

## Philosophy 148 — Announcements & Such

- HW #4 grades posted ( $\mu = 75$ ). [This one was tougher than I thought.]
- **New Plan for HW #5** (owing to my flu)
  - It will be due on the last day of class — next Thursday 5/8.
  - Our HW #5 discussion will be Tuesday 5/6 @ 6pm @ **110 Wheeler**.
- I will also be preparing some final extra-credit problems. They will be distributed next week, and due at the final exam (5/20 @ 8am).
- The final exam is **Tuesday, May 20 @ 8am @ 20 Barrows**.
  - I will hold a review session the day before the final (May 19). Would a time in the afternoon (say 4-6pm) work for people? Pencil it in.
- Today's Agenda
  - The Raven Paradox (cont'd)
  - Next: The Grue Paradox

- So (i) this cannot undergird a *purely comparative* approach - one that is *consistent with* a qualitative <sub>$\alpha$</sub>  approach, and (ii) it entails (7), which is bad.
- It would be nice to have a *purely comparative* approach ... to wit:
- (2) and (3) can be replaced by the following, *strictly weaker* assumption:
 
$$(\ddagger) \Pr(H | Ra \& K_\alpha) = \Pr(H | \sim Ba \& K_\alpha)$$
- ☞ (1) & ( $\ddagger$ )  $\Rightarrow \Pr(H | Ra \& Ba \& K_\alpha) > \Pr(H | \sim Ba \& \sim Ra \& K_\alpha)$ .
- Thus, all one *needs* for a purely comparative approach are (1) and ( $\ddagger$ ).
- Our alternative, purely comparative approach has many virtues.
  - (1) & ( $\ddagger$ ) do *not* entail (5), (6), *or* (7) [or their negations]. In this sense, they capture the “*purely comparative part*” of the desired Theorem.
  - Recall Hempel's intuition about (PC) and (PC\*). In Bayesian terms, it is:
 
$$(\star) \mathfrak{c}(H, \sim Ba \& \sim Ra | T) > \mathfrak{c}(H, \sim Ba | \sim Ra) = 0$$
  - **Fact**. The standard Bayesian (1)–(3) *entail* that Hempel's ( $\star$ ) is *false!*
  - But, our (1) & ( $\ddagger$ ) are perfectly compatible with Hempel's ( $\star$ ).
  - Thus, a Bayesian can have their Hempelian cake and eat it too!

- The traditional, Bayesian “comparative” assumptions are as follows (protocol: for each object in the universe, write a true description in terms of  $R/B$ , and then throw slips into a giant urn, which is mixed and then sampled):
  - (1)  $\Pr(\sim Ba | K_\alpha) > \Pr(Ra | K_\alpha)$
  - (2)  $\Pr(Ra | H \& K_\alpha) = \Pr(Ra | K_\alpha)$  [ $\therefore \sim Ra \perp H | K_\alpha$  (!)]
  - (3)  $\Pr(\sim Ba | H \& K_\alpha) = \Pr(\sim Ba | K_\alpha)$  [ $\therefore Ba \perp H | K_\alpha$  (!)]
- **Theorem** (HW #5!). Any  $\Pr$  satisfying (1), (2) and (3) will also be such that:
  - (4)  $\Pr(H | Ra \& Ba \& K_\alpha) > \Pr(H | \sim Ba \& \sim Ra \& K_\alpha)$ .
- Assumption (1) is uncontroversial. But, assumptions (2) and (3) are not. They are quite un-Hempelien, since they rule-out Hempel's “indirect confirmation” effect for  $\sim Ra$  and  $Ba$ . They also entail *many* claims, *e.g.*:
  - (5)  $\Pr(H | Ra \& Ba \& K_\alpha) > \Pr(H | K_\alpha)$
  - (6)  $\Pr(H | \sim Ba \& \sim Ra \& K_\alpha) > \Pr(H | K_\alpha)$
  - (7)  $\Pr(H | Ba \& \sim Ra \& K_\alpha) < \Pr(H | K_\alpha)$
- A *purely comparative* approach should be *neutral* — *especially* on (7)!

