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Temporal entities in space

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### 1 Introduction

Ordinary, commonsensical material objects, such as tables and chairs and stones, are tightly and clearly connected to space. They have a location, i.e. can be found at an address. They occupy space (we leave for the time being the notion of occupation unspecified; for some, spatial occupation is to be defined in terms of exclusive location; others suggest that it be defined as possession of spatial parts; unclear are the links between these two marks). They have a more or less clearly delineated spatial boundary. The simplest criterion for individuating a region of space consists in providing a material object that occupies it, be it in the real world or in some nearby possible world, or in providing an object of which the region is a cavity. So tight and clear is the relationship material objects bear to space, that they might be with reason termed 'spatial entities'.

Commonsensical material objects have also a tight, but slightly less clear, connection to time. The most important fact about spatial entities in time is change: tables and chairs have at certain times, and at other times have not, given properties, or relations to other individuals, as in the case of movement. Another connection, one that takes us closer to the notion of a temporal boundary, is that tables and chairs were born and will die - their life-spans have an initial point and an end point (even though these might be indeterminate).

The connection to time is on the other hand tight and clear in the case of temporal entities, such as events, states or processes. Paradigmatic temporal entities (those things that occur or take place: picnics, explosions, whistles and runs) take time or have a precise temporal location. They have a more or less clearly delineated temporal boundary. The simplest criterion for individuating an interval of time consists in providing a temporal entity that occupies it, be it in the real world or in some nearby possible world (or maybe, in providing a pause between two events, which would be the temporal analogon of a spatial hole).

The less clear, and more poorly investigated conceptual connection is that between temporal entities and space. Fred Dretske held that events do not move, and we can very well assume that events do not change as well. If he is right, then change is not the right place to look at in order to find the linkage between events and space. Donald Davidson insisted on the possibility, for two different events, to occur at exactly the same place, in the context of a discussion of identity criteria for events. If he is right, and if spatial occupation is to be defined as exclusive location, then occupation is not the right the place to look at when looking for the conceptual connection between events and space. Other features, such as the spatial boundaries of an event, have been found somewhat artificial. Is location the only relevant link events have to space? And how it differs, if it does, from spatial location of material objects?

In this paper I shall examine one main aspect of the very last issue - temporal entities in space. As the above presentation suggests, I will be dealing mostly with spatio-temporal analogies; I shall hypothesize that some concepts, such as the concept of a boundary, are not completely domain-specific (there can be spatial as well as temporal boundaries, and structural analogies between these compel us to think that 'boundary' is not used in two different senses here). I contend that this hypothesis, in short the hypothesis of complementarity or HC, is crucial in the heuristic of the investigation of spatial and temporal concepts, and that it ought to be used for importing into the unfocussed problem of temporal entities in space some results about the much neater problem of spatial entities in time. It is thus important to assess the scope and the validity of HC. Over and above the mainly philosophical issues I will briefly consider some broader hypotheses about the architecture of cognition that might back HC.

## 2 The spatio-temporal analogies

The study of spatio-temporal (dis)analogies has two main historical sources. On the one hand, there are "ordinary language" (and "descriptive metaphysics", at large) criticisms [Strawson 1959] of revisionary construals of material objects and events. According to one line of thought, tokened by Russell and Whitehead and championed by Quine [1950, 1960, 1985, 1987], endorsed by Davidson [1985], and reharsed by Pat Hayes' notion of 'histories' [1985], there is no substantial metaphysical difference between the entities that common-sense classifies as material objects and those it classifies as events. In Quine's words

Physical objects, conceived [...] four dimensionally in space-time, are not to be distinguished from events or, in the concrete sense of the term, processes. Each comprises simply the content, however heterogeneous, of some portion of space-time, however disconnected or gerrymandered [1960:131].

What distinguishes then material objects from events is, accordingly, not a matter of kind but one of degree: events are less stable in space and time than objects. As a reaction to this view, David Wiggins urged that "we take note of all the hints of analogy and disanalogy we get from the unreformed language of things and events" ([1980:26, n. 12]; Wiggins refers to complementarity by means of terms like 'dual' or 'transposition'). There exists moreover a tradition of discussions of time travel that purports to show (or to criticize the idea) that it is no less sensible to talk of time travel than it is to talk of spatial travel, once the corresponding concepts are interpreted in a suitable way: [Taylor 1955, 1959], [Mayo 1961] [Dretske 1962, 1967], [Thompson 1965]. In this context, Taylor holds that

temporal and spatial relations, contrary to much traditional thought, are radically alike; or, more precisely, that (1) terms ordinarily used in a peculiarly temporal sense have spatial counterparts and vice versa, and that accordingly (2) many propositions involving temporal concepts which seem obviously and necessarily true, are just as necessarily but not so obviously true when reformulated in terms of spatial relations; or, if false in terms of spatial concepts, then false in terms of temporal ones too : [Taylor 1955:599].

