Confirmation Theory (Continued)

- Sad News: David Lewis died suddenly on Sunday evening.
- Administrative: let's talk about paper topics.
- Early (Qualitative) Accounts of Confirmation
  - Hypothetico-Deductivism (re-cap)
  - Instance Confirmation (continued)
  - Classic Constraints on Qualitative Confirmation
    - EC, SCC, CC, CCC, NTC, ...
- Problems *&* Paradoxes for the H-D and Hempelian Accounts
  - Raven Paradox
  - Grue Paradox
  - Other Problematic Cases

The Hypopthetico-Deductive (H-D) Method (Re-Cap)

- The general form of a deductive (*i.e.*, H-D) prediction is:

  H. Hypothesis under test.

  K. Background assumptions (initial conditions, *etc.*).

  E. Observational (deductive) prediction.

- We can also look at the "reverse inference", *from* the observation E *to* the hypothesis H (*given* K). NOTE: this direction is *inductive*!

  E. Observational (deductive) prediction.

  K. Background assumptions (initial conditions, *etc.*).

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  H. Hypothesis under test.

- Of course, an H-D theorist in *not* claiming that E *conclusively* supports (or even *strongly* supports) H, given K. They would concede that the support provided by E (given K) may *not* be strong.

- This is merely a *qualitative* claim, that E confirms H, relative to K.

The Hypopthetico-Deductive (H-D) Method (Re-Cap)

- What happens if $\sim E$ is observed? Where should we place the *blame*? Why doesn't the $\sim E$ disconfirm K, and leave H unscathed?
- This problem of *locating the blame* in cases of H-D–*dis*confirmation is known as the *Quine-Duhem Problem.* Quine and Duhem both shoed that hypotheses only entail predictions *in conjunction with auxiliaries*.
- This seems to be an insurmountable problem for the H-D theory. But, in a Bayesian (or probabilistic) account of confirmation, this problem can be addressed (if not overcome) in an interesting way.
- Example: We may have overwhelming (independent) evidence supporting the high accuracy of some test (say, an HIV test). And, although is is highly unlikely (*pre-test*) that someone has HIV, a positive test result (E) should (in such a case) be viewed as evidence in favor of HIV (H), not as evidence against the accuracy of the test (K).

The Hypopthetico-Deductive (H-D) Method (Re-Cap)

- Other Problems with the H-D Theory of Confirmation
  - The Problem of Alternative Hypotheses (underdetermination)
    - For any (finite) collection of evidence E, there are infinitely many inconsistent hypotheses which (together with K) entail E. The H-D account gives us no way to favor any of these.
  - The Problem of Statistical Hypotheses (*non*-deductive prediction)
    - Most (if not all) hypotheses in science are statistical in nature. They do not *entail* observational data (but only *confer a probability on* them). H-D (falsely) assumes that all prediction (and testing) is *deductive*.
  - The Problem of Irrelevant Conjunction (tacking problem)
    - According to H-D, if E confirms H, then E confirms $H \,\&\, X$ for *any* X — even for *irrelevant* (or *negatively relevant*!) X's.
  - The Problem of Quantitative Generalization (*degrees* of confirmation)

Hempelian "Instance" Confirmation I

- In Hempel's classic "Studies in the Logic of Confirmation" (in reader), he outlines an alternative to H-D (qualitative) confirmation.
- The basic idea (or slogan!) behind this account is:

  "Hypotheses are confirmed by their positive instances."
- What this means, precisely, is not so easy to say!
- Before Hempel, Nicod tried to explain the notion of "positive instance" for universal conditionals (H) having the following logical form:

$$H: \quad (\forall x)(Rx \rightarrow Bx) \qquad [\textit{e.g.}, \text{ all ravens are black}]$$

- According to Nicod, E is an instance of such an H just in case E satisfies both the antecedent and consequent of H (*e.g.*, $Ra \,\&\, Ba$).
- When applied to confirmation, this leads to absurd results …

