Explanation, Prediction & Unification: Achinstein Meets Kitcher and Morrison

- Peter Achinstein in his 1994 article ("Explanation vs. Prediction: Which Carries More Weight?") evaluates the question concerning **prediction** versus **explanation** in a manner that is mostly a response to what he considers is the "explanationist" thesis advocated by esteemed historian of science Stephen Brush.[1]

- What is of interest in this "prediction" versus "explanation" issue, concerning the normative debate dealing with the criteria of theory-selection, **is that it evolved into a debate *in the first place,* from the standpoint of the logical empiricists.** Recall (**Lecture XVIII**) that Hempel argued that scientific **explanation and prediction were coextensive; that they mutually entailed each other**.

- However, as evidenced by the articles of Hempel, Kitcher, as well as in the selections of Morrison's book (to name just a few instances) Hempel's prediction/explanation symmetry claim has been subsequently called into serious question.[2] Hence, once one recognizes that **prediction and explanation are quite distinct,** from **logical, epistemological,** and **methodological** standpoints, the above question concerning their prominence and their normative strength (concerning the issue of theory selection) is apropos.

- According to Achinstein, there are two extreme positions: **"predictionist"** versus **"explanationist."** The former predictionists (according to Achinstein) included the likes of Whewell,[3] Popper, etc. In general, predictionists (in the spirit of Lakatos' notion of a productive research program "anticipating hitherto unknown facts") maintain that "a theory that predicts phenomena that did not prompt the initial formulation of that theory is better supported by those phenomena than a is

[1] Who happens, by the way, to be an honorary (and now emeritus) faculty in the CPaS (Committee for Philosophy and the Sciences) at the University of Maryland!

[2] As mentioned (**Lecture XVIII**) commonsensical questions are easily posed revealing the dubious nature of Hempel's claim. For instance, physical meteorology *explains* local, regional, and global weather phenomena quite cogently and accurately, even though local weather phenomena is practically impossible to *predict* after three days. Conversely, one can think of geocentric GPS (global positioning system) algorithms (which, incidentally, are still employed in many aircraft and ship navigation systems, due to their relative computational simplicity, when compared to Newtonian heliocentric or General Relativistic alternatives) as *instrumentally reliable* (i.e., giving *accurate predictions*, within agreement of certain error bounds and short-term forecasts) but are obviously non-explanatory. Admittedly, Hempel responded to such criticisms in his "Thesis of Structural Identity" article, in which the following qualifications are made: "*Every adequate explanation is potentially a prediction*," and vice versa. However, Hempel's qualifications are subject to the same problems that his overall theory of explanation is (problem of irrelevance, asymmetry, laws versus accidental generalizations).

[3] Recall Morrison's treatment of Whewell, viz. his notion of 'consilience.'

a theory by known phenomena that generated the theory in the fist place." (**CC1998,** 481.) While the latter (Stephen Brush) maintain that "generally speaking scientists do not regard the fact that a theory predicts new phenomena…[rather] **scientists tend to consider known phenomena explained by a theory as constituting much stronger support than novel predictions**." (ibid.)

- According to Achinstein, both predicitonist and explanationist adhere to the **historical thesis**, which maintains that the interrelation among evidence *E*, hypothesis *H* (that *E* purports to support), as well as the notion of supportive strength thereon[4], **is based on the particular historical period in which they've arisen.** (481) Recall, for example, that this claim of historical contingency is supported by Glymour (**Lecture XVII**) who argued against Bayesian confirmation theory for similar reasons. For example, at least three different positions are based on the historical thesis, according to Achinstein's summary of Musgrave (1974): (482)
    a.) *E* supports *H*, only if *E* wasn't known when *H* was first proposed. (**purely temporal view**).
    b.) *E* is evidence for *H*, only if *H's* original proposal wasn't intended to explain *E* (**heuristic view**).
    c.) *E* is evidence for *H*,[5] only if *E* cannot be explained by some competing *H′* formulated prior to *H* (**successor view**).

