TOWARDS AN ANALYSIS OF THE PROGRESSIVE

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1. Preliminaries

In an attempt to understand the philosophical, linguistic and logical problems of the progressive tense, it may be valuable to start with a detailed analysis of *actions*, and the verbs relating to them. The loss of generality of such an analysis may perhaps be excused if it helps shed some light on the main issues, even if it does not provide answers to all questions on the subject. The issues that are approached in this paper are: (i) to define a formal language suitable for analysing certain aspects of action sentences, (ii) to outline a theory of action with sufficient precision to formulate plausible truth-conditions for action sentences in the progressive tense, and (iii) to provide a partial analysis of tenses that satisfy basic inferential patterns for action sentences.

The main work of this paper is to formulate a theory of actions precisely enough to enable us to construct a simple formal language in which simple assertions about actions can be given precise truth-conditions. This means that a number of issues relating mainly to action theory will have to be addressed. Despite this, many, if not most, issues relating to problems in the theory of actions will have to be ignored, and so the theory, as presented, will have to be viewed as a rough sketch.

The sentences discussed here are primarily of the form: *a* is *v*-ing. The focus is on defeasible progressives such as:

(A) Anne was walking to the store when she was run over.

In particular, the truth-conditions for such sentences and their logical relation to other sentences, such as "Anne walked to the store", are discussed.

2. Speaking of Actions

The infinitive form of action verbs is the most basic means available in English for speaking of actions. The verb phrase (*to*) *walk to the store* can be said to designate an action-type (as opposed to an action token). The infinitive form is not normally manifested in actual utterances of English; rather, different aspects of the performance of actions are manifested: an

Nordic Journal of Philosophical Logic, Vol. 5, No. 1, pp. 39–59.

action (type) is being performed (instantiated), an action has come to an end, and so on. These are referred to as the different action *modes* of an action verb.[1] In addition, there are any number of ways to relate these action modes temporally: an action came to an end in the past, one action preceded another, and so on.

One cannot here do justice to all the complexities involved. The action modes that are treated here are *technical* in that they may, or may not, have direct correlations to tense constructions of a natural language, the ambition being that some tense constructions can be analysed in terms of these technical modes. The three action modes that are examined are *prog*, *culminates* and *terminates*. In this section, these will be characterised quite informally; the formal definitions will be given in later sections. Even these should be seen as fair approximations; several more sophisticated definitions are conceivable.

prog walk is supposed to mean that the agent (left unspecified) is walking. *culminates walk* asserts that the agent just now has walked. That is, from this instance onwards it will be true that the agent has walked. The formula *P culminates walk*, where *P* is the operator "at some time in the past …", is supposed to capture "the agent has walked".[2] Finally, *terminates walk* is true if the agent, at this instant, has stopped walking.

The culmination of a routine, in this sense, does not imply its termination. True, an action such as *walk to the store* will probably terminate when it culminates, but others, such as *walk*, will culminate throughout the performance of the action while it need never, in principle, terminate. The intuition being, roughly, that every walk has a sub-part that is also a walk, which is not the case with a walk to the store. Following Vendler (1967) I distinguish between activity verbs (or verb phrases) and accomplishment verbs (or verb phrases). Examples of activity verbs are *walk* and *draw*, examples of accomplishment verbs (verb phrases actually) are *walk to the store* and *draw a circle*. As it happens, achievement verbs will in general describe *defeasible* progressives, while activity verbs do not.

3. The Language *L*

To discuss these matters with more precision, a simple formal language is introduced. The language *L* consists of two sets $\mathrm{InfV}_{\mathrm{act}}$ and $\mathrm{InfV}_{\mathrm{acc}}$ of

[1] The history of these ideas is not clear to the author. von Wright (1982, pp. 100–129) considers a deontic logic where actions-types—described by the infinitive form—take *modes* (this is not what he calls it) to form sentences. The idea of treating the infinitive form of verbs as, in some sense, basic can be found in other authors, notably, Kamp and Reyle (1993, chapter 5).

[2] Perhaps the correct formalisation of "the agent has walked" should be *culminates walk* $\vee$ *P culminates walk*.

the infinitive form of activity and accomplishment verbs respectively, usually denoted by: $v_1, v_2, \ldots$, whenever it is convenient, these two sets will be treated as one: InfV. The language will also contain two sets of attributives Attr_1 and Attr_2, usually denoted by $f, g, \ldots$. Attributives combine with the infinitive form of verbs to produce new verbs, with the restrictions:

1. If $f \in \text{Attr}_1$ and $v \in \text{InfV}_x$, then $f(v) \in \text{InfV}_x$, for $x =$ acc or act
2. If $f \in \text{Attr}_2$, then $f(v) \in \text{InfV}_{\text{acc}}$

Attributives of the first type are: *slowly*, *with a knife* while attributives of the second type are *to the store*. Thus the activity verb *walk* combines with *slowly* to produce a new activity verb: *slowly* (*walk*), while *walk* combines with *to the store*, to produce the accomplishment verb *to the store* (*walk*). This subdivision is meant to capture the logical properties of certain adverbs and prepositional phrases and not their status in a descriptively accurate grammar. Further, the language contains three action modes *prog*, *culminate* and *terminate*, the standard sentential connectives and the sentential operators P and F which are to be read in a standard fashion "at some point in the past …", "at some point in the future …".

The well-formed formulas (wffs) of L are defined:

(i) if $v \in \text{InfV}$, then *prog* v, *culminates* v and *terminates* v are all wffs
(ii) if ϕ and ψ are wffs, then $\neg\phi$, $\phi \vee \psi$, $\phi \wedge \psi$, $\phi \rightarrow \psi$, $\phi \ll \psi$ are wffs
(iii) if ϕ is a wff, then $\text{P}\phi$ and $\text{F}\phi$ are wffs.

