Finding Space in a Nonspatial World

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The Two Images

- The manifest image: How things appear to be in everyday perception and thought.

- The scientific image: How things are according to science.

Space in the Manifest Image

- Space in the manifest image is

  - Euclidean

  - Three absolute dimensions of space in one absolute dimension of time

  - Fundamental

Space in the Scientific Image

- Space as revealed in the scientific image is
  - Non-Euclidean
  - Four-dimensional spacetime without absolute space or time
  - Perhaps non-fundamental

Finding Space

- How do we locate space as we experience it in the world as described by physics?

- We need to move from *spatial primitivism* to *spatial functionalism*.

Plan

1. The Case of Color
2. The Case of Space
3. Motivating Spatial Functionalism
4. What Functional Analysis?
5. Virtual Reality and Skepticism

The Case of Color

- Vision presents a world of colored objects

- Colors seem to be primitive acquaintable qualities on the surface of objects.

The Edenic Model of Color

- Edenic redness: primitive redness, as it was in the Garden of Eden (a place where things are exactly as in the manifest image).

- In color experience, we're presented with an Edenic world of primitive color qualities

The Fall From Eden

- Color scientists ate from the Tree of Science, and discovered that we do not live in Eden

- Objects don't have primitive color qualities

- Just complex surface reflectances and a causal chain to color experience

Color as an Illusion

- Galileo's reaction: objects in the world aren't really colored. Colors exist only in the mind.

- Apples aren't really red, grass isn't green.

- This is *eliminativism:* the manifest image is eliminated in favor of the scientific image.

Compatibilism

- A better reaction: apples are still red, grass is still green.

- Even though we don't live in Eden, objects still have colors.

Colors as Complex Properties

- We reidentify colors, not as primitive qualities but as surface reflectances (and other physical properties that affect light)

- In effect: redness is now identified as that physical quality that is causally responsible for our experiences of redness.

From Color Primitivism to Color Functionalism

- We've moved from *color primitivism*: colors are primitive Edenic qualities

- to *color functionalism*: colors are whatever is normally causally responsible for our color experience

Concepts vs Properties

- Note that this view doesn't require that color properties are functional properties (they may e.g. be physical properties)

- But it suggests functionalism about color concepts, on which colors are conceived as whatever causes color experience.

- Minimal view: a causal theory of reference to color properties.

Imperfect Realism

- There is are no perfect colors: colors exactly as presented in experience.

- But there are still imperfect colors: properties that play the color role.

Two Layers of Content

- Color experience and color sentences have perfect and imperfect veridicality conditions:

    - Edenic content, representing primitive colors

    - ordinary content, representing imperfect colors in virtue of their roles

Two Concepts of Color

- There are arguably two concepts of color

  - An Edenic concept, *RED*, for which primitivism and eliminativism are correct

  - A non-Edenic concept, *red,* for which functionalism and realism are correct

- The functionalist concept is most useful in making sense of the world

Categorical and Structural Grasps

- Intuitively, we have a categorical grip on (perfect) colors: a direct grasp of their intrinsic nature.

- After the fall, we have a structural grasp of (imperfect) colors: grasping them in virtue of the roles they play.

From Color to Space

- What holds for color also holds for space.

Space in Eden

- In Eden, there were perfect spatial properties -- Euclidean distances, perfect squares, and so on -- with everything embedded in primitive spacetime

- Then we ate from the Tree of Science.

Relativity

- Newton: fundamental Euclidean space, supporting the Edenic model

- Einstein: non-Euclidean space in which spatial properties are relative

    - nothing is absolutely square, just square relative to a reference frame.

- A spatial fall from Eden.

Quantum Mechanics

- Quantum mechanics: what's fundamental aren't particle positions but wave functions

- Wave functions inhabit a high-dimensional configuration space

- So 3-dimensional space isn't fundamental, but arises derivatively from configuration space

String Theory

- String theory postulates various models on which space isn't fundamental (see e.g. Seiberg, 'Emergent Spacetime', 2005)

    - Eguchi-Kawai models

    - models based on gauge/gravity duality

    - BFSS matrix model

Computational Physics

- It-from-bit hypothesis: It might turn out that computational structure (e.g. cellular hypothesis structure) underlies the spatial structure in physics.

- (Compare: It might turn out that we live in a Matrix, with computationally simulated physics.)

Space as an Illusion

- One reaction: space is an illusion. We have the experience that things are located in 3-space when they aren't.

- Requires that all spatial experience is illusory and that ordinary spatial claims are false.

Compatibilism

- Better reaction: compatibilism. Space is a complex derivative property.