- Views about (PC): Does  $\sim Ba \& \sim Ra [E]$  confirm  $(\forall x)(\sim Bx \supset \sim Rx) [H]$ ?
  - **Hempel**: Yes, relative to T. But, don't conflate this with the claim (PC\*) of confirmation relative to  $\sim Ra$ , which is *intuitively* false. That's a nice intuition, but, unfortunately, it contradicts Hempel's theory [ $M_K$ ].
  - **Scheffler**: Yes, but this does not imply that  $E$  confirms  $(\forall x)(Rx \supset Bx)$ , since  $E$  is also a positive instance of the *contrary* of  $(\forall x)(Rx \supset Bx)$ .
  - **Quine**: No [relative to T] because  $(NC_T)$  *does not apply* to  $\sim Ba$ ,  $\sim Ra$ , since they are not “natural kinds,” despite the fact that  $Ra$  and  $Ba$  are “NKs”. For Quine, “NKs” must have “sufficiently similar instances”.
  - **Maher** (2004): No, not even relative to T, since  $(NC_T)$  is demonstrably *false* within a Carnapian theory of “confirmation relative to T”. Note: the falsity of  $(NC_T)$  does not depend on “naturalness” of  $F$  and  $G$ .
  - **Bayesians**: Depends on whether  $\Pr(H | E \& K_\alpha) > \Pr(H | K_\alpha)$ , where  $K_\alpha$  is our *actual* background knowledge. Bayesians think that  $(NC_T)$  is *irrelevant*, epistemically, and so *they don't care* whether it's true. And, *even if* the  $K_\alpha$  version is true, we can still give a *comparative* account.

### Goodman's "Grue" Paradox: Basic Linguistic Structures and Facts I

- Let  $Ox \stackrel{\text{def}}{=} x$  is observed prior to  $t$ ,  $Gx \stackrel{\text{def}}{=} x$  is green, and  $Bx \stackrel{\text{def}}{=} x$  is blue.
- "Grue":  $Gx \stackrel{\text{def}}{=} x$  is either observed prior to  $t$  and green or  $x$  is not observed prior to  $t$  and blue. That is,  $Gx \stackrel{\text{def}}{=} (Ox \ \& \ Gx) \vee (\sim Ox \ \& \ Bx)$ .
- We can also define "Bleen" as:  $Bx \stackrel{\text{def}}{=} (Ox \ \& \ Bx) \vee (\sim Ox \ \& \ Gx)$ .
- **Two Facts.**
  - $Gx$  is logically equivalent to  $(Ox \ \& \ Gx) \vee (\sim Ox \ \& \ Bx)$ .
  - $Bx$  is logically equivalent to  $(Ox \ \& \ Bx) \vee (\sim Ox \ \& \ Gx)$ .
- So, from the point of view of the Green/Blue language, "Grue" and "Bleen" are "gerrymandered" or "positional" or "non-qualitative".
- But, from the point of view of the Grue/Bleen language, "Green" and "Blue" are "gerrymandered" or "positional" or "non-qualitative".
- So, no appeal to syntax will forge an asymmetry here, unless one assumes a *privileged language*. Note: the languages are expressively equivalent.

### Goodman's "Grue" Paradox: Basic Linguistic Structures and Facts II

- I'm going to simplify things by re-defining "grue" using green and non-green. Quine wouldn't have liked this, but Goodman/Hempel wouldn't have minded. It will make the subsequent discussion easier.
- Thus, "Grue" becomes:  $Gx \stackrel{\text{def}}{=} Ox \equiv Gx$ . Now, consider the following two universal generalizations, and three singular evidential claims:
  - $H_1$ : All emeralds are green.  $(\forall x)(Ex \supset Gx)$ .
  - $H_2$ : All emeralds are grue.  $(\forall x)(Ex \supset Gx)$ . *I.e.*,  $(\forall x)[Ex \supset (Ox \equiv Gx)]$ .
  - $E_1$ :  $a$  is a green emerald.  $Ea \ \& \ Ga$ .
  - $E_2$ :  $a$  is a grue emerald.  $Ea \ \& \ Ga$ . *I.e.*,  $Ea \ \& \ (Oa \equiv Ga)$ .
  - $\mathcal{E}$ :  $a$  is a *grue and green* emerald.  $Ea \ \& \ (Oa \ \& \ Ga)$ .
- The first part of Goodman's argument involves identifying an evidential claim that Hempel-confirms  $H_1$  and  $H_2$ .  $E_1/E_2$  do not fit the bill. Why?
- As Goodman points out (more detail later),  $\mathcal{E}$  Hempel-confirms both  $H_1$  and  $H_2$ . Goodman thinks this is "bad news" for Hempel's theory. *Why?*