  Achinstein asks:

> Is the historical thesis true or false? **I propose to argue that it is sometimes true, and sometimes false, depending on the type of evidence in question**…I will consider what implications, if any, this has for the debate between Brush and the predictionists. (482)

- We could extend Achinstein's question here to encompass Morrison's and Kitcher's claims: My basic conjecture is that **Kitcher would appear to defend an explanationist account, though he'd perhaps disagree with Achinstein that this means he must buy into the historical thesis**.[6] **Morrison, on the other**

[4] Recall the Confirmations who argued that the notion of strength of support is an inductive one, and based on the Bayesian algorithm. "Deductive chauvinists" (as mentioned in Kitcher's article), on the other hand, whether traditionally hypothetico-deductivist or of the latter-day explanatory-unificationism variety, would hold that evidential support strength is ultimately based on logical *derivation.*

[5] Musgrave switches to *T* (theory) notation, but for the sake of consistency I keep the *H* (hypothesis) notation. In this case, as in the Bayesian literature we've gone over, the *H* versus *T* distinction is a difference that doesn't make a difference in this context.

[6] Recall (**Lecture XX**) that for Kitcher, what scientific *explanation* and *theoretical know-how* share in common include the **internalization of a theory's argument patterns**. This essential feature (according Kitcher's realist views) is indispensable for the quest of the scientist (i.e. according to Kitcher, science's "global methodology") to achieve ***greater understanding*****.** All these points naturally seem to merit an **explanationist** position advocated by Kitcher. On the other hand, the set theoretic and logical machinery Kitcher introduces to construct the "explanation-as-unification" explanatory store *E*(*K*) (conceived of as a generating set) certainly leaves out the role of historical contingency as constitutive of explanatory strength.

hand, I claim would favor the historical claim, as she points out that it's a mtter of historical accident whether or not a scientific theory is developed well enough to subsequently *explain* its unifying activity.[7]

- Achistein offers two toy scenarios (482-484) to illustrate his above point. In one scenario, the hypothesis:

> H_D : Drug D relieves symptom S in approximately 95% of the cases.

Achinstein makes a clear-cut case that there are *other crucial factors besides* any logical connection between E and H_D alone which constitute the overall supportive strength of E with respect to H_D and hence the overall plausibility of H_D. Such "historical" factors include the *selection procedures* (*SP*): In other words, *what* statistical sampling strategy was employed, or more generally, *how was the experiment designed, in the evidence-gathering process.* For example, concerning the item of evidence:

> E : Given one sample of 1,000 (the experiment) suffering from S, 950 reported experiencing relief when taking D. Given another sample of 1,000 (the control) suffering from S, none reported experiencing any relief, when administered a placebo in place of D.

We'd agree *prima facie* that E provides strong supportive strength for H_D if the first selection procedure (*SP*1) was employed in gathering evidence E:

> *SP*1: A sample of 2,000 people was chosen, all suffering from S, **in a *random manner* independent of the race, age, sex, and geographical location of the subjects. A random procedure was adopted in deciding whether the subject would be administered D or the placebo.**

One the other hand, should some sampling procedure (*SP*2) be adopted instead, whose random procedures was stratified according to 2,000 five-year-old girls suffering S in some mild form, this would obviously undermine the supportive strength of E with respect to H_D . "If [E] was obtained by following *SP*2, then [E] is pretty weak evidence for [H_D], if it confirms it at all." (484) Moreover, imagine some other selection procedure (*SP*3) similar to *SP*1 save for the fact that the experimental group was given drugs D and D', in which the latter also relieves in 95% of cases but blocks the curative effects of D when taken together:

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[7] Recall **Lecture XX**: Unification is a heterogeneous activity that precedes explanation. ("Scientists unify first, explain later.") Morrison disdains any quest for an overarching philosophical accounts for unification, let alone explanation: "Philosophy ceases to be a metascience dictating standards of rationality and instead becomes a practical discipline whose normative forces arises out of cooperation with other disciplines." (**Lecture XX**, p. 7) **So in this respect, asking whether or not Morrison would favor the historical thesis on "fundamentally" explanationist or on predictivist grounds might prove itself to be a moot point.** She might answer: "yes to both," in the sense that sometimes the historical thesis makes most sense, based on the particular case-study at hand, from a predictivist standpoint. And in other case studies, from an explanationist standpoint.