Hempelian "Instance" Confirmation II

$$H' : (\forall x)({\sim}Bx \rightarrow {\sim}Rx) \qquad [\textit{e.g.}, \text{ all non-black things are non-ravens}]$$

- According to Nicod, $Ra \,\&\, Ba$ *confirms* H *but not* H'. This is *absurd*, since H and H' are *logically equivalent* (*they say the same thing*)!
- This suggests the following *desideratum* for accounts of confirmation:

  Equivalence Condition (EQC). If E confirms H, and H is logically equivalent to H' ($H \Leftrightarrow H'$), then E confirms H'.[a]

- Things get *even worse* for Nicod! Consider the following hypothesis:

$$H'' : \quad (\forall x)[(Rx \,\&\, {\sim}Bx) \rightarrow (Px \,\&\, {\sim}Px)]$$

- *Nothing* can satisfy the consequent of H''. Therefore, on Nicod's account, nothing can confirm H''. But, $H \Leftrightarrow H''$!

[a] Strictly speaking, we should always be saying "confirms *relative to* K", "entails *relative to* K", etc. But, since all the K's must be the same in these sorts of *desiderata* (*why?*), we will just omit the "relative to K"s from their definitions. Don't forget they are there!

Hempelian "Instance" Confirmation III

- After giving-up on Nicod's instance account, Hempel laid down the following *desiderata* (in addition to the Equivalence Condition).

  Entailment Condition (EC). If E entails H, then E confirms H. ☺

  Special Consequence Condition (SCC). If E confirms H, and H entails H', then E confirms H'.[a] ⚠

  Consistency Condition (CC). If E confirms H, and E confirms H', then H and H' are logically consistent. ☹

  Non-Triviality Condition (NTC). For all H, there exists an E which does *not* confirm H. ☺

- Because Hempel accepts these desiderata, he *must* reject:

  Converse Consequence Condition (CCC). If E confirms H, and H' entails H, then E confirms H'. ⚠

[a] See Dretske's "Epistemic Operators". SCC claims that confirmation is *penetrating*.

More on Hempel's Desiderata

- In the new paper topics, I include a question which involves careful analysis and thought concerning these conditions.
- The EQC, the EC, and the NTC all seem quite intuitive.
- The CC is *not* obvious (as Jeff pointed out last time). Typically, competing theories will *not* be consistent. Nonetheless, we might think that our evidence confirms both theories — it just confirms one *more strongly* than the other (we will see examples in Bayesian framework).
- The SCC and the CCC are not as straightforward. I think Dretskean considerations can be raised in connection with SCC. But, giving clear, concrete counterexamples to these principles will require an alternative theory of confirmation — Bayesian confirmation, for instance . . .
- Questions: Is confirmation *transitive* (if X confirms Y, and Y confirms Z, must X confirm Z)? Is confirmation *symmetric* (if X confirms Y must Y confirm X)? Which properties (EQC, . . .) does H-D have?

Hempelian "Instance" Confirmation IV

- Hempel then gave an account satisfying his 5 desiderata. The key definition behind his "instance" account is as follows:
- The *development of a hypothesis H for a set of individuals I* $[dev_I(H)]$ is (intuitively) "what H says (*extensionally*) about the members of I."
- Formally, $dev_I(H)$ is obtained by (i) *conjoining* all the I-instances (in the naive, Nicod sense) of H, if H is a *universal* ($\forall$) claim, and (ii) *disjoining* all the I-instances of H, if H is an *existential* ($\exists$) claim.
- Examples: Let $I = \{a, b\}$, then we have:
  - If $H = (\forall x)Bx$, then $dev_I(H) = Ba \,\&\, Bb$.
  - If $H = (\exists x)Rx$, then $dev_I(H) = Ra \vee Rb$.
  - If $H = (\forall x)(\exists y)Lxy$, then (working from the outside-in):

$$\begin{aligned} dev_I(H) &= (\exists y)Lay \,\&\, (\exists y)Lby \\ &= (Laa \vee Lab) \,\&\, (Lba \vee Lbb) \end{aligned}$$

