

The Variety-of-Evidence Thesis

A Bayesian Exploration of its Surprising Failures

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Formal Models of Scientific Inquiry

ÉPISTÉMO
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et la technologie



Introduction

Evidence amalgamation

- Typical justification in the sciences
- Variety-of-evidence (VoE) thesis



Some formal results on the VoE thesis

- Bovens and Hartmann (2003)
- Claveau (2013)
 - François's **hopeful conjecture**: the VoE thesis might **hold in cases that matter** to the sciences

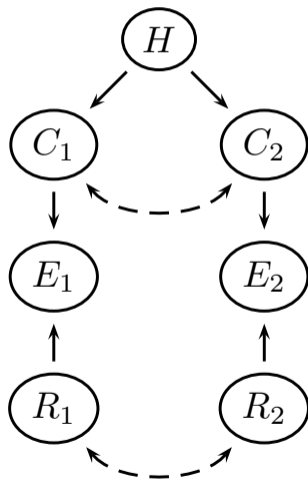
This paper

Goal Testing François's hopeful conjecture

Result Conjecture is false...



Setting up the model



Types of variety

- 1 Degree of reliability independence, δ
- 2 Degree of consequence indep., γ

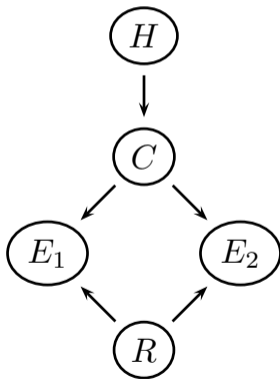
VoE thesis in our model

- 1 $\frac{\partial P(h|e_1, e_2)}{\partial \delta} > 0$
- 2 $\frac{\partial P(h|e_1, e_2)}{\partial \gamma} > 0$

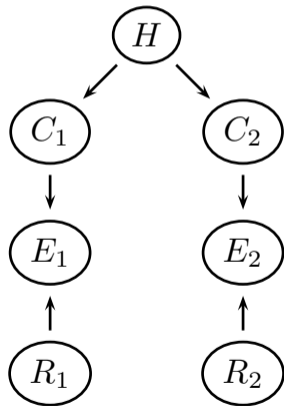
Results

Cases where variety is always better for confirmation

Maximal difference in variety always confirms more



$$\delta = \gamma = 0$$



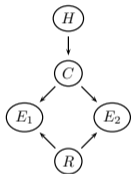
$$\delta = \gamma = 1$$



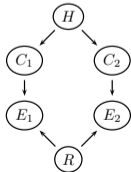
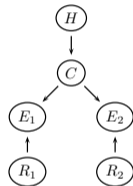
Results

Cases where variety is always better for confirmation

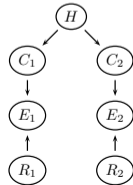
Fully shared reliability ($\delta = 0$) loses to full reliability independence ($\delta = 1$)



is always worse than



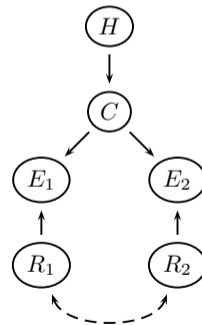
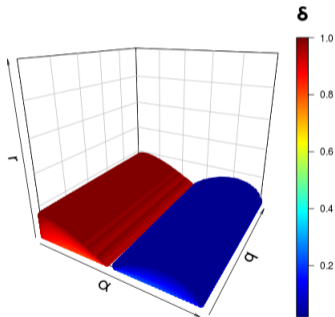
is always worse than



Results

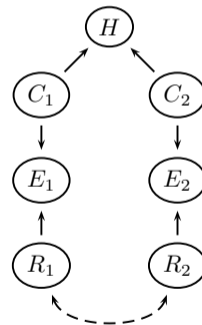
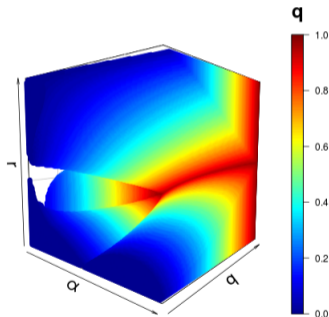
Cases where the VoE thesis is not too damaged

When consequences are fully dependent: reliability independence increases confirmation if $P(\text{source is reliable}) > .2$



NB. Changing δ (i.e., reliability independence)

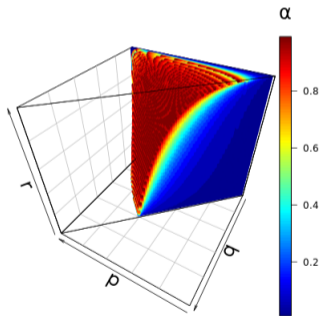
If consequences are fully independent?



