SEBASTIAN'S STROLLS

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A construal of events as propositions like that developed by Richard Montague in (1960) and David Lewis in (1986) is the most convincing one under my aspects. It is an open problem, however, whether coarse-grained events can be accomodated in this frame, and if so, how. As propositions events tend to be fine-grained. The event that Caesar died is different from the event that he was murdered. Nevertheless we should say that his death and his murder is one and the same event. We also conceive of the instances of generic events like Sebastian's strolls as coarse-grained events. If Sebastian took only one stroll through Bologna and if that was the one stroll, in the course of which he met Max, his stroll in Bologna is identical with the stroll on which he met Max, although the propositions, that he strolled in Bologna, and that he strolled and met Max, are different. In this paper I want to make a proposal for the definition of such coarse-grained events in the frame of a propositional theory.

1. *Events as propositions*

Often the word "event" is used only for singular events, like the death of Socrates, that occur just once in every world in which they occur at all. We shall talk about them at first. While Montague only considers instantaneous events that occur in a moment, we shall proceed from the view that events occur in finite (open, closed or half-open) time intervals, that it takes them some time to come about.

The frame for a specification of appropriate propositions is a combination of modal and tense logic. We can, for instance, use

TxW-frames as defined by Richard Thomason.[1] Such a frame consists of a non-empty set T of moments (t, t′,...), on which < is an ordering relation, and a non-empty set W of worlds (w,w′,...). For all $t \in T$ $w \sim_t w'$ is to be an equivalence relation on W that obtains if at t w is in the same momentary state as w′. $w' \sim_t w$ and $t' < t$ imply $w \sim_{t'} w'$: Worlds that are in the same state at t have always been in the same state before t.[2]

Propositions (X,Y,...) are subsets of WxT. That proposition X obtains in w exactly in the interval τ will be expressed by $L(X,w,\tau) := \forall t(\langle w,t \rangle \in X \equiv t \in \tau)$. τ_1 is to be the starting point of the interval τ, τ_2 its endpoint. Then a singular event is a proposition X satisfying the conditions: (a) $\forall w(\exists t(\langle w,t \rangle \in X) \supset \exists \tau L(X,w,\tau))$, (b) $\forall w w' \tau(L(X,w,\tau) \wedge w(\tau_2) = w'(\tau_2) \supset L(X,w',\tau))$, and (c) $\forall w w' \tau \tau'(L(X,w,\tau) \wedge L(X,w',\tau') \wedge \exists(t \in \tau \cap \tau' \wedge w(t) = w'(t)) \supset \tau_1 = \tau'_1)$. Condition (a) says that X is a singular event occurring exactly in an interval in each world in which it occurs at all. This excludes events that would be scattered in time. (b) says: If X occurs in w in the interval τ, what happens in w after τ_2 is not relevant for this occurrence. Condition (c), finally, says: If an event X occurs in w in the interval τ and in w′ in τ' and w and w′ coincide at some moment belonging to both intervals, X starts in both worlds at the same time. If X occurs in w in τ and w′ coincides with w up to some time $t<\tau_2$ in τ, it does not follow that X occurs in w′, too. If John climbs a mountain in w and τ he might start climbing the mountain also in a world w′ coinciding with w up to t, but in w′ he might turn back before reaching the summit. But if John climbs the mountain in w′, too, there would not be much sense in saying, that in w′ he begins his climbing later than in w. With the beginning of his climbing in w he does something that belongs to it, and as he also

1. Cf. Thomason (1984), p. 146.

2. WxT-frames correspond to tree universes as used in Kutschera (1986) and – for discrete time orderings – in (1993). The set $\{\langle w',t' \rangle: t' = t \wedge w \sim_t w'\}$ can be taken as the momentary state of world w at time t, and worlds may also be considered as functions mapping T into the set of world states, so that w(t) is the momentary state of w in t. This conception of worlds is used in what follows. For a theory of events it is not necessary to refer just to worlds branching only into the future, but what is lost in formal generality is won by the greater intuitive plausbility of tree universes.

does it in w′, it will have to be reckoned as a part of his climbing in w′, too.