- Here is a “*reductio*” of classical deductive logic (this is naïve and oversimplified, but I’ll re-examine it on the next slide):
  - (1) For all sets of statements  $X$  and all statements  $p$ , if  $X$  is inconsistent, then  $p$  is a logical consequence of  $X$ .
  - (2) If an agent  $S$ ’s belief set  $B$  entails  $p$  (and  $S$  knows  $B \models p$ ), then it would be reasonable for  $S$  to infer/believe  $p$ .
  - (3) *Even if*  $S$  knows their belief set  $B$  is inconsistent (and, hence, that  $B \models p$ , for *any*  $p$ ), there are still *some*  $p$ ’s such that it would *not* be reasonable for  $S$  to infer/believe  $p$ .
  - (4)  $\therefore$  Since (1)–(3) lead to absurdity, our initial assumption (1) must have been false — *reductio* of the “explosion” rule (1).
- Harman [8] would concede that (1)–(3) are inconsistent, and (as a result) that *something* is wrong with premises (1)–(3).
- But, he would reject the relevantists’ diagnosis that (1) must be rejected. I take it he’d say it’s (2) that is to blame here.
- 👉 (2) is a *bridge principle* [12] linking *entailment* and *inference*.
- (2) is correct *only* for *consistent*  $B$ ’s. [*Even if*  $B$  is consistent, the correct response *may* rather be to *reject* some  $B_i$ ’s in  $B$ .]

- Note: the choice of *deductive* contexts in which  $S$ ’s belief set  $B$  is (known by  $S$  to be) *inconsistent* is intentional here.
- In such contexts, there is a *deep disconnect* between (known) *entailment* relations and (kosher) *inferential* relations.
- One might try a more sophisticated deductive bridge principle (2’) here. But, I conjecture a *dilemma*. *Either*:
  - (2’) will be *too weak* to yield a (classically) *valid* “reductio”.  
*or*
  - (2’) will be *false*. [Our original BP (2) falls under this horn.]
- Let  $B$  be  $S$ ’s belief set, and let  $q$  be the conjunction of the elements  $B_i$  of  $B$ . Here are two more candidate BP’s:
  - (2’<sub>1</sub>) If  $S$  knows that  $B \models p$ , then  $S$  should *not* be such that *both*:  $S$  believes  $q$ , *and*  $S$  does not believe  $p$ .
  - (2’<sub>2</sub>) If  $S$  knows that  $B \models p$ , then  $S$  should *not* be such that *both*:  $S$  believes each of the  $B_i \in B$ , *and*  $S$  does not believe  $p$ .
- (2’<sub>2</sub>) is *false* (preface paradox) *and* too weak (it’s wide scope).
- (2’<sub>1</sub>) *may* be true, but it is also *too weak*. [It’s wide scope, and the agent can reasonably disbelieve *both*  $q$  and  $p$ .]

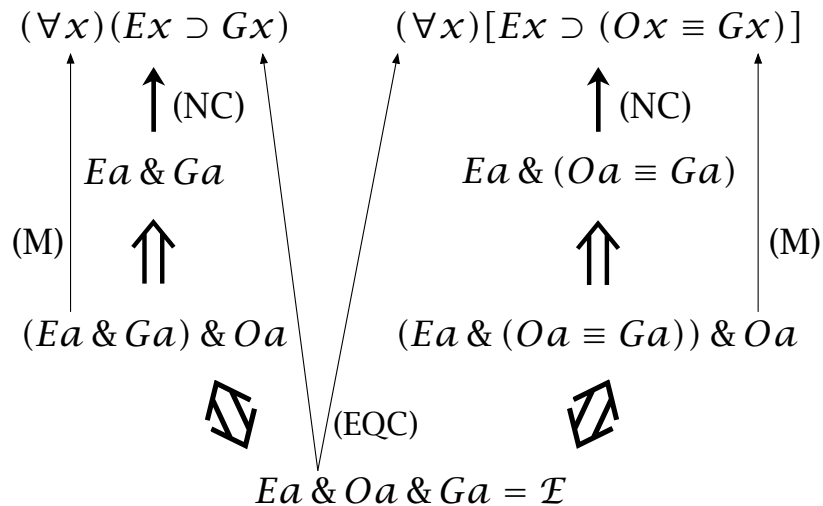
- So, I think Harman is *right* about such “relevantist” arguments.
- Next, I will argue that Goodman’s “grue” argument against CIL fails for analogous reasons (indeed, I’ll argue it’s *even worse!*).
- I’ll begin by discussing the IL’s of Hempel and Carnap.
- Hempelian IL (confirmation theory) uses *entailment* to explicate “inductive logical support” (confirmation) — a logical relation between statements. [*i.e.*,  $E$  confirms  $H$  iff  $E \models_{dev_E} H$ ]
- Hempel’s theory has the following three key consequences:
  - (EQC) If  $E$  confirms  $H$  and  $E \models E'$ , then  $E'$  confirms  $H$ .
  - (NC) For all constants  $x$  and all (consistent) predicates  $\phi$  and  $\psi$ :  
 $\lceil \phi x \ \& \ \psi x \rceil$  confirms  $\lceil (\forall y)(\phi y \supset \psi y) \rceil$ .
  - (M) For all  $x$ , for all (consistent)  $\phi$  and  $\psi$ , and all statements  $H$ :  
 If  $\lceil \phi x \rceil$  confirms  $H$ , then  $\lceil \phi x \ \& \ \psi x \rceil$  confirms  $H$ .
- These three properties are the crucial ones needed to reconstruct Goodman’s “grue” argument against Hempel.
- Before giving a precise reconstruction of Goodman’s “grue” argument, we’ll look at the essentials of Carnapian IL/CT.