It is part (1) of this program that will be dealt with here. Mayo explicitly formulates the principle underlying HC in the following form:

Since the concept of a material object, or body, is fairly determinate, we shall first specify it in spatiotemporal terms and then, by exchanging spatial for temporal terms and vice versa, we shall obtain a specification of the complementary concept [1961:341].

Mayo cautiously suggests that the complementary entity is not to be taken to be an event from the onset; the corresponding concept is projected through complementation, and it is not to be expected to represent any kind of existing entity. Nevertheless, he does expect it to coincide with the commonsensical category of an event. Here is his list (p. 343, partly drawn from Taylor) of the spatio-temporal principles that articulate the complementarity hypothesis:

- I(a) 1. An object has a limited extension and an unlimited duration.
- 2. It cannot occupy the whole of space, but it could occupy the whole of time.
- 3. There must be room in space for many objects, which may or not overlap temporally.
- I(b) 1. An event has a limited duration and an unlimited extension.
- 2. It cannot occupy the whole of time, but it could occupy the whole of space.
- 3. There must be room in time for many events, which may or not overlap spatially.
- II(a) An object can, at different times, occupy the same space (rest, endurance) or different spaces, normally of the same size (locomotion, endurance).
- II(b) An event can, at different places, occupy the same time (occurrence, extension) or different times, normally of the same length ("propagation", extension).
- III(a) An object cannot be at different places at the same time, unless its spatial size is greater than the interval between the places.
- III(b) An event cannot be at different times at the same place, unless its temporal size is greater than the interval between the times.

I shall comment briefly on each of these principles, and I shall also address general issues about their structure.

The status of (I) seems to be dubious. After all, one can very well conceive of a possible world the only individual in which is a very big, indefinitely extended object; and one can conceive as well of a possible world whose sole happening lasts beyond any assigned limit. In fact, what is dubious is

the modal status attached by Mayo to (I). Given that, on the other hand, most worlds are likely to have a higher cardinality than the ones of my counterexample, I am willing to accept a weakened version of (I). The propositions ought to be rewritten along the following pattern:

I(a)1'. In the norm, an object has a limited extension and an unlimited duration. (...)

I(b)1'. In the norm, an event has a limited duration and an unlimited extension. (...)

The revision preserves the original point, i.e. the complementarity of the characterizations. Clearly, if we are not to beg any question as regards complementarity, we have to scrutinize more closely in what sense the propositions in (Ib) are derived from those in (Ia) "by exchanging spatial for temporal terms and vice versa", as Mayo puts it. Take (Ia1') and (Ib1'). We are asked to assume that 'duration' and 'extension' are complementary temporal and spatial terms. This can be easily seen if we read 'extension' as 'spatial extension' and 'duration' as 'temporal extension'. That 'spatial extension' is complementary to 'temporal extension' is now a simple fact due to the assumption that 'spatial' complements 'temporal'. A similar redefinition should apply to 'size' and 'length', where the latter is meant to be just temporal size. The complementarity of (a)s and (b)s becomes interesting as soon as we succeed in proving that these propositions are all true - in particular, that (b)s are true of events as commonsensically understood. Here, however, one might think that the rewriting produces a (Ia1') and a (Ib1') that do not respect the conceptual flavor associated with their sources. For talk of unlimited duration of an object and of unlimited extension of an event is no more felicitous than talk of limited extension of an object and of limited duration of an event. Chairs have normally not too long a life, and picnics, big as they might be, cannot normally trespass certain very obvious limits. (Part of this problem derives from Mayo's sticking to a notion of an event as a sort of indefinitely spreading perturbation - as a radio broadcast can be.)

The second analogy contains more promising material; it also proves to be the more difficult to correctly assess. It reads, again,

II(a). An object can, at different times, occupy the same space (rest, endurance) or different spaces, normally of the same size (locomotion, endurance).

II(b). An event can, at different places, occupy the same time (occurrence, extension) or different times, normally of the same length ("propagation", extension).