    - "Spacetime is an emergent concept. The fundamental formulation of the theory will not have spacetime and it will emergence as an approximate classical concept which is valid only macroscopically" (Seiberg 2005)

Finding Space

- Question: If space is not fundamental, how do we pick out the complex properties that are spatial properties?

- Answer: Spatial propeties are those properties that play the right role: in the structure of physical dynamics and in bringing about spatial experience.

From Spatial Primitivism to Spatial Functionalism

- We've moved from *spatial primitivism*: space involves primitive Edenic qualities

- to *spatial functionalism*: space is whatever plays the space role

- Space is as space does.

Functionalism

- Color functionalism: color is as color does
  - Color = whatever causes color experience
- Mass functionalism: mass is as mass does
  - Mass = whatever resists acceleration...
- Space functionalism: space as as space does
  - Space = whatever plays the space role in physical laws and experience

Imperfect Realism

- There is no perfect spatial properties: primitive space exactly as presented in experience.

- But there are still imperfect spatial properties: complex properties that play the space role.

Two Concepts of Space

- There are arguably two concepts of space
  - Edenic: *SPACE*, for which primitivism and eliminativism are correct
  - A non-Edenic concept, *space,* for which functionalism and realism are correct
- The functionalist concept is most useful in making sense of the world

Categorical and Structural Grasps

- Intuitively, we have a categorical grip on (perfect) space: a direct grasp of its intrinsic nature.

- After the fall, we have a structural grasp of (imperfect) space: grasping it in virtue of the roles it plays.

Motivating Spatial Functionalism

- Spatial functionalism can be motivated even in physical frameworks where space is fundamental (e.g. Newtonian and relativistic physics)

Twin Earth Experiments

- Twin Earth thought experiments (Doubled Earth, Lorentz Earth) suggest functionalism about

  - absolute size concepts (even in Newtonian physics)

  - shape and relative size concepts (in relativistic physics).

Nonfundamental Space

- Spatial functionalism is especially relevant for making sense of frameworks where space is not fundamental (e.g. some interpretations of quantum mechanics, string theory, computational physics)

Wavefunction Fundamentalism

- Wave function fundamentalism: quantum mechanics with only a fundamental wave function (collapse/Everett interpretations)

- How do we recover 3-4/space from infinite-dimensional configuration space?

- Spatial primitivism leaves an explanatory gap, but spatial functionalism does not.

Inconsistent Quintet

1. Wave function fundamentalism (only wavefunction is fundamental).
2. Spatial realism (things have spatial properties)
3. Spatial primitivism (spatial concepts are primitive).
4. Scrutability (no epistemic gap between fundamental and nonfundamental).
5. Epistemic gap: (epistemic gap between wavefunction and primitive spatial properties).

Cf. Mind-Body Quintet

1. Physicalism (only physics is fundamental)
2. Phenomenal realism (things have phenomenal properties)
3. Phenomenal primitivism (phenomenal concepts are primitive).
4. Scrutability (no epistemic gap between fundamental and nonfundamental).
5. Epistemic gap: (epistemic gap between physics and primitive phenomenal properties).

A More Austere Fundamental Ontology

- Lewis's Humean mosaic: natural properties so-distributed through space-time

- A more austere Humean mosaic: natural properties and relations, so-distributed

- Austere NonHumean mosaic: Perfectly natural properties and relations, so-distributed and nomically connected.

What Functional Analysis?

- Two options for functionally analyzing space

  - Phenomenal analysis: space is what causes spatial experience

  - Nonphenomenal analysis: space is what plays the physical space role

Phenomenal Analysis

- Spatial properties = that manifold of properties that serve as the normal causal basis for the manifold of spatial phenomenal properties. [Cf. Color properties.]

Nonphenomenal Analysis

- Space = what plays the physical space role

- This sort of analysis may be more useful for a materialist who wants to reduce space without presupposing phenomenal notions

- And for making sense of derivative space in terms of physics alone.

Ramsifying Space?

- Ramsey-Lewis method:

- List the platitudes of our folk theory of space

- Regiment these into a space role

- Identify space with whatever fills the role

Spatial Platitudes I: Structural Platitudes

- Space is three-dimensional (with one dimension of time)

- There are locations in space with distances between them

- Objects take up space, i.e. are located at various locations (at times), thereby having shapes, sizes, and relative distances

Spatial Platitudes II: Phenomenal Platitudes

- Phenomenal platitudes

  - Square things normally look square

  - Small things normally look small

  - Distant things normally look distant

  - …..

Spatial Platitudes III: Dynamic Platitudes

- Objects move continuously through space

- Objects interact with nearby objects in space

Spatial Platitudes IV: Familiarity Platitudes

- Our bodies are located in space.

