Comments on Belief and Beyond

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Outline

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Definitions of Evidence

- The OED offers this definition of evidence, "`Ground for belief; testimony or facts tending to prove or disprove any conclusion.`"
- Notice there are (at least) two different concepts that go by the name evidence.
- This confusion persists in the philosophical literature as well.
- Vaguely these two notions of evidence are:
  1. Evidence is grounds for belief. If you have evidence for a hypothesis you also have reason to believe it is true.
  2. Evidence is information which favors one hypothesis over another whether or not the favored hypothesis is true or believed true.

- B&T are interested in the second notion of evidence. That is data which favors one hypothesis over another and doesn't necessarily provide grounds for belief.
- This kind of evidence *compares* two hypothesis H_1, H_2 on the basis of evidence E.
- *NB* Other philosophers may use the term in the other sense.
- *NB* On this notion of evidence not only was information supporting a false hypothesis evidence but it remains evidence.

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Fundamental or Just Useful?

- B&T claim that evidence is a distinct notion from confirmation or belief and has a useful role to play.
- This could mean two things:
  1. Just that evidence and reason to believe sometimes diverge and some problems are better understood in terms of evidence.
  2. That evidence is not only distinct from confirmation but in some sense irreducible to it as many likelihoodists believe.
- If the later is false then everything we can explain with evidence should be explainable in terms of confirmation.
- The concept of evidence may still be necessary to explain how scientists talk.

Evidence and Confirmation

- B&T take evidence to be measured by BF/LR.
  $e(D, H_1/H_2) = \frac{P(E|H_1,A_1)}{P(E|H_2,A_2)}$
- B&T use confirmation to mean absolute confirmation.
  - D confirms H_1 iff $1 > P(H|D) > 0$.
  - Strength can be measured by $c_A(D, H_1) = P(H_1|D)$.
- There is also incremental confirmation.
  - (roughly) D confirms H_1 iff $P(H_1|D) > P(H_1)$
  - One common measure of incremental confirmation is $c_I(D, H_1) = \frac{P(H_1|D)}{P(H_1)}$
- Fitelson notes by Bayes Theorem: [Fitelson 05]
  $e(D, H_1/H_2) = \frac{c_I(D,H_1)}{c_I(D,H_2)}$

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Base Rate Fallacy

- B&T suggest that the belief/evidence distinction can be used to defend Bayesianism against the charge of unrealistic expectations.
- People consistently discount base rates in problems such as determining the probability of a disease given a positive test [Kahneman 82].
- B&T suggest the subjects are confusing a belief and evidence question rather than being irrational.
- There are then two component claims:
  1. The base rate fallacy is explained by a confusion of belief and evidence questions.
  2. The base rate fallacy is not the result of error prone probabilistic reasoning.

Base Rates and Rationality

- A tendency to conflate belief and evidence would be just as irrational.
- The subjects could only be acting nearly rationally if they really believed the questions were evidence questions.
- This seems unlikely. Even medical students and faculty demonstrated the neglect on diagnosis questions.
- Subjects get the answers right when only given base rates.
- The problem persists even with questions one would think clearly asked a belief question

Green and Blue Cabs

Example (Kahneman)

- Two cab companies, the Green and the Blue operate in the city.
- Witness identified a blue cab as being involved in a hit and run.
- Given a 50/50 sample of cabs the witness erred 20% of the time.
- 85% of the cabs in the city are green 15% are blue.
- Subject is asked for the probability the cab was blue.

- Correct answer is .41 but median response is .80
- This question is effectively a question of guilt of innocence which should be recognized as a belief question.

Causal Base Rates

- Modify the question to say 85% of the accidents involve green cabs and 15% involve blue.
- Now the base rate can be interpreted causally.
- Improves median to .60 [Sloman 04].
- This same effect has been illustrated in other situations.
- These features can't be explained in terms of correct answers to the wrong question.
- Similar errors in the conjunction fallacy do not disappear when probability questions are replaced with real bets [Sides 01]

Evidence Based Heuristics

- Evidence doesn't seem to offer an explanation of the base rate fallacy in terms of rational calculations.
- The notion of evidence may be useful within the heuristics and biases model.
- A possible explanation is that we use evidence as a heuristic to modify our prior causal base rate information.

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Old Evidence Problem

- Glymour challenges Bayesians to explain how data already known at the creation of a theory can be evidence for that theory.

