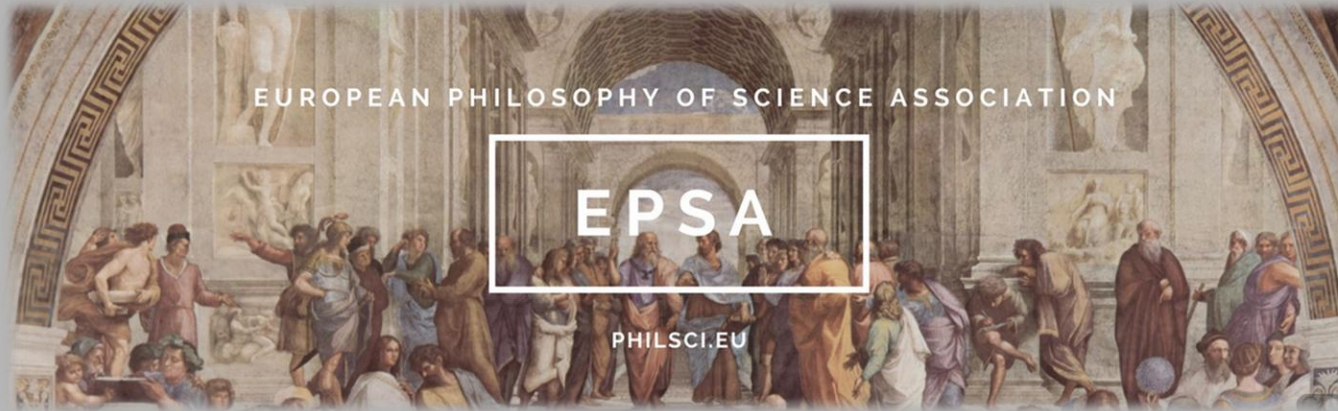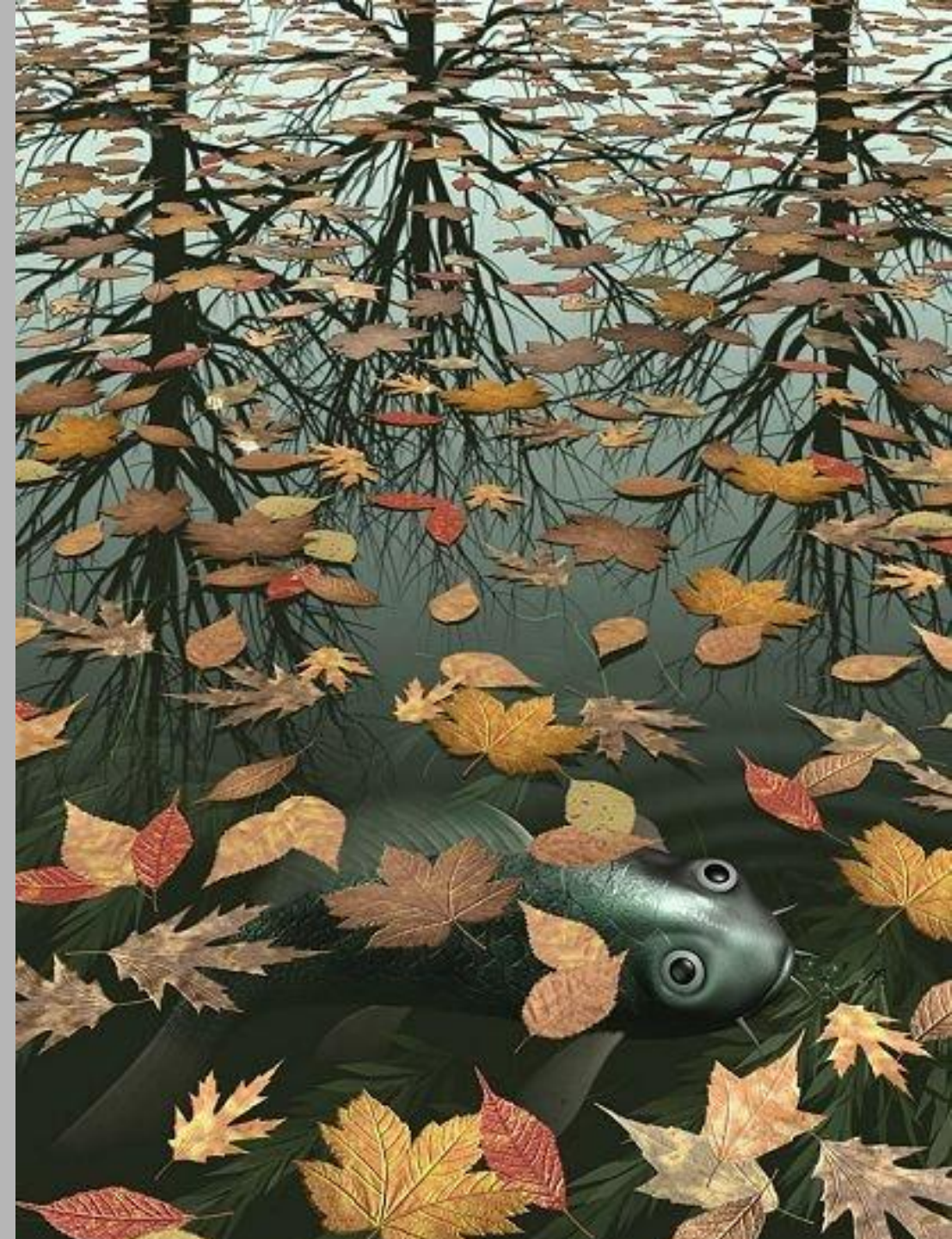# The space of (un)conceived alternative (spacetime) theories