Singular events correspond uniquely to sets of world segments w_τ. The segment w_τ is to be the function w, restricted to τ, or simply the set of the momentay states of w in the interval τ. If X is an event, the set $E = \{w_\tau: L(X,w,\tau)\}$ of the world segments in which X occurs satisfies the conditions: (d) $\forall w\tau\tau' (w_\tau \in E \wedge w_{\tau'} \in E \supset \tau = \tau')$, and (e) $\forall ww'\tau\tau' (w_\tau \in E \wedge w'_{\tau'} \in E \wedge w_\tau \cap w'_{\tau'} \neq \emptyset \supset \tau_1 = \tau'_1)$. Inversely, if E is such a set of world segments, the proposition $X = \{\langle w,t \rangle : \exists\tau (w_\tau \in E \wedge t \in \tau)\}$ is an event. Therefore we shall also refer to the sets of world segments, for which (d) and (e) hold, as "events".

Another type of proposition is a *state*. States are propositions X that obtain in a world w at a moment t irrespective of the development of w after t, i.e. $\forall ww't(\langle w,t\rangle \in X \wedge w(t) = w'(t) \supset \langle w',t \rangle \in X)$. States uniquely correspond to sets of momentary world states.

Our concept of an event is very wide. For instance, it is an event, that Socrates dies and it rains on the west-coast of Australia. Marking off "natural events", however, would be a hard task, and it would not be much use for our problem, either. We could follow D. Lewis and consider only contingent events, i.e. those that occur in some, but not all worlds, but that is only a minor point. Lewis construes events not as sets of temporal segments of worlds but as sets of spatio-temporal segments.[3] Since there are fewer events occuring in the same spatio-temporal region than events that occur in the same time interval, this approach allows for a stronger differentiation of events just by reference to their elements. But since, as Lewis emphasized, even at the same place different events can occur at the same time, a specification of events would still have to refer to properties of events that do not just apply in view of the space-time region, in which the events occur. In our approach we have to count among such properties also those that specify the place where the event occurs, but that is not a sufficient reason to depart from Monatgue's simpler conception of events.

Besides singular events there are those that may occur repeatedly

3. If we not only assume the same time intervals for all worlds, but also the same local regions, we cannot define events as sets of space-time regions, as Lewis does, but have to determine them as pairs of worlds and such regions.

in the same world. We shall call them, with Montague, generic events. Socrates' birth and his death are singular events. You can only be born once and only die once, but you can do almost everything else repeatedly. It would be artificial not to call such goings-on as Socrates' walks and thunderstorms "events", or to construe them as classes of singular events. Therefore we shall also conceive of them as propositions and take singular events to be special cases.

For the definition of the generalized concept of an event we use two abbreviations: τ/τ' is to mean there is a time point t between the two intervals τ and τ' and $L'(X,w,\tau) := \forall t(t\in\tau \supset <w,t>\in X) \wedge \forall\tau'(\tau\subset\tau'\supset \exists t(t\in\tau'\wedge \neg <w,t>\in X))$ says that X obtains all through the interval τ but not throughout any larger interval. An event, then, is a proposition X, for which instead of (a), the condition (a′) $\forall w\tau\tau'(L'(X,w,\tau)\wedge L'(X,w,\tau')\supset \tau=\tau' \vee \tau/\tau')$ is fulfilled, and instead of (b) and (c) the conditions (b′) and (c′) obtained from them by replacing L by L′. (a′) means that different occurences of X in the same world are temporally separated, so that X uniquely determines the intervals in which it occurs. This condition is too strong for some cases. Between the revolutions of the hand around the dial of a clock, say from 12 to 12, there is no separating timepoint. But for the sake of simplicity we shall leave it at the given definition. Events correspond to sets E of world segments, for which (e) obtains, and instead of (d) the condition (d′) $\forall w\tau\tau'$ $(w_\tau\in E \wedge w_{\tau'}\in E \supset \tau = \tau \vee \tau/\tau')$.

This definition of events as sets of world segment corresponds to that of Montague in (1960), essentially. There he considers instantaneous generic events only and defines them as properties of moments of time. If E is an event in our sense, a set of world segments, $f_w(\tau) := w_\tau\in E$ is the corresponding property – $f_w(\tau)$ is to say that the interval τ has the property f in world w. And if f is a property of time intervals, $E = \{w_\tau : f_w(\tau)\}$ is the corresponding set. We have, then, only added conditions (d′) and (e) that are superfluous for instantaneous events. The definition of events as propositions or classes of world segments renders a clearcut criterion of identity for them. Events X and Y, or sets E and E′, are identical if they have the same elements.