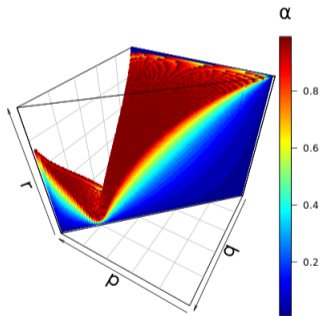
NB. Changing δ (i.e., reliability independence)

And what about changing the degree of variety with respect to consequences?

Shared reliability ($\delta = 0$)



Independent reliability ($\delta = 1$)



NB. Changing γ (i.e., consequence independence)

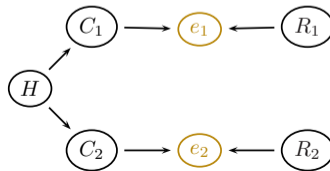
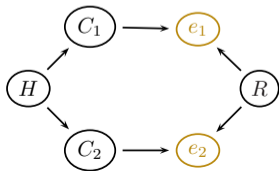
Interpretation

What's going on?

Degree of **reliability** independence: case where variety increases confirmation

		$P(e_i)$	$P(h \cdot)$			$P(R_i = +bias \cdot)$			$P(c_i \cdot)$		
			\emptyset	e_1	e_1, e_2	\emptyset	e_1	e_1, e_2	\emptyset	e_1	e_1, e_2
$\delta = 0$	$i = 1$	0.504	0.5	0.844	0.85	0.15	0.298	0.3	0.505	0.853	0.852
	$i = 2$									0.846	
$\delta = 1$	$i = 1$	0.504	0.5	0.844	0.967	0.15	0.298	0.202	0.505	0.853	0.969
	$i = 2$						0.15			0.846	

Parameter values: $r = 0.7$, $\alpha = 0.5$, $p = 1$, $q = 0.01$, $\gamma = 1$



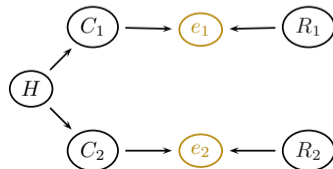
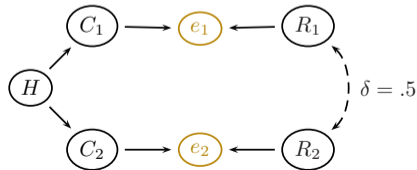
Interpretation

What's going on?

Degree of **reliability** independence: case where variety diminishes confirmation

		$P(e_i)$	$P(h \cdot)$			$P(R_i = +\text{bias} \cdot)$			$P(c_i \cdot)$		
			\emptyset	e_1	e_1, e_2	\emptyset	e_1	e_1, e_2	\emptyset	e_1	e_1, e_2
$\delta = 0.5$	$i = 1$	0.588	0.5	0.66	0.796	0.025	0.043	0.013	0.75	0.989	0.997
	$i = 2$				0.009		0.83				
$\delta = 1$	$i = 1$	0.588	0.5	0.66	0.79	0.025	0.043	0.039	0.75	0.989	0.993
	$i = 2$				0.025		0.83				

Parameter values: $r = 0.75, \alpha = 0.1, p = 1, q = 0.5, \gamma = 1$



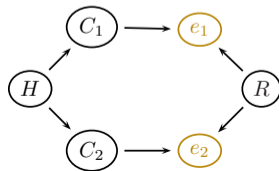
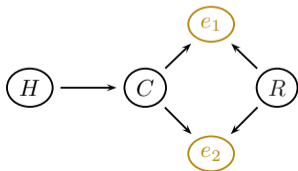
Interpretation

What's going on?

Degree of consequence indep.: case where variety diminishes confirmation

		$P(e_i)$	$P(h \cdot)$			$P(R_i = +bias \cdot)$			$P(c_i \cdot)$		
			\emptyset	e_1	e_1, e_2	\emptyset	e_1	e_1, e_2	\emptyset	e_1	e_1, e_2
$\gamma = 0$	$i = 1$	0.21	0.5	0.79	0.79	0.08	0.39	0.39	0.17	0.67	0.67
	$i = 2$										
$\gamma = 1$	$i = 1$	0.21	0.5	0.79	0.67	0.08	0.39	0.67	0.17	0.67	0.44
	$i = 2$										

Parameter values: $r = 0.75$, $\alpha = 0.33$, $p = 0.33$, $q = 0.01$, $\delta = 0$



Conclusion

Two types of degrees of variety

Surprising failure of the VoE thesis

Even when sources are highly trustworthy and consequences are strong predictors of the hypothesis, more variety of each type can result in lower confirmation.

Should we trash the VoE thesis?

Note: VoE thesis holds for roughly 80 % of the parameter space.

New hopeful conjecture (!): VoE thesis as a relevant **rule of thumb** for practical epistemology.