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EUROPEAN PHILOSOPHY OF SCIENCE ASSOCIATION

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The New Induction: classifying its critics

What is it to conceive of an unconceived theory?

What a space of theories could (not) be

A space of (un)conceived alternative spacetimes

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The argument consists of three parts.

1. The justification of eliminative inference:

> **Problem of unconceived alternatives** (**PUA**). For theoretical science, *eliminative inferences* are unreliable, because there exist scientifically serious, and at least empirically equivalent alternative theories that scientists are not taking into account.

2. throughout history, scientists consistently fail to exhaust the space of serious alternatives, because of successor theories:

> **Recurrent transient underdetermination** (**RTU**). Theorists in the past have repeatedly failed to consider scientifically serious alternatives: namely those that came to be accepted later. (see also Mathias Egg 2016)

Our current time is no exception to that:

> **New (meta-)Induction** (**NI**). Past *theorists* can be considered as having the same cognitive capabilities as current theorists. So, by induction, current *theorists* are *also* suffering from PUA when endorsing a theory.

→ So we cannot trust our current theories to be true.
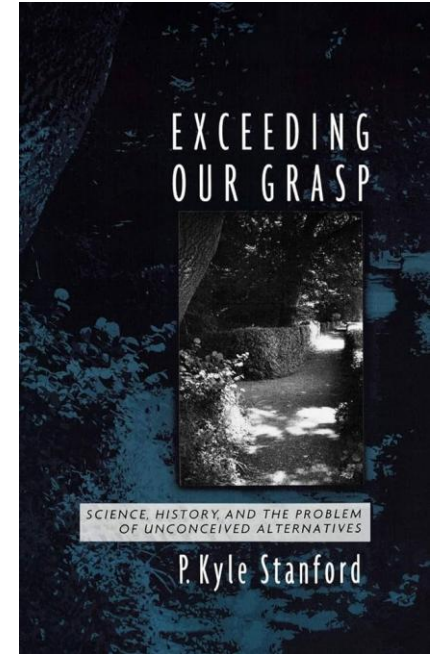
A (tractable) literature of counterarguments