2. *Accidental properties of events*

The murder of Caesar took place in Rome, on the ides of March, and with Brutus among the assassins. It could also have taken place outside Rome, in April or without the partcipation of Brutus. Events, therefore, have different properties in different worlds. To occur in the interval τ or after some other event, to cause another event or be caused by it, are all accidental properties of events. An event, moreover, has a property in a world only at a certain time. If E occurs repeatedly, it may happen in one interval at one place, in another one at a different place. A property of E in w and τ is not a property of the world segment w_τ of E. It would make no sense, e.g., to say that such a segment occurs at a certain place, or a certain person is involved in it. Whether E is the cause of another event E' in w at τ, depends also on occurences of E in other worlds.[4]

If we consider properties of propositions we are faced by the problems David Kaplan has pointed out in (1983). Since the set of all proposition, as subsets of WxT, has a highter cardinality than WxT there is no function mapping WxT into the set of propositions. There is, for instance, no property f of propositions such that for each proposition X there is a world w and a time t such that f at w and t applies exactly to X. This undesirable limitation of properties may be eliminated by distinguishing types of propositions. If $w \approx w'$ is an equivalence relation on W, propositions of type 1 may be taken as such that $\forall ww'\, t(\langle w,t\rangle \in X \wedge w \approx w' \supset \langle w',t\rangle \in X)$. For properties f of such propositions we do not generally have $f_{w,t}(X) \wedge w \approx w' \supset f_{w',t}(X)$. If X is a proposition of type 1, $\{\langle w,t\rangle : f_{w,t}(X)\}$ would be a proposition of type 2, and so on.[5] In what follows we shall not consider propositions of higher types, however.

3. *Abstract and concrete events*

Caesar's death is mostly taken to be a more special, a thicker event than the one, that Caesar dies. If E ist the latter event, and E^0 Caesar's

4. Cf. Kutschera (1993).
5. This idea is discussed for the case of beliefs in Kutschera (1993a).

death, E^0 is E as this event has happened in our own world, w. How, where and under which circumstances E came about in w is given by the properties of E in w. This idea suggests determining E^0 as that subset of E which consists of those occurences of E, in which E has the same properties as in w. To be self-identical while the world is identical with w, however, is a property E only has in w. Therefore E^0 would be the unit set of w_τ, if τ is the interval in which E occurs in w. Caesar's death, however, is not this special, and E^0 would also be identical with every concrete event E'^0, for which E' also occurs in w_τ. For instance, Caesar's death would be the same event as the thunderstorm that occurred at the same time in Athens. The idea for a definition of concrete events, therefore, is only feasable, if we restrict the set of properties, by which they are determined.

We encounter an analogous problem in the case of states of objects. Since here its solution is simpler, we shall make some remarks on it. In view of our definition of states in section 1 we say that g is a *state-property*, if the applicability of g to an object x in world w at time t depends only on the momentary state of w in t, not on w's development after t. Then we have: $\forall ww't(g_{w,t}(x) \wedge w'(t) = w(t) \supset g_{w't}(x))$. *States of objects* are nothing but such state-properties. That x is a certain state, means that x has a certain state-property. A person is in a state of intoxication, if he is intoxicated. The set G of all state-properties is a complete Boolean algebra, i.e. if H is a subset of G, the conjunction of all the properties in H is also a state-prop-erty. Now the state John is presently in might, at first glance, be taken as the conjunction of all the state properties which John presently has. If x is John, w our actual world and t the present moment, this would be the property $Z(x,w,t) = \cap\{g \in G: g_{w,t}(x)\}$. But as 'to be identical with x' and 'to be self-identical while y has the property g in t'' are also state-properties for all x,y,g and t', Z(x,w,t) would then be a property applying only to x, and even to x only in w, for worlds in which all the objects have the same properties at the same times may be taken to be identical. If we talk about "the state John is presently in" no such special property is meant. Now this expression has a definite meaning only in a linguistic and conversational context. It may mean, among other things, the state of John's health, his financial situation or his social standing. If H is the set of state-properties relevant for a person's physical condition, John's state of health would be the property $Z(x,w,t,H) := \cap\{g \in H: g_{w,t}(x)\}$. The expression "the state of x", then, is ambiguous, and in logic, where terms usually are assigned a context-independent meaning, this ambiguity can only be resolved by a relativisation to a set H of state-properties, i.e. by speaking just about the H-state of some object or, its state considered under the H-aspects. The description of a state may be called "abstract", if it characterizes the state as a certain state-property, "concrete" if it determines the state by reference to an object, a time and the actual world, as the conjunction of the properties from a set H, which the object actually has at the time. If we also call states themselves "abstract" or "concrete", it has to be kept in mind, therefore, that both abstract and concrete states are state properties and that the same property may be both abstract and concrete.

