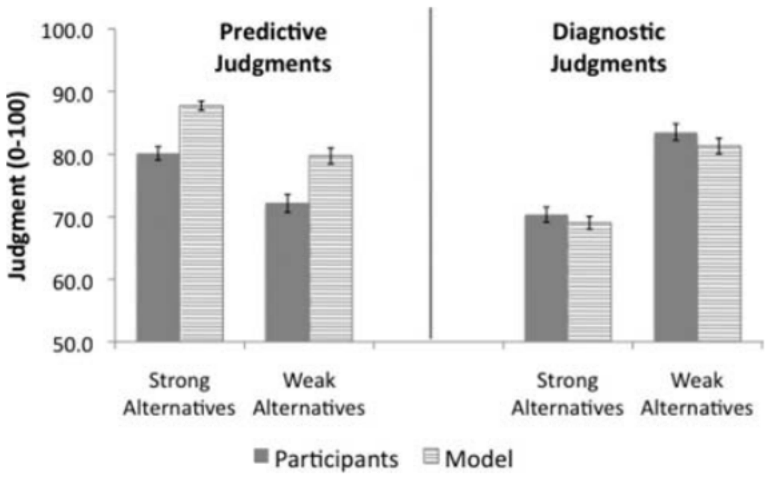
Diagnostic Inferences

Fernbach et al. (2011)

Table 1
Example Question Forms From Experiment 1

Parameter/judgment	Wording of example
Prior probability of cause (P_c)	A woman is the mother of a newborn baby. How likely is it that the woman is drug addicted?
Causal power of cause (W_c)	The mother of a newborn baby is drug addicted. How likely is it that her being drug addicted causes her baby to be drug addicted?
Strength of alternatives (W_a)	The mother of a newborn baby is not drug addicted. How likely is it that her baby is drug addicted?
Predictive judgment (P)	The mother of a newborn baby is drug addicted. How likely is it that her baby is drug addicted?
Diagnostic judgment (D)	A newborn baby is drug addicted. How likely is it that its mother is drug addicted?



"[W]hen making diagnostic judgments, participants integrated multiple causal parameters to measure the relative strength of different causes, as prescribed by the model"

Cummins (2014)

Table 5
Model Fitting Results in Experiment 2

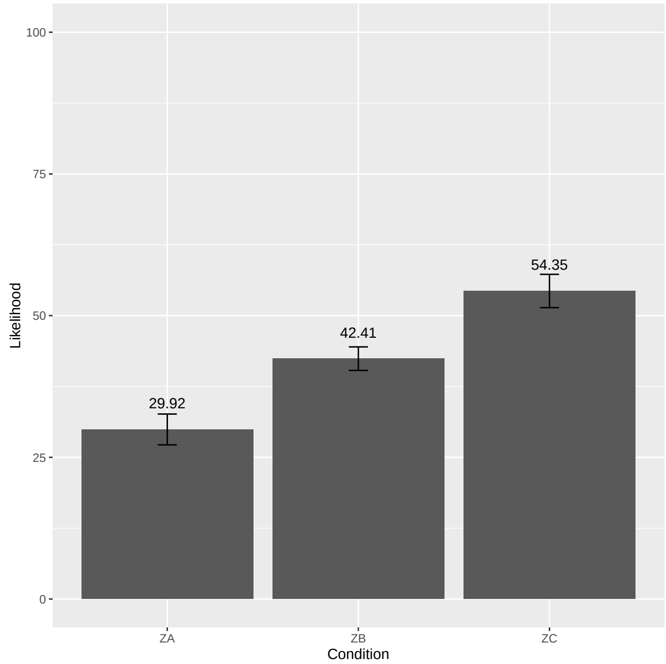
Judgment	Model	Model mean	Observed mean	$t(df = 113)$	p
Diagnostic	CBN-D	56.8	54.3	−1.09	.28
Standard predictive	CBN-P	80.0	62.5	−11.44	.001
Standard predictive	W_c	63.1	62.5	−0.49	.63
And/or predictive	CBN-P	80.0	70.2	−6.0	.001
And/or predictive	W_c	63.1	70.2	4.69	.001

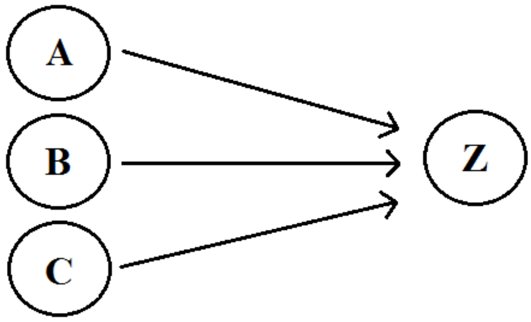
Note. *df* = degrees of freedom; CBN-D = causal Bayes network–diagnostic; CBN-P = causal Bayes network–predictive; W_c = causal power.

If disablers are considered twice in predictive inferences, "[t]he impact of knowledge-retrieval effects and differential processing demands may be sufficient to explain the failure of human predictive inference."