Abbr.	Argument	
(COMM)	Individual scientists may not exhaust the space of serious alternatives, but a **scientific community** as a whole can.	(Godfrey-Smith2006); (Forber2006); (Ruhmkorff2011).
(PAST)	The **past epistemic moment** is qualitatively worse off than in the present: methods, checks, incentives, … .	(Godfrey-Smith2006); (Roush2010); (Devitt2011); (Park2016); (Fahrbach2017); (DawidHartmannSprenger2015); (BuonocoreMargoniPera2023).
(SERIOUS)	It is not sufficiently clear what a "**serious**" (or "**relevant**", "**plausible**") alternative is.	(Votsis2006); (Magnus2006); (Silva2022).
(LONGUE)	**In the long run** we may exhaust all the alternatives.	(Ruhmkorff2019).
(CONSTR.)	There are tight **constraints** on (or limits to) the set of (unconceived) alternatives.	(Shimony1970); (Earman1992); (Boyd1991).
(RED)	The New Induction **reduces** to the (old) PMI (or weaker: solutions to PMI will likely solve NI too)	(Magnus2006); (Chakravartty2007); (Brigandt2007); (Harker2007); (Saatsi2009); (Hoyningen-Huene2011); (Alai2022); (BuonocoreMargoniPera2023).
(SELECT)	A suitable **selective** realism will be able to account for continuity in theory change (causal knowledge/)	(Enfield2008); (Harker2010); (Psillos2011); (Chakravartty2010); (Votsis2011); (Egg2016).
(INDIV.)	Not clear how to **individuate** a theory: use a more coarse-grained individuation or theoretical equivalence.	(Mulder202?); (Ruhmkorff2011) mentions this briefly.
(BASE)	**Bad inductive base** or incorrect sampling of (first- and second-order) evidence.	(Harker2006); (Votsis2006); (Wray2008); (Bird2020).
(SELF-DEF.)	Stanford's argument is somehow **self-defeating**.	(Mizrahi2014,2016).

(**COM**) Godfrey-Smith (2007) and Forber (2008):
- **Individuals** may fail, but **science as a whole** need not !
- The very history Stanford surveys shows *at least some* alternatives were eventually conceived.
- Especially for mature sciences, the number of alternatives may be small enough for communities to cover.
  - → Today, the scientific community is *much* larger.

(**PAST**) **Methods** seem to have improved (Devitt 2011, Godfrey-Smith):
- peer review, Big Science;
- institutionalized training, data collection standards;
- improved communication and information flow.

Stanford's reply: Big Science funding, peer review, and professional incentives actually **discourages developing radical alternatives.**
- → these structures incentivise **theory conservatism**
- → so communities may not be as epistemically strong as hoped.

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(**PUA**) claims that these unconceived theories *exist.*

A **conceived** theory exists: on paper, or in our epistemic practices,
or – at least abstractly – in our minds.

But what does it mean for an **unconceived** theory to exist?
Three options:
1. They waiting in the **Platonic** realm for us to remember them.
2. They have a **potential existence** in terms of possible future conception: candidates awaiting discovery.
3. They exist *logically* in the sense of a **possibility-space**: theories are members of a set of logically possible descriptions of phenomena.

