Aiming at culmination: causal models, event types, and the imperfective paradox

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Progressives of telic predicates famously give rise to the **imperfective paradox** (IP; Dowty 1979), in the clash between a standard *culmination assumption* (that uninflected telic predicates exclusively denote culminated eventualities) and the observation that telic progressives are acceptable in culmination-precluding contexts.

(1) Mahler was writing a tenth symphony (when he died). $\nrightarrow$ *He completed the symphony.*

Given the culmination assumption, prominent accounts of the IP propose intensionalizing the progressive operator, PROG, so that it instantiates qualifying (culminated) P eventualities in modal alternatives to the evaluation world (Dowty, Asher 1992, Bonomi 1997, a.o): thus, an evaluation world eventuality satisfies PROG(P) iff it continues to culmination across the relevant alternatives.

We propose an alternative approach, on which the intensionality relevant for IP effects is not introduced by PROG, but instead inheres in the mereological structure of telic predicates. On our analysis, the truth of a telic progressive depends on a correspondence between reference time facts and an **event type** $[\![P]\!]$, which is structured as a **causal model** for P's culmination condition (C_P). A reference-time token *aims at culmination* iff it represents a plausible 'cross-section' of a causal pathway for C_P as defined by $[\![P]\!]$. This approach delivers improved judgements for challenging IP data, in particular offering an account of contexts in which agents' intentions appear to supersede a realistic assessment of the (im)possibility of culmination.

Culmination, expectation, intention. Culmination alternatives for intensional PROG are usually identified with worlds containing *normal* (or *inertial;* Dowty) developments of a reference-time situation, thus predicting telic progressives to be false whenever C_P is unexpected from the salient *perspective* (cf. Asher). The predictions are reasonable for contexts like (2), ruling out the 'objective' progressives (2a), but permitting (2b) (as assessed from the child's unrealistic perspective).

(2) *Context:* Meena's five-year old daughter Maya wrongly believes that the earth is made entirely of sand and soil. She is digging a hole with the intention of tunnelling through to the other side.
　　(a) *Meena:* #/?Maya is digging a hole to China.　　　　　　(b) *Maya:* I am digging a hole to China.

However, intensional PROG approach incorrectly predicts the falsity of *out of reach* (OOR) progressives, where an agent's intentions are at odds with their (realistic) assessment of the reference-time accessibility of culmination. (3a-b) are judged to be both acceptable and true, even though his inevitable pre-finish collapse is explicitly included in Benny's perspective as well as that of an objective (but knowledgeable) observer (cf. Szabó 2008).

(3) *OOR context:* Benny began an ultramarathon for which he (knowingly) undertrained; it was certain before the start that he had insufficient stamina to complete the run.
　　(a) *Objective:* Benny was running an ultramarathon (when he collapsed from exhaustion).
　　(b) *Benny:* I was running an ultramarathon (when I collapsed).

(Informal) desiderata. OOR data show that the truth of a telic progressive cannot be based solely on a 'local' expectation of culmination, but must take a more general view of the relationship between reference-time facts and the goal at which they aim. What unites (2b)-(3), and differentiates them from (2a) is a *world-historical* possibility of culmination, assessed from the speaker's perspective. In each acceptable example, the speaker associates predicate P with at least one realizable culmination procedure; the progressive assertion reports the belief that reference-time facts correspond to steps along such a completion pathway. On this view, licensed telic progressives are true as long as reference-time facts are compatible with *what would need to be happening* for culmination to take place. This comes apart from the intensional PROG approach in cases like (3), where culmination is contextually but not categorically precluded. Informally speaking, knowledge of an agent's intentions provides evidence of adherence to a culmination procedure: thus, (3a-b) are true because the speaker believes Benny to be (intentionally) doing *what one does* in order to run an ultramarathon.

Causal models for telic event types. The intuition underlying our approach is that telic progressives (agentive or otherwise) report a match between reference-time facts and a culmination procedure for predicate P. We formalize this intuition in terms of the relationship between a reference-time **token** and a (structural equation) **causal model** for the P event type. Such models establish generalizations about causal relationships between a finite set Σ of propositional variables by means of a directed acyclic graph with vertices in Σ, accompanied by a set of equations indicating how the value of a particular variable is determined by the values of its ancestors in the graph (Pearl 2000, Schulz 2011).

An event type model M_P for telic predicate P relates conditions (facts, properties of individuals or objects) which are causally relevant for $P's$ culmination condition (dependent variable C_P). Maximal (culminated) P-eventualities correspond to *complete causal pathways* for C_P: that is, sets S of condition-valuation pairs (whose causal interrelationships are provided by M_P) that are jointly sufficient for the truth of C_P ($\text{SUFF}^{M_P}(S, C_P)$). M_P induces a type-level mereological structure where $[\![P]\!]$ contains (non-)culminated eventualities; $e_1, e_2 \in [\![P]\!]$ are comparable if and only if they are partial realizations of the same causal pathway S for C_P.