In both (IIa) and (IIb) the disjunction has an apparently trivial term, concerning the occupation of different times/spaces at different spaces/times. As a matter of fact, the analogy seems to yield a result that is not only symmetrical, but that is virtually indistinguishable from its source. It does not seem to matter much if we talk of 'occupation of different spaces at different times' or of 'occupation of different times at different spaces'. But, this being the case, two problems arise. First, what is the difference (suggested by Mayo) between locomotion and propagation (viz. what is the proper meaning to be assigned to 'propagation', insofar as it is supposed to complement 'locomotion'), apart from the fact that the former is predicated of objects, and the latter of events? Second, does this difference depend upon spatial or temporal facts only? If 'event movement' is to be defined in terms of the structural complement of object movement, then no apparent asymmetry emerges: event movement and object movement are one and the same thing. A difference, we shall see, emerges in the subobjectual (and subeventual) structure.

Now, is the point that order in (IIa) and in (IIb) does matter, contrary to appearances, as determined by the role played by the notion of occupation? We are required here to make sense of the occupation of a place by an event. Let us consider what Dretske and Hacker have to say on this matter. In his [1967] Dretske observes that events have spatial location; that they often occur in spatial containers, and that these can move. One is thus allowed to say that some events, at least, move. Dretske nevertheless holds that events are at their location in a way material objects are not. A chair can be said to be in a building (at a particular time) even though most of its life is spent elsewhere, whereas a picnic cannot be said to occur in a building if it just starts there but if its conclusion is in the garden (we can at most say that the picnic occurred in the place which is the mereological fusion of the space of the building and the space of the garden, or of the relevant portions thereof). An event expression (such as 'the picnic') refers to the entirety of an event, i.e. it refers to the event as temporally extended. It follows that there is an incompatibility between our ascription of spatial location to events and the concept of movement; that, therefore, if events are

located, they cannot move. I shall call this Dretske's thesis, (DT), that includes an intuitive criterion for motion (ICM):

An event cannot move because (ICM) for anything to move it has to be wholly present at different places at different times, and events can at most be partly present at different places at different times.

Hacker [1982] adds that the difference between objects and events regarding movement is apparent from their respective relation to space. Both objects and events have spatial location, but objects, not events, occupy space. Now I do not think that the notion of occupation (exclusive location) should play any big role here. One can accept both the fact that events do not occupy space and the fact that events do not move, without accepting that there is any logical relationship between these facts. Presumably, that a occupies b entails that a is wholly located at b, but the converse is not true (at least, it is not if we construe occupation as exclusive location). Hence from the fact that a does not occupy b one cannot infer that a is not wholly located at b. The immobility of events seems to be linked only to the fact that events do not wholly occupy the places from which they are supposed to move or on which they are supposed to land, if the starting place and the landing place are different (or, whenever they are identical, if they are different from some intermediate place; in order to simplify the discussion, I shall bar this case in the following).

But then, if motion is to be defined in terms of location and of a difference of starting and landing place, one can very simply prove that some clear cases of motion of material objects are not cases of motion at all. For consider. A perfectly circular disc spins on its center and does not undergo any translational motion. The starting place and the landing place of the disc are one and the same place (which is identical to all intermediate places occupied by the disc in the period under consideration; incidentally, note that the disc occupied -and was not only located at- that very place over the period). But clearly the disc moved. Now we cannot predict this from Drestke's (ICM) criterion for assigning motion to objects and denying it to events. Moreover, we do not think that circular motion is of a metaphysically bizarre sort (but for an attenuation, see Armstrong [1980] and Robinson [1982]). The point is not only epistemological, i.e., it does not merely concern the impossibility of telling a spinning disc from a still disc (it is not as if we were not allowed to paint stripes on the disc in order to see whether it rotates); the point is that according to (ICM) circular motion would be metaphysically impossible.

There is an obvious improvement of (ICM). We can require, for motion, that at least some parts of the moving object change their location. Obviously, objects that move translationally satisfy this improved version, for all their parts change location. And the spinning disc too would be moving, for some of its parts are now here that will be at another time there. Of course, the notion of a part has to be taken with some qualifications. But a nice consequence of accepting improved (ICM) is that, granted that a mereological atom is an object that has itself as its sole part, atoms can translate but cannot rotate. Less welcome are some limit cases. Take a disc that neither spins nor translates, but simply expands and contracts. Here some would be unwilling to apply the concept of motion. Others would not. But the main shortcoming of improved (ICM) is that it does not yield any significant distinction between objects and events - which is what (ICM) was supposed to do, after all. Maybe there is no picnic, and no event in general, all parts of which are first in one place, and then in another. But the picnic that starts in the building and lands in the garden has some parts in the building and some other parts in the garden. Thus, the picnic moves - at least in the same sense in which the disc rotates.