- Carnapian confirmation (*i.e.*, *later* Carnapian theory [13] — see “Extras”) is based on *probabilistic relevance*, not entailment:
  - $E$  confirms  $H$ , relative to  $K$  iff  $\Pr(H \mid E \ \& \ K) > \Pr(H \mid K)$ , for some “suitable” conditional probability function  $\Pr(\cdot \mid \cdot)$ .
    - Note how this is an *explicitly* 3-place relation. Hempel’s was only 2-place. This is because  $\Pr$  (unlike  $\models$ ) is *non-monotonic*.
    - Carnap thought that “suitable  $\Pr$ ” meant “logical  $\Pr$ ” in a rather strong sense (see “Extras”). However, Goodman’s argument will work against *any* probability function  $\Pr$ .
- 👉 Carnap’s theory implies *only 1* of our 3 Hempelian claims: (EQC). It does *not* imply (NC) *or* (M) (see “Extras” & [3]/[13]).
  - This will allow Carnapian IL to avoid facing the full brunt of Goodman’s “grue” (but, it will still face a serious challenge).
- For Carnap, confirmation is a *logical* relation (akin to entailment). Like entailment, confirmation can be *applied*, but this requires *epistemic bridge principles* [akin to (2)].
- Carnap [1] discusses various bridge principles. The most well-known of these is the *requirement of total evidence*.

- **The Requirement of Total Evidence.** In the application of IL to a given knowledge situation, the total evidence available must be taken as a basis for determining the degree of confirmation.
- This *sounds* like a plausible principle. But, once it is made more precise, it will actually turn out to be subtly defective.
- More precisely, we have the following *bridge principle* connecting *confirmation* and *evidential support*:  
 (RTE) *E* evidentially supports *H* for *S* in *C* iff *E* confirms *H*, relative to *K*, where *K* is *S*'s total evidence in *C*.
- The (RTE) has often been (implicitly) presupposed by Bayesian epistemologists (both subjective and objective).
- However, as we will soon see, the (RTE) is not a tenable bridge principle, and for reasons independent of “grue”.
- ☞ Moreover, Goodman’s “grue” argument will rely *more heavily* on (RTE) than the relevantists’ argument relies on (2). In this sense, Goodman’s argument will be *even worse*.
- Before reconstructing the argument, a brief “grue” primer.

- Let  $Gx \stackrel{\text{def}}{=} x$  is green,  $Ox \stackrel{\text{def}}{=} x$  is examined prior to  $t$ , and  $Ex \stackrel{\text{def}}{=} x$  is an emerald. Goodman introduces a predicate “grue”  
 $Gx \stackrel{\text{def}}{=} x$  is grue  $\stackrel{\text{def}}{=} Ox \equiv Gx$ .
- Consider the following two universal generalizations  
 $(H_1)$  All emeralds are green.  $[(\forall x)(Ex \supset Gx)]$   
 $(H_2)$  All emeralds are grue.  $[(\forall x)[Ex \supset (Ox \equiv Gx)]]$
- And, consider the following instantial evidential statement  
 $(\mathcal{E}) Ea \ \& \ Oa \ \& \ Ga$
- Hempel’s confirmation theory [(EQC) & (NC) & (M)] entails:  
 (+)  $\mathcal{E}$  confirms  $H_1$ , and  $\mathcal{E}$  confirms  $H_2$ . [proof]
- As a result, his theory entails the following weaker claim  
 (‡)  $\mathcal{E}$  confirms  $H_1$  if and only if  $\mathcal{E}$  confirms  $H_2$ .
- What about (later) Carnapian theory? Does it entail even (‡)?  
 ☞ Interestingly, NO! There are (later) Carnapian Pr-models in which  $\mathcal{E}$  confirms  $H_1$  but  $\mathcal{E}$  disconfirms  $H_2$  (see “Extras”).
- In this sense, Hempel was an easier target for Goodman than Carnap (Goodman claims to be attacking both).
- Now, we’re ready to reconstruct Goodman’s argument.

