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(revised version)

Without time, the world becomes Leibnizian

There is no general agreement on whether Gödel's argument for the non-existence of time is valid. Nonetheless, if there is even a small chance that this could be the case it is surely worth considering how the non-existence of time would change our worldview. In this essay, I want to focus on the question: how would it affect our metaphysics, especially the notion of causality, if we assume that objective time does not exist? I also argue that the best candidate for the metaphysics of the world without time is Leibniz's monadology.

1. Preliminary remarks

1.1 Time is 'directional'

Let me start with a couple of remarks concerning the notion of time. I want to stick to the Kantian conceptual framework which will serve as a background for further reflections[1]. According to Kant, one of the essential features of time is that "[t]ime is in itself a series (and the formal condition of all series)" (Kant 1998, B 438-439[2]). Accordingly, time "has only one dimension: different times are not simultaneous, but successive (just as different spaces are not successive, but simultaneous)" (B 47). Conversely, in space "there is no difference between progress and regress, because it constitutes an aggregate, but not a series, since all its parts exist simultaneously" (B 439).

From these passages, I want to extract the simple intuition which lays behind our common-sense notion of time, namely that *time is 'directional'*. It simply means that time

[1] Considering issues discussed here, I believe such an approach is well-motivated. Gödel as well as Einstein were 'raised' in the Kantian tradition which, surely, dominated the German-speaking world of their times.

[2] When referring to Kant's *Critique of pure reason* (1998), I give the pagination of the second original edition (B) (i.e. *Kritik der reinen Vernunft*, Riga 1787).

passes in a certain direction: from past to future and not in any different direction[3]. In other words – to use the term used by Gödel (see 1949/1995, 235) – "the flow" of time has a certain, fixed direction. On the other hand, things are different when it comes to space. As Kant puts it, space is "an aggregate", not a series and there are no differentiated directions in space[4]. It is also worth noting, that these considerations accord with Leibniz's view on space and time as specific kinds of *relations* between substances and not substances themselves.

Interestingly, one can also draw a connection between the 'directionality' of time and the classical Aristotelian notion of time. As Aristotle states: "[t]ime is a measure of motion" (Aristotle 2004, 61). If time depends on motion in a strong sense then it seems reasonable to assume that if motion always has a direction, then its measure, i.e. time, should also have a direction, 'corresponding' to the direction of this motion.

1.2 Temporal series and causality

According to what was said earlier, it seems that for Kant the causal relation between two objects is based on the idea of the 'temporal series'. The concept of time (as it is the "formal condition of all series") should then be regarded as a fundament of the concept of causation. But this is only partly true[5]. In his "Second Analogy of Experience" (see B 232-257), Kant inverts the relationship between time and causation saying that "[a]ll alterations occur in accordance with the law of the connection of cause and effect" (B 232) (to be precise: "all alterations" meaning "all change in time"). How can we make sense of this? Is Kant contradicting himself?

In the first case, Kant speaks of *subjective* time – a transcendental form of the perceiving subject. Subjective time is a precondition of the scheme of causal relationships between appearances in the inner intuition and in this case, time is more fundamental than the category of causality. But the second case concerns *objective* time of the outer world where the concept of causality is a necessary condition for establishing the objective temporal order (cf. Kant's "Refutation of Idealism" in his B

[3] If we assume that time is one-dimensional (which also seems to be the essential feature of the intuitive notion of time) it is enough to say that it does not go in the opposite direction, i.e. from future to past.
[4] I am considering here an intuitive, physical space, i.e. the three-dimensional Euclidean space.
[5] I want to thank Prof. Dr. Dr. Brigitte Falkenburg for drawing my attention to this matter.

274-294). Here, when considering the objective world, causality comes first, before the temporal order.