> In **this** case, [i.e. *SP*3] [*E*] supports [H_D] **not at all.** And, again, whether this is so cannot be ascertained simply by examining the propositions [*E*], [H_D] or their 'logical' relationship. **We need to know an historical fact about** [*E*], viz. that the information it (truly) reports was obtained by following *SP*3. (484)

On the other hand, in the second toy scenario involving the lottery:

> H_L : John won the lottery.

The true evidence report *E*:

> *E*: 1,000 tickets were sold and John bought 999 of them. The selection procedure was fair, insofar as one ticket was selected at random.

…Seems *prima facie* to strongly support H_L **on the basis of the connection between *E* and H_L alone.** Different selection procedures (e.g., *SP*4, *SP*5, *SP*6) determining the establishment of *E* (by asking lottery officials, or standing next to the person who sold the tickets, or by consulting the published information in the newspaper, respectively) "unlike the drug example…[are] **completely irrelevant in determining whether, or to what extent, [*E*] is evidence for [H_L].**" (485)

- The lottery example is a case in which *E* is **empirically complete** with respect to *H*. The drug example isn't. By **empirically complete,** Achinstein states:

> [A] putative evidence statement [*E*] is *empirically complete* with respect to an hypothesis [*H*] **if whether, or to what extent, *E* is evidence for, or confirms, *H* depends just on what *E* reports, what *H* says, and the relationship between them. It does not depend on any additional facts**—e.g., facts about when *E* or *H* were formulated, or with what intentions, or on any (other) facts about the world. (485)

So, for instance, in the drug example *E* isn't empirically complete with respect to *H* because "[i]nformation in addition to *E* is necessary to determine the extent to which *E* supports *H*." (ibid.) Achinstein does admit in passing that in such cases of empirical incompleteness, the extra information required to ascertain *E*'s support of *H* may not be of a purely historical nature, yet this proviso is relatively insignificant for his claims as well as mine in these notes here.

- Achinstein's basic point is:

> [R]eturn[ing] to the original question proposed by Brush. Do predictions of novel facts provide stronger evidence than explanations of old ones…? My answer is this: **Sometimes a prediction provides better evidence for an hypothesis, sometimes an explanation does, and sometimes they are equally**

> **good. Which obtains has nothing to do with the fact that it is a prediction of novel facts[8] or that it is an explanation of known ones.** (487)

Achinstein revisits the drug scenario to bolster his points. The explanationist would cite *previous* studies ('drug *D has*…') as providing the best case for H_D, while he predictivist would cite some predictive claim ('drug *D will*…'). In both cases, argues Achinstein, the 'have' versus 'will' distinction flies in the face of the *real* issue at hand, in terms of supportive strength, namely, the nature of the selection procedure:

> [W]hat makes putative evidence have the strength it does **has nothing to do with whether it is being explained or predicted. It has to do with the selection procedure used to generate the evidence**…[t]his is what matters for confirmation. (488)

- Achinstein sweeps up his case by claiming that the normative aspect of Brush's explanationist position entails three claims, of which Achinstein disputes the first and third (489):

> 1.) Selection procedures for testing hypothesis *H* are flawed or inferior to those *ceteris paribus*[9] that bring in explicit consideration of alternatives.[10]
> 2.) Over time, scientists are likely to find actually plausible alternative copetitors to some hypothesis *H* …in other words, the procedure of claiming *H* based on *E* should ideally be slow and deliberate.
> 3.) With evidence known before the formulation and development of *H*, scientists (viz. claim 2.) above) have had more time to consider plausible alternatives to *H* than in cases dealing with novel predictions.

