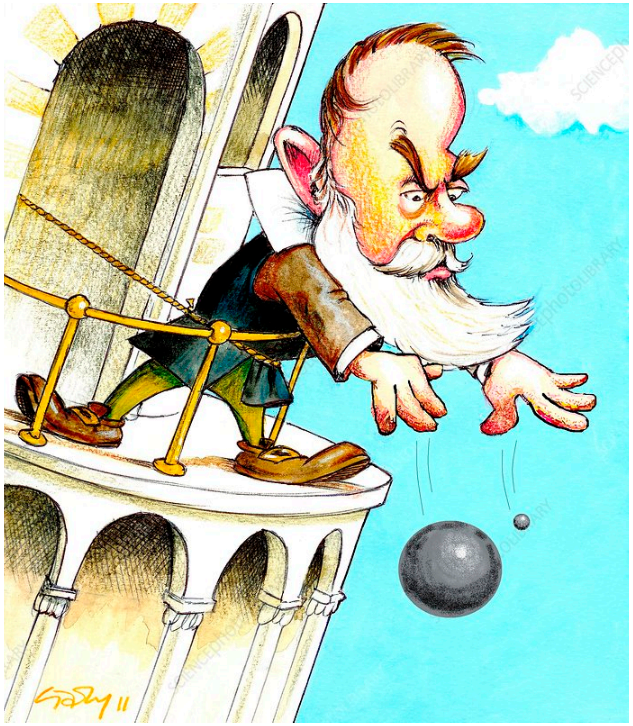


Philosophy of Science

Why thought experiments do not transcend empiricism II

Chapman University. PHIL321. Lecture 16. 10/21/2021.
Kelvin McQueen

W8 discussion board posts: due (10/23)

- **Post 1**: In your own words, identify a specific point of disagreement between Brown and Norton. Then, explain who you agree more with and why. 200-300 words.

- **Post 2**: Provide constructive feedback to a post on another student's thread. 150-250 words.

Assignment Rubric Details ×

Discussion Board Posts

Criteria	Ratings			Pts
Post 1 Response to prompt	**5.0 pts** **Excellent** The post clearly answers the prompt, demonstrates understanding of the reading, and illustrates independent thinking.	**3.0 pts** **Adequate** The post attempts to answer the prompt, demonstrates partial understanding of the reading, but lacks independent thinking.	**1.0 pts** **Inadequate** Does not provide clear answer to the prompt and does not demonstrate understanding of the reading.	5.0 pts
Post 2 Constructive feedback	**5.0 pts** **Excellent** The post responds clearly to another student's post, offers constructive ideas, and is respectful.	**3.0 pts** **Adequate** The post attempts to respond to another student's post, but lacks either constructive ideas or respectful language.	**1.0 pts** **Inadequate** Does not respond to another student's post in way that demonstrates thoughtfulness.	5.0 pts
				Total Points: 10.0

Norton's primary claims

- A thought experiment is an (empiricist-friendly) *argument* that is *disguised* in a pictorial or narrative form.
  - The *premises* are consistent with empiricism. They are either:

    (i) Synthetic *a posteriori*; or

    (ii) Analytic *a priori*.
  - The *inference to the conclusion* is consistent with empiricism. It is either:

    (i) deductive; or

    (ii) inductive.

- What Brown calls "mathematical intuition" is mysterious!
  - We have no account of how it gives "access" to "abstract objects".
  - We have no account of how it might go wrong, so we have no way to resolve thought experiment / anti-thought experiment pairs.

Brown's three counterexamples

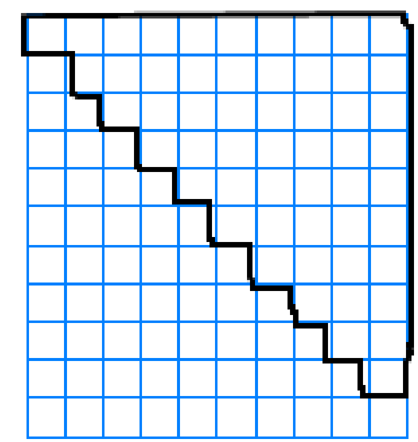
1) Galileo's thought experiment.
- The *output* is synthetic knowledge of a law of falling bodies.
- There is *insufficient input from experience* to explain this output.
- So, the *output* must be explained by *input from a priori intuition*.