The distinction between abstract and concrete events is to be understood in the same way. An event is designated abstractly by a sentence A expressing it, i.e. in the form "the event, that A". Concrete designations of events mostly use nominalizations of verbs or nouns, as in "The stabbing of Caesar" or "Caesar's death". They determine the event as it happens in the actual world. Let E be a singular event, at first, occuring in our world w in the interval τ. We have already seen, that the event E, as it actually happens – we called it E^0 above –, cannot be defined simply as the set of all world segments $w'_{\tau'}$ from E, for which E has the same properties in w' and τ' that it has in w and τ. As in the case of states of objects we have to relativize concrete events and say: The event E, as it happens in w with respect to the properties from a set F, is the set $K(E,w,F) := \{w'_{\tau'} \in E: \forall f(f \in F \supset (f_{w,t}(E) \equiv f_{w',t'}(E)))\}$. This event, then, comes about in each world segment, in which E occurs, just as it does in w, considered under the F-aspects.[6] Again it has to be emphasized that the expressions "concrete" and "abstract events" are just abbreviations for "concretely" and "abstractly determined events". One and the same event can be both abstract and concrete.

According to our definition the murder of Caesar is a murder of Caesar in all the worlds where it occurs. That, in another world, it

6. Since K(E,w,F) is a subset of E, it is an event, i.e. conditions (d') and (e) from section 1 are satisfied.

could be the birth of Caesar, the murder of Cicero, or even a sunrise, will not be presumed. But it might be considered as problematic, that this event is to have all F-properties essentially that the event, that Caesar is killed, has accidentally in our world. If F contains the relevant properties, the murder of Caesar necessarily occurs in Rome, by stabbing and with Brutus participating. Should we not rather say, that the murder could have occured outside Rome, by poison or without Brutus being involved? In one sense this is certainly correct. Caesar could have been poisoned, i.e. there is a world w′ in which the event E, that Caesar is murdered, does not have the property f of being a stabbing. As seen from w′, then, the murder of Caesar, i.e. the event K(E,w′,F), is not a murder by stabbing. But this does not mean that the murder of Caesar, as it actually happened, i.e. the event K(E,w,F), does not have the property f in other worlds. Actually Eve is married to Jack. Instead of Jack Eve might have married John. Therefore Jack is not necessarily the person, Eve is married to. But Jack is necessarily the person, Eve is actually married to – here we have a dthat-description in the sense of David Kaplan. The fact that Caesar might have been murdered by poison, that there is a possible murder of Caesar by poison, therefore is no argument against accidental properties of the event, that Caesar is murdered, being essential properties of the murder of Caesar, as it actually happened – Montague's and Lewis' scruples notwithstanding.

As with states a relativization of concrete events to certain aspects is only adequate, if it corresponds to natural language. The expression "The event that occurred in Richmond on the 3rd of May, 1991", in itself, has no well-defined meaning, since at the same place and time several events will have occurred. By determining an event as a murder or thunderstorm, or as somebody's walking or marrying, however, certain aspects are, more or less clearly, distinguished, that are normally considered as relevant for such goings-on. In the case of murders these are, among others, the agent, the victim, and the instrument. That such aspects are tacitly presupposed in talk of concrete events, is shown by the fact that they may be cancelled, explicitly or by the context. An explicit cancellation of a normally relevant aspect occurs, for instance, when we say "Aside from an excursion to Amiens it was the same journey that he made last year".

On contextual cancellations we will have to say something in the last section.

