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A progress-based analysis of the progressive in English*

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Kim, Nam-Hee, Ji-Hee Kim, and Yae-Sheik Lee. 2024. A progress-based analysis of the progressive in English. *Linguistic Research* 41(3): 517-545. Much of the literature on the English progressive has focused on the relationship between an event in progress and its potential future culmination, often overlooking its broader range of uses—event-in-progress, characterizing, and futurate readings. Event-based analyses have struggled to establish a unified core meaning that accounts for these interpretations. In response, this study advances a process-based approach, positing that the progressive aspect systematically emphasizes a process unfolding within a specific reference time. By foregrounding the ongoing process as the fundamental element, this account provides a cohesive explanation for the progressive across its diverse readings. Additionally, it addresses or resolves longstanding challenges in the semantics of the progressive—such as the Imperfective Paradox, Existential Generalization, (Un)Interruption, and Contextual Influence—in a more principled manner. **(Kyungpook National University)**

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1. Introduction

In the literature, it is well known that the progressive construction is mainly used

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for three different readings as the following examples show:

(1) a. Mary **was crossing** the street when a truck hit her.
b. Mary **was leaving town** in the following month.
c. Mary **was biking to work** until she bought a car.

(1a)-(1c) exhibit the **event-in-progress** reading, the **futurate** reading and the **characterizing** (the subject) reading, respectively[1]. To date, no study has tried to account for these three different uses in a unified way.

Since Reichenbach (1947) introduced the idea that the reference time is contained within the event time in the semantics of the progressive, numerous scholars (e.g., Dowty 1979; Landman 1992; Portner 1998; Deo 2009; Ferreira 2021, among others) have developed alternative accounts of the progressive aspect. Notably, these approaches consistently maintain the notion of temporal containment as a core ingredient of the semantics of the progressive.

This study aims to introduce a novel framework for the progressive aspect, challenging traditional accounts that analyze the reference time as being subsumed within the runtime of an overarching event. Instead, the progressive is interpreted as denoting a process whose runtime is fully contained within the reference time. This perspective highlights the progressive as inherently expressing an ongoing process, rather than a relationship between an event in progress and its hypothetical future culmination. Within this framework, the three distinct readings of the progressive—event-in-progress, characterizing, and futurate—are uniformly analyzed as denoting processes.

Moreover, another aim of this study is to show longstanding issues in the literature, such as the Imperfective Paradox, Existential Generalization, (Un)Interruption, and Contextual Influence (e.g., Dowty 1979; Landman 1992; Bonomi 1997; Higginbotham

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1 Deo, A. (2009) also lists the first two readings are crosslinguistically triggered by imperfective or progressive marking. She adds to this list one more reading, so-called "continuous" reading which is delivered by imperfective constructions with state verbs like the following examples:

(i) a.The socks are lying under the bed.
b. One corner of the piano is resting on the bottom step.
(ii) a. ?New Orleans is lying at the mouth of the Mississippi River.
b. ?The argument is resting on an invalid assumption.

2004), are either rendered spurious or resolved in a more principled manner within the current framework.

To establish this framework, the article is structured as follows: Section 2 reviews two prominent accounts of the progressive, highlighting how it has been analyzed thus far. Section 3, divided into three subsections, outlines our theory of the progressive in English. Section 3.1 focuses on the metaphysical distinction between processes and events, clarifying their ontological differences. In Section 3.2, we introduce the process structure, characterized as an atomic join semilattice. Section 3.3 then presents the formal semantic theory of the progressive, providing a precise definition of the progressive operator grounded in the concept of process. This section also demonstrates how the current process-based semantics of the progressive can deal with progressive constructions with the four issues of Imperfective Paradox, Existential Generalization, (Un)Ineterrption, and Contextual influence on the semantics of the progressive. Furthermore it shows how three different uses, event-in progress, characterizing, and futurate reading, of the progressive can be analyzed in a unified way. Section 4 offers concluding remarks on the implications of this theory for the understanding of the progressive.

