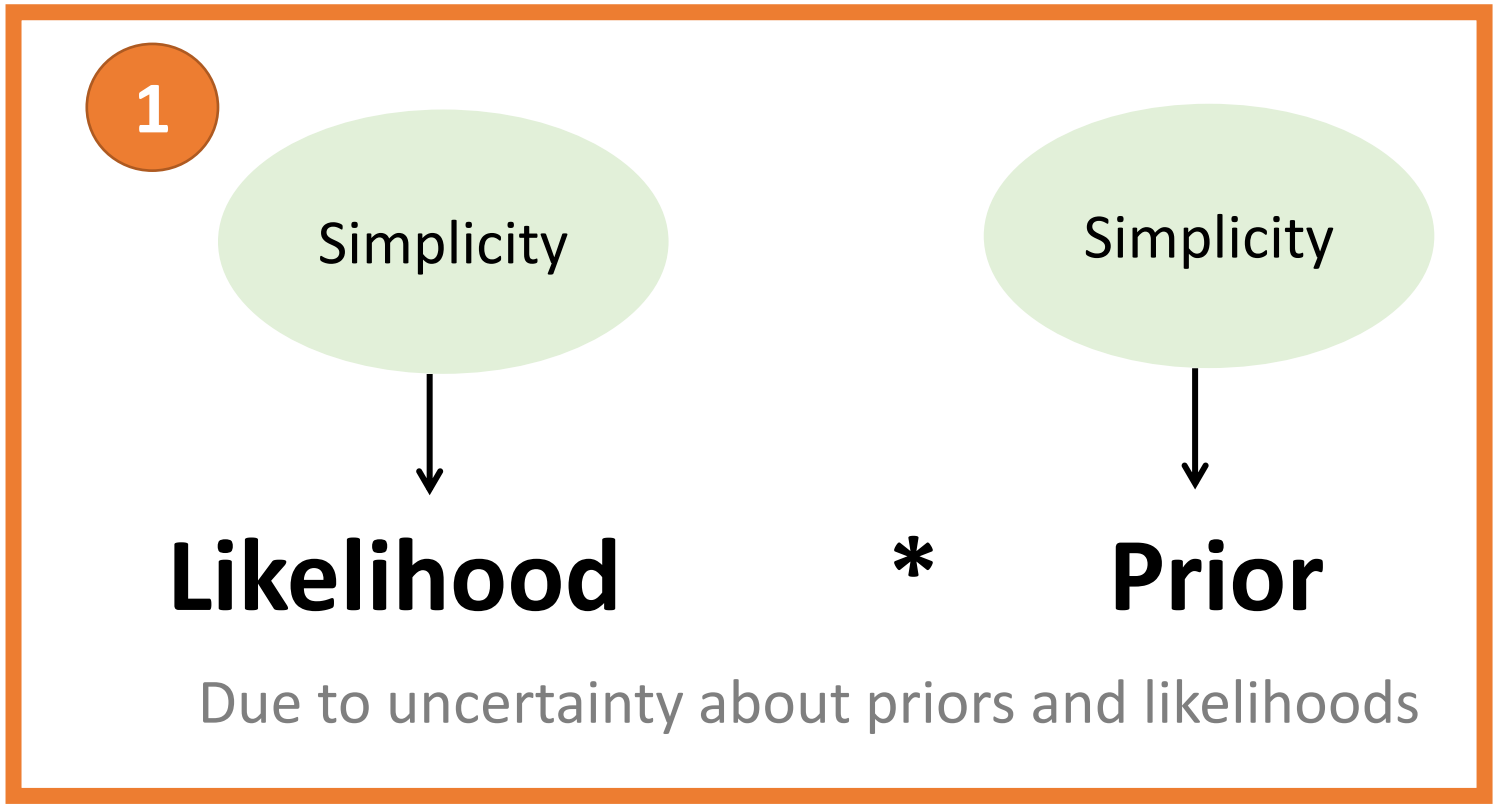
Posterior ∝ Likelihood * Prior



Might explanatory virtues help us overcome the challenges faced in using Bayesian inference to evaluate explanations? If so, how?