Truth and felicity of telic progressives. Given a model M_P for telic predicate P with culmination condition C_P, $\text{PROG}(P)$ is true just in case the reference-time situation s is a possible 'cross-section' of a non-culminated P-eventuality: i.e., iff (a) s realizes some part (i.e., some condition Q) of a causal pathway for C_P, (b) does not realize a complete pathway for C_P, and (c) does not realize a sufficient set for non-culmination ($\neg C_P$).

$$(4)\ \text{PROG}(P, t) = 1 \text{ iff } \exists s[\tau(s) \circ t \wedge [\exists Q \exists S : Q \in S \wedge \text{SUFF}^{M_P}(S, C_P) \wedge Q(s)] \tag{a}$$
$$\wedge\, [(\forall S' : \text{SUFF}^{M_P}(S', C_P)[\exists Q' \in S' : Q'(s) \rightarrow \exists Q'' \in S' : \neg Q''(s)]] \tag{b}$$
$$\wedge\, [\forall \Omega : \text{SUFF}^{M_P}(\Omega, \neg C_P)[\exists \omega \in \Omega : \neg \omega(s)]]] \tag{c}$$

Given an epistemic state which supports event type M_P, telic progressives are true of situations which *aim at culmination* (insofar as they have the possibility of continuing to develop along a causal pathway for C_P; cf. Landman 1992). Telic progressives are therefore true not in virtue of the actual consequences of the reference-time situation, but instead in view of type-level causal relationships between reference-time facts and C_P.

This approach captures the empirical judgements in (2)-(3). (2a) is infelicitous (not false) because the speaker's realistic perspective does not admit causal models for physically impossible tasks. By contrast, (2b)-(3) are felicitous and true (from the speaker's perspective) because reference-time facts are compatible with partial P-eventualities in the causal structure of $[\![P]\!]$. By severing the truth of telic progressives from the local accessibility of culmination, the causal approach also allows us to account for the role of agents' intentions. Within models for agentive telic predicates, intentions hold a special status as *globally necessary* conditions for C_P: intent belongs to all sufficient sets for culmination, and insofar as they must be *sustained* through the development of a P-eventuality (cf. Varasdi 2014), their negations are singleton sufficient sets for $\neg C_P$. (4c) thus predicts the falsity of agentive progressives in any context where goal-directed intention fails.

Insofar as sustaining conditions (including intentions and non-agentive analogues like momentum or velocity) provide evidence that licenses comparison between a reference-time situation and event type P, we further suggest that these conditions operate as minimal preconditions for membership in $[\![P]\!]$: telic progressives are thus felicitously used only when (a) the event type model is licensed, and (b) any sustaining conditions in M_P are set in the culmination-conducive way ($\forall Q : \text{SUFF}^{M_P}(\{\neg Q\}, \neg C_P), Q(s)$). Example (5) supports a presuppositional role for intention, showing that Benny's nonspecific intention is enough to make both claims infelicitous, even where his actions otherwise adhere to established procedures for completing either distance.

(5) *Nonspecific intention:* Benny began running in a marathon (42km). Knowing that he had undertrained, he planned to decide at 15km whether to stop there or continue to 21km. He collapsed at 10km.
    (a) *Benny:* ?I was running a 15K.   (b) *Benny:* ?I was running a half-marathon.

Outlook. It has long been clear that intensional approaches to the IP must be supplemented by a mereological theory which permits the comparison of (non-)culminated telic eventualities (Bach 1986, Landman, Bonomi). We here propose to capture IP effects via a mereological structure which is inherently intensional in that it unifies (non-)maximal P-eventualities in terms of a shared relationship to culmination condition C_P. Causal event type models not only provide a means of measuring the development of telic eventualities in the absence of concrete correlates (such as incremental themes; cf. Parsons 1990), but, through the special status awarded to sustaining conditions within the model, also establish formal criteria for minimal P-eventualities, thus accounting for judgements like (3)-(4), which resist analysis on received intensional PROG approaches. Insofar as the type of data which provides evidence for intention is distinct from that for non-agentive sustaining conditions, we anticipate that the causal approach will shed light on independently-observed agentivity contrasts in the derivation of culmination entailments (see, e.g., Martin & Schäfer 2012 on *defeasible causatives*).

The 'normality' intuition underlying intensional PROG approaches to the IP—i.e., that culmination should represent a 'normal' outcome of P-in-progress—is recognized here as a type-level intuition: $\text{PROG}(P)$ is true of a reference-time situation s because s corresponds to a *normative* path for culmination, or what is causally normal in contexts where culmination is taken for granted (see also Nadathur & Filip 2021). Looking ahead, we anticipate that the causal approach can be combined with a uniform partitive theory of aspects (e.g., Altshuler 2014) to account for non-culminating uses of telic predicates in (non-)progressive contexts (Martin, 2019, a.o.).

The approach also offers an expanded view of the role of causal information in (lexical) semantic judgements. Where previous studies focused on instances of token causation (such as the use of causative verbs; Nadathur & Lauer 2020, Baglini & Bar-Asher Siegal 2021), we demonstrate that type-level information also factors into the interpretation of (non-causative) predicates, insofar as it here determines the felicity and truth conditions of telic progressives.

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