4. States, Paths and Temporal Perspectives

One can think of the world as passing through a succession of states. States as conceived here are *total* and *static*. *Total*, in the sense that every relevant state-of-affairs of the world is determined, *static* in the sense that any such state taken in isolation will not be sufficient grounds for a claim that something (e.g. a process) is going on, that some state used to obtain, or that some state will obtain.

In part, this corresponds to the rather conventional view that, for instance, a process is only recognisable as such over an interval of time. This is sometimes taken as an argument for an interval- or event-based semantics, but whatever the merits of such approaches, they are not justified on the basis that "the process p is in progress at t", where t is an instant, is meaningless. On the contrary, it seems quite plausible to argue that the sentence is meaningful, at least if by the *meaning* of a sentence one means the conditions under which it is true. There seems to be no contradiction in the claim that the *conditions* under which a progressive sentence

is true at some instant t involve facts about the world in some interval surrounding t (cf. Montague 1968).

The set of possible states will be denoted by U. A *path* is any linearly ordered subset of U, possibly empty. Paths can be either discrete or dense. The basic operation is concatenation of two paths p and q, this is written $p;q$, and can take place if p has a last element and q has an identical first element, so, for instance, if $p = \langle u_1, \ldots, u_n \rangle$ and $q = \langle u_n, \ldots, u_{n+m} \rangle$, then $p;q = \langle u_1, \ldots, u_n, \ldots, u_{n+m} \rangle$. The empty path is denoted by $\varnothing$. A path is *extended* if it contains at least two elements. Let P denote the set of paths on U.[3]

Three different kinds of overlap between paths are distinguished:

p *terminates with* q if and only if $\exists r \in P,\ q = r;p$
p *continues past* q if and only if $\exists r, s, t \in P,\ q = r;s,\ p = s;t$,
where s and t are extended p *extends* q if and only if $\exists r \in P,\ p = q;r$

The world is, at the present moment in some state u_0, prior to reaching the state u_0 the world will have passed through a number of states: first u_{-2}, say, then u_{-1}. From u_0, the world will go on to other states u_1 and u_2, say. In a natural sense a sequence of states generates an implicit notion of time, so one need not assume any explicit notion of time in the modelling. The sequence of states described above could be represented as $(\langle u_{-2}, u_{-1}, u_0 \rangle, \langle u_0, u_1, u_2 \rangle)$. In general, a *temporal standpoint* t is a pair (r, s), where r is the sequence of states describing the past states of the world ending with the state that obtains *now*, and s is the sequence of states starting with *now*, followed by the future states of the world. So temporal succession can be seen as a tree with two branches with the "now" acting as the root. When $t = (r, s)$, let $t_P = r$ and $t_F = s$. t_P will always have a last element (the state obtaining *now*), while t_F will always have a first element (the *now*). Let T denote the set of temporal standpoints.

Given two temporal standpoints t and t' it is quite natural to wonder whether one precedes or succeeds the other. Let $t < t'$ denote that t precedes t' or, equivalently, that t' succeeds t, this is defined as follows:

$t < t'$ if and only if $\exists q \in P$, q is extended, $t'_P = t_P;q$ and $t_F = q;t'_F$

Note that $<$ is a transitive and anti-symmetric relation on the set of temporal standpoints T. Where $t < t'$, let $[t, t']$ denote the path q such that $t'_P = t_P;q$ and $t_F = q;t'_F$.

[3]The notion of a *path* is very similar to and inspired by notions studied in Segerberg 1992 and 1985.

5. Action Descriptions

Assume that the world is in some state where Anne is standing outside her house. It seems meaningful to ask what sequence of states must proceed from this initial state for Anne to have walked to the store at the end of the sequence. Chances are, there will be many such sequences. Anne may choose from a number of different routes. For any particular route her choice of movements may vary; she may stop at some crossing and wait for cars to pass, or she may make a dash for it and hope for the best. On the way, events quite irrelevant to Anne's walk may or may not occur and so one possible sequence would contain this event, another, perhaps, would not. It would be an impossible task in practice to state exactly even one such path. In certain well-delineated settings, however, such a task may not be impossible. If the "world" is a chess-board for instance, or the internal state of a computer, the task may be possible in principle.

If one for each agent and each state supplied the proper sequences needed for the agent to walk to the store from that state, then it seems natural to say that one has supplied the *meaning* or *intension* of the expression "walk to the store".

The intension of the different expressions of L will be dependent on some model M for L, the precise structure of such models will not be given until section 9, but it will contain an assignment function V, such that when $v \in \text{InfV}$, $V(v) \subseteq P$. Throughout I shall assume that for every $p \in V(v)$, p contains at least three elements. Two-element paths can be used to model instantaneous events and one-element paths can be used to model states, but neither of these will be studied here. Activity verbs and accomplishment verbs are subject to quite different conditions:

(i) If $v \in \text{InfV}_{\text{act}}$, then $\forall p \in V(v)\, \exists r, s \in P$, r and s are extended, $p = r;s$ and $r \in V(v)$.
(ii) If $v \in \text{InfV}_{\text{acc}}$, then $\forall p \in V(v)$, $\forall r, s \in P$, if $p = r;s$ and s is extended, then $r \notin V(v)$.

V evaluates attributives as functions from sets of paths to sets of paths. The evaluation of a complex expression $f(v)$ becomes: $V(f)(V(v))$. The only attributives considered here will be ones satisfying: $V(f(v)) \subseteq V(v)$. For instance, if the expression is *slowly*(*walk*), *slowly* will be interpreted as a function selecting all those paths of *walk* that are deemed slow, while in *to the store*(*walk*), *to the store* will be interpreted as a function selecting all those paths of *walk* where the agent ends up at the store.

Given these distinctions it is easy to see why *walk* and *walk slowly* are activity verbs while *walk to the store* is an accomplishment verb. *to the store*(*walk*) contains all paths of *walk* such that the agent ends up at the

store. So if p is such a path, and $p = r;s$ where s is extended, then r will end before the agent reaches the store and so r will not be a path in *walk to the store*. *slowly*(*walk*) on the other hand contains all the paths that constitute slow walks, some of these will be "long" such as slow walks to the store, others will be short fragments of walks.