2) The *picture proof* of $1 + 2 + 3 + \ldots + n = (n^2 + n)/2$.
- The *output* is (synthetic?) knowledge of a law of numbers.
- There is *insufficient input from mathematical premises* to prove this *output*.
- So, the *output* must be explained by *input* from *a priori intuition.*

3) The picture (darts) disproof of the continuum hypothesis.
- This one is beyond the scope of our course!
- Its interest lies in the fact that the hypothesis is provably independent of all known mathematical axioms, so a thought experiment that disproves it can't (even implicitly) be using those axioms as premises.

Brown's counterexample

- Mathematical law:
  - $1 + 2 + 3 + \ldots + n = (n^2 + n)/2$
- Proof by thought experiment:



- Brown's response to Norton:
  - You can *intuitively* see that this thought experiment justifies the law without (even implicitly) grasping the argument-form proof (see next slide).
  - If so, thought experiments are not (always) disguised arguments.

The argument-form proof "by induction"

- Step 1: base case
  - Prove that the law is true for the first value of n (i.e. $n=1$).
- Step 2: inductive hypothesis
  - *Assume* that the law is true for the k^{th} value of n.
  - $1 + 2 + 3 \ldots + k = k((1 + k)/2)$.
- Step 3: inductive step
  - Use the inductive hypothesis to show that the law is true for the $k+1^{th}$ value of n i.e. show that:
  - $1 + 2 + 3 \ldots + k + (k+1) = (k+1)((1 + (k+1))/2)$.
  - $1 + 2 + 3 \ldots + k$ can be replaced by $k((1 + k)/2)$, given step 2.
  - The rest just uses algebra to transform the left side of the equation into the right side, thereby proving the equality (next slide).

$$\frac{k(1+k)}{2} + (k+1)$$

$$= \frac{k(k+1)}{2} + \frac{2(k+1)}{2}$$

The common denominator is 2

Add the fractions

$$= \frac{k(k+1) + 2(k+1)}{2}$$

Simplify the numerator

$$= \frac{k^2 + k + 2k + 2}{2}$$

$$= \frac{k^2 + 3k + 2}{2}$$

Factor the numerator

$$= \frac{(k+1)(k+2)}{2}$$

The term $(k+2)$ is the same as $((k+1)+1)$

$$= \frac{(k+1)((k+1)+1)}{2}$$

Norton's reconstruction of Galileo's TE

1. Assumption for reductio proof:
   - The speed of fall of bodies in a given medium is proportional to their weights.
2. From 1:
   - If a large stone falls with 8 degrees of speed, a smaller stone half its weight will fall with 4 degrees of speed.
3. *Added Assumption* (weight creates *drag*):
   - If a slower falling stone is connected to a faster falling stone, the slower will drag the faster and the faster will speed the slower.
4. From 3:
   - If the two stones are connected, their composite will fall slower than 8 degrees of speed.
5. *Added Assumption* (weight is *additive*):
   - The composite of the two has greater weight than the larger.
6. From 1 and 5:
   - The composite will fall faster than 8 degrees.
7. Conclusions 4 and 6 contradict.
8. Therefore, we must reject assumption 1.
9. Therefore, all bodies fall alike, despite their weights.

Brown's response (p30-1):

9 does not follow from 8 without also assuming: *The speed of falling bodies depends only on their weights.*

Galileo's insight applies not just to weight, but *to any extensive property imaginable.* This goes well beyond anything that Galileo could have experienced. This general conclusion is therefore *a priori.*

Three counterexamples to empiricism?

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- So, the *output* must be explained by *input from a priori intuition*.

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- The *output* is (synthetic?) knowledge of a law of numbers.
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