### A Proof of (+) From Hempel’s (NC), (M), and (EQC)



← back

- There is just one more ingredient in Goodman’s argument:
  - The agent *S* who is assessing the evidential support that  $\mathcal{E}$  provides for  $H_1$  vs  $H_2$  in a Goodmanian “grue” context  $C_G$  has  $Oa$  as part of their total evidence in  $C_G$ . (e.g., [14].)
- Now, we can run the following Goodmanian *reductio*:
  - $\mathcal{E}$  confirms  $H$ , relative to  $K$  iff  $\text{Pr}(H \mid \mathcal{E} \ \& \ K) > \text{Pr}(H \mid K)$ .
  - $\mathcal{E}$  evidentially supports  $H$  for  $S$  in  $C$  iff  $\mathcal{E}$  confirms  $H$ , relative to  $K$ , where  $K$  is  $S$ 's total evidence in  $C$ .
  - The agent  $S$  who is assessing the evidential support  $\mathcal{E}$  provides for  $H_1$  vs  $H_2$  in a Goodmanian “grue” context  $C_G$  has  $Oa$  as part of their total evidence in  $C_G$  [i.e.,  $K = Oa$ ].
  - If  $K = Oa$ , then—c.p.— $\mathcal{E}$  confirms  $H_1$  relative to  $K$  iff  $\mathcal{E}$  confirms  $H_2$  relative to  $K$ , for **any**  $\text{Pr}$  [i.e., (‡) holds,  $\forall$  Pr’s].
  - Therefore,  $\mathcal{E}$  evidentially supports  $H_1$  for  $S$  in  $C_G$  if and only if  $\mathcal{E}$  evidentially supports  $H_2$  for  $S$  in  $C_G$ .
  - $\mathcal{E}$  evidentially supports  $H_1$  for  $S$  in  $C_G$ , but  $\mathcal{E}$  does *not* evidentially support  $H_2$  for  $S$  in  $C_G$ .
- $\therefore$  (i)–(vi) lead to an absurdity. Hence, our initial assumption (i) must have been false. Carnapian inductive logic refuted?

- Premise (vi) is based on Goodman’s *epistemic intuition* that, in “grue” contexts,  $\mathcal{E}$  evidentially supports  $H_1$  but *not*  $H_2$ .
- Premise (v) follows logically from premises (i)–(iv).
- Premise (iv) is a theorem of probability calculus (**any** Pr!).
  - The *c.p.* clause needed is  $\Pr(Ea \mid H_1 \ \& \ K) = \Pr(Ea \mid H_2 \ \& \ K)$ , which is assumed in all probabilistic renditions of “grue”.
- Premise (iii) is an assumption about the agent’s background knowledge  $K$  that’s implicit in Goodman’s set-up. See [14].
- Premise (ii) is (RTE). It’s the *bridge principle*, akin to (2) in the relevantists’ *reductio*. This is the premise I will focus on.
- Here are my two main points about Goodman’s argument:
  - (ii) must be rejected by Bayesians for independent reasons.
  - Carnapian confirmation theory *doesn’t even entail* (‡). [Hempel’s theory does, just as deductive logic entails (1).]
- This suggests Goodman’s argument is *even less a reductio* of (i) than the relevantists’ argument is a *reductio* of (1).
- Next, I will explain why Carnapians/Bayesians should reject (ii) on *independent* grounds: The Problem of Old Evidence.

- As Tim Willimson points out [16, ch. 9], Carnap’s (RTE) must be rejected, because of the problem of old evidence [2].
- If  $S$ ’s total evidence in  $C$  ( $K$ ) entails  $E$ , then, according to (RTE),  $E$  cannot evidentially support *any*  $H$  for  $S$  in  $C$ .
- As a result, one cannot (in all contexts) use  $\Pr(\cdot \mid K)$  — for *any* Pr — when assessing the *evidential import* of  $E$ .
- There are (basically) two kinds of strategies for revising (RTE). Carnap [1, p. 472] & Williamson [16, ch. 9] propose: (RTE<sub>+</sub>)  $E$  evidentially supports  $H$  for  $S$  in  $C$  iff  $S$  possesses  $E$  as evidence in  $C$  and  $\Pr_+(H \mid E \ \& \ K_+) > \Pr_+(H \mid K_+)$ . [ $K_+$  is *a priori*,  $\Pr_+$  is “inductive” [13]/“evidential” [16]/“logical” [1].]
- Note: Hempel explicitly *required* that confirmation be taken “*relative to*  $K_+$ ” in all treatments of the paradoxes [9, 10]. (RTE<sub>+</sub>) is a charitable Carnapian reconstruction of Hempel.
- A more “standard” way to revise (RTE) is [(RTE’)] to use  $\Pr_{S'}(\cdot \mid K')$ , where  $K \models K' \neq E$ , and  $\Pr_{S'}$  is the credence function of a “counterpart”  $S'$  of  $S$  with total evidence  $K'$ .

