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TOWARDS A SPATIAL THEORY OF CAUSATION

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Almost every theory of causality is closely connected with time. Some analyse the causal relation presupposing the existence of temporal precedence. In that case the definition of causation usually includes the notion of time when it establishes that the cause must always precede the effect or that, at least, the effect cannot precede the cause. The supporter of such analysis must also accept that the causal relation depends on time and thus, that causality is not as simple as it seems.

Other theories, on the other hand, base the concept of *time* on causal grounds, which is a simplification of the causal relation, since they do not need the precedence notion in order to define causation. But those theories, I think, often suffer explanation loops or describe the notion of time better than the notion of causality.

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There is also the issue about whether *spacetime* precedes causation or whether they coexist, although I am not sure if there exists any account that, after introducing the causal relata to work with, does not already presuppose the notion of *space* in order to define causality. Causal theories of time, like the one developed by Tooley [6], must have primarily the notion of space—even if they do not say it explicitly—to establish that our notion of time is based on our notion of causality.

The other type of theories cannot take it easier. They must also presuppose the notion of space if they define causation using temporal precedence; I do not think that causality based on pure absolute time could make it any better. Perhaps, it should be asked whether those theories understand space and time as independent notions or whether they pose them as a spacetime continuum. Nevertheless, that would be no longer an analysis of the causal relation, but of the metaphysics of spacetime. Thus, I am sure that the causal relation must be analysed in terms of spatial relations.

What is not so clear is whether causation does not need any other notions in order to be defined and that is precisely my goal here. I will briefly show a first general basis of how a serious analysis of causality could be developed by avoiding the previous use of temporal precedence and by assuming that space is the only fundamental notion we need to define it. It must be noticed, however, that such assumptions do not correspond to a merely *physical*, but to an *ontological* notion of causality.

1.

A good place to start at is a *mereological* theory of causality, although similar ideas can also be expressed in topological terms based on a *system of betweenness*, as

the one established by Grünbaum [1]. Such view is partly compatible with what follows and the details of that compatibility might be a very motivating topic.

Nevertheless, I will focus particularly on mereology. The account proposed by Koons [2] takes *facts* as causal relata and is based on the *parthood* relation to define causation. I would rather prefer regions as causal relata, instead of facts or situations, which better suits my time aversion. My proposal has some differences compared with Koons', but it is ultimately grounded on his account. It goes like this. Suppose that the world is just a big region of space and every part of the world is also a region. The parthood relation is defined in terms of *intersection*, such that a is a part of b just in case every region that intersects a also intersects b. It is also *reflexive*, i.e. every region can always be part of itself, but whenever two regions are part of each other, then both are the same region. This last consequence asserts that parthood is *antisymmetric*.

It should also be assumed that effects are not part of their causes—considering that they are total sufficient causes, i.e. they include every factor, even if it is indirect or irrelevant—and if the effect of a determined cause has a part, then that part is also an effect of the same cause. It follows immediately that cause and effect do not overlap. For some part of the cause would also be part of the effect. Now that part must also be an effect of the cause under analysis but it would lead to nonsense, since, as we have established, effects cannot be part of their causes. This is a very interesting consequence, because it says that causal relata are not only regions, but also *separated* ones, which suggests that they must be regions of the same kind. However, that is not going to be a topic here.

Until now I have given only some characteristics of the

causal relation, but we have not defined it yet. A definition of the causal relation can be based on Mackie's account on causation [4]. A cause, in the sense Mackie defines it, is a necessary part of an unnecessary but sufficient condition (INUS). Thus, a necessary cause is understood as a part of a total sufficient cause and, since for total causal regions holds that they do not overlap with their effects, that also holds for INUS causes.

In order to avoid some unwanted consequences shared by many accounts that use sufficient conditions to define causality, we might introduce a counterfactual to the analysis. If one tries to understand how it is possible for the total cause to be sufficient for the effect, one can notice that it actually is not, unless we include some regularity or law that permits one to derive the proposition that describes the effect from the set of sufficient conditions (i.e. the set of propositions that describe the set of sufficient causes). Well, that introduces the danger of backward causation, as Lewis warned [3], because the proposition describing the cause can also be entailed by the effect, together with the laws and the remaining part of the conditions. One solution against backward causation is given, of course, by theories that presuppose the temporal precedence of the cause, a feature that cannot be present in a theory of causality based on spatial relations, like the one I am sketching here.

Counterfactual accounts of causation have been able to manage these problems nicely, since the counterfactual relation itself is not symmetric. The common counterfactual definition of causality establishes that a causes b if and only if the following three conditions are satisfied: a and b occur; if a were the case, then b would be the case; and if a had not been the case, then b would

not have been the case. This definition solves the problem of backward causation, because it is not true that if b were not the case, then a would not be the case.

Nevertheless, many inconveniences come together with the counterfactual solution, like preemption problems. But these situations can show that regularity theories of causation are also in trouble. A good account of causation must be capable of tackling preemption problems in a simple way and I am going to show that if the causal relation is based only on spatial grounds, such a way is at hand. But let me first describe what these problematic situations are.

2.

