1. **Background**

The No Miracles Argument (NMA) is the foremost argument for scientific realism (SR).

Typically, the NMA is typically presented as follows:

P1. Our best scientific theories are empirically successful.

P2. That our best scientific theories are approximately true best explains why they are empirically successful.\

C. Our best scientific theories are approximately true.

Musgrave thinks that this formulation is too crude, so he refines it, and then defends this refined version against some well-known objections.

1.1. **What is an inference?**

The NMA is an instance of a broader pattern of inference called *Inference to the Best Explanation (IBE)*. An inference is a set of propositions such that one member of that set, the conclusion, can be affirmed on the basis of the others, the premises.

In **deductively valid** inferences, the conclusion is *necessarily true* if all of the premises are true. In **inductively strong** inferences, the conclusion is *probably true* if all of the premises are true. An inference is **sound** if it is deductively valid or inductively strong and all of its premises are true.

2. **Inference to the Best Explanation (IBE)**

2.1. **The Classic Formulation of IBE**

Typically, IBE is assumed to be an *inductive* inference having the following form:

CF1. $F$ is a fact.

CF2. $H$ best explains $F$. [probably]1

CF3. $\therefore H$

Here “$F$” and “$H$” stand for declarative sentences, which are typically called *propositions*.

2.2. **Musgrave’s rejection of the classic formulation**

Musgrave thinks that IBE should be *deductively valid*. Yet it’s clear that IBE is, at best, only inductively strong, e.g.:

Suppose that I hear scratching in the walls, see nibbling in the cheese, etc. and that there are a far greater number of mice than lizards (e.g. 99999999:1) in my area. The best explanation is that a mouse is in the house, but in fact, my houseguest is a rare lizard.

2.3. **Musgrave’s reformulation**

M1. It is reasonable to believe that the best explanation of any fact is true.

M2. $F$ is a fact.

M3. Hypothesis $H$ explains $F$.

M4. No available competing hypothesis explains $F$ as well as $H$ does.

M5. $\therefore$ It is reasonable to believe that $H$ is true.

Musgrave’s major revision to the classical formulation of IBE is to transform it from a pattern of inference about what’s true to a pattern of inference about what’s reasonable to believe.

2.4. **Skeptical Objection to M1**

O1. It is possible that the best explanation of some facts is false (think of the mouse & lizard example above).

O2. If it is possible for a proposition to be false, then it is unreasonable to believe that it is true.

$\sim$M1. $\therefore$ It is not reasonable to believe that the best explanation of any fact is true.2

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1 I’ll often present arguments in this manner, which is called standard form. Inductive inferences will have the subscripted “[probably]” in between the last premise and the conclusion. Deductive inferences will have no subscript.

2 It’s standard logical notation to abbreviate the expression “It’s not the case that…” with “$\sim$”. For example, “$\sim$Khalifa is a ballerina” is equivalent to “Khalifa is not a ballerina.” Sometimes, I’ll use this symbol, so don’t be freaked out by it.
Musgrave’s reply: O2 is too strong, for it would mean that we only know necessary truths (math, logic) but nothing contingent or empirical.

2.5. Empiricist Objection to M3
Can’t the empiricist offer an explanation of science’s success?

M1. It is reasonable to believe that the best explanation of any fact is true.
M2. F is a fact.
E3. Hypothesis \(H^*\) explains \(F\): \((H^* = H \text{ is empirically adequate/it's as if } H)\)
M4. No available competing hypothesis explains \(F\) as well as \(H\) does.
EA. \(\therefore\) It is reasonable to believe that \(H\) is \textit{empirically adequate}.

Musgrave’s reply: But \(H^*\) is no explanation of \(F\). “The hypothesis that it is raining explains why the streets are wet—but ‘The phenomena are as if it were raining’ does not.”

2.6. Empiricist Objection to M1 (not considered by Musgrave)
Why not replace M1 with a weaker empiricist principle?

E1. It is reasonable to believe that the best explanation of any fact is true \textit{empirically adequate}.
M2. \(F\) is a fact.
M3. Hypothesis \(H\) explains \(F\).
M4. No available competing hypothesis explains \(F\) as well as \(H\) does.
EA. \(\therefore\) It is reasonable to believe that \(H\) is \textit{empirically adequate}.

3. The NMA, 1st Revision
So far, we’ve been dealing with the general structure of IBE without looking at its particular application in the scientific realism debates. However, recall that the NMA is an instance of IBE.

Assuming that Musgrave’s version of IBE is defensible (see §2.3), how would it justify scientific realism?