Stanford seems to refrain from heavy metaphysical commitments.
→ Perhaps a modest version of 3:
- (**PUA**) reformulated: there exist many logically possible theory-structures that *could* explain the data.
- Humans have only ever explored a tiny fraction of this logical space.
- Therefore, many serious unconceived theories exist in possibility space, whether or not they are ever actualized.
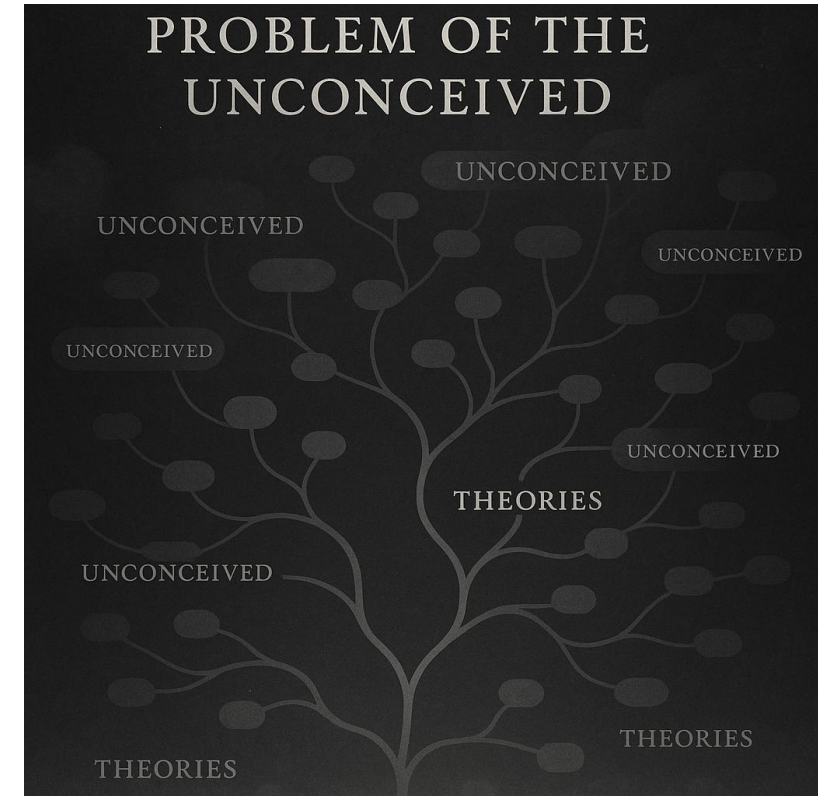
(conceived of by ChatGPT)

(Buonocore, Margoni, Pero, 2023) argues that Stanford overlooks an important distinction:
- **Unconceived but conceivable**: compatible with the evidence and *background assumptions of the time*, but simply not formulated.
- **Unconceived but inconceivable**: impossible to formulate at the time due to background assumptions that formed empirical, methodological, or theoretical limitations.

Newton could not have conceived of special relativity because he lacked:
- **experimental results**, like Fizeau's and Michelson–Morley's experiments;
- **conceptual frameworks**, like Lange's inertial frames; and absolute simultaneity by Mach and Hume.

Claim: if unconceived alternatives are conceivable, Stanford's argument is **restricted** to revolutionary science.
But if they are inconceivable, Stanford's argument is **weak**, leaving room for a tamed realism.

I think this is very helpful – but not *per se* as an argument against Stanford.
- conceiving an alternative theory can be taken to be independent of background assumptions.
- Rowbottom's (2016) extension of Stanford's argument to unconceived observations, models, methods, instruments, and values, will **cover the background assumptions.**

→ This analysis at least shows that Stanford's conception of the space of unconceived theories is **atemporal**.

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It genuinely matters for Stanford's argument how large the Space of (Unconceived) Alternatives (**S(U)A**) is!

Stanford makes it plausible that:

> (**Sufficiency**): There are currently, in all probability, scientifically plausible unconceived alternatives to our best scientific hypotheses about fundamental aspects of nature. (Ruhmkorff 2011, p.880)

Ruhmkorff argues Stanford hasn't shown the logically stronger claim that the space of alternatives is inexhaustible. So there is no conclusive argument for:

> (**Plenitude**): No matter how many previously unconceived scientifically plausible alternatives become conceived, there will remain, in all probability, scientifically plausible unconceived alternatives to our best scientific hypotheses about fundamental aspects of nature.

Counterarguments that directly depend on the size of the space: (**COMM**), (**PAST**), (**CONSTR.**) and (**LONGUE**).
→ if (**Sufficiency**) is true but not (**Plenitude**), then with enough scientists and distributed effort, we could conceivably exhaust SUA, or at least approximate exhaustion closely.

Can we say more about the **structure** of this space?

The space of (un)conceived alternatives (S(U)A) to a given theory T: the structured set of possible theories that differ from T along theoretical, mathematical, empirical, or explanatory dimensions, such that each point in this set represents a consistent, potentially serious, and sufficiently distinct, candidate for describing the same empirical domain.
→ If they posit *more* structure than T, there exists a well-defined limiting procedure to reproduce the same structure as T.