Preemption problems could be defined as follows. There is a rich distinction between early preemption, late preemption and preemption with trumping, but I will focus only on a general version, which may include the first two. There are two possible causes for an effect to occur and the actual cause interrupts the second, potential cause, making it impossible for it to produce the effect. Modal notions like 'possible' and 'actual' involved in this definition will be set aside later; we need them for the moment in order to describe the problem.

Firstly, a problem arises immediately for counterfactual theories of causality, since it is not true that if the cause were not the case, then the effect would not be the case. The backup cause is waiting and would produce the effect after the first cause fails. In other words, as the definition does not detect the cause, we have too *few* causes (none actually).

Secondly, an opposite problem arises for regularity theories of causality. The definition detects the cause rightly; the cause is a necessary part of a sufficient total

cause of the effect. But what happens if we replace the first cause with the backup, putting it among the same set of conditions? In that case the effect should also follow, meaning that the back up cause is also the cause. In short, we have too many causes now. Neither of both accounts can solve this problem in a simple way.

On the one side, regularity accounts must introduce more detailed propositions into the conditions. On the other side, counterfactual accounts must either accept *fragility*, i.e. a higher standard for the definition of the essence of causal relata, or introduce some suspicious causality transporting entity—a moving *influx* perhaps —between the causal relata.

If we accept high standards for essences, i.e. if we think that what it is to be a state of affairs depends on, say, every millisecond and every detail, then we have to accept spurious causes in other common cases, which won't be useful for a more general theory of causality. Besides, introducing fragility grounds causation on temporal blocks, which is not the aim here. The other kind of solution for the counterfactual analysis introduces an influx, an entity that is not acceptable in more simple theories of causation, since they permit cause and effect to overlap. The best solution for preemption lies, I think, in some kind of unification between regularity and counterfactuals. That seems to be a tendency these days.

Let us see how preemption could look like in an example based only on regions as causal relata. This is not easy at all. For temporal notions—e.g. interruption —are already present in the preemption problem. I will first say a few things about regions. Suppose that we represent the world in a two dimensional manner, with a temporal axis and a spatial axis and every event is represented, as usually, by a point in the graphic. If one

looks only at the spatial axis, for every point in it, one can construct a line that is parallel to the

temporal axis and that contains every state of affairs, everything that occurs, occurred and will occur in that region.

That is the sense of region I consider for the spatial approach of causality. The only thing to do is to eliminate from the world the temporal axis and what remains are the regions of the world, charged with everything that occurs in them. This model of the world, which is only based on spatial regions, has the form of a Leibnizean *preestablished harmony*. Every point, as well as every segment of the spaceline, is a region, assuming that every point contains a perpendicular line of intemporal states of affairs, which can also be divided vertically in many regions of the same sort.

The preemptive problem poses then that there are two regions that might cause a third. The small region that actually causes the effect does not overlap with the region of the effect, as we defined earlier. The potential cause does neither overlap with it, but it would be necessary in different sets of regions for the production of the same effect. In this sense of necessitation, the actual cause does not overlap with the back up, which means that preemptive cases relate three different non overlapping regions of space.

The problem arises when the notion of cause in consideration is related to the one of *necessary* condition. In the regularity account, the result is that too many causes are pointed out, but that is not the case if one considers the notion of total sufficient cause. The small cause is just one member of the set of regions that should be there in order to produce the effect. Total causes are big regions and counterfactual causes are

small ones.

If the solution of the preemption problem can be met after understanding the crucial alliance between regularity theories of causation and counterfactual theories of causation, then it is also a task—in the context of a spatial account of causality—to understand the affinities between the total cause and the regions that conform it. If total causation is understood in terms of *production* and partial or counterfactual causation in terms of *dependence*, as Pearl does [5], then causation is definable in a manner that builds up the partial region and permits to make it sufficient for its effect.

Thus, the part of the counterfactual definition for causation we must focus on to understand the affinity between both accounts is the second condition, i.e. if the cause were the case, then the effect would be the case. The difficulty arises when one wants to make that counterfactual true without first having the actual occurrence of the causal relata (the first condition).

A hypothesis posed by Koons [2] should give us some light on this point. Consider that if two regions are total causes of the same event and none of them causes the other, then there exists a mereological intersection of both that totally causes the effect. This is called the *no overdetermination* hypothesis and, since preemption is one kind of overdetermination, it could be very helpful for our purposes. It establishes, in other words, that if one region is produced by two sufficient causes (i.e. if it is overdetermined), then these two causes are not really sufficient by themselves, but only their intersection is. This suggests that total causes are composed by regions that are smaller than one usually thinks, even outside overdetermination.

But what might this smaller region be? In many cases it is enough to think that if the causal region had been

different, then the region of the effect would have also been different. But that is not always the case. I would say that those small differences come from other, perhaps more distant regions. After all, as neither temporal precedence nor temporal vicinity are needed for the ideas I present here, a cause must not be strictly composed of regions that are in a relation of connectedness to each other. Some regions across the whole pure space represent a pattern that meets other bigger regions. Thus, when a particular cause takes place and produces the effect, its causal region shares parts with other regions in the whole spaceline.

Those extremely small mereological intersections could give us a hint about the above mentioned laws of nature. But that is another topic, though it is analysable under a theory purely based on spatial relations, a theory that can surely be more elaborated than what I have explored here.

References

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