Gödel's view accords with the second presumption. Wang in his *Time in philosophy and in physics: From Kant and Einstein to Gödel* (1995) presents some of Gödel's remarks made by him in their private conversations. According to (Q6), Gödel said:

> The real idea behind time is causation: the time structure of the world is just its causal structure. Causation in mathematics, in the sense of, say, a fundamental theorem causing its consequences, is not in time, but we take it as a scheme in time. (Wang 1995, 229)

In general, I think we can call Gödel's approach to philosophy more 'objective' than Kant's transcendental one. Gödel used to insist that our human concepts need to be derived from something objective – in this case, that the concept of time should come from objective causation which, according to Gödel, is the structure of the world in itself.

1.3 Intuitive and metaphysical causation

Let me here draw a terminological distinction that I regard as crucial in the discussed issues. To put things in order, I want to sketch the distinction between two opposing notions of causation. The first one is *intuitive causation* and the second is *metaphysical causation*.

To put it pictorially, *intuitive causation* is the 'causation of pool balls'[6]. It is a causal relation between objects – in most cases, physical objects like pool balls – which directly interact with each other. It can also be a causal relation between two events (like the explosion of the bomb causing the collapse of the bridge) that involve some physical objects (in this case: the bomb and the bridge). As well as it can be a relation between an agent and an object or an event[7]. I believe that the roots of this notion lie in Newtonian physics and when Kant would speak of 'causality' he probably had this notion of causation in mind. There are two distinctive features of intuitive causation that

[6] Famously brought up by Hume (1964, 164) in his *Treatise on Human Nature* where he discusses the nature of causality. See the section "Of the idea of necessary connexion" (Hume 1964, 155-172).

[7] In this case, causal relation can also involve non-physical entities like mental states (e.g. my desire to know Gödel's theorem better can be a cause of me grabbing the handbook of mathematical logic). Anyway, I would still claim that we should call the 'agentic causation' an intuitive causation.

I would like to emphasize. First, usually in the case of intuitive causal relations, we can easily distinguish cause from effect and, what follows, we can easily put them in a temporal order. Second, this 'direct interaction' is always local.

The notion of *metaphysical causation* can be understood in various ways, depending on the given metaphysical theory, but the key idea behind it is that there exists a specific structure – namely the *causal* structure – in the world in itself (the world of objects, events or substances that in their existence are independent of any cognitive subject). This kind of causal structure can be broader and more general than the intuitive causal structure. Especially, it is not limited to physical objects or agents. Let us come back here to the cited passage from Gödel, where he speaks of the mathematical theorem causing its consequences (see Wang 1995, 229). At first glance, this concept seems counterintuitive for in this example there is no interaction between any objects – we don't see here any 'action' and hence any 'causation' (in the intuitive sense). There is rather a logical relation between propositions. But when we go deeper, we can see that there is a strong analogy between the relation of logical consequence and the intuitive relation between cause and effect. Both have the structure of the *series*, both have fixed directions, and both provide a specific type of ordering, which we can call *metaphysical causation*.

The essential difference between these two types of causation is that intuitive causation (i.e. the direct interaction action between objects) always takes place *in time*. On the contrary, metaphysical causation is not so limited. According to the 'classical view'[8], in the world of mathematical objects (or mathematical truths), there is no change and thus no need for time. But, and this is a crucial insight, there still can be a time-like (or series-like) ordering in this world and that is exactly what 'metaphysical causality' stands for.

2. Non-existence of time and metaphysics

Having set the grounds, let me consider now 'the Question' of this essay: *What does it mean for our worldview if, according to Gödel, we also assume the non-existence of time?* I want to focus here on the matter of how the non-existence of time would affect our

[8] Also Gödel's view which sometimes he would call "Platonism" (see Gödel 1951, 311).

metaphysics[9], especially in one of the most fundamental of its aspects, namely: in the matter of causation. It is because I believe that causality plays a crucial role in our worldview (let alone the role it plays in the scientific worldview!) as it expresses one of the most basic aspects of the way we think about how things are related to each other. Furthermore, the concept of cause in the essence is attached to the category of *explanation*, since to explain something – to answer the question: why? – is to indicate the cause[10].