- Carnap never re-wrote the part of LFP [1] that discusses the (RTE), in light of a probabilistic *relevance* (“increase in firmness” [1]) notion of confirmation. This is too bad.
- If Carnap had discussed this (“old evidence”) issue, I suspect he would have used something like Williamson’s (RTE<sub>+</sub>) as his bridge principle connecting confirmation and evidence.
- Various other philosophers have proposed similar accounts of “support” as some probabilistic relation, taken relative to an “informationless” or “*a priori*” background/probability.
  - Richard Fumerton (who, unlike Williamson, is an epistemological *internalist*) proposes such a view in his [4].
  - Patrick Maher [13] applies such relations extensively in his recent (neo-Carnapian) work on confirmation theory.
  - Brian Weatherson [15] uses a similar, “Keynesian” [11] inductive-probability approach to evidential support.
- So, many Bayesians *already* reject (RTE). [Of course, “grue” gives Bayesians another important reason to reject (RTE).]

- So far, I have left open (precisely) what I think Bayesian confirmation theorists *should* say (*logically & epistemically*) in light of Goodman’s “grue” paradox (but, see “Extras”).
- Clearly, BCTs will need to revise (RTE) in light of “grue”. But, the standard (RTE’) way of doing this to cope with “old evidence” isn’t powerful enough to avoid *both* problems.
- Williamson’s (RTE<sub>+</sub>) revision of (RTE) — also suggested by Carnap — avoids both problems, from a *logical* point of view (*if* “inductive”/“logical”/“evidential” probabilities *exist!*). But, what should BCTs say on the *epistemic* side?
- I don’t have a fully satisfactory answer to this question (yet). But, I remain unconvinced that the epistemic problem (if there is one) is caused by the “non-naturalness” of “grue”.
- The problem, I suspect, may involve an *observation selection effect*: we know something about the “grue” observation process that *undermines* (or *defeats*) evidence it produces.
- I hope we can discuss this (and IL) in the Q&A (see “Extras”).

“Carnapian” Counterexamples to (NC) and (M)

[1] R. Carnap, *Logical Foundations of Probability*, 2nd ed., Chicago Univ. Press, 1962.  
 [2] E. Eells, *Bayesian problems of old evidence*, in C. Wade Savage (ed.) *Scientific theories, Minnesota Studies in the Philosophy of Science* (Vol. X), 205-223, 1990.  
 [3] B. Fitelson, *The Paradox of Confirmation*, *Philosophy Compass* (online publication), Blackwell, 2006. URL: <http://fitelson.org/ravens.htm>.  
 [4] R. Fumerton, *Metaepistemology and Skepticism*, Rowman & Littlefield, 1995.  
 [5] C. Glymour, *Theory and Evidence*, Princeton University Press, 1980.  
 [6] I.J. Good, *The white shoe is a red herring*, *BJPS* 17 (1967), 322.  
 [7] N. Goodman, *Fact, Fiction, and Forecast*, Harvard University Press, 1955.  
 [8] G. Harman, *Change in View: Principles of Reasoning*, MIT Press, 1988.  
 [9] C. Hempel, *Studies in the logic of confirmation*, *Mind* 54 (1945), 1-26, 97-121.  
 [10] \_\_\_\_\_, *The white shoe: no red herring*, *BJPS* 18 (1967), 239-240.  
 [11] J. Keynes, *A Treatise on Probability*, Macmillan, 1921.  
 [12] J. MacFarlane, *In what sense (if any) is logic normative for thought?*, 2004.  
 [13] P. Maher, *Probability captures the logic of scientific confirmation*, *Contemporary Debates in the Philosophy of Science* (C. Hitchcock, ed.), Blackwell, 2004.  
 [14] E. Sober, *No model, no inference: A Bayesian primer on the grue problem*, in *grue! The New Riddle of Induction* (D. Stalker ed.), Open Court, Chicago, 1994.  
 [15] B. Weatherson, *The Bayesian and the Dogmatist*, manuscript, 2007. URL: <http://brian.weatherson.org/tbatd.pdf>.  
 [16] T. Williamson, *Knowledge and its Limits*, Oxford University Press, 2000.

(K) Either: (H) there are 100 black ravens, no nonblack ravens, and 1 million other things, or (~H) there are 1,000 black ravens, 1 white raven, and 1 million other things.

• Let  $E \stackrel{\text{def}}{=} Ra \ \& \ Ba$  ( $a$  randomly sampled from universe). Then:

$$\Pr(E \mid H \ \& \ K) = \frac{100}{1000100} \ll \frac{1000}{1001001} = \Pr(E \mid \sim H \ \& \ K)$$

• ∴ This K/Pr constitute a counterexample to (NC), assuming a “Carnapian” theory of confirmation. This model can be emulated in the later Carnapian  $\lambda/\gamma$ -systems [13].