Pacer & Lombrozo , 2017

We consider 3 possibilities…



Lombrozo, 2007; Johnson et al. 2019

We consider 3 possibilities…

2

Simplicity

Posterior $\propto$

Due to difficulty computing posteriors

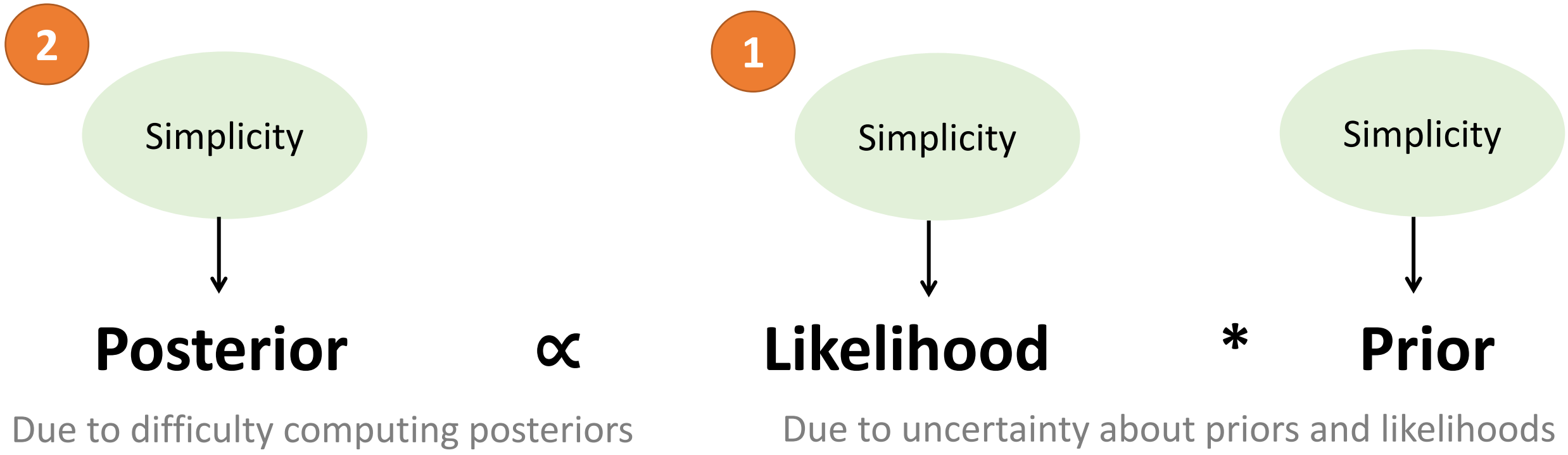
1

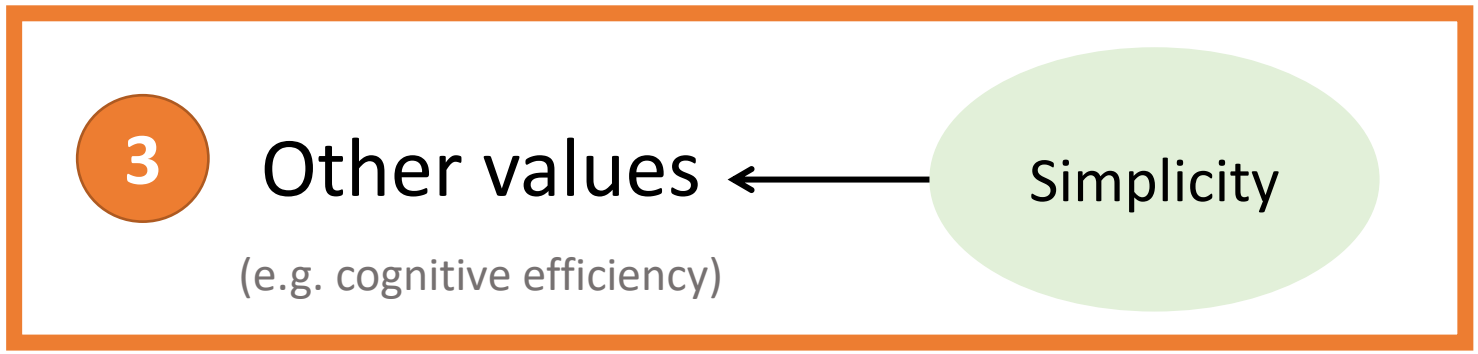
Simplicity