Moreover, a much deeper connection between causality and metaphysics can be drawn. When speaking of causal law as the condition of possibility of experience, Kant explicitly says: "This causality leads to the concept of action, this to the concept of force, and thereby to the concept of substance" (B 249). If Kant is right here, the concept of causality constitutes the concept of substance – arguably the most important concept in the history of metaphysics. One can also see the 'Newtonian theme' in this quotation, namely, the crucial role of the concept of *force* – absolutely central in the whole of physics.

2.1 No time, no intuitive causation

So, if we assume that there is no objective time, how does it affect the concept of the world's causal structure? As was pointed out earlier, time is directional and so is the intuitive causality. Furthermore, in our intuitive worldview, the direction of causal chains perfectly corresponds to the direction of the flow of time. Hence, without objective time, there would be no objective ordering of events, and no objective direction of causality.

Let us consider a simple example: the explosion of the bomb (let us call this event 'A') causing the collapse of the bridge (event 'B'). From the intuitive perspective, it is absolutely obvious that A can cause B and that B cannot cause A. Saying that the collapse of the bridge can cause the explosion of the bomb seems ridiculous. And, what is far more significant here, it seems pointless to use the category of 'cause' (in the intuitive sense) in such a case.

[9] In this essay I perpetually use the term 'metaphysics', but I suppose that in most cases it can be exchanged for the term 'ontology'.
[10] This is actually the traditional, Aristotelian view of what the notion of cause stands for. See, e.g., Aristotle (2009, 4).

But if we consider the special case within Gödel's rotating universe with closed temporal loops (see Yourgrau 1991, 129-133), in principle it is possible that the time order of two events can get inverted: if we imagine that A and B are connected by the time-like loop, it is true to say both: that A happened before B, and that B happened before A.

Problems occur if we still claim that events A and B are causally related. In an intuitive sense, it means that the causal order corresponds to the temporal order. In this example, it would follow that it is true that A caused B and it is true that B caused A. But 'B caused A' means that for example: 'the collapse of the bridge caused the explosion of the bomb' (let us call this proposition 'p'). Again, if we use the term 'caused' in the intuitive sense, this seems ridiculous and I believe everyone would agree that (p) is just false and moreover, that it cannot be true.

Let me summarise this argumentation. We assumed that:

(1) in Gödel's universe with time loops it is possible that for some pairs of events A and B, A happened before B and B happened before A;
(2) according to the intuitive view, there is a strong *correspondence* between temporal and causal order. So, if two events A and B are causally related and A happened before B then it follows that A caused B;
(3) according to the intuitive view, if A caused B then B could not have caused A and vice versa[11].
(4) A and B are causally related.

If we then combine these four assumptions we conclude that: A caused B and B caused A. But if we consider our bomb-bridge example 'B causes A' is false. This example is aimed to show that the intuitive concept of causality does not apply to such cases in Gödel's universe. Furthermore, it seems that it does not apply to the 'world without objective time'. In such a world there would be no objective flow of time and hence no objective causation (in intuitive sense).

2.2 Need for a different notion of causality

[11] For the matter of simplicity, I leave aside the problem of 'reflective causation', i.e. the question whether given event A can be the cause of itself. Logically speaking, if A = B and we assume the possibility of reflective causation, then it is possible that A caused B and B caused A (what contradicts (3)).

But maybe if we broaden the concept of causality and make it independent from any temporal order, causation in the world without time can be maintained?

First, I want to start with aforementioned Kant's insight: if we were to change the concept of causation, then we are forced to change our concept of interaction between objects, therefore also the concept of the object itself, and, eventually, the concept of substance. Hence, we need to change our metaphysics.