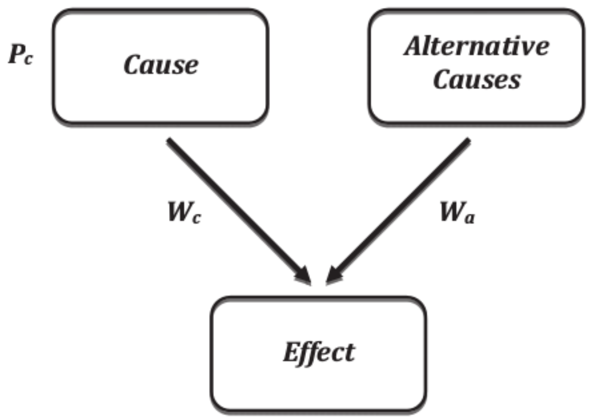
Question

What about diagnostic thinking allows inferences to so closely match normative estimates?





Fernbach-Cummins Model & Equations



Predictive

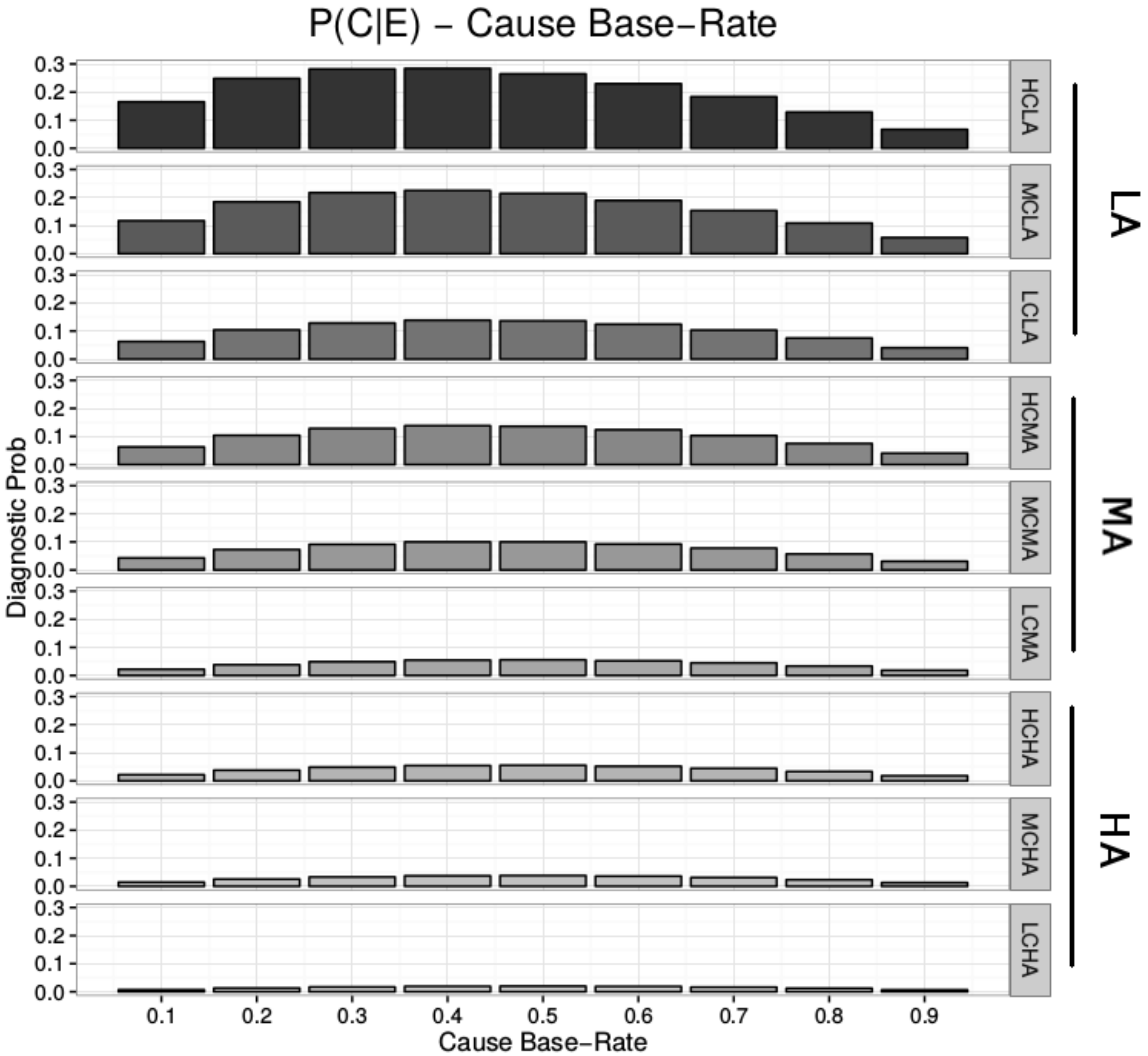
$$P(Effect \mid Cause) = W_c + W_a - (W_c W_a)$$