Of course, several attributives can be combined. Thus, *to the store* (*slowly*(*walk*)) would correspond to the verb phrase *walk slowly to the store*. A potential problem of scope arises here. The verb phrase *walk slowly to the store* seems more or less synonymous with *walk to the store slowly*. But how can one guarantee that $V(\textit{to the store}\ (\textit{slowly}(\textit{walk}))) = V(\textit{slowly}(\textit{to the store}(\textit{walk})))$? Their equivalence can, in fact, be established given that we impose the following conditions on attributives:

(a) if $V(v) \subseteq V(u)$, then $V(f(v)) \subseteq V(f(u))$.
(b) if $V(v) \subseteq V(u)$, then $V(f(u)) \cap V(v) \subseteq V(f(v))$

For attributives such as *to the store* or *with a knife* these conditions clearly hold. If $p \in V(v)$ and p is judged to be a path that takes the agent to the store, then p is still a path that takes the agent to the store, even if $p \in V(u)$, similarly for *with a knife*. For *slowly* matters are a bit more complicated. *Slowly* is usually sensitive to some comparison class. Thus, to take a classic example: Mary may swim the Channel quickly but her swim is a slow crossing. We can easily model this example in the present framework as presumably $V(\textit{swim}) \cap V(\textit{cross})$ is non-empty—some swim-paths are crossing-paths. It is also quite possible that $V(\textit{quickly}(\textit{swim})) \cap V(\textit{slowly}(\textit{cross}))$ is non-empty. But in this case we cannot conclude from the fact that $p \in V(\textit{quickly}(\textit{swim}))$ that p is a "quick" path, as it may also be a "slow" path when it occurs in $V(\textit{slowly}(\textit{cross}))$.

Considerations such as these seem to count against the synonymy of *walk slowly to the store* and *walk to the store slowly*. It is conceivable that a walk can be slow for being a walk to the store, but not for being a walk *simpliciter*. This may be more plausible if we consider phrases such as *walk with a crutch slowly* as compared to *walk slowly with a crutch*. One can conjecture that in general attributives of type Attr_2 ought to satisfy the condition of monotonicity, but that the attributives of type Attr_1 ought to be further subdivided: *with a crutch* and *with a knife* are of type Attr_1 and clearly satisfy monotonicity, while *slowly*, which is also of type Attr_1, does not.

Sentences of L will be evaluated relative to a temporal perspective t. At this point one can state the truth-conditions of *culminates v*:

$$\vDash_t \textit{culminates } v \text{ iff } \exists q \in V(v), \text{ such that } q \text{ terminates with } t_p.$$

Or, equivalently:

$$M \vDash_t \textit{culminates } v \text{ iff } \exists\ t' \in \mathcal{T},\ t' < t \text{ and } [t', t] \in V(v).$$

That is, the *v*-ing culminates (the agent has *v*-ed) at t, whenever there is

some path q of $V(v)$ that coincides with the path that the world has taken from some point in time earlier than t, up to and including t (remember $[t', t]$ does not denote an interval of temporal standpoints, but the path that connects t' and t, see section 4).

It should come as no surprise that the notions introduced so far are not sufficient to give a satisfactory account of the progressive. To make this point explicit one can look at a flawed account (this will be indexed with "0" as the definition will be changed):

$$\models_t \textit{prog}_0\ v \text{ iff } \exists q \in V(v),\ q \text{ continues past } t_{\mathrm{P}}.$$

$\textit{prog}_0\ v$ corresponds to a view of the progressive as extrapolation: the agent has, up to now, been performing in a manner consistent with v, and so one concludes that the agent is now doing v. But consider this situation: the agent is walking to the store, there is a post office just beyond the store, so while the agent is walking to the store, the agent's movements up to now are consistent both with walking to the store and walking to the post office and so it would be correct to assert both. But, *ex hypothesi*, the agent was *not* walking to the post office, only to the store and so this view makes too many false progressives true.

Another proposal which is also obviously flawed is:

$$\mathrm{M} \models_t \textit{prog}_1\ v \text{ iff } \exists t', t'' \in T, \text{ such that } t' < t < t' \text{ and } [t', t''] \in V(v).$$

That is, $\textit{prog}_1\ v$ is true at t if and only if there is some path of $V(v)$ that corresponds to what actually happens in some interval surrounding t. This form of the progressive can never be defeated as it will always be the case that $\textit{prog}_1\ v \rightarrow F\ \textit{culminates}\ v$. So $\textit{prog}_1\ v$ makes too many true progressives false and so it cannot be the whole story, but in the final analysis it will still play a rôle.

6. Intentions and Routines

What makes "Anne was walking to the store when she was run over" true? A tempting analysis is to say that it is true because Anne had the *intention* of walking to the store and that she was acting in accordance with that intention when she was run over. The presence of the intention of walking to the store, together with her acting upon that intention, justifies the assertion that Anne was walking to the store.

But this analysis has flaws. The presence of an intention to perform an action v and of an actual performance of v are neither necessary nor sufficient conditions to justify the assertion that the agent is *doing* (has done) v, at least on fairly standard views on the notion of intention. True, if, for instance, Anne is walking and has the intention to meet Bill at the store,

one may well assert that she is walking to the store. But say that the store, unknown to Anne, is a red brick building. It seems equally correct to assert that

(B) Anne was walking to the red brick building.

This is so, even though she has no *de dicto* intention to walk to the red brick building. Plausibly this might be handled by a more sophisticated treatment of intention, but there is another problem: say that Bill is *not* by the store; however, Anne believes that he is. It would still be correct to assert that she is walking to the store, but it would no longer be correct to assert that Anne is walking to meet Bill, although she believes that she is. When intentions and false beliefs conspire in such a manner, a simple intentional theory of progressive actions becomes implausible.

