

# BOYD'S "EVIDENCE ENRICHED"

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Aim: In light of modern scientific practice, what must scientific theories be constrained by?

## van Fraassen's Empiricism

van Fraassen's answer: empirical adequacy.

Roughly (and as Konstantinos mentioned), a theory  $T$  is empirically adequate just in case there is a model  $\mathfrak{M}$  of  $T$  such that the empirical sub-structure of  $\mathfrak{M}$  is "isomorphic" to the data-structure.

## vF's Observable

The distinction between observable and non-observable is of central importance to vF and to the traditional empiricist programme.

vF doesn't touch this topic in the paper but has a rather detailed discussion in his *The Scientific Image*. See esp. §2 "Arguments Concerning Scientific Realism." There we find a heuristic (not! a definition as vF stresses):

$X$  is observable if there are circumstances which are such that, if  $X$  is present to us under those circumstances, then we observe it.

Note that on this criterion moons of Jupiters are observable but electrons are not.

## Why the Need for Enriched Evidence?

Dearth of arguments for vF's empiricism. Rosen ("What is Constructive Empiricism", 157):

The naive realist who approaches van Fraassen's work looking for reasons to change his mind will find surprisingly little to go on. Van Fraassen often writes as if his aim were simply to show that one may be a constructive empiricist - that the stance he favors is not irrational

[A] theory is empirically adequate if it has some model such that all appearances are isomorphic to empirical substructures of that model.

van Fraassen, *The Scientific Image*: 64.

vF modifies and refines this in his *Scientific Representation*. Boyd's last section discusses her account with the later vF. I won't discuss that today but feel free to ask me!

...on the face of it, not irrational to commit oneself only to a search for theories that are empirically adequate, ones whose models fit the observable phenomena, while recognizing that what counts as an observable phenomenon is a function of what the epistemic community is (that observable is observable-to-us)  
ibid.

I don't know but none of the objections I've come across seem fatal to vF's empiricism in the way some objections to the logical positivists seem. Does anyone know? Let me know!

Observable/Unobservable distinction (Churchland, Hacking, ...)

Scientific Practice

Strangely, Boyd doesn't mention any of these. I suspect this is because Boyd's own account – in so far as it is an empiricist account – faces similar worries. Then what's the motivation for her account? To explain the practices of modern science? Sure but I have my reservations about that. To be fair, Boyd lists three advantages of her account. We'll circle back to them later.

← COAL

## Enriched Evidence

The evidence with respect to which empirical adequacy is to be adjudicated is made up of **lines of evidence** enriched by **auxiliary information** about how those lines were **generated**.

Boyd lists out her allies: Bogen & Woodward, Chang & Fisher, and (to some extent) Leonelli.

## Lines of Evidence

By "line of evidence" I mean a sequence of empirical results including the records of data collection and all subsequent products of data processing generated on the way to some final empirical constraint.

*The records of the data as transformed by the sequence of data-processing steps—as well as the original records of data collection—are all what I will call "empirical results."*

Additionally empirical results must not be *maladapted* to the theory which it constrains. Recall the classical Chinese astronomy example. When is an empirical result? Boyd writes that an empirical result

...is well adapted either when all of the presuppositions that have been incorporated into it throughout the course of data collection and processing are formally compatible with the theory to be constrained or else their incorporation does not make a relevant difference to the constraint.

## Auxiliary Information

Important for Boyd because of the *inconsistency* of empirical results.

By "auxiliary information", I mean the metadata regarding the provenance of the data records and the processing workflow that transforms them.

Boyd distinguishes provenance and workflow metadata.

Sure if evidence just is empirical results (*say* what scientists report) then it is trivially inconsistent. One needn't give examples of the Hubble parameter

← Gem: good examples.

to show that as Boyd does. Even within an experiment inconsistencies arise. But no one believes that evidence is so thin. Indeed some think that evidence is knowledge. See Williamson *Knowledge and its Limits* and Bird *Knowing Science* for accounts of evidence as knowledge in philosophy of science. This is a strawman. Many instances of equivocations of evidence and empirical results throughout the paper.

← COAL

Boyd concludes:

Epistemically responsible use of empirical results (such as data) depends on access to their associated metadata: data can never be permanently decoupled from their associated enriching information and retain epistemic utility. Epistemically useful data are never fully liberated of the details of their provenance; their utility derives from their enrichment by such details.

### *Three Advantages*

#### *Underdetermination*

Boyd asks:

Given that empirical results are often heavily processed and often involve presupposing resources from the very theory that they are generated to constrain, how is it that the same evidence could be used to constrain alternative theories?

Answer: Enriched evidence can be used in different contexts.

But this is not the problem of underdetermination.

#### *Accumulation*

No idea what's going on here. Boyd asserts that enriched evidence "make[s] sense of how evidence produced using significantly different instruments and techniques might be fruitfully combined" and gives an example but concludes just by saying that combining results "requires knowing what presuppositions have gone into those results."

But what's new? Again no one thinks that empirical results (not evidence!) can be combined wily-nilly.

#### *Amalgamation*

...it may be possible to salvage a constraint in the new context, as long as enough information is available about how the result in question was generated to backtrack through the stages of data processing in order to find a

product of an earlier stage that is adaptable to the theory to be constrained and reprocess using its own resources, thereby generating a well-adapted result.

#### *Enriched Evidence Cannot Do Any Work*

Evidence is evidence for a hypothesis (or theory). But enriched evidence is too fine grained. For example, Boyd suggests that on enriched evidence:

Hubble's estimated value of a rough 500 km/s/Mpc conditioned on the presuppositions with which it was generated should not be inconsistent with the Planck satellite value of  $67.8 \pm 0.9$  conditioned on the presuppositions with which it was generated.

Let the first be  $e1$  and second  $e2$ . Consider now a hypothesis in cosmology which predicts the value of the Hubble constant as  $H$ . How should we go about confirming the hypothesis? That all three point to the same parameter value is not obvious. Indeed it's a bit of a miracle.

How much of an improvement is it of vF's views? Except being cordial with scientific practice it doesn't seem an improvement.

#### *Evidence Enriched But Empiricism Impoverished*

Is enriching evidence in tension with the empiricist guiding principle about putting observation as the central pillar of our epistemology?



#### *Works Cited*

Ask me!