• Let  $Bx \stackrel{\text{def}}{=} x$  is a black card,  $Ax \stackrel{\text{def}}{=} x$  is the ace of spades,  $Jx \stackrel{\text{def}}{=} x$  is the jack of clubs, and  $K \stackrel{\text{def}}{=} a$  card  $a$  is sampled at random from a standard deck (where Pr is also standard):

- $\Pr(Aa \mid Ba \ \& \ K) = \frac{1}{26} > \frac{1}{52} = \Pr(Aa \mid K)$ .
- $\Pr(Aa \mid Ba \ \& \ Ja \ \& \ K) = 0 < \frac{1}{52} = \Pr(Aa \mid K)$ .

A “Carnapian” Counterexample to (‡)

(K) Either: ( $H_1$ ) there are 1000 green emeralds 900 of which have been examined before  $t$ , no non-green emeralds, and 1 million other things in the universe, or ( $H_2$ ) there are 100 green emeralds that have been examined before  $t$ , no green emeralds that have not been examined before  $t$ , 900 non-green emeralds that have not been examined before  $t$ , and 1 million other things.

• Imagine an urn containing true descriptions of each object in the universe (Pr  $\stackrel{\text{def}}{=} \text{urn model}$ ). Let  $\mathcal{E} \stackrel{\text{def}}{=} “Ea \ \& \ Oa \ \& \ Ga”$  be drawn.  $\mathcal{E}$  confirms  $H_1$  but  $\mathcal{E}$  disconfirms  $H_2$ , relative to K:

$$\Pr(\mathcal{E} \mid H_1 \ \& \ K) = \frac{900}{1001000} > \frac{100}{1001000} = \Pr(\mathcal{E} \mid H_2 \ \& \ K)$$

• This K/Pr constitute a counterexample to (‡), assuming a “Carnapian” theory of confirmation. This probability model can be emulated in the later Carnapian  $\lambda/\gamma$ -systems [13].

Is “Grue” an Observation Selection Effect? Part I

• **Canonical Example of an OSE:** I use a fishing net to capture samples of fish from various (randomly selected) parts of a lake. Let  $E$  be the claim that all of the sampled fish were over one foot in length. Let  $H$  be the hypothesis that all the fish in the lake are over one foot  $[(\forall x)((Fx \ \& \ Lx) \supset O x)]$ .

• Intuitively, one might think  $E$  should evidentially support  $H$ . This may be so for an agent who knows *only* the above information ( $K$ ) about the observation process. That is, it seems plausible that  $\Pr(E \mid H \ \& \ K) > \Pr(E \mid \sim H \ \& \ K)$ , where Pr is taken to be “evidential” (or “epistemic”) probability.

• But, what if I *also* tell you that ( $D$ ) the net I used to sample the fish from the lake (which generated  $E$ ) has holes that are all over one foot in diameter? It seems that  $D$  defeats the support  $E$  provides for  $H$  (relative to  $K$ ), because  $D$  ensures  $O$ . Thus, intuitively,  $\Pr(E \mid H \ \& \ D \ \& \ K) = \Pr(E \mid \sim H \ \& \ D \ \& \ K)$ .

## Is “Grue” an Observation Selection Effect? Part II

- Note: the “grue” hypothesis ( $H_2$ ) entails the following claim, which is not entailed by the green hypothesis ( $H_1$ ):  
 $(H')$  All green emeralds have been (or will have been) examined prior to  $t$ .  $[(\forall x)((Ex \ \& \ Gx) \supset O_x)]$ .
- Now, consider the following two observation processes:
  - **Process 1.** For each green emerald in the universe, a slip of paper is created, on which is written a true description of that object as to whether it has property  $O$ . All the slips are placed in an urn, and one slip is sampled at random from the urn. By *this* process, we learn ( $E$ ) that  $Ea \ \& \ Ga \ \& \ Oa$ .
  - **Process 2.** Suppose all the green emeralds in the universe are placed in an urn. We sample an emerald ( $a$ ) at random from this urn, and we examine it. [We know *antecedently* that the examination of  $a$  will take place prior to  $t$ , *i.e.*, that  $Oa$  is true.] By *this* process, we learn ( $E$ ) that  $Ea \ \& \ Ga \ \& \ Oa$ .
- Goodman seems to presuppose Process 2 in his set-up.

## What Could “Carnapian” Inductive Logic Be? Part I

- The early Carnap dreamt that probabilistic inductive logic (confirmation theory) could be formulated in such a way that it *supervenes* on deductive logic in a *very strong* sense.
  - **Strong Supervenience (SS).** All confirmation relations involving sentences of a first-order language  $\mathcal{L}$  supervene on the deductive relations involving sentences *of*  $\mathcal{L}$ .
- Hempel clearly saw (SS) as a *desideratum* for confirmation theory. The early Carnap also seems to have (SS) in mind.
- I think it is fair to say that Carnap’s project — understood as requiring (SS) — was unsuccessful. [I think *this* is true for reasons that are *independent* of “grue” considerations.]
- The later Carnap seems to be aware of this. Most commentators interpret this shift as the later Carnap simply *giving up* on inductive logic (*qua logic*) altogether.
- I want to resist this “standard” reading of the history.