In special cases the choice of an appropriate set H of properties for the determination of concrete events may be difficult, but this is a problem not of our definition itself, but of its application. The construal of concrete events would be much simpler, of course, if there were smallest species of events, each of which would determine a set of relevant properties. In effect, this would abolish the relativization, but actually the linguistic and conversational context seems to play an important role in determining relevant aspects.

4. *Coarse grained events*

Concrete events are coarse grained since for different abstract events E and E′ the concrete events K(E,w,F) and K(E′,w,F) may be identical. How coarse or fine grained concrete events are depends on the choice of the relevant aspects in F, of course. The murder by Mr. Smith is identical with the murder of Mr. Brown, e.g., if Mr. Smith actually murdered Mr. Brown, and the relevant aspects are the place, the people involved and how the murder was committed, but not the property, to be known to the investigating detective. John's saying 'hello' is identical with his saying 'hello' loudly, if he actually said it loudly. D. Lewis' argument against the identity is that more special events also have more special causes.[7] Now, it is certainly right, that the events, that John said 'hello', and that he said it loudly, may have different causes, but whether this tells against the identity of the concrete events depends on the relevant aspects, and causes, at least, are no intrinsic properties of events.

If we maintain that E is the same event as E′, this is not always to be understood as an identity statement, however, even if E and E′ are concrete events. If I said: "I have the same car as Max", this would not normally mean that our cars are identical, that we own just one car among us, but rather that my car is of the same type as his one. Statements about strict identities x = y are to be distinguished from statements about sameness relatively to a set G of

7. Cf. Lewis (1986), pp. 255 seq.

properties, meaning that x and y have the same G-properties, i.e. $\forall g(g \in G \supset (g(x) \equiv g(y))$. An identity is a special case with G being the set of all properties. In the same way we can say that event E, relatively to the properties in F, is the same event as E′, if we have $\forall f(f \in F \supset (f_{w,t}(E) \equiv f_{w,t}(E'))$. For this we also write $E =_F E'$, the presupposition being that E and E′ occur in w in the same interval. From $E =_F E'$ it doesn't follow that $K(E,w,F) = K(E',w,F)$.

We have defined the concrete event K(E,w,F) in such a way that it will generally differ from the abstract event E. But we should have: (*) $E =_F K(E,w,F)$, i.e. in the actual world the abstract event E should have the same F-properties as the concrete E-event, defined relatively to these same properties. This principle does not hold generally, though. If F contains properties an event has if it has a certain cause or effect, (*) does not hold, according to the remarks on John's saying 'hello'; as a more special event K(E,w,F) may have more special causes and effects than E. If we talk about an event, how it actually came about, we frequently refer only to its intrinsic properties, those that characterise the course it took, but not its relations to other events, or to persons or objects not directly involved. Now the distinction between intrinsic and relational properties is fraught with difficulties. The principle (*) does not imply that F only contains intrinsic properties, however. To occur in a certain place is not an intrinsic property. The murder of Caesar might have occurred in a different place, but the concrete event happens at the same place as the abstract one. Therefore the best course is to take (*) as a normal condition for admissible sets F of properties.

Of the three statements: (a) $E =_F E'$, (b) $K(E,w,F) = K(E',w,F)$, and (c) $K(E,w,F) =_F K(E',w,F)$ only (b) implies (c). Together with (*), however, (a) follows from (b), and (a) and (c) are equivalent. Intuitively (a) should certainly follow from (b), and this, too, is a reason to accept (*).[8]

8. Postulate (*) does not make the definition of concrete events circular, of course. The definition does not presuppose (*). (*) is only a condition for distinguishing the intuitively acceptable ones among concrete events.

5. *Instances of generic events*

In section 3 we have defined concrete events K(E,w,F) only for singular events E. If E occurs repeatedly in the actual world, like the event, that Sebastian takes a stroll, there are concrete events only for the different occurrences of E. Sebastian's actual strolls will be termed instances of the generic event, that Sebastian strolls. Mostly they are called "occurrences", but we have already used this term for the elements of an event. Instances are events, not world segments. Though the unit-sets of such segments are events, too, instances are not such specific events. Sebastian's stroll on May 3rd would also have occurred, if many things had been different on this day.