Likelihood * Simplicity **Prior**

Due to uncertainty about priors and likelihoods

We consider 3 possibilities…



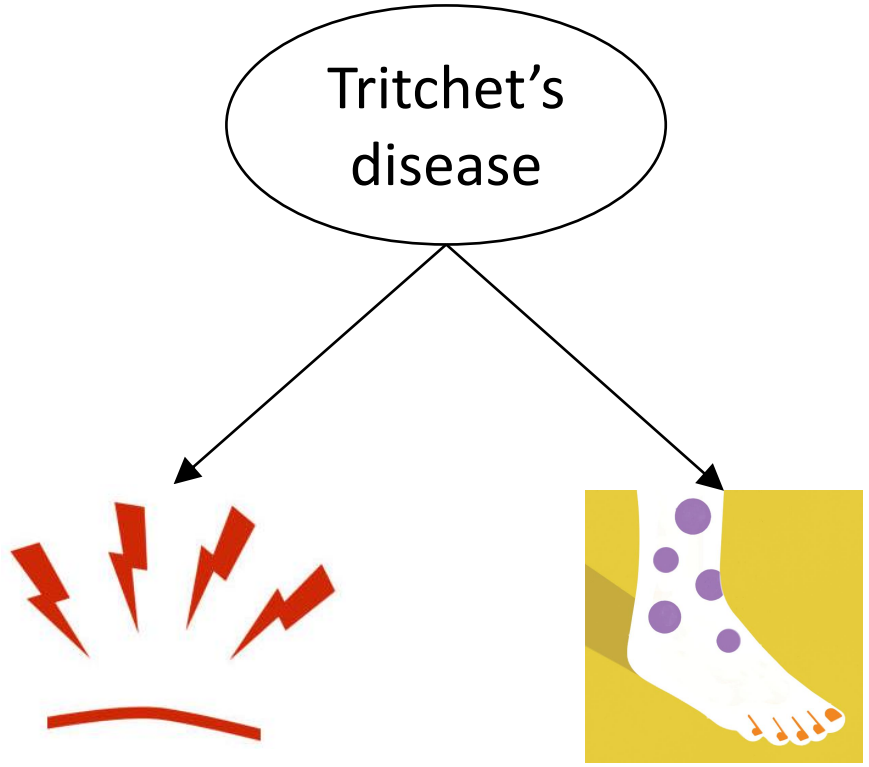


Dasgupta & Griffiths, 2021; Wilkenfeld, 2019; Pacer & Lombrozo, 2017

Methods (study 1 and 2)

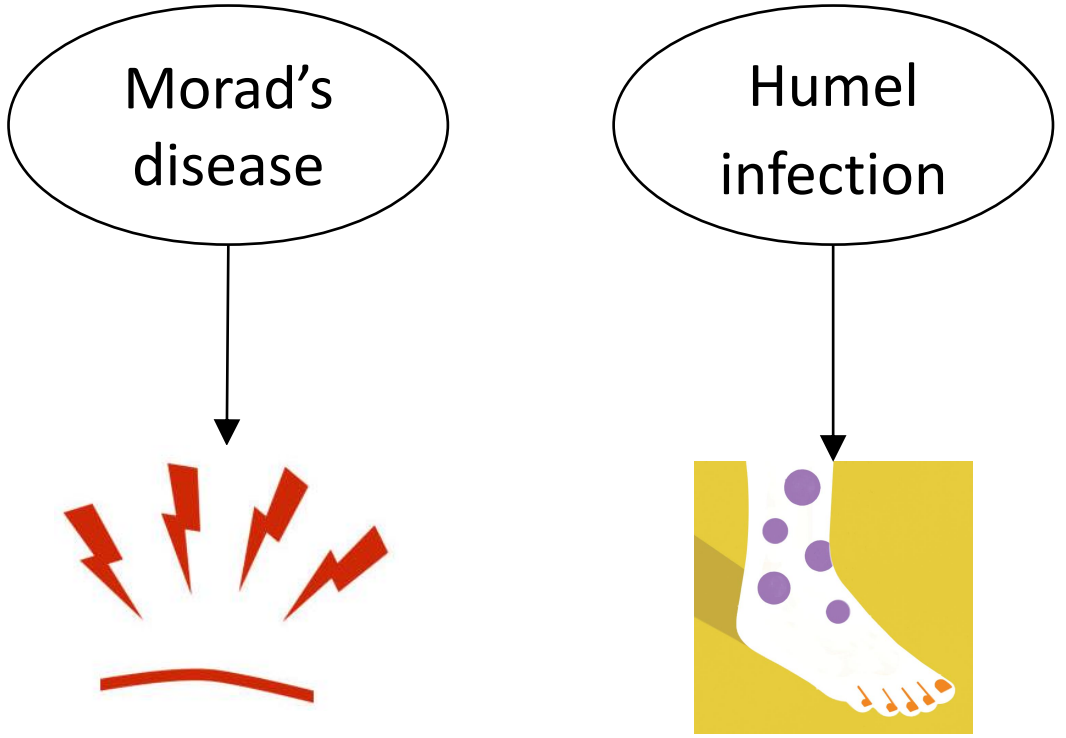
Scenarios:

Simple explanation



One disease causes both symptoms

Complex explanation



Two diseases each cause one symptom

Participants evaluated each explanation in terms of either:

- **Posteriors**

  e.g. Please estimate the probability of Treda having each disease or combination of diseases:

  -Tritchet’s syndrome -Morad’s disease and a Humel infection

- **Satisfaction**

  e.g. How satisfying is each explanation for Treda's symptoms?

  -"Treda has Tritchet’s syndrome.” -"Treda has Morad’s disease and a Humel infection."

In study 1, participants also **estimated priors and likelihoods** for each explanation

Priors

Suppose a **random alien** was selected from planet Zorg. The alien may or may not be sick, and may or may not have any symptoms; you have no knowledge either way.
How likely do you think this random alien would be to have:

...Tritchet's syndrome?

…Morad's disease and a Humel infection?

Likelihoods

Imagine an alien who has [Tritchet's syndrome/ Morad's disease and a Humel infection].
How likely is it that this alien would have both sore minttels and purple spots?

In study 2, participants **were told the priors and likelihoods** for each explanation

Priors

If an alien has Tritchet's syndrome, **72%** of the time they will have both sore minttels and purple spots.

Likelihoods

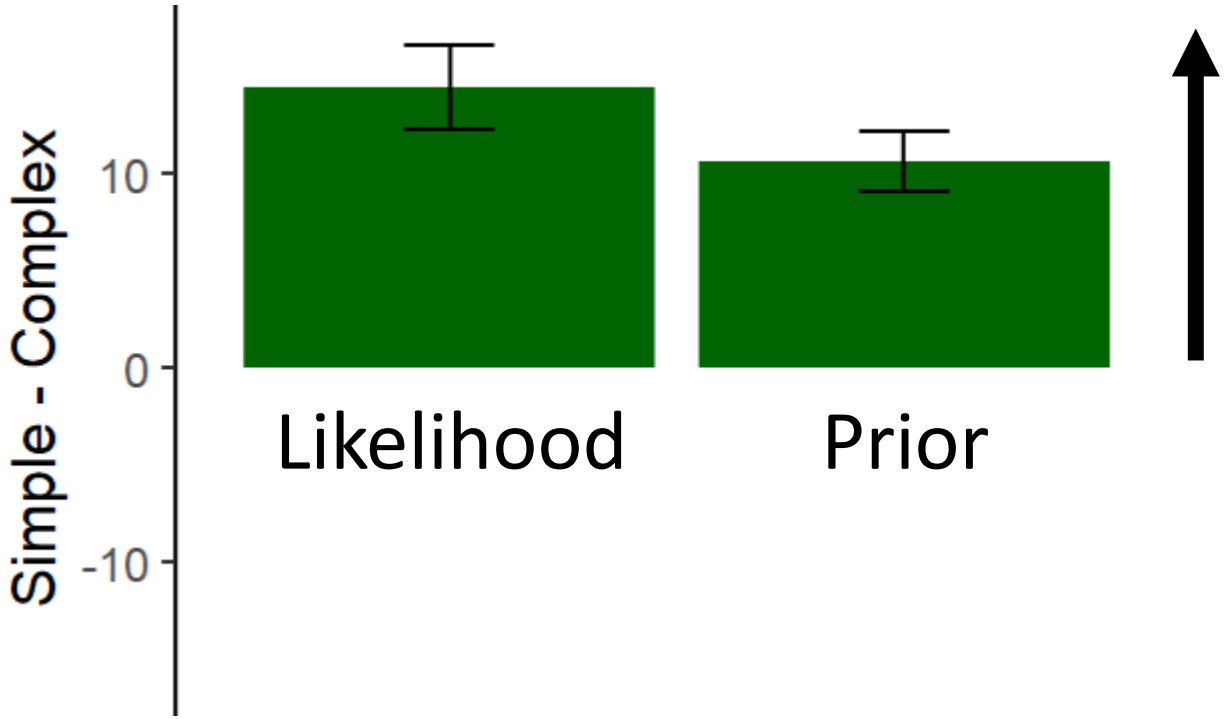
About **50%** of the aliens on Zorg have Tritchet's syndrome.