Let me say something about the metaphysics of intuitive causation, i.e. the 'metaphysics of the pool balls' – the 'everyday-life metaphysics' of macroscopic objects, which, I believe, lies behind classical, Newtonian physics. For the time being, we can stick to the image of pool balls which serves as a paradigmatic example of objects that interact with each other *causally*. This kind of objects have well-defined space-time positions and momenta, and interact with each other directly – by contact. Through this interaction, they pass some of their properties to each other – like velocity and kinematic energy. It is very easy to apply the concept of causality in the case of pool balls as we can trace their interaction moment by moment and distinguish the series of causes and effects.

But one can easily see that this intuitive metaphysics cannot be applied so efficiently to other kinds of interactions (other than these basic 'kinematic' ones). Let us consider Newtonian gravity. It is still an interaction between two macroscopic objects, but the nature of this interaction is significantly different than the one described above. First, the interaction is not *direct* as there is no need for any contact, for there to be a gravitational interaction. Second, it is not so easy to apply the concept of *causality* to this interaction. Let us consider the Sun and the Earth going around it. Maybe, it seems right to say that the force of gravity *makes* the Earth follow the orbit (and not escape it) and so this force is the *cause* of this particular form of motion of the Earth. But keeping in mind the view shared by Kant and Gödel, i.e. that causality has the time-like structure of a series, we can see that this notion of a cause is in this respect different than in the 'pool balls causation'. It is very hard to impose any kind of 'serial causation' on the gravitational interaction. There is no straightforward causal chain that we can trace back in order to find out *why* the Earth is now in this particular position in reference to the position of the Sun.

A few years before Einstein's Special Relativity has been published, Bertrand Russell wrote:

> All philosophers, of every school, imagine that causation is one of the fundamental axioms or postulates of science, oddly enough, in advanced sciences such as gravitational astronomy, the word 'cause' never occurs. (Russell 1912, 1)
> (…) In the motions of mutually gravitating bodies, there is nothing that can be called a cause, and nothing that can be called an effect. (Russell 1912, 14)

Russell concludes that the notion of 'cause' does not fully apply to the world as described by the science of his time. Fully geometrized General Relativity as well as Quantum Mechanics with its indeterministic processes in a way have even worsened the situation for the use of the intuitive notion of causality in contemporary physics.

So the question is even more imperative: if there is no time, how do we need to alter our notion of causation in order to maintain the basic idea laying behind it, namely that there is an order in the objective world or, in other words, that the objects are related to each other in an ordered way?

3. Answer: Leibniz's monadology

As we have seen, in a world without time there would be no room for intuitive causation and therefore no room for intuitive interaction between objects (vel. substances). Therefore, considering the non-existence of time, we are looking for a metaphysical system in which there are no interacting substances and no intuitive causation. But, as stated at the end of the previous section, it should be a system that allows us to preserve the idea of ordering in the world.

Surprisingly, it is Leibniz's monadology (one of the most 'exotic' metaphysical systems!) that comes with help. Let me then present some of the fundamental tenets of this system that answer our 'metaphysical needs'.

First, in Leibnizian metaphysics there is no interaction between substances – no monad can cause any change in the other. "Monads have no windows (…) the natural changes in monads come from an internal principle, since an external cause could not influence [*influer dans*] their interior" (Leibniz 1989, 643-644). Moreover, there is no genuine *physical* interaction between them as monads are simple spiritual, hence not material, substances (see Leibniz 1989, 643-644). Any change (essentially associated with time) of monad's attributes comes from its 'interior'. Thus, Leibniz's metaphysics is

not limited to the idea of temporal ordering of causal relations (which intuitively refers to the interaction between objects)[12].

Second, there is a specific ordering in the world of monads – specific 'harmony' as it is in Leibniz's concept of "pre-established harmony" (Leibniz 1989: 651). This harmony sets relations between substances but these are not causal relations (in the intuitive sense). Even though substances don't interact with each other, changes of their attributes are perfectly 'harmonised'. Moreover, this harmony is established independently from the perspectives of individual substances.