Nevertheless, an asymmetry seems to remain. Discs rotate, but does the same applies to picnics? In the middle of a football game there is a rotation - players exchange fields. But is this a rotation of the game? Dancers in a ballroom traced more or less circular trajectories, but did the second waltz of the evening itself rotate? The rotation here is more credibly predicable of the plurality of actors in these events - the teams, or the group of dancers - but not of the events themselves, but I shall leave the question undecided. If one wants to explain the conceptual asymmetry here, one alleged way consists in rejecting the notion of a spatial part of an event. For on all other aspects the notions involved in describing events and, respectively, objects appear to be conceptually symmetric - the revised version of (ICM) applies straight to both objects and events. One might thus think that

symmetry founders on the very notion of part. For the parts of the picnic that are now here and then there are temporal parts, or phases of it; whereas the parts of the disc that are now here, and then there, are spatial parts. One might thus object that it is spatial parts that are required to move according to improved (ICM). And that it is the notion of a spatial part of an event that is unclear. Simons [1987:131], for one, thinks that it is not.

In a football match, the first half of the play is a temporal part, the events taking place in one half of the field make up a spatial part, and the part played by one of the players is neither purely spatial nor purely temporal.

Still, the difficulty remains to see why spatial parts play an important role in accounting for the motion of objects and play no clear role in the disputable case of event motion. Moreover, arguments in favour of spatial parts of events open the way to parallel arguments in favour of temporal parts of objects.

### 3 Imperfect complementarity?

Simons [1987: 131 n. 6] denies that we can carry spatio-temporal analogies too far (it is a criticism of complementarity, which he calls 'duality').

Continuants occupy space but persist through time. Dual to continuants would be objects which had temporal but no spatial parts.

Continuants (objects), according to Simons, do not have temporal parts. As our previous quote allows us to infer, he thinks that events have spatial parts. But the absence of qualification with which parts such as the left half of a football game are introduced allows one to accept without qualification that dual to these are temporal parts of objects. Thus complementarity is restored. On the other hand, one might think that there are serious objections to the doctrine of temporal parts of objects. But, again, the matter is not one of mere stipulation; for if it is, then what can prevent one to take the following description of objects (here referred to as 'continuants'):

(C) Characteristic of a continuant is that at any time at which it exists, it is present as a whole, and not just in part [Simons 1987:130],

and produce a complement of it:

(E) Characteristic of an event is that at any place at which it exists, it is present as a whole, and not just in part.

(E) would rule out spatial parts of events, as (C) ruled out temporal parts of objects. Now the reason adduced by Simons for accepting (C) is that "when a continuant has first one property and then another, contrary property, it is the whole continuant which has the properties and not different parts of it, whereas with occurrents we can always refer such temporary properties down to temporal parts" (ibid.; 'occurrent' is a term of art covering both events and processes, temporal entities in general). Again, look at how sensible the complement of this characterization sounds: when an event has here one property and there another, contrary property, it is the whole event which has the properties and not different (spatial) parts of it, whereas with continuants (=objects) we can always refer such local properties down to spatial parts. My wording of the latter complementary principle should make it apparent what went wrong in Simons' thesis of imperfect complementarity: he equivocated on 'part' when presenting (C). If he talked of spatial parts, the thesis is obviously true; but if he talked of temporal parts, he did beg the question against the problem of their existence and relevance.

It might be thought that the problem with the temporal parts of an object is that it is difficult to see which kind of properties they could have. What is the shape of the temporal part of me in the period in which I turn around a table? Is it a quasi-toroidal shape, with the table occupying the hole in its middle? How is such a shape to be related or contrasted with the human-like shape I believe I have? Or, suppose I am happy for the most of my life, and unhappy during a very short phase of it - can I use this fact for classifying my temporal parts into the short, unhappy one and the long, happy one? But obviously such odd problems arise with spatial parts of events as well. If football were played in triangular fields, such that one team a time would play in a trapezoidal 'half', would we talk of the trapezoidal part of the game?

To take stock. There seems to be no important difference between objects and events as to the possession of parts of any kind. There might be differences between the ways in which events relate

to their spatial and temporal parts respectively; but, for that matter, one can find exactly analogous differences between the ways in which objects relate to their temporal and spatial parts respectively. Simons suggests that there is an asymmetry here between objects and events, but at most this is an asymmetry between the relations events and objects respectively bear to their parts. We can safely accept for the time being this latter thesis, expressed by Wiggins [1980:25 n.12] in the following neat way:

An event does not have spatial parts in any way that is to be compared with (or understood by reference to) its relation to its temporal parts.