Probabilities yoked to study 1 responses

Results

Study 1:

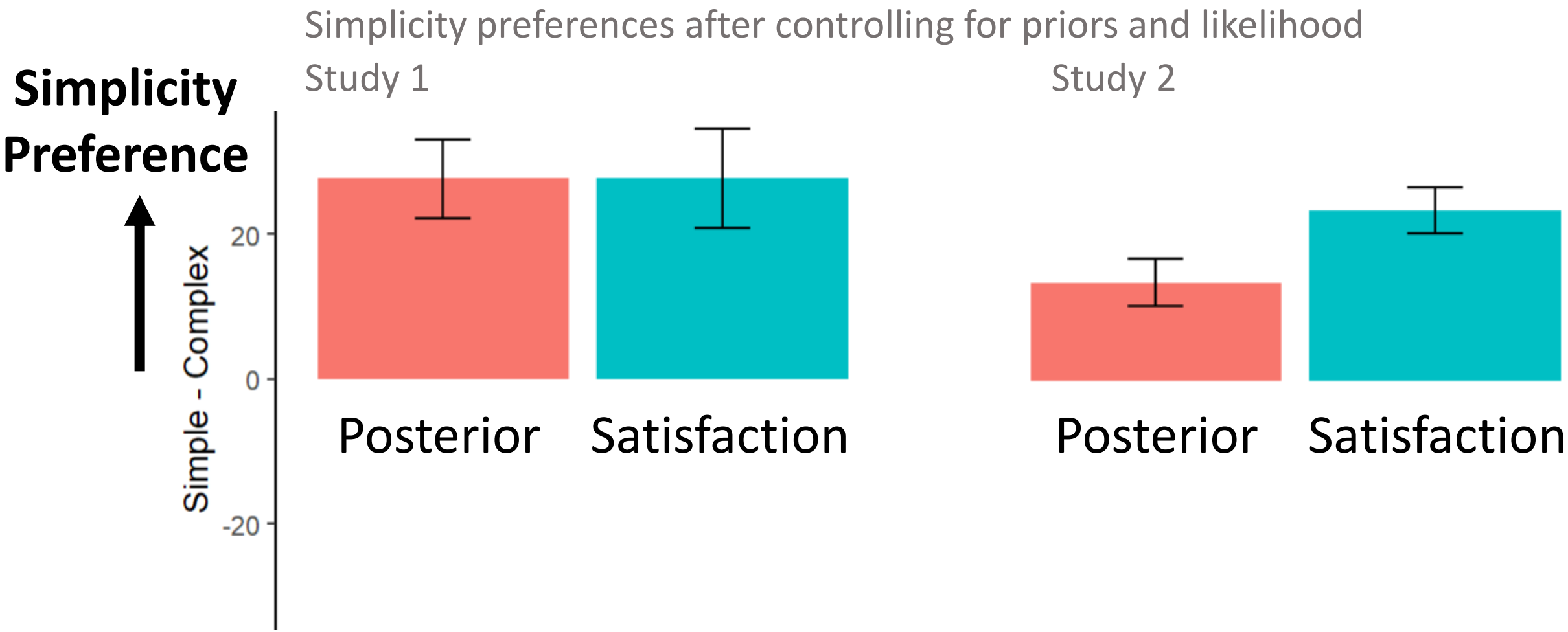
Simpler explanations were given higher priors and likelihoods



Simplicity was used as a **cue to the inputs of Bayesian inference** (likelihoods and priors)