Third, Leibniz speaks of causes (and describes several types of them: efficient, final, and formal) but he uses this term in a different sense than we usually do. In simple words, I would say that for him the notion of cause has a more *formal* character. With his rather bizarre metaphysics, he is not limited to the physical causes and local interaction. From the historical point of view, I believe that he inherited the notion of cause from the Scholastic tradition whose roots go back to Aristotle himself (who introduced four types of causes: the same as Leibniz, plus the material cause[13]). Moreover, his philosophy is considered to be *deterministic*. But it is crucial to see, that this is a significantly different determinism than e.g. Laplace's determinism based on classical physics. In monadology, the determination does not come from causal interactions between substances which follow some necessary laws. It is established by universal harmony and hence is independent of causality and the 'time parameter' present in the dynamical laws of classical physics.

Fourth, finally, let us consider the Leibnizian notion of time. By my lights, Leibniz's metaphysical system is absolutely consistent with the non-existence of the 'cosmic time' as it is described by Gödel[14]. According to Leibniz, the world in itself is the world as it is perceived by God. But from God's perspective, there is no change and,

[12] Furthermore, it is not limited to *locality* as well: "It follows that this communication extends to any distance whatever. As a result, every body responds to everything which happens in the universe, so that he who sees all could read in each everything that happens everywhere, and, indeed, even what has happened and will happen, observing in the present all that is removed from it, whether in space or in time." (Leibniz 1989, 649). Presumably, it can also help to set the metaphysical background for non-local interactions in quantum mechanics. If that would be the case, it would also show that Leibniz's monadology not only serves as a good ground for the theory of relativity but also for quantum mechanics – two most important paradigms in contemporary physics. This issue has been addressed in detail by a Polish philosopher of physics Marek Woszczek in his "Serie Leibniza i problem dynamiki w kwantowaniu grawitacji" (2011) (eng. "Leibniz's Series and the Problem of Dynamics in the Quantization of Gravity").

[13] See Aristotle (2004, 19-21).

[14] The term 'cosmic time' is used by Gödel in order to refer to the 'objective' or 'real' time in models of General Relativity (see Gödel 1946/9-B2). This 'cosmic time' in principle is supposed to be independent form the 'subjective' time of any particular observer. For Gödel it is the time of the world in itself.

hence, no flow of time. In monadology, time is only a phenomenon of finite substances and their 'subjective' perspectives which fits surprisingly well with the conceptions of the 'relative time' of Einstein's theory and the 'subjective time' in Kantian philosophy[15]. And in the case of Einstein, it is not of coincidence as is argued in Agassi (1969), where the author writes that "Einstein professed himself a Leibnizian and declared (…) the superiority of Leibnizianism [over Newtonianism]" (Agassi 1969, 331).

Furthermore, we can see a deep connection between Leibniz's view on the world in itself and Gödel's idea of a world without time. It is worth noting here, what Wang writes about Gödel's own view on his philosophy: "On several occasions Gödel said that his philosophy is, in its general outline, like the monadology of Leibniz."[16] (Wang 1995: 233). Reading Wang's memories from conversations with Gödel, one can get the impression that Gödel would insist on the irrelevance of time in our perception of the world. For instance, when speaking of Hegel, Gödel was supposed to say that Hegel "[took] time too seriously" (Wang 1995: 229).

4. Summary

I've been trying to show that in the world without time there would be no causality in the intuitive sense. But, it doesn't have to mean that we need to abandon this fundamental notion. It rather forces us to consider the broader concept of causality which can be found in Gödel's as well as Leibniz's philosophy. The disappearance of intuitive causality leads us to the counterintuitive metaphysics of non-interacting substances which are the base of Leibniz's monadology.

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[15] About the connection between conceptions of time in theory of relativity and Kantian philosophy, see Gödel (1946/9-B2).
[16] For the expansion of this thought see (Lethen 2020), especially the second section "Monads and types" (pp. 2-5).

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