M1. It is reasonable to believe that the best explanation of any fact is \textit{true}.
NM2. It is a fact that our best scientific theories are \textit{empirically adequate}.
NM3. The hypothesis that our best scientific theories are \textit{true} explains why they’re \textit{empirically adequate}.
NM4. No available competing hypothesis explains why our best scientific theories are \textit{empirically adequate} as well as the hypothesis that they’re \textit{true} does.
SR*. \(\therefore\) It is reasonable to believe that our best scientific theories are \textit{true} is true.

3.1. Objection to NM2

We can never know that our best theories are empirically adequate.

Musgrave’s reply: NM2 only requires that our best theories \textit{are} empirically adequate, even if we don’t \textit{know} that they are empirically adequate.

3.2. Objection to NM4

The empiricist explanation of science’s empirical adequacy is at least as good as the realist (truth) explanation.

Musgrave’s reply:
P1. The empiricist explanation of a theory’s empirical adequacy is that theories are empirically adequate because they’re empirically adequate.
P2. Circular explanations (i.e. statements of the form \(F\) explains \(F\) or \(F\) because \(F\)) cannot be the best explanation.
P3. The realist explanation is noncircular.
C. \(\therefore\) The empiricist explanation is worse than the realist explanation of a theory’s empirical adequacy.

4. Partial truth: 2nd Revision to NMA

4.1. The pessimistic induction: a challenge to NMA

PI. Our best theories in the past are false. [probable]
~SR. \(\therefore\) Our best theories in the present are false.
4.2. Partial vs. approximate truth

Typical realist response to the Pessimistic Induction: Insofar as our past theories were empirically successful, they were *approximately true*.

- Ex. Copernicus’ assumption that the planetary orbits are *circular* is an approximation of the modern idea that they’re *elliptical*.

This concept faces a number of technical difficulties.

Musgrave: a more straightforward way to account for the “partial success” of sciences is to replace the notion of *approximate* truth with *partial* truth.

- Ex. “All swans are white” is *strictly false*, but *partly true*, insofar as it entails the true statement that “All swans in Europe are white.”

Generally, a theory $T$ is *partly true* if there is some set of conditions $C$, such that in $C$, $T$ makes correct predictions and unobservable nature behaves as $T$ says it does. ($C$ is sometimes specified in terms of domains or limiting cases.)

4.3. Implications for NMA

Note that we need to change the NMA accordingly:

**M1.** It is reasonable to believe that the best explanation of any fact is true.

**NM2.** It is a fact that our best scientifi c theories are empirically adequate.

**PT1.** The hypothesis that *parts of our best scientific theories are true* explains why they’re empirically adequate.

**PT2.** No available competing hypothesis explains why our best scientific theories make novel predictions as well as the hypothesis that they’re partly true does.

**SR**. ∴ It is reasonable to believe that *parts of our best scientific theories are true*.

5. Novel success: 3rd Revision to NMA

5.1. Restricting empirical success

Some theories/hypotheses are used to *accommodate* evidence that is already known. Moreover, this evidence is used in the very construction of the theory/hypothesis. The fit between theory and evidence in such cases does not require a realist explanation. Rather, accommodation is easily explained by the intentions and actions of the theorist.

Thus, we need to restrict the *kinds* of empirical success that the realist is out to explain. Specifically, we must restrict realist explanations to *novel empirical success*:

- A theory’s fit with the empirical data is *novel* when the data was not used to construct the theory.

5.2. Implications for NMA

As before, we must revise the NMA in light of these considerations. Specifically:

**M1.** It is reasonable to believe that the best explanation of any fact is true.

**NP1.** It is a fact that our best scientific theories *make novel predictions*.

**NP2.** The hypothesis that *parts of our best scientific theories are true* explains why they *make novel predictions*.

**NP3.** No available competing hypothesis explains why *our best scientific theories make novel predictions* as well as the hypothesis that they’re partly true does.

**SR**. ∴ It is reasonable to believe that *parts of our best scientific theories are true*. 


Food for thought:

• We have four different versions of the NMA (§§1, 3, 4.3, 5.2), each of which builds off of its predecessor. What do you find most interesting about this progression?
• Musgrave rebuts some objections to the NMA in earlier sections, and appears to assume that these rebuttals will carry through to subsequent versions of the NMA. Agree or disagree? For instance…
  o Does Musgrave adequately defend M1? If not, what are the implications for any of his uses of IBE? Are you willing to accept those consequences? Is there a better way of glossing IBE that doesn’t involve M1?
  o In §3 the empiricist explanation of empirical adequacy was deemed circular. Is the empiricist explanation of novel prediction, as would be required by the final version of the NMA presented in §5.2, also circular? If not, is it a worse explanation of novel prediction than the realist explanation?
  o Is the explanation of novel empirical success in terms of partial truth a good explanation? Can you think of alternative explanations?