Broadly consistent with: Lombrozo, 2007; Johnson et al. 2019

Simplicity preferences after controlling for priors and likelihood

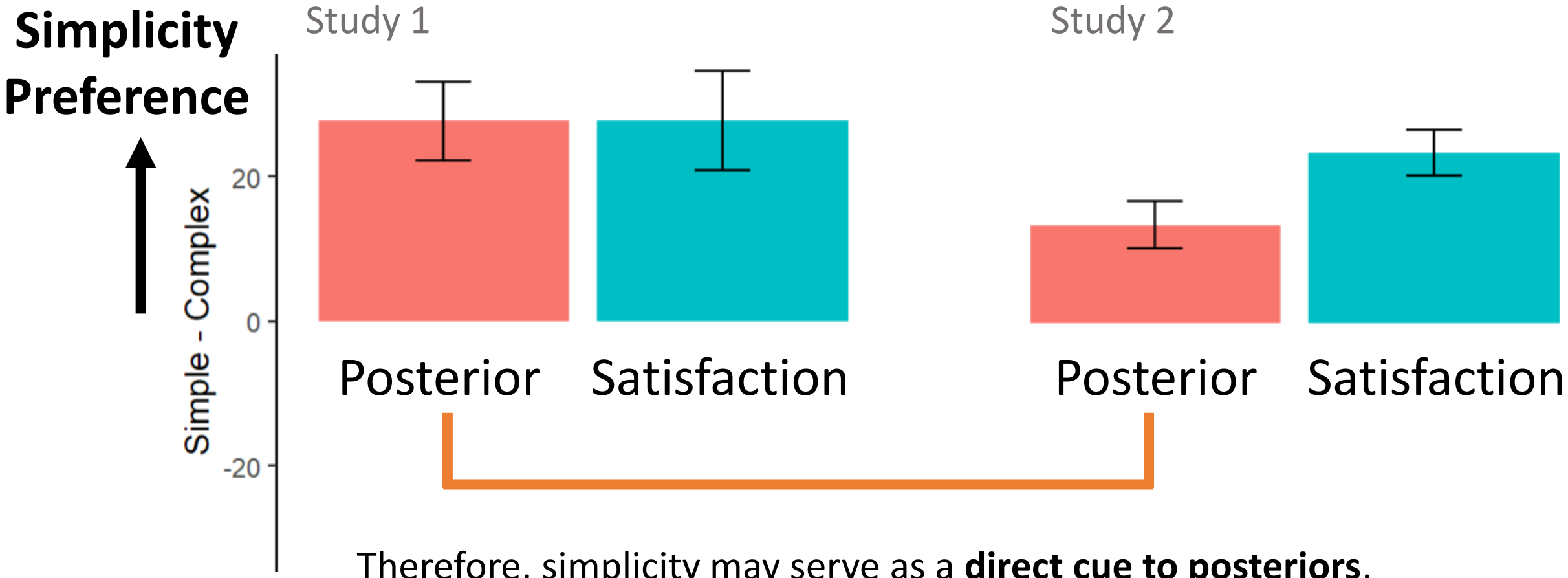


Simplicity preferences after controlling for priors and likelihood

Simplicity had less influence on posteriors when priors and likelihoods were provided (in study 2) vs. estimated (in study 1)

