Determinism, generalism, and the hole argument

The problem of determinism and the problem of the status of spacetime in general relativity are inextricably connected. In this paper I would like to focus on the available interpretations of the stance od determinism, taking into account the position of generalism (also known within the ontology of spacetime as sophisticated substantivalism). The received view is that sophisticated substantivalism avoids the indeterminism of the hole argument, while 'haecceitistic' substantivalism falls prey to it (Pooley 2006). The main goal of my paper is to argue that there is a concept of determinism/indeterminism available to (moderate) generalism, according to which GR is weakly indeterministic after all. However, this form of indeterminism turns out to be rather harmless, as it is "perspectival" or "indexical" rather than "absolute". But before we can get to this conclusion, a thorough evaluation of possible interpretations of determinism and their connections with generalism is in order.

There are three possible-world-based definitions of determinism known from the literature (Belot 1995, 2018; Hawthorne 2006; Halvorson et al. 2025). The weakest one (D1) states that a world W is deterministic, if for any nomologically possible world W' whose initial segment is a duplicate of the corresponding segment of W, the entire world W' is a duplicate of W (where duplicates are interpreted in terms of isomorphisms). The second variant of determinism (D2) insists that any duplicate function (isomorphism) connecting initial segments of W and W' can be extended to a global duplication function. The strongest version of determinism (D3) in addition requires that the extension be unique. Our first step is to assess the above concepts of determinism from the perspective of the position of generalism (qualitativism). By generalism I understand a view according to which two distinct possibilities must differ qualitatively. This broad intuition can be interpreted twofold. In the most typical approach, possibilities are straightforwardly interpreted as possible worlds, and their qualitative identity is their isomorphy. But it is also conceivable to introduce fine-grained possibilities within a given possible world. These possibilities are represented by particular counterpart functions connecting actual objects with their possible counterparts (representations de re). For a given pair of worlds there may be more than one counterpart function connecting them.

The key question is how to define qualitative (in)distinguishability applied to counterpart functions. Here is one proposal:

> Two counterpart functions f_1 and f_2 connecting worlds W and W' are qualitatively indistinguishable iff there is an automorphism g of structure W such that the composition $f_2 \circ g \circ \left(f_1\right)^{-1}$ can be extended to an automorphism of W'. Otherwise they are qualitatively distinguishable.

Moderate generalism insists that two distinct possibilities must be represented by qualitatively distinguishable functions in the above sense. Applying the above-introduced concepts and distinctions, we can easily prove that the definition D1 of (in)determinism is acceptable by both standard ('world-based') and moderate ('function-based') generalism, while D2 is admissible in moderate generalism only. In other words, moderate generalists can accept cases in which D1 is satisfied while D2 is violated as representing genuine indeterministic scenarios. Definition D3 is not acceptable by any form of generalism, since it involves irreducible individualistic (haecceitistic) distinctions (distinctions between qualitative indistinguishable counterpart functions).

These definitions can be tested using simple physical systems. One such case is known as a symmetry-breaking indeterministic scenario (Wilson 1993; Melia 1999, Bigaj 2024) involving for instance two entirely indistinguishable particles, one of which decays at a specified time. According to def. D1 this system is deterministic, while D2 and D3 classify it as indeterministic. Moderate generalism agrees with the latter assessment, while standard generalism classifies the case as indeterministic. Then there is a case which apparently supports determinism D3 over D2 and D1. This is a case of a single particle decaying into two indistinguishable particles of a new kind. Since there are two extensions of a duplication of the initial particle, the system is deemed indeterministic according to D3 but not D2. Yet it is open to debate whether our intuitive, pre-theoretical judgment indeed supports the claim of indeterminism. I argue that there are good reasons to insist that the considered case is deterministic, thus choosing D2 over D3.

Moving to the case of the hole transformations in general relativity, we can easily prove that both variants D1 and D2 are satisfied, which may be seen as supporting the Received View that both versions of generalism (standard and moderate) deny any indeterminism related to this case. However, there is a loophole that can be exploited here. By modifying slightly version D2, it may be argued that some form of indeterminism is indeed present in this case. The requisite modification is that for every initial duplication of two isomorphic models (worlds), this duplication should not be extendable to two qualitatively distinguishable counterpart functions. As is easy to see, this condition is patently violated in the case of hole transformations. Subsequently I will show that the violation of the modified condition D2' is contingent upon and relative to the selection of the world called "actual". If the actual world is ours, D2' is broken. However, if we designate an empty world as the "actual" one, then relative to it the non-empty worlds connected by a hole transformation do not create distinct alternative scenarios characteristic of indeterminism.

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