1. Put a currently leading theory T at the **centre** of a space.

2. **Points** represent atemporal (un)conceieved alternative theories.

3. **Distance metric** captures how *different* an alternative is from T:
    *   Nearby points: variations of parameters, small structural tweaks, ..
    *   Further points: new formalisms but same domain.
    *   Far-away points: totally new ontology or conceptual scheme.
    *   Furthest away: not humanly conceivable.
        → Thus metric combines structural, empirical and conceptual dissi

4. **Topology** what counts as a "neighbour" vs. a "radically distinct" rival
    *   Families/clustering,
    *   Theory individuation/equivalence (density; continuity vs. eff, discr
    *   Connectedness (e.g., through limiting procedures).

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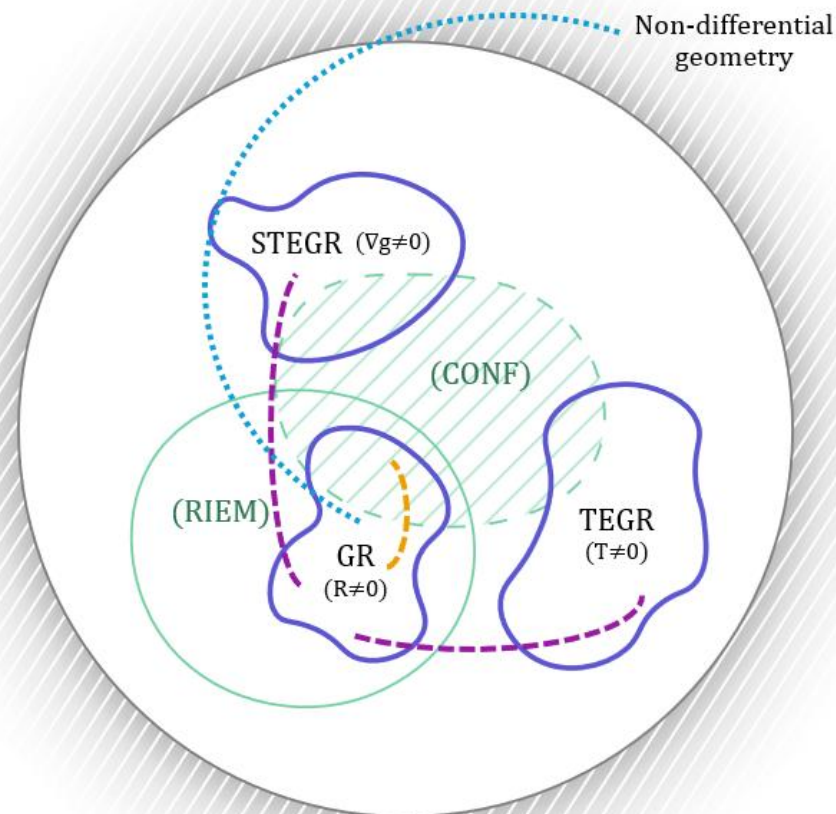
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Lehmkuhl, Schiemann, Scholtz (2016): we don't yet have a full map of the solution space of General Relativity (GR), let alone of all possible relativistic spacetime theories.

However, they show some control over the solution space of spacetimes:
- there are **conceived alternatives**: teleparallel theories (incl. TEGR and STEGR), Weyl geometry, Riemann–Cartan geometry, general metric-affine theories, scalar–tensor theories.
- there are methods for systematically comparing GR with rival theories, like **Parameterized Post-Newtonian framework (PPN)**.

I believe equivalence proofs and non-equivalence proofs (like Weatherall & Manchak 2014; cf. Dürr and Ben-Menahem 2022, Mulder 2025, 202?, Robert 202?) give **inter-connections** within the space of spacetimes:

- (**CONF**): The alternative metric is conformally related to the standard metric: $\tilde{g}_{ab} = \Omega^2 g_{ab}$.
- (**RIEM**): Geometric geometries must be pseudo-Riemannian.
- (**DIM4**): The manifold has 3+1 dimensions.
- (**HAUS**): Points can be kept apart by open sets.

(Mulder 2025, p. 13)

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