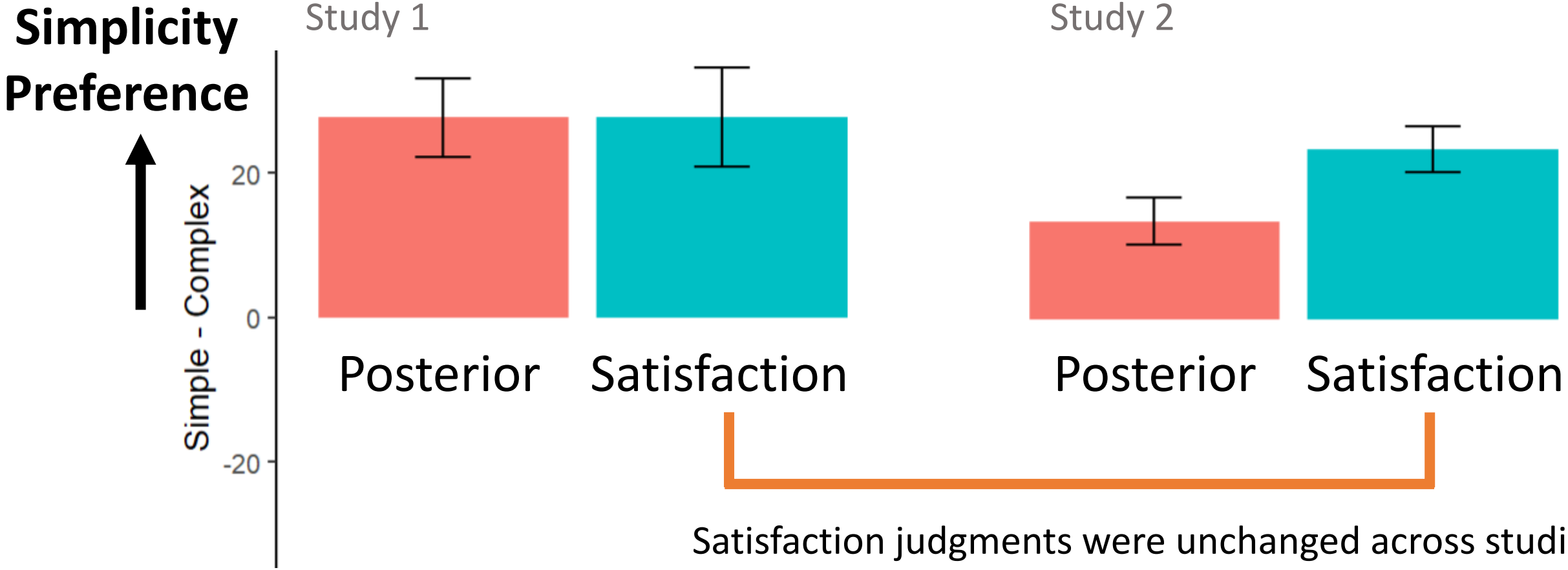
– i.e. when posteriors were easier to compute

Simplicity preferences after controlling for priors and likelihood



Therefore, simplicity may serve as a **direct cue to posteriors**, especially when posteriors are more **difficult to compute**

Simplicity preferences after controlling for priors and likelihood



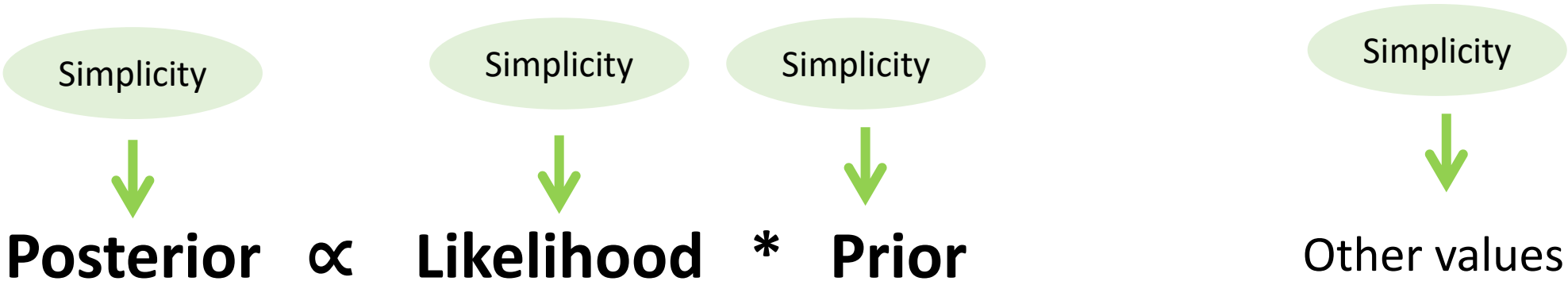
Satisfaction judgments were unchanged across studies

Therefore simpler explanations may also be **valuable for reasons unrelated to probabilities**.

Conclusions

Simplicity may be used in explanation evaluations in multiple ways:

- As a cue to priors and likelihoods, when these values are uncertain
- As a direct cue to posterior probabilities, especially when these are more difficult to compute
- And it may also be valued for other reasons



Simplicity may help deal the multiple challenges of we face when trying to evaluate explanations using Bayesian inference

To find out more…

Check out our recent publication:

Vrantsidis, T., & Lombrozo, T. (2022). Simplicity as a Cue to Probability: Multiple roles for Simplicity in Evaluating Explanations. *Cognitive Science*, 46 (7), e13169.

Freely accessible through:

https://cognition.princeton.edu/publications

Or contact:

Thalia Vrantsidis
Princeton University
tvrantsidis@princeton.edu