- There are certain familiar objects (…) with familiar shapes, sizes, relative locations, …

- Their spatial properties evolve according to certain familiar principles (folk physics)

Counterexamples

- One can perhaps conceive of space that plays none of these roles; but then one is invoking the primitive conception

- One can perhaps conceive of nonprimitive space that doesn't play the dynamic or familiarity roles; but then one is invoking the phenomenal conception.

Motion and Action at a Distance

- For a nonphenomenal analysis, the dynamic platitudes seem especially crucial:

  - distance governs motion and interaction

    - there's no discontinuous motion

    - there's no action at a distance

    - or at least: there's less motion and action at a distance

Ramsifying

- The Ramsey method reverses this:

    - Distance is what there's no action at (Cantwell Smith)

    - Distance is what there's no motion at

- Or at least: distance is what there's less action and motion at

Causality and Locality

- "There is a causality condition on locality, not a locality condition on causality."

  — Gregg Rosenberg, *A Place for Consciousness: Probing the Deep Structure of the Natural World*

Interactive Conception of Space

- This is the interactive conception of space.

- It's perhaps just one strand in our ordinary conception of space, but it's one that can play a key role.

Generic Space and Physical Space

- Arguably the interactive notion of space corresponds to a more generic notion (e.g. social space, virtual space).

- But perhaps (when combined with further constraints) it can also yield ground a reduction of physical space

Open Question

- Just what constraints on a functional analysis of space does one need to ground a reduction in e.g. quantum mechanics, string theory, computational physics.

  - Structural/phenomenal/analysis?

  - Structural/interactive/familiarity analysis?

Functionalism and Skepticism

- In general, X primitivism opens the door to skepticism about Xs

- While X functionalism makes skepticism about Xs harder to get off the ground

  - consciousness

  - color

  - space

Space and Skepticism

- I think: many skeptical intuitions about the external world are grounded in skeptical intuitions about space, which are grounded in an underlying spatial primitivism.

- Spatial functionalism makes these skeptical intuitions harder to sustain.

Physics and Virtual Reality

- I think: a plausible analysis that grounds the existence of space in QM, string theory, computational physics, will also ground the existence of space in virtual reality (and in many other putatively skeptical scenarios).

Virtual Reality and the Platitudes

- In virtual reality, virtual objects (computational entities) have virtual locations (computational properties).

- These satisfy

  - phenomenal platitudes

  - dynamic platitudes

  - familiarity platitudes (in realistic VR)

Space in VR

- In virtual reality, there's an interactive space, governing the appearances and interactions of things, just as in QM/etc.

- If we're in virtual reality, this interactive space is our space (and thereby is space).

The Matrix as Fall from Eden

- A Matrix scenario is analogous to the Galiliean and Einsteinian falls from Eden:

  - After Galileo, red is a reflectance property

  - After Einstein, square is a relative property

  - After the Matrix, square is a virtual property

The Intuition of Error

- The intuition that a Matrix scenario is an error scenario is explained by its being one where Edenic content is incorrect and our experiences are not perfectly veridical

- It's a skeptical scenario by the Edenic standard.

- But so is quantum mechanics.

Objection 1

- Spatial primitivism is the correct view of the contents of spatial experience and spatial expressions.

- Response: OK, but then our spatial beliefs are already falsified by relativity and QM. (We've already fallen from Eden.)

- So we needn't be skeptics, just error theorists.

Objection 2

- Even given spatial functionalism, there will be further constraints, so 'square' won't refer to a virtual property in the Matrix.

- Response: What are the constraints? Do they require transparent grasp of some aspects of space?

Physics and Skepticism

- Plausibly: physicists don't invoke these further constraints in finding space in fundamentally non spatial worlds.

- E.g. computational physics is consistent with the computation underlying physics being realized in arbitrary ways.

- What matters is the abstract structure.

Matrix as Computational Physics

- The Matrix hypothesis can be seen as a computational physics hypothesis with a specific realization of the physics.

- Good enough for physicists, should be good enough for us!

Objection 3

- There will still be some skeptical scenarios, e.g. recent envatment hypotheses.

- Response: Yes, this reasoning doesn't allow us to rule out temporary/local illusions or random hallucinations. But systematic permanent error can be excluded.

Structuralism

- What's doing the work is an underlying structuralism

- What's required for the truth of ordinary claims is appropriate structure in the external world, not intrinsic properties

- That structure is present in the Matrix

Conclusion

- Space is whatever plays the space role

- Construed functionally, space is present in non-spatial physics and in virtual reality.

- Spatial functionalism helps us to deflate some forms of global skepticism about the external world.