A typical agent has the ability to perform stereotypical sequences of bodily movements.[4] Some such movements are characteristic for the activity one would call "walking", others are characteristic for tying one's shoelace. The presence of such movements is not sufficient to truthfully assert that the agent is walking or tying his shoelace, respectively, this will depend on the circumstances. If the agent is out of his depth in water, a "walking" movement would not constitute a walk but a treading of water. If the agent is performing movements characteristic of tying his shoelace but has no shoelace in his hand, one may not know what to say about his activity, but one could not truthfully assert that he is tying his shoelace. There may be circumstances where the agent cannot perform a certain pattern of movements due to his being tied down or being extremely tired, or to some other factor.

One can think of an agent as having certain *routines* at his disposal which can be run at will given the appropriate circumstances. One routine will generate the characteristic movements of tying one's shoelace, another the characteristic movements of walking. If these routines are run in normal circumstances they will result in the shoelaces being tied and the agent walking, respectively. In atypical circumstances, such as those described in the previous paragraph, the mere running of such a routine is not sufficient to claim that the agent is tying his shoelaces or walking.

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[4] Here I shall take humans as the prototypical agent. An institution of some sort could also be an agent. Clearly, in such a case, bodily movements would not be the appropriate level of analysis, but this complication will be ignored. I see no principled reason why the present framework could not be extended to such cases. In fact we need not restrict our attention to agents of any kind. A physical process such as ice melting or a star collapsing could be described as a routine taking place in some spatio-temporally bounded area. Of course, no agent is there to choose the routine, the "choice" is determined by the laws of nature.

A routine may fail, either due to external circumstances—the shoe lace breaks—or due to the agent's fickle mind. A routine may be successful in several different ways. One need not demand that a sequence of hand-movements be identical from time to time. The routine may be flexible and generate quite different movements on different occasions.

At any time the agent will have a repertoire of routines to choose from. When it is said that the agent *chooses* a routine, the choice is not to be understood as the decision to start performing the routine but rather as the *instigation* of the routine, the commencement of the first move of the routine. Of course, there are more than *instigative* choices. In any temporally extended routine, there will be continuous *supportive* choices, choices to continue or discontinue an on-going routine. If surrounding circumstances do not interfere and the agent does not terminate the routine prematurely, the routine will culminate successfully. Speeding cars or a fickle mind, however, may prevent a successful culmination of a routine.

The choice of a routine can be said to constitute a *commitment*. By choosing a routine the agent is, at the time of choice, committed to run the routine through. This commitment can be overridden by the agent. External factors such as speeding cars may brutally interrupt the routine. But before any such interruption the instigative and supportive choices of a routine constitute a strong enough commitment to the successful culmination of the routine to justify the claim that the routine is in progress, i.e. that the agent is *doing* whatever would constitute a successful performance of the routine, regardless of whether this performance is ever brought to success. The choice of routines is the mark of agency.

On this view the relationship between intentions and actions is, at best, indirect. Because of, say, false beliefs, the routine chosen may not have the results intended. The agent may come to realise this while performing the routine and so choose to interrupt it, or the agent may remain happily unaware of the consequences of the routine chosen and so see the routine through. In neither case will the result of the routine be the result originally intended.

The notion of a routine has some intuitive appeal as long as one talks about simple bodily movements, or about largely repeatable actions, such as setting a dinner table. It is far from obvious that we can appeal to routines when an agent is walking to the store or writing a book. Because of the great complexity of the actions described, one could claim that they are impossible to analyse without resorting to notions such as *belief* and *intention*. Notions that are used to give an analysis of the reasons for an action, be their influence conceptual or causal. The presence of an intention explains, in part, *why* an action has been performed, but this is not the topic of this paper, so it would be desirable to leave this aside. On the

other hand, maybe action descriptions such as *walk to the store*, or *write a book* describe such complex activities that they deserve to be called action descriptions only in virtue of there being overriding intentions that throughout any performance of the action offers unity to the activity.

I will not give higher order intentions any special treatment in the analysis, but here is a brief sketch of how it could be done. One can understand the beliefs and the higher order intentions (''plans'') of the agent as constraints. The particular routine being run (''setting a table'') may not, even if successfully completed, guarantee that the higher order intention (''preparing for a dinner party'') will be realised. However, no successful run of the routine should be irreconcilable with the higher order intention. We say that the agent is preparing for a dinner party because the higher order constraints on the routines to be chosen (for the next hour or so) are such that if the constraints endure (if the intention remains) the result will be that the dinner party is prepared.

This is how it *could* be done. But to keep things simple I will not distinguish between ''low level'' routines and ''high level'' intentions. Instead I will treat the agent as running the complex routine of preparing for a dinner party, even if such an analysis feels more artificial.

The major assumptions at this point will be that the routines available to an agent can be understood well enough for one to say how the world must progress in order to be in accordance with a successful run of a routine—to state, so to speak, the *success conditions* for a routine. Of course, one could also be interested in how the world is affected by a routine being run, so that one could say what *would* happen given that a particular routine is run under some particular circumstances, but this topic will not be addressed here.

Ideally, one can state how the world must progress in order for a routine to be run successfully, here a routine will be identified with the success paths of the routine. Formally, let the repertoire of the agent be a set R such that $R \subseteq \not\wp P$. The agent is represented by a choice-function γ, where $\gamma(t) \in R$, subject to the restriction: $\gamma(t)$ is non-empty, for each $t \in T$. The choice may be either instigative or supportive, in a more sophisticated analysis this distinction would be important, but here the two will be conflated. The routine of doing nothing, if there is one, would be represented by P, the set of all paths.

Note that the routine that the agent is running can be a complex one that constitutes both, say, walking and talking. It may be natural to think of these as constituting two different routines that are being run in parallel; in that case the agent's choice would constitute the *resultant* routine, i.e. the routine that results from running these two (or, quite probably, many more) routines in parallel. But such a view is in no way essential to the

present approach, the routine chosen may well be unanalysable in terms of "constituent" routines. The much debated problem of "the individuation of actions" (see, for instance, Davidson 1980b) does not need to be resolved in this framework.