If E occurs in the intervals $\tau_1,\ldots,\tau_n$ in w, there are exactly n instances of E in w, and they occur in these intervals. We conceive of instances as concrete events. Let $K(E,w,\tau,F) = \{w'_{\tau'} \in E: \forall f(f \in F \supset (f_{w,\tau}(E) \equiv f_{w',\tau'}(E))\}$ be the instance of E occurring in τ. Then there is an instance of E for every interval in which E occurs in w. We cannot generally say, that K (E,w,τ,F) occurs only in the interval τ in w; it might be the case that $\forall f(f \in F \supset (f_{w,\tau_i}(E) \equiv f_{w,\tau_k}(E))$ for some k≠i. But even if Sebastian took the same stroll on two different days relatively to the aspects in F, he didn't take just one stroll on these days. Our definition makes sense, therefore, only if F contains sufficiently many distinctive properties, i.e. if we have:
(**) $\forall \tau\tau'(w_\tau \in E \wedge w_{\tau'} \in E \wedge \forall f(f \in F \supset (f_{w,\tau}(E) \equiv f_{w,\tau'}(E))) \supset \tau = \tau')$.
We need distinctive properties to individuate the instances of E, properties characteristic for the time of their occurrence, or other ones.

Condition (**) does not imply that the stroll Sebastian took on the 3rd of May 1991 cannot occur repeatedly in another world. Instances are not generally singular events. But that is not something we have to postulate. An instance of E in w need not be an instance of E in every world where it occurs. If the strolls Sebastian took in another world w′ on the 1st and 7th of May 1991 passed, relatively to the F-aspects, just as the stroll he took in our world w on the 3rd of May of that year, and which is unique under these aspects in w, there is no reason to identify the stroll in w′ on the May 1st rather than that on May 7th with the stroll on May 3rd in w, without reference to additional properties. Instances of an event E in the actual world w are individuated by certain properties, and these may not suffice for an individuation in other worlds. Therefore the postulate that (**) hold for all worlds w is unnecessarily strong.

6. *Counterfactual statements about concrete events*

Concrete events can be the subject of contrafactual statements. Since we have already used such sentences, especially in section 3, we shall add some remarks on them here. The sentence

1) *The murder of Caesar could have occurred outside of Rome.*

does not have exactly the same content as

2) *Caesar could have been murdered outside of Rome.*

Let E be the abstract event, that Caesar is murdered, then (2) says that there is some world w' and an interval τ', such that E occurs in w',τ', but there does not have the property f to occur in Rome. But (1) can be paraphrased by

3) *The murder of Caesar, as it actually occurred – aside from the place and conditions connected with it – could have occurred outside of Rome.*

(3) is a statement about the concrete event K(E,w,F′), where F′ differs from F in not containing the property f, and says that there is a world w' and an interval τ' such that K(E,w,F′) occurs in w',τ', without having the property f there. We need not cancel the local specification explicitly, as in (3), however. (1) expresses the same content, since the cancellation of property f is already implied by the context. Such contextual cancellations of aspects are an argument for understanding talk of concrete events relatively to certain properties, even if they are not explicitly mentioned. We could also interpret (1) in such a way that there is to be a world w' and an interval τ', such that E occurs in w',τ' and the concrete event

K(E,w′,F) does not have the property f. But in view of our postulate (*) in section 3 this would be equivalent to (2). Talk of concrete events, then, refers to how they come to pass in the actual world even in modal contexts. If we say, for instance, that Sebastian could have taken the stroll, in the course of which he met Max, a second time, we mean the stroll as it actually occurred; in another world w′ Sebastian could not take the same stroll on different days as the same instance of his strolling in w′.

The case of contrafactual conditionals is somewhat different, if we refer to an analysis of such sentences by similarity relations between worlds, as used by Stalnaker or Lewis, e.g. the statement

4) *If the sinking of the Titanic had not occurred in icy waters, the losses would have been less heavy.*

has the same meaning as

5) *If the Titanic had not sunk in icy waters, the losses would have been less heavy.*

This sentence is true, if in all the worlds most similar to the actual one, w, in which the antecedent holds there are fewer victims than in w. But the worlds most similar to w, in which the Titanic does not sink in icy waters, are the worlds in which, aside from the water temperature, it sinks exactly as it acutally sunk. Again the contrafactual context in (4) cancels an aspect that is normally used to determine the concrete event.

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