Example (Mercury's Perihelion)

The shift in Mercury's perihelion (M) was already known at the creation of General Relativity (GR) but when GR was found to predict the shift it was taken as evidence for GR over Newtonian Gravity (NG)

- This problem could be interpreted in (at least) two ways.
  - New Theories: How can evidence already known at theory creation justify the acceptance of that theory.
  - Old Evidence: How can information already factored into our probability function still be evidence.

What Does Evidence Say?

- B&T argue that the belief/evidence distinction resolves the old evidence problem.

Calculation (B&T)

- *Let A_1 be approximation assumptions for GR. Let A_2 be the Newtonian assumption that only the known masses are significant.*
- $P(M|GR\&A_1) \approx 1$
- $P(M|NG\&A_2) \approx 0$
- *Thus* $e(M, GR/NG) \approx \infty$

- B&T claim that this calculation is independent of whether the agent knows or believes M.

Old Evidence Returns

- This solution depends on the objectivity of the LR.
- Changes in credences can change the LR.
- If M is known for sure then $P(M) = 1$ and $P(M|X) = 1$ for any X.
- Hence once M is known $e(M, GR/NG) = 1$ and the old evidence problem returns.
- In fact Hawthorne has shown in quite general situations updating can destroy the objectivity of likelihoods [Hawthorne 05].

Credences Aren't Enough

- Either we need to abandon updating or we get the wrong notion of evidence.
- Eliminating updating is not the answer. We really do want to updated our credences.
- This seems to force us to an unappealing counterfactual approach in order to explain evidence in terms of credences.
- Rejecting counterfactuals, it seems no account with just one probability function can explain both evidence and credences.
- Auxiliaries suggest we need to evaluate evidence relative to something more objective.

Support Functions

- Hawthorne suggests we adopt a support function Q as well as our credence function P .
- Thus P tells us how to bet and what to believe while Q tells us what is justified or evidential.
- On this account the support function sacrifices updating for public likelihoods.
- (roughly) one can be said to have a justified probability judgment of X if P(X)=Q(X|K) where K is your observed knowledge.
- This accords with the way we answer questions like, "What is the probability of M under GR." We don't say it is 1 because it has been observed rather we give a number relative to some agreed upon background.

Restrictions on Support

- Public likelihoods seem too strong.

Calculation

- *Let H by a hypothesis and O be some independent observation.*
- $Q(O|H) = \frac{Q(O\&H)}{Q(H)} = Q(O)$
- $Q_1(O|H) = Q_2(O|H) \rightarrow Q_1(O) = Q_2(O)$

- Thus any event independent from some hypothesis requires agreement.
- Observations like the initial distribution of matter after the big bang may be independent of all theories yet also be a vital piece of data.
- Instead require agreement on likelihood ratios, i.e., B&T evidence!

What are Support Functions?

- Hawthorne suggests support functions are a type of logical probability function.
- This seems to bring with all the difficulties of logical probability.
- Also this would seem to completely preclude the possibility of data ceasing to be evidence.

Example

- Let our data be the existence of fossils of extinct animals.
- In the middle ages this seemed rightly to be evidence for Noah's flood.
- Now we would not only take it as evidence for evolution but deny it is evidence for the flood.

Models

- A logical probability function which guarantees agreement on likelihoods would thus require that rationality rule out a creationist support function.
- This requirement seems much too strong.
- Fitelson suggests another option. Simply take the support function to give support in a model.
- This seems to better capture actual practice. We reason from certain basic assumptions which are widely held but occasionally shift.
- This also better explains why we can't always find lapses in rational probability assignment in those with radically different worldviews.

Outline

Achinstein

- Achinstein seems quite aware that evidence has several uses and explicitly chooses the notion of veridical evidence to be evidence that provides good reason to believe a hypothesis.
- Thus in B&T's terms Achinstein is really talking about belief not evidence.
- Hence the differences between his account and B&T's intuitions for evidence just indicate they are calling different concepts evidence.
- B&T can't be arguing this notion is incoherent as it is essentially the notion they call confirmation.
- Instead the claim may be his account can never hope to explain certain features but it is unclear how one would establish what he couldn't explain by this analysis.

Summary

- B&T correctly observe that we need a concept of evidence or something similar in addition to belief.
- The notion of evidence offers promise in helping to explain our reasoning errors. However, even explained they still seem to be errors.
- The OEP seems to resist explanation in terms of belief but also seems difficult to explain using the notion of evidence suggested by B&T.
- Explaining the OEP seems to require something besides a credence function. Support functions and/or models are one promising avenue.
- So while evidence is distinct from belief it may still be reducible to confirmation relative to a model.

For Further Reading

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