7. The Progressive

Thus far, two quite different notions, action-descriptions and routines, have been given a similar representation. The former is represented as the set of paths which would be consistent with the behaviour associated with the action-description, the latter is represented as the set of paths that would constitute successful runs of a routine. One should stress that despite the similarity of representation, they are quite different things. The set of paths that constitute a walk to the store constitutes the meaning of the verb phrase *walk to the store*. The set of paths that constitutes a successful run of a routine may not, and in general will not, correspond exactly to any description. A description can come closer to describing the routine being run by adding modifiers such as *to the store*, *slowly* or *with a slight limp every* 23*rd step*, but we would not expect to be able to correctly and completely describe the doings of anyone at any time, that is we would not expect to find a verb phrase v such that $V(v) = \gamma(t)$. The distinction between routines and descriptions is essential to capture the distinction between what happens and the linguistic resources we have to describe what happens.

How can these notions be combined? The first suggestion is the following, if some run of a routine, from some point, coincides with some path of action description v, then the agent is v-ing, formally:

$$\models_t \mathit{prog}^W v \text{ iff } \exists p \in \gamma(t),\ p \text{ continues past } t_P, \text{ and } p \in V(v).$$

As it happens, this notion has problems with defeasible progressives. For instance, assume that the road to the store divides into two different roads, both taking the agent to the store. Call one route a and the other route b. If, prior to reaching the divide, the agent is running a routine such that no decision has been made which road to take at the division, then, according to prog^W, both "the agent is walking route a to the store" and "the agent is walking route b to the store" would be true. But one might well argue that at that point neither is true, but rather "the agent is walking one route a or b to the store".

Let us instead look at the following proposal, if *every* run of a routine, from some point, coincides with some path of an action-description v, then every successful run of the routine from that point would be a v-ing:

$$\models_t \mathit{prog}^S v \text{ iff } \forall p \in \gamma(t), \text{ if } p \text{ continues past } t_P, \text{ then } p \in V(v).$$

One can refine this analysis somewhat. It is enough that every path of $\gamma(t)$

extends some path of v from t. To see why, assume that the agent has chosen a routine that will first take him to the store and then to the post office, it seems correct to assert that, at the outset at least, the agent is walking to the store. This corresponds to the following condition:

$\models_t prog^S\ v$ iff $\forall p \in \gamma(t)$, if p continues past t_P, then $\exists r \in V(v)$, s.t. p extends r

While $prog^S$ seems reasonable for many defeasible progressives, it is *too* strong for progressives that are not defeasible. I may, for instance, by chance move my hand in a perfect horizontal line. This is not something I can accomplish at will, I do not have such control over my hands, but on a particular occasion it can happen that this is how I, in fact, move my hand. It seems perfectly reasonable to say that I was moving my hand in a perfect horizontal line, even though my control over my hand was not sufficient to *guarantee* this—I have no routine every path of which corresponds to my hand moving in a perfect straight line.

Now, *move my hand in a perfectly straight line* is an activity verb phrase. So one way of dealing with this problem is to let the truth-condition of the activity verbs be given by $prog^W$ and the truth-conditions for accomplishment verbs be given by $prog^S$, but this analysis would be wrong.

Consider the verb phrase *move my hand* 967.76 *millimetres*. This is an accomplishment verb phrase that surely can be used to describe some particular action of mine: *I moved my hand* 967.76 *millimetres*. But once it has become a fact that I moved my hand 967.76 millimetres it becomes quite reasonable to say things such as: *I was thinking of something else while I was moving my hand* 967.76 *millimetres*. The fact that I moved my hand 967.76 millimetres is sufficient to allow me to speak of what was happening when I was moving my hand 967.76 millimetres. But if accomplishment verb phrases in the progressive are analysed by $prog^S$ that would mean that I have a routine every outcome of which is a 967.76 millimetre movement of my hand. But I do not have such control over my hand and so $prog^S$ seems too strong for accomplishment verbs as well.

In normal usage it would seem that any walking movements that actually bring Anne to the store constitute a sufficient basis for saying that Anne has walked to the store and, consequently, that Anne previously was walking to the store. Similarly, that any 967.76 millimetre hand-movement is a sufficient basis for saying that the agent moved his or her hand 967.76 millimetres,[5] and consequently a sufficient basis to say that the agent was moving his or her hand 967.76 millimetres.

[5] Perhaps we do not want to include every such hand-movement, we could exclude such hand-movements that are coerced by some external force. Remember we as speakers decide what *move my hand* means by specifying what paths should be counted as *move my hand*-paths.

A word of caution though. Say that Anne when walking to the store changes her mind and decides to go to the post office. In retrospect the whole walk was "consistent" with Anne walking to the post office, but it must be wrong to say that prior to changing her mind she was walking to the post office. Thus even if she ends up at the post office it is wrong to say that she throughout her walk was walking to the post office. Some path in the routine being run at a time t must be an element of the paths of v in order to say that the agent is v-ing at t: it is not sufficient that the actual course of events turn out to be an instance of having v-ed. Note, however, that at *some* point it must be true that the agent is v-ing, even if it isn't true at t.

According to the present analysis the progressive must be divided into two different cases. We can say that the agent was doing so-and-so, because, in a sense, the agent eventually *did* so-and-so *and* because this was consistent with the routine she was running (it was a path in that routine). We can also say that the agent was doing so-and-so irrespective of whether this doing ever culminated. Is this duality a flaw in the analysis or does it represent a duality in the usage of the progressive construction? I do not know what considerations would provide an answer to this question. It seems that the best we can do is to compare different analyses and see which fares better, which addresses the fundamental questions in the most fruitful way.