## What Could “Carnapian” Inductive Logic Be? Part II

- I propose a different reading of the later Carnap, which makes him much more coherent with the early Carnap.
- I propose *weakening* the supervenience requirement in such a way that it (a) ensures this coherence, and (b) maintains the “logicality” of confirmation relations in Carnap’s sense.
- Let  $\mathcal{L}$  be a formal language strong enough to express the fragment of probability theory Carnap needs for his later, more sophisticated confirmation-theoretic framework.
  - **Weak Supervenience (WS).** All confirmation relations involving sentences of a first-order language  $\mathcal{L}$  supervene on the deductive relations involving sentences *of*  $\mathcal{L}$ .
- As it turns out,  $\mathcal{L}$  needn’t be very strong (in fact, one can get away with PRA!). So, even by early (*logician*) Carnapian lights, satisfying (WS) is all that is *really* required for “logicality”.
- The specific (WS) approach I propose takes confirmation to be a *four*-place relation: between  $E$ ,  $H$ ,  $K$ , and a function  $\text{Pr}$ .

## What Could “Carnapian” Inductive Logic Be? Part III

- Consequences of moving to a 4-place confirmation relation:
  - We need not try to “construct” “logical” probability functions from the syntax of  $\mathcal{L}$ . This is a dead-end anyhow.
  - Indeed, on this view, inductive logic has nothing to say about the *interpretation/origin* of  $\text{Pr}$ . That is *not* a *logical* question, but a question about the *application* of logic.
    - Analogy: Deductive logicians don’t owe us a “logical interpretation” of the truth value assignment function  $v$ .
  - Moreover, this leads to a vast increase in the *generality* of inductive logic. Carnap was stuck with an impoverished set of “logical” probability functions (in his  $\lambda/\gamma$ -continuum).
    - On my approach, *any* probability function can be part of a confirmation relation. Which functions are “suitable” or “appropriate” or “interesting” will depend on *applications*.
    - So, some confirmation relations will not be “interesting”, *etc.* But, this is (already) true of *entailments*, as Harman showed.
  - Questions: Now, what *is* the job of the inductive logician, and how (if at all) do they interact with *epistemologists*?

## What Could “Carnapian” Inductive Logic Be? Part IV

- The inductive logician must explain how it is that inductive logic can satisfy the following Carnapian *desiderata*.
  - The confirmation function  $c(H, E | K)$  quantifies a *logical* (in a Carnapian sense) relation among statements  $E$ ,  $H$ , and  $K$ .
    - ( $\mathcal{D}_1$ ) One aspect of “logicality” is ensured by moving from (SS) to (WS) [from an  $\mathcal{L}$ -determinate to an  $\mathcal{L}$ -determinate concept].
    - ( $\mathcal{D}_2$ ) Another aspect of “logicality” insisted upon by Carnap is that  $c(H, E | K)$  should *generalize* the entailment relation.
      - This means (at least) that we need  $c(H, E | K)$  to take a maximum (minimum) value when  $E \& K \models H$  ( $E \& K \models \sim H$ ).
      - Very few *relevance* measures  $c$  satisfy this “generalizing  $\models$ ” requirement. That’s another job for the inductive logician.
  - ( $\mathcal{D}_3$ ) There must be *some* interesting “bridge principles” linking  $c$  and *some* relations of evidential support, in *some* contexts.
    - ( $\mathcal{D}_2$ ) implies that *if* there are any such bridge principles linking *entailment* and *conclusive evidence*, these should be *inherited* by  $c$ . This brings us back to Harman’s problem!

## Three Salient Quotes from Goodman [7]

☞ The “new riddle” is *about* inductive *logic* (not *epistemology*).

**Quote #1** (page 67): “Just as deductive logic is concerned primarily with a relation between statements — namely the consequence relation — that is independent of their truth or falsity, so inductive logic ... is concerned primarily with a comparable relation of confirmation between statements. Thus the problem is to define the relation that obtains between any statement  $S_1$  and another  $S_2$  if and only if  $S_1$  may properly be said to confirm  $S_2$  in any degree.”

**Quote #2** (73): “Confirmation of a hypothesis by an instance depends ... upon features of the hypothesis other than its syntactical form”.

☞ But, Goodman’s *methodology* appeals to *epistemic* intuitions.

**Quote #3** (page 73): “... the fact that a given man now in this room is a third son *does not increase the credibility of* statements asserting that other men now in this room are third sons, *and so does not confirm* the hypothesis that all men now in this room are third sons.”