Diagnostic

$$P(Cause \mid Effect) = 1 - P(\sim Cause)\frac{P(Effect \mid \sim Cause)}{P(Effect)}$$

$$P(Cause \mid Effect) = 1 - (1 - P_c)\frac{W_a}{P_c W_c + W_a - P_c W_c W_a}$$

Degree of Inaccuracy if Inferences for $P(Cause \mid Effect) = P_c$



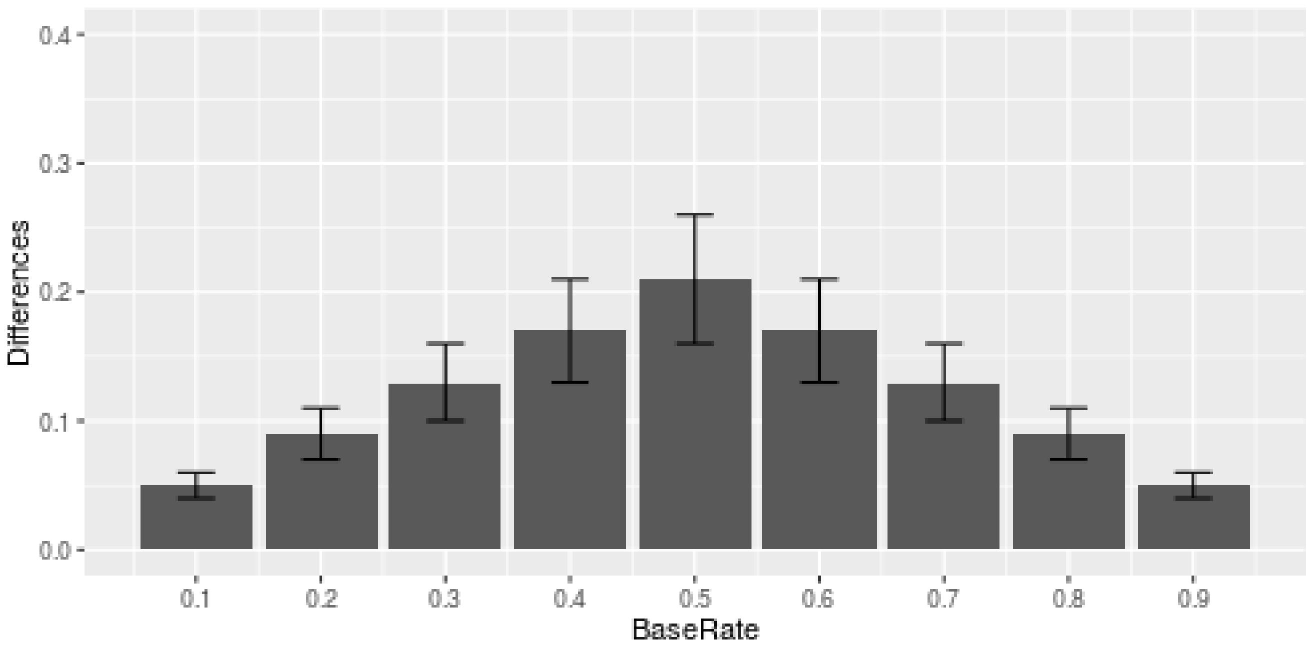
$$P(Cause \mid Effect) = 1 - (1 - P_c)\frac{W_a}{P_c W_c + W_a - P_c W_c W_a}$$

Fernbach & Cummins Examples

Categories and Predicates Used in Experiments 1 and 3

Cause category	Effect category	Strong alternatives predicate	Weak alternatives predicate
Experiment 1			
Mother	Newborn baby	Has dark skin	Is drug addicted
Parents in New York City	Only child	Speak(s) English as first language	Know(s) child's birthday present
Coach	High school football team	Is motivated	Knows a complicated play
Commuter train	Commuter	Is late	Passes through several stations
Machine for manufacturing lenses	Lens	Is defective	Has micrometer precision
Mayor of a major city	New policy	Is unpopular	Is fiscally conservative
Hard disk	Computer	Is broken	Cannot hold any more files
Wheels	Car	Fail(s) inspection	Move(s) fast
Television manufacturers	Electronics stores	Sold an above-average number of defective products in 2007	Introduced a TV based on a new standard in 2007
Oranges	Orange smoothie	Are/is sweet	Are/is sour
Apple slices used to make an apple pie	Apple pie	Are/is sweet	Have/has seeds
Music at a party	Party	Is loud	Is good for dancing
Company on the New York Stock Exchange	Senior manager at the company	Is doing well financially	Uses Blue Cross health insurance
Transfusion blood at African hospital	Transfusion patient	Has an infectious disease	Is anemic
Early spring day in New York City	An apartment in New York City	Is warm	Is sunny

Prediction



Degree of Inaccuracy if Inferences for $P(Effect \mid Cause) = W_c$