On my view the appropriate analysis of the progressive should handle two different cases, one where the action eventually succeeds and one where it (may be) defeated:

$$M\models_t \mathit{prog}\ v \text{ iff (a) both } M\models_t \mathit{prog}_1\ v \text{ and } M\models_t \mathit{prog}^{ev}\ v, \text{ or (b) } M\models_t \mathit{prog}^{S}\ v$$

8. Culminates and Terminates

The truth-condition given for *culminates* v is concerned only with the *behaviour* of the agent, not with the routine chosen by the agent. However, to connect with the analysis of the progressive one might suspect that a stronger notion is needed: $\mathit{culminates}^S\ v$ which would be true when the agent behaves in accordance with v *and* does so on the basis of some chosen routine. This would verify the inference

$$\mathit{culminates}^S\ v \rightarrow P\ \mathit{prog}^S\ v$$

However, as I above settled on a disjunctive reading of the progressive it seems reasonable to settle on a disjunctive reading for culminates as well, but $\mathit{culminates}^S\ v \vee \mathit{culminates}\ v$ is equivalent to *culminates* v so this is superfluous.

$M\models_t$ *terminates* v iff (a) $\exists t' < t, \forall t'', t' \leqslant t'' < t', M\models_{t''} \mathit{prog}^S\ v$
and not $M\models_t \mathit{prog}^S\ v$
or (b) $\exists q \in V(v)$, such that q terminates with t_p and $\forall q \in V(v)$, q does not continue past t_p

9. Some Properties of the Modelling

A model M for L is a rather complex structure (U, T, R, γ, V) where U, T, R, γ and V are as before (remember $\leqslant$ is defined from T). The remaining truth-definition for sentences of L are

$M \models_t \phi \wedge \psi$ iff $M \models_t \phi$ and $M \models_t \psi$, $M \models_t \neg \phi$ iff *not* $M \models_t \phi$, etc.

$M \models_t P\phi$ iff $\exists t'$, $t' < t$, $M \models_{t'} \phi$

$M \models_t F\phi$ iff $\exists t'$, $t < t'$, $M \models_{t'} \phi$

Let $M \models \phi$ denote that for every $t \in T$, $M \models_t \phi$. *Logical* truth is defined as truth in all models M at all temporal perspectives and is written $\models \phi$. As is customary, a formula is said to be *falsifiable* if there is a model M and a temporal perspective t, s.t. *not* $M \models_t \phi$, and *satisfiable* if there is a model M and some $t \in T$, s.t. $M \models_t \phi$.

Theorem 1

(1) $\models$ (T tautologies)
(2) $\models$ *culminates* $v \rightarrow P$ *prog* v
(3) $\models$ *terminates* $v \rightarrow P$ *prog* v
(4) $\models$ *prog* $v \rightarrow \neg$ *terminates* v
(5) $\models$ *prog* $f(v) \rightarrow$ *prog* v
(6) $\models$ *culminates* $f(v) \rightarrow$ *culminates* v

Proof of (2) *and* (5): (2) Assume that $M \models_t$ *culminates* v, i.e. $\exists q \in V(v)$, such that q terminates with t_p, that is $\exists r \in P$, $t_p = r;q$. By the conditions on V, q contains at least three elements, thus q can be subdivided into two extended paths q_0 and q_1 such that $q = q_0;q_1$. Let $t' = (r;q_{0,} q_1;t_F)$. Clearly, $t' \in T$ and $t' < t$. Let $t'' = (r, q_0; q_1;t_F)$. So $t'' < t' < t$ and $[t'', t] = q$, i.e. $[t'', t] \in V(v)$. But then $M \models_{t'}$ *prog*$_1$ v, so $M \models_{t'}$ *prog* v and so $M \models_t P$ *prog* v. (5) Assume that $M \models_t$ *prog* $f(v)$. Thus, either (a) $M \models_t$ *prog*^{S} $f(v)$, in which case, $\forall p \in \gamma(t)$, if p continues past t_p, then $\exists r \in V(f(v))$, s.t. p extends r. Now, if $r \in V(f(v))$, then $r \in V(v)$ and so $M \models_t$ *prog*^{S} v. (b) $M \models_t$ *prog*$_1$ $f(v)$, in which case, $\exists t'$, $t'' \in T$, such that $t' < t < t''$ and $[t', t''] \in V(f(v))$, again $[t', t''] \in V(v)$ so $M \models_t$ *prog*$_1$ v.

The following properties are formal counterparts of Kenny's (1963) test for activity verbs: "A is v-ing" implies "A has v-ed", and accomplishment verbs: "A is v-ing" implies "A has not v-d".[6]

[6]Note that Kenny's test for accomplishment verbs is not quite adequate. From "A is walking to the store" we cannot conclude that "A has not walked to the store" as A may have walked to the store the day before. We need something more along the lines of "A is walking to the store" implies that Anne has not at this instant walked to the store, and this is all that the formal counterpart of the test says.

THEOREM 1

(a) $\models$ *prog* $v \rightarrow$ *culminates* v, if $v \in \mathrm{Inf}V_{\mathrm{act}}$
(b) $\models$ *prog* $v \rightarrow \neg$ *culminates* v, if $v \in \mathrm{Inf}V_{\mathrm{acc}}$

The following are samples of sentences that are falsifiable:

(1) *prog* $v \rightarrow$ *culminates* $v \vee F$ *culminates* v
(2) *terminates* $v \rightarrow$ *culminates* v
(3) *culminates* $v \rightarrow$ *terminates* v

