

PHILOSOPHY 4360/5360 – METAPHYSICS

A Causal Theory of the Direction of Time

The Analysis of Simultaneity and Temporal Priority

1. According to our ordinary, non-relativistic conception of time, two relations suffice to order events in the universe: simultaneity and temporal priority.

2. Those two relations are **mutually exclusive**, and, together with the inverse of temporal priority, **exhaustive**.

3. According to our ordinary, non-relativistic conception of time, those relations are both transitive relations:

(M) If *A* is earlier than *B*, and *B* is earlier than *C*,
then *A* is earlier than *C*.

(N) If *A* is simultaneous with *B*, and *B* is simultaneous with *C*,
then *A* is simultaneous with *C*.

4. Two further consequences of our ordinary conception of time are as follows:

(P) If *A* is earlier than *B*, and *B* is simultaneous with *C*,
then *A* is earlier than *C*.

(Q) If *A* is simultaneous with *B*, and *B* is earlier than *C*,
then *A* is earlier than *C*.

5. Suppose now that one introduces the following assumption:

(R) If *A* causes *B*, then *A* is earlier than *B*.

R specifies one condition under which one event is earlier than another. Clearly, however, there must be other conditions that are also sufficient, since *A* can be earlier than *B* even if they are not causally connected.

6. It is at this point that the idea of shifting from talk of causal connections to talk of causal connectivity naturally arises. But that idea, as we have seen, appears unsatisfactory.

7. The thing to notice is that acceptance of *R*, in the context of our ordinary conception of time, commits one to further propositions concerning conditions that are sufficient to ensure that one event is earlier than another:

(a) *R*, when conjoined with *P* and *Q*, entails, respectively:

(S) If *A* causes *B*, and *B* is simultaneous with *C*, then
A is earlier than *C*.

(T) If *A* is simultaneous with *B*, and *B* causes *C*, then
A is earlier than *C*.

(b) These two conditions, in turn, in conjunction with (M) and (N) – that is, the transitivity of the relations of temporal priority and simultaneity, entail another, much more encompassing condition:

- (U) If $\{A_1, A_2, \dots, A_i, \dots, A_{n-1}, A_n\}$ is a set of n instantaneous events such that, for every $i < n$, either A_i causes A_{i+1} , or A_i is simultaneous with A_{i+1} , and if, in addition, there is some $i < n$ such that A_i causes A_{i+1} , then A_1 is earlier than A_n .

8. Principle U , entailing, as it does, principles R , S , and T , and more as well, is a very comprehensive principle relating causation to temporal priority, and the fact that it follows from the conjunction of our ordinary conception of time with the very modest claim involved in R shows how strongly any causal theory of time is constrained by assumption R .

9. Principle U , however, suffers from a certain obvious defect, if one's goal is to formulate a causal theory of time, since its specification of the conditions under which one event is earlier than another is not done in terms of causal and other non-temporal notions alone: the description involves the concept of **simultaneity**.

10. My suggestion, at this point, is that one introduce the following claim:

- (V) If events A and B are spatially related, instantaneous events, then they are simultaneous.

11. Given principle V , it is possible to derive a principle that, like U , specifies a very wide range of conditions under which one event is earlier than another, but which, unlike U , characterizes those conditions in **non-temporal** terms. For the conjunction of U and V entails:

- (W) If $\{A_1, A_2, \dots, A_i, \dots, A_{n-1}, A_n\}$ is a set of n instantaneous events such that, for every $i < n$, either A_i causes A_{i+1} , or A_i is spatially related to A_{i+1} , and if, in addition, there is some $i < n$ such that A_i causes A_{i+1} , then A_1 is earlier than A_n .

12. To recap briefly. I have argued that two quite modest principles - namely, R and V - in conjunction with our ordinary conception of non-relativistic time entail principle W . The first of those principles asserts that, if one event causes another, then it is also earlier than the other event - a proposition that, unless backwards causation is possible, would certainly appear to be true. The other principle asserts that spatially related, instantaneous events must be simultaneous - a claim that also seems very plausible. Accordingly, any account of our ordinary temporal notions would appear to be subject to the very strong constraint that is embodied in principle W .

13. W formulates a very comprehensive **sufficient** condition for one event's being temporally prior to another. But could the condition in question also be a **necessary** condition? In that case, the converse of W would also be true:

- (W*) If A_1 is earlier than A_n , then there is a set of instantaneous events $\{A_1, A_2, \dots, A_i, \dots, A_{n-1}, A_n\}$ such that, for every $i < n$, either A_i causes A_{i+1} , or A_i is spatially related to A_{i+1} , and, in addition, there is some $i < n$ such that A_i causes A_{i+1} .

14. Does W^* express a necessary truth? If not, then I think that it is not easy to see how an analysis of temporal priority can be formulated in terms of actual causal connections, rather than in terms of causal connectibility.

15. In thinking about this issue, one might consider, for example, the idea of an immaterial being - God - who was in time, but not in space, and so not spatially related to the physical universe. Could some instantaneous state of God be simultaneous with some instantaneous state of the physical universe?

One possible way of handling this sort of case would be by assuming that since God is omnipotent, at any given time he has knowledge of all **earlier** states of affairs by virtue of their being a cause of his mental state. If, then, only the present and the past are real, the state of the physical universe that is simultaneous with God's state at any given moment is that one temporal slice that is not causally connected with God's mind. Alternatively, if the future is also real, then the state of the physical universe that is simultaneous with God's state at a given moment is the earliest temporal slice that is not causally connected with God's mind.

If one finds this case convincing, one needs to shift to a disjunctive analysis of simultaneity.

16. For simplicity, however, let us assume that both W and W^* , as they are presently formulated, express necessary truths. This allows us to formulate the following **definition of temporal priority**:

A is earlier than B

means the same as

For some number n , there is a set of n instantaneous events $\{A_1, A_2, \dots, A_i, \dots, A_{n-1}, A_n\}$ such that, first, A is identical with A_1 , and B is identical with A_n ; secondly, for every $i < n$, either A_i causes A_{i+1} , or A_i is spatially related to A_{i+1} ; and, thirdly, there is some $i < n$ such that A_i causes A_{i+1} .

17. Similarly, the simplest way of extending principle V into an analysis of simultaneity is by assuming that the condition for simultaneity specified by it is necessary as well as sufficient, so that one can offer the following definition:

A is simultaneous with B

means the same as

A is spatially related to B .