Here we have a weaker and more reasonable claim than the one that events do not have spatial parts; and we can reasonably extend it to a claim to the effect that objects (continuants), far from not having temporal parts, simply do not have temporal parts in a way that is to be compared (or understood by reference to) their relation to their spatial parts. I am not saying that the notion of a temporal part of an object is to be recommended; all I maintain is that it is neither more nor less plausible than the notion of a spatial part of an event. Complementarity is here to stay.

## 4 Object vs event movement

We can summarize the results so far, and add a few more intuitive ones, by stating the following propositions:

In order for an object *o* to move, its spatial parts must be located at different places at different times. In order for *o* to rotate, its spatial parts must be located at different places at different times, but the whole of *o* (the fusion of its parts) must be always located at the same place, and the parts must bear the same spatial relations to each other (barring this conditions yields a description of a sort of internal viscous movement). In order for *o* to expand, some of its spatial parts must be located at different places at different times, but some other parts must remain at the whole of the place that *o* occupied at the beginning. In order for *o* to translate, it must be wholly located at different places at different times. In order for an event to move, its temporal parts (its phases) must be located at different places at different times. But intuitions seem unclear as to whether we can make finer distinctions for event movement (whether we have event expansion, rotation and translation).

Note, first, that these propositions do not impinge on the facts of complementarity. The only conclusion we are allowed to draw is that event movement is not complementary to object movement. Second, observe that according to the foregoing an object cannot rotate and translate at the same time. This is only superficially counterintuitive. Even though we can decompose an object's movement into a rotation and a translation (if, for instance, the object describes a cycloid trajectory), it does not follow from this that the object in fact both rotates and translates. As a matter of fact, an object's trajectory can be described as the resultant of indefinitely many components on indefinitely many trajectories, and it does not follow from this that the object moves in indefinitely many different ways. On the other hand, it is fairly obvious how to modify the previous propositions so as to cover the case of compound kinds of movement (translation cum rotation, translation cum expansion, rotation cum expansion, etc.).

## 5 More analogies

Mayo's third set of analogies consisted in the following pair:

- III.a An object cannot be at different places at the same time, unless its spatial size is greater than the interval between the places.
- III.b An event cannot be at different times at the same place, unless its temporal size is greater than the interval between the times.

These principles again rely upon the interaction between spatio-temporal and mereological concepts; again, they require some qualification. What (IIIa) excludes is that, say, one single normally sized one-piece chair be located simultaneously in Paris and New York. A chair can be located in both places in two circumstances only: either it is at different times in these places (it moves thus from the one to the other) or it is simultaneously at both places, but only partially so. In the last case, there are two quite different possibilities: (1) the chair is so big that it reaches Paris and New York and has, say, one leg here and another there; (2) the chair is a normally sized chair, but it has one leg



in Paris and another in New York because it is broken into two pieces- it is a scattered chair (a possibility not contemplated by Mayo). The complementary case seems to be straightforward; if a single, one-piece event lasts less than one minute it cannot be in a given place at two times separated by an interval longer than one minute. And the qualifications hold too: in order to be at the same place at two times separated by a one-minute interval, either (1) the event lasts longer than one minute (and its duration includes the two times) or (2) the event is composed by two scattered events (as in the case of the successive explosions of two time bombs, that together form one single bombing). Observe that it appears exactly as meaningful to attribute a duration to scattered bombings as it appears to attribute a length to scattered chairs. In some cases spatially scattered objects have a size which can be greater than the sum of the sizes of the places their parts are located at (as it might be in the case of an army that covers a large battlefield); and in some cases spatially scattered events have a size that can be greater than the sum of the sizes of the intervals their parts cover (as it might be in the case of a theater performance whose two acts are separated by a pause).

## 6 Temporal entities in space: occupation and localization

Another analogy, related to the ones dealt with so far, is that

- (a) An object has definite spatial boundaries, and indefinite temporal boundaries.
- (b) An event has definite temporal boundaries, and indefinite spatial boundaries.

It has an intuitive appeal, but I think we can explore some of its intricacies by investigating the distinction between occupation and localization.