To show this for (1) assume that $U=\{u, w, x\}$. Let $t=(\langle u\rangle, \langle u, w\rangle)$, $t'=(\langle u, w\rangle, \langle w\rangle)$, $V(v)=\{\langle u, x\rangle\}$, $\gamma(t)=\{\langle u, x\rangle\}$ and $\gamma(t')=\{\langle u, x\rangle\}$. $M\models_t$ *prog* v, as $\langle u, x\rangle$ continues past $\langle u\rangle$ and $\langle u, x\rangle \in V(v)$. However, *not* $M\models_t$ *culminates* $v \vee F$ *culminates* v, as $\langle u, x\rangle$ does not terminate with $\langle u\rangle$ or $\langle u, w\rangle$. For (2), note that in this model, $M\models_{t,}$ *terminates* v holds, but $M\models_{t'}$ *culminates* v does not. For (3) $U=\{u, w, x\}$, $t=(\langle u\rangle, \langle u, w, x\rangle)$, $t'=(\langle u, w\rangle, \langle w, x\rangle)$, $V(v)=\{\langle u, w\rangle, \langle u, w, x\rangle\}$, $\gamma(t)=\{\langle u, w, x\rangle\}=\gamma(t')$. Here $M\models_{t'}$ *culminates* v and $M\models_{t'}$ *prog* v and so, as is easy to check, *not* $M\models_{t'}$ *terminates* v.

The intuitive reason for rejecting (1) has been discussed; Anne may be walking to the store, but never reach the store. Similarly, (2) claims that whenever an action terminates it has been successfully performed, which is clearly not true. (3) claims that whenever an action has been successfully performed, the action is interrupted, this is clearly not true for *walk*, which can be successfully performed and yet continue.

10. CAUSAL DESCRIPTIONS

I shall say that an agent is *active* if he is moving his body by means of a routine. The focus so far has been on actions described by verbs such as *walk*, which apply only while the agent is active. But a large part of the philosophical literature on actions has been concerned with descriptions involving not so much agent activity but the *consequences* of agent activity. Thus Anne comes home and turns on the light by flipping a switch, the light alerts a burglar in the house. Or Anne shoots Bill who, as a result, dies in hospital a week later.

The descriptions *turn on the light*, *alert the burglar* and *shoot Bill* are similar to *walk* in that they involve an active component, this is what qualifies them as action descriptions. But they differ from *walk* in that while a walk is constituted by the agent's movements, turning on the light also involves a causal component, typically, beyond the agent's control. When Anne shoots Bill she squeezes the trigger of the gun, this is the active part of the

action, the rest—the internal workings of the gun, the bullets trajectory, Bill's slow death—is, in Donald Davidson's words (1980a), up to nature.[7]

When analysing *turn on the light*, say, in terms of paths we specify the different ways in which the world can proceed in order to be in accordance with the action of turning on the light. Each path p will consist of an *active* component denoted by $active(p)$, the part judged to involve the agent directly and a *causal* component, denoted by $causal(p)$. In some cases p itself is constituted by these components, so $p = active(p);causal(p)$, but here I will allow the causal and active components to overlap. Note that I am taking causality for granted and not analysing it, the model will give those paths that, according to the analyst, constitute causal continuations from the agent's action. The truth-conditions for *The agent has shot Bill* would be unchanged, but the truth-conditions for *The agent is shooting Bill* would be (leaving out the first disjunct)

$$M \models_t \textit{prog shoot Bill} \text{ iff (a) } \ldots \text{ or (b) } \exists r \in V(\textit{shoot Bill}), \exists t', t, s \in T,$$
$$\text{such that } t' < t < t'' \leqslant s, [t', t''] = active(r) \text{ and } [t', s] = r.$$

This generalises our previous definition for *prog*: if for every $q \in V(\textit{shoot Bill})$, $active(q) = q$, the two definitions coincide. According to this definition the agent is shooting Bill even if Bill makes a sudden move and thus avoids being hit by the bullet. That is, to be shooting Bill, the agent must be fulfilling the active requirements of shooting at Bill, what happens afterwards need not be important to the truth of *the agent is shooting Bill*.

All inferential patterns are maintained, so, for instance, this will still hold:

$$\models \textit{culminates shoot Bill} \rightarrow P\ \textit{prog shoot Bill}$$

The fact that every path of *shoot Bill* will be divided up into an active and a causal part, neither of which are by themselves sufficient to constitute a shooting of Bill, gives the semantical motivation for letting *shoot Bill* be an accomplishment verb phrase. So we also have the following:

$$\models \textit{prog shoot Bill} \rightarrow \neg\, \textit{culminates shoot Bill}$$

However, this exposes a problem. Say that the agent fires twice at Bill in rapid succession so that he is hit by the first shot just as he fires the second. Then it would make sense to affirm both that the agent has just now *shot* Bill and that the agent is just now *shooting* Bill. To handle this problem we

[7] If the agent is an institution, say, then the active part will not be bodily movements, but that part of an institutional action that is still within the institution's control, delegating responsibility, drafting memoranda, etc., the causal component will, much as in the personal case, be outside the direct control of the institution.

have to modify the constraint put on accomplishment verbs. Where we previously had

(ii) If $v \in \mathrm{Inf}V_{\mathrm{acc}}$, then $\forall p \in V(v)$, $\forall r, s \in P$, if $p = r;s$ and s is extended, then $r \notin V(v)$.

We now should have

(ii′) If $v \in \mathrm{Inf}V_{\mathrm{acc}}$, then $\forall p \in V(v)$, $\forall r, s \in P$, if $\mathit{active}(p) = r;s$ and s is extended, then $r \notin V(v)$.

11. Comparison with Other Approaches

Dowty (1979) gives the truth-condition of "Anne was walking to the store when she was run over" by invoking what he calls "inertia worlds". Roughly, the analysis says that the defeated progressive is true if in all inertia worlds Anne actually reaches the store. According to Dowty, inertia worlds have the same history as the actual world, but the future "develops in ways most compatible with the past course of events" (p. 148). A standard objection to this account is that the development most compatible with the past course of events is the *actual* development. The problem that a Dowty-style account must face is to provide a better interpretation of what is meant by an inertia world (for a more extensive criticism, see Parsons 1990).