For instance, in the drug case, contra 1.) above the first selection procedure (*SP*1) for H_D "does not call for explicitly considering competitors to [H_D]…[y]et it does not seem flawed on that account." (ibid). Contra 3.) above:

> [A]n investigator planning a **future** trial can have as much time as she likes to develop a selection procedure calling for consideration of a competing hypothesis…[I]n designing a novel experiment to test some hypothesis *H* as much time may be spent in precluding competing hypotheses that will explain the test results as is spent in considering competing hypotheses for old data. (ibid)

- Whether or not one buys into Achinstein's points raised here, as well as his interpretation of the case study involving Hertz's 1883 hypothesis that cathode rays don't respond to presence of electric fields and hence are not comprised of

[8] The latter normative implication seems (on the surface) reminiscent of Carnap, who (recall **Lecture XVIII**) argued that 'predictions' can appeal to past explananda. (Recall the historian invoking some general law to explain/predict some past event.)

[9] "All things being equal"

[10] Recall here, naturally, the literature on Bayesian confirmation theory we explored, and the problems associated with testing alternatives (especially the 'catch-all.') In the case of explanation, consider van Fraassen's 'contrast class' *X* as bringing into explicit consideration alternatives.

electrically charged particle (a hypothesis that was subsequently disconfirmed by J. J. Thompson in 1897) is an interesting but separate issue from what points I like to raise here, in relation to our previous readings and our subsequently new section on theory underdetermination. My points are:

1.) Recalling footnotes 6. & 7. above it seems most plausible to seat Kitcher's realist-inspired unificationist thesis as supportive of Achinstein's concluding remark that the "have" versus "will" (i.e. explanation versus prediction-based evidence) distinction is undercut by more crucial issues like selection procedures. **However, Kitcher would *disagree* with Achinstein's larger claim that such issues would undermine general explanationist claims.** As mentioned in footnote 6. above, Kitcher certainly makes a case for why he would consider his characterization of scientific explanation as central to the global methodological quest of science for an increase of *understanding*. You don't get that from mere prediction alone.
2.) Morrison (as elaborated in footnote 7. above) **would certainly be sympathetic in Achenstein's case-by-case approach (that sometimes explanation prevails, sometimes prediction, and sometimes both)**. This falls nicely in line with Morrison's generally pluralist[11] views concerning the epistemics of unification and her generally deflationary account of explanation. (For her, in reference to the historical thesis, it's a matter of historical accident whether or not a scientific theory is sufficiently developed or evolved to provide an explanatory account of its unifiying activity.)
3.) In anticipation to the upcoming topics, are Achinstein's central points an instance of underdetermination?

[11] As mentioned in **Lecture XX**, thanks to questions brought up by Jessica Elmore, and Kevin Dwyer, and some of the responding points given by Stephen Mahanes, epistemic and methodological monists ultimately advocate that all reasoning and concepts can reduce to **one kind of entity or process.** Dualists say 'two' and pluralists say 'more than two.' Stephen Mahanes brought up an interesting case of **methodological monism** in ethics, in his example in which cited that if ethical claims don't reduce or agree on one kind of notion of property or predicate like 'goodness', then the very coherence of ethics is called into question. In general (recall Morrison's 'Kantian' notion of unification) methodological monists invoke reduction to one kind of reasoning/method **as a process or procedure.** (Kant, for instance, assumed that notions like unity in the world and knowledge were regulative ideals, necessary for cognition to do its work, and not metaphysical principles: Scientific *presupposes* unity but won't *find* such unity). Epistemic monists would invoke reduction to one kind of concept or concept-type (focusing hence more on the products of reasoning). Metaphysical monists, on the other hand, argue that ultimate reality is fundamentally constituted by one kind of entity. For example, materialists are metaphysical monists, as they maintain that ultimate reality is reducible to the category of matter alone. Notice the word 'reduction' here, how often it's used in the discussion of monism. *Monism presupposes reductionism (whether methodological, epistemic, or metaphysical*). On the other hand, the connection between pluralism and reductionism is less clear. On the one hand, like Morrison does, one can argue that explanatory reduction is not the same as reduction in the case of unification. On the other hand, one can adopt an extreme anti-reductionism (or holism) which tends to occur among metaphysical *anti-essentailists*, i.e. those who deny in the exstence of essences, or necessary properties. Metaphysical anti-essentialists argue that all properties are contingent. Hence, to give an example, *pace* Aristotle if the property 'rational' is merely contingent, and not necessary to the notion of 'human', then one could not *reduce* talk of 'man' to 'rationality.'