Hempelian "Instance" Confirmation V

- Now, we're ready for the definition(s) of *Hempel-confirmation.*
- *E directly-Hempel-confirms H*, relative to background K, just in case $E \mathbin{\&} K \vDash dev_I(H)$ for the class I of individuals mentioned in E.
- *E Hempel-confirms H*, relative to K, iff E directly-Hempel-confirms (rel. to K) every member of a set of sentences S such that $S \mathbin{\&} K \vDash H$.
- Why the two definitions? $Ra \mathbin{\&} Ba$ does *not directly* Hempel-confirm $Rb \to Bb$, but $Ra \mathbin{\&} Ba$ *does* Hempel-confirm $Rb \to Bb$ (α-variants).
- Problematic Examples for Hempel's Theory:
  - Let $I = \{a, b\}$, $H = (\forall x)Rxy$, $E = Raa \mathbin{\&} Rab \mathbin{\&} Rbb \mathbin{\&} Rba$, and $E' = Raa \mathbin{\&} Rab \mathbin{\&} Rbb$. E Hempel-confirms H, but E' does not.
  - *No consistent* E can confirm the following, which is *true* on $\mathbb{N}$,

$$(H) \qquad (\forall x)(\exists y)x < y \mathbin{\&} (\forall x)x \not< x \mathbin{\&} (\forall x)(\forall y)(\forall z)[(x < y \mathbin{\&} y < z) \to x < z]$$

since $\mathrm{dev}_I(H)$ *is inconsistent, for any finite* I! Prove this!

Hempelian "Instance" Confirmation VI

- Two Deeper, Philosophical Problems with Hempel's Account:
  - Paradox of the Ravens: Consider the hypothesis that all ravens are black, H: $(\forall x)(Rx \rightarrow Bx)$. Which of these Hempel-confirms H?

E_1: $Ra_1 \,\&\, Ba_1$	E_2: $\sim Ra_2$	E_3: Ba_3
E_4: $\sim Ra_4 \,\&\, \sim Ba_4$	E_5: $\sim Ra_5 \,\&\, Ba_5$	E_6: $Ra_6 \,\&\, \sim Ba_6$

    Answer: *All but* E_6 *Hempel-confirm* H! *Red Herrings* confirm H?!
  - Goodman's Grue Paradox: Consider the hypothesis that all ravens are "blite", where the predicate "blite" (B) is defined as follows:

    x is blite iff *either* (i) x is examined before (the end of) today, and x is black *or* (ii) x is examined after today, and x is white.

    On Hempel's theory, $Ra \,\&\, Ba$ confirms H. But, this means that a black raven observed today confirms the hypothesis that ravens observed tomorrow (and thereafter) will be white![a]

[a] See Rosenkrantz's "Does the Philosophy of Induction Rest on a Mistake" for insights.

Prelude to Probabilistic Accounts of Confirmation

- Historically, there have been two kinds of probabilistic confirmation:
  1. **Absolute**: E confirms H (relative to K) if $\Pr(H \mid E \,\&\, K) > \tau$, for some "threshold value" τ (*i.e.*, if $\dfrac{E \,\&\, K}{\therefore H}$ is "*inductively strong*").
  2. **Incremental**: E confirms H (rel. to K) if $\Pr(H \mid E \,\&\, K) > \Pr(H \mid K)$ (*i.e.*, if E is *positively stochastically relevant to* H, given K).

  Incremental confirmation has become more popular in recent years.
- As we will see, these accounts behave much differently than either H-D or Hempel confirmation (and much differently than each other). For instance, these accounts do not satisfy either SCC or CCC. Moreover, on *neither* of these accounts is confirmation *transitive*. On the incremental (but *not* on the absolute!), confirmation *is symmetric*.
- Before we move on to such issues, we will have to talk a bit more about *probability* and its *interpretation*. We will start there next time ...