The most neutral way of talking of localization is by using the notion of an address. Addresses are the referent of certain singular terms which can be semantically structured or unstructured (as in the case of 'I live at Fifth Avenue and 34th Street' and 'I live at the Empire State Building', respectively - the semantical complexity of the latter has no spatial relevance). To have an address is to be localized, without this implying that one occupies the place at which one is localized. The distinction can be dimensional: the place one occupies can be indifferently bigger or smaller than the place at which one is localized. This suggests that localization does not necessarily include a dimensional feature, which seems on the other hand essential in the case of occupation. Understanding what it means to occupy a spatial region requires a competence that allows one to compare the size of the occupying body and the size of the occupied region; understanding what it means to be localized at a certain place requires a competence allowing one to find the place in question (to find out an address). It is also possible to use a stronger notion of localization, i.e. dimensionally exact localization (the shadow of occupation, so to speak). A chair is thus exactly localized at the region of space which is enclosed within the chair's boundary (for a precise assessment of the notion I rely on Cartwright [1975], where he discusses the germane concept of a "container" region of space). The distinction between spatial occupation and spatial localization becomes particularly important as soon as we consider events. Events have an address ('There is a fire at the Empire State Building') but, if we use the notion of dimensionally exact localization, and define spatial occupation in terms of exclusive dimensionally exact localization, we can argue that events do not occupy space. Philosophers (Wiggins [1968], Davidson [1980] Simons [1985] among others) have discussed at length the issue, and the main results can be so summarized: (1) different entities can occupy the same region only if they are categorially different (as a statue and the material it is composed of are often assumed to be); (2) two categorially homogeneous events can be localized at the same place; (3) events do not occupy the place at which they are localized; (4) two categorially homogeneous objects cannot occupy the same place, but can (under particular circumstances) be co-localized, in the weak sense in which they can share an address, and not in the sense of dimensionally exact localization.

Spatial occupancy is thus intimately related to the notion of a boundary: if to occupy a place is for

an object to be exclusively localized at that place, this in turn depends on the object's capability of excluding other objects from that place, capability which obviously manifests itself at the boundaries, which are impenetrable. (The conceptual triad constituted by spatial occupancy, impenetrability and possession of a boundary has an obvious cognitive relevance too, especially insofar as perception uses natural boundaries as the foremost cues to object segmentation.) This fact contributes to an explanation of why material objects are taken to have determinate boundaries whereas the boundaries of an event are not so clearly individuated: in the case of objects exact localization matters - it is constitutive of occupation - whereas in the case of events only the loose sense of localization applies.

I shall conclude with some less structured and more hypothetical remarks on complementarity.

## 7 Complementarity as registered in natural language

A range of predicates can be applied rather indifferently to both objects and events: 'spread', as in 'the spreading tree/epidemic'; 'begin' and 'end', as in 'Italy/the performance begins/ends here'. Moreover, a range of prepositions can receive both a spatial and a temporal interpretation ('in', 'at', 'through', 'over'). There is no obvious explication for this relative topic-neutrality; its existence does in any case strongly suggest that there is a deep connection between spatial and temporal characterizations of objects and events.

## 8 Analogical equations

The foregoing was supposed to demonstrate the relative robustness of complementarity in a limited but, I hope, representative range of cases. A suggestion I find plausible is that we draw on the Hypothesis of Complementarity in order to elaborate predictions as to the structure of some concepts. This amounts to use analogical ways of solving structural equations, i.e., attempts at individuating missing concepts in patterns that allegedly have (some) dual structure. The idea is simple: take a pattern P with a missing concept and then systematically replace with one another temporal and spatial predicates in it; then hope that the obtained complement C(P) has a solution, and replace with one another temporal and spatial predicates in the solution. You should thus find a solution to P (the idea being that  $\text{Solution}(C(P)) = C(\text{Solution}(P))$ ). There is a natural extension of this strategy, which consists in starting with an already resolved P and then trying to produce C(P) so as to 'force' the surfacing of analogical concepts. Before finding full application the method requires calibration. And, of course, we ought not to beg any question against the hypothesis of complementarity - we ought not to project onto the data our desire to see the hypothesis at work.

## 9 The underlying architecture

Assume HC is true. Why is it that some concepts exhibit internal structural analogies in the way HC suggests? Here various hypotheses are open. According to one, both the concept of a material object and the concept of an event are superficial manifestations of a single deeper concept. According to another, one among the concepts of object and of event is primary (not 'primitive' or 'paradigmatic'), and the other one is obtained from it by some complex conceptual transformation. A third hypothesis has it that one among the two concepts in question is paradigmatic, and that the other one is obtained by deletion and accretion of conceptual marks. Choosing among these hypotheses, however, requires that more data be collected.

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