In one way the account proposed in the present paper resembles Dowty's. The paths that correspond to what would constitute the successful runs of a routine at any time (that is $\gamma(t)$) could be seen as alternative developments of the world in much the same way as inertia worlds. There are two substantial differences, however. First, the paths that constitute the successful runs of a routine do not specify a whole "world". They typically have a short duration and this means, among other things, that a path of a routine will not in general coincide with the past history of the world, nor will it extend far into the future. Second, as $\gamma(t)$ represents the set of paths that would constitute a successful run of a routine by the agent, and as this is different for each agent, the perspective is *local* rather than *global*. The inertia worlds, so to speak, are in the present account relativised to an agent or a process and not to a world.

Parsons (1990) gives a different account. Quantifying over events, Parsons analyses a sentence such as "Mary is building a house" approximately thus: there is an event e such that Mary is the agent of e, e is a building-event, e holds (at the present moment) and there is an x such that x is a house and x is the theme of e. An important distinction here is that *e holds* but need never *culminate*. Thus, if Mary falls ill and dies it need never become true that Mary has built a house.

A rather surprising consequence of Parsons' account is that "Mary is building a house" implies that there is a house that Mary is building. That is, even after the first couple of barrels of dirt have been filled when digging the foundations of the house, the hole in the ground is a house. Of course, if Anne was not only planning to build a house but a whole city (and so was building a city), then the hole in the ground is a city. This sounds very strange but Parsons tries to reduce the impact of these claims by saying that although the hole is both a house and a city it is an *unfinished* house and an *unfinished* city. Parsons argues that we sometimes do call an unfinished house, "a house" (he is, however, more sceptical about calling an unfinished circle "a circle") and this may be so. Even so it seems strange to claim that if Mary is building a house, then it follows as a matter of logic that there is a house that Mary is building.

As I have not addressed this problem in my account of the progressive, there is no way of comparing it with Parsons' account. So let me briefly sketch what seems to be an appropriate analysis: in the final state of each path of Mary's routine of building a house there exists a house that has been built by Mary (alternatively, there is an x such that at the final state of each path of Mary's routine of building a house, x is a house). It may well be that prior to the final state, say, after half or perhaps already after a quarter of what will become the house has been built there is something that we would call an unfinished house (but perhaps not a house). Exactly when the house becomes a house is a tricky problem. It is not, in my mind, solved by simply stipulating that it was a house all along.

My account may remind the reader of Åquist's (1977) account of something becoming more-and-more a house. According to Åquist, "Mary is building a house" is true because the object that she has created (the hole in the ground) is becoming more and more like a house. But this extrapolation view gets things backward according to the present analysis: to the extent that the hole is becoming more and more like a house, it is because the hole is the result of Anne's building a house.

Parsons is of course aware of the problem with the unfinished house and discusses it at length. But there is a related problem that he does not discuss that suggests that the account is incomplete even if not defective. Take "Mary was walking to the store when she was run over by a truck". Parsons' analysis would say that there is a walking event e that holds at some point in time t that has Mary as its agent and that has *the store* as its theme. The last clause is problematic. Why would one say of an event that does not leave Mary at the store, but badly hurt on the street, that it has *the store* as its theme? Discussing the related problem of "crossing the street", Parsons claims, "In the case of 'cross' we know exactly what kind of event to look for to see whether Agatha is now crossing the street" (p. 172). But

do we? What if Agatha had spotted an unused bus ticket lying in the middle of the street and started crossing the street with the intention of picking up the ticket and returning. Exactly what should we be looking for in order to tell whether Agatha is crossing the street or is going to pick up the bus ticket? Indeed, is it not this that an analysis of the progressive should tell us?

Landman (1992) gives yet another account of the progressive. His account contains many ingredients but the gist of it is given by the following quote:

> [T]he idea is that you follow [the event] *e* in our world: if its continuation stops, you follow it in the closest world where it doesn't stop, if that world is a reasonable option for *e* in *w*; if the continuation stops in that world, you go to the closest world again, if it is reasonable, and you continue until [...] you reach a point where going to the closest world is no longer reasonable and you stop there. (p. 25)

For instance if *e* is an event of Mary's walking which stops (she is run over), "Mary was walking to the store" becomes true if before the point where going to the closest world is no longer reasonable, Mary reaches the store.

There are some unclear points in this analysis: what does it mean that an event stops but continues in another world and the notion of a "reasonable" option for an event in a world is potentially problematic. But even if the analysis is sufficiently clear, it does not seem adequate. Consider the case where Mary is walking to the store. Halfway she changes her mind and decides to go to the post office (which you recall was just beside the store). Let *e* be the event of Mary's walking prior to changing her mind. It would seem strange to say that *e* stops when she changes her mind as she keeps on walking much like she just has been doing. Indeed *e* doesn't stop until she reaches the post office. So according to Landman's analysis she was walking to the post office all along, but *ex hypothesi* she was initially, at least, walking to the *store* before she changed her mind. So it appears that Landman's account fails in this example.

12. Concluding Remarks

The formal language *L* studied here is meant to give a simple means for explicating basic inferential patterns surrounding action sentences. The associated semantics, for all its simplifications, is more complex, but sufficiently rich to model a theory of actions based on routines that validate the desired inferential patterns.

It should be noted that the choice of a formal language does not commit us to any particular theory of actions, nor for that matter to any particular semantics. The separation of logic from "ontology" we regard as a methodological bonus. We all *know*, more or less, the basic inferential patterns of

simple action sentences, but we do not all agree *why* they should be so. Resorting to a regimented notation that guarantees a simple way of expressing the logic involved, should, if possible, be done without forcing a commitment to a particular explanation. This, at least, is one way to approach the problem.

Acknowledgements

The theory of actions outlined here and the semantic machinery to represent the theory, have emerged gradually through conversation and work with Krister Segerberg, who is hereby acknowledged. Sten Lindström had several important comments on an earlier version of the paper. The anonymous referees made several valuable suggestions on points that needed clarification. The work on this paper was in part financed by a grant from the Swedish Institute for Classical Studies in Rome.

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