2. Literature review

In the literature on the semantics of the progressive, two primary perspectives emerge regarding its interpretation for an event-in-progress reading. The first is the intensional view, which posits that the progressive relates an ongoing event to a larger event that may culminate at some point in the future. The second is the extensional view, where the progressive is understood as capturing an incomplete event or an event in progress, considered in relation to its corresponding complete event. The following studies are representative of both approaches:

(2) Intensional view
   a. Dowty (1979): PROG (φ) is true at an interval i in a world w iff for some interval i' that includes i as a nonfinal subinterval and for every **inertial world** w' relative to <i, w>, φ is true at <i', w'>.

b. Landman (1992): PROG(e, P) is true in world w iff for some event e' and world w', <e', w'> is part of the continuation branch that starts in w with event e and P(w')(e') is true.

(3) Extensional view

a. Parsons (1989): PROG(φ)(t)=1 iff there is an event of φ holding at a time t.

b. Szabó (2008): PROG(φ)=1 iff there is an event of φ in progress.

Among the issues addressed in studies from both camps, four are particularly significant: the **Imperfective Paradox, existential generalization, (un)interruption, and contextual influence**.

One central puzzle in the semantics of the progressive is the Imperfective Paradox (Dowty 1979), which highlights a discrepancy in entailments:

(4) a. John was walking in the park.

b. John was building a house.

Sentence (4a) entails that John walked in the park, whereas (4b) does not entail that John built a house. This paradox challenges traditional truth-conditional accounts of meaning, which determine a sentence's truth by whether the situation it describes holds in the real world.

Intensional accounts attempt to resolve the paradox by positing that the truth of a progressive sentence depends not only on the actual world but also on a set of possible worlds. Dowty's (1979) analysis, which employs the notion of inertia worlds, exemplifies this approach. Inertia worlds are those most similar to the actual world up to the evaluation time, where events unfold without unusual disruptions. A progressive sentence is true if the described event culminates in these inertia worlds, even if it is interrupted in the actual world.

In contrast, extensional accounts, such as Parsons's (1989) theory, argue that the progressive simply denotes an ongoing process without implying culmination. These accounts focus on the developmental portion of the event, separating it from the notion of completion. While this approach avoids reliance on possible worlds, it faces challenges in explaining cases where an event is completed despite difficulties or interruptions. Both interrupted and completed events involve an ongoing process at

some stage, making it difficult for extensional accounts to differentiate them based solely on the presence of an ongoing process.

Another issue related to the Imperfective Paradox is existential generalization, which concerns whether progressive sentences imply the existence of the objects involved in the event. Let us consider the following sentences:

(5) a. John was building a house.
b. John was drawing a circle.

Do these sentences guarantee that a house or a circle exists at the reference time? Szabó (2008) introduces an operator, “IP (in progress),” to apply to properties expressed by noun phrases such as *a house* and *a circle*. In his account, incomplete objects are represented as IP(a house) or IP (a circle).

Similarly, Parsons (1989) directly addresses this issue, arguing that progressive sentences with creation verbs entail the existence of incomplete objects, which can still be considered instances of the object type they are becoming. For instance, an unfinished house or circle is still a house or circle in linguistic terms, even if incomplete. He bases this claim on two points: first, that the world ontologically contains incomplete objects, and second, that language users conventionally refer to incomplete objects using terms for complete ones. For example, "Jack London's house" may refer to an unfinished structure.

However, Parsons's proposal has been criticized. While the notion of incomplete objects may be intuitive for certain cases, such as houses, it is less clear for others, such as a partially drawn circle. Additionally, Parsons’s account primarily focuses on creation verbs and struggles with non-creation verbs, such as those involving changes of state or location (e.g., "John is walking to the store").
Furthermore, intensional accounts, such as those by Landman (1992: 9) and Zucchi (2021: 4), challenge extensional approaches with examples like (6):

(6) God was creating the unicorn when he changed his mind.

Despite its shortcomings, Parsons's proposal provides a valuable starting point for understanding existential generalization in the context of the progressive aspect. His

recognition of incomplete objects as legitimate entities and his observation of linguistic conventions surrounding their denotation offer insights into the complexities of how language represents ongoing processes and their relation to the existence of the objects involved.

As Landman (1992) discussed, frameworks like Dowty (1979)[2] struggle to address progressive constructions like the following:

(7) a. Mary was crossing the street when a truck hit her.
b. Mary was swimming across the Atlantic.

In (7a) or (1a), the sentence is judged true despite the interruption caused by the truck, while in (7b), the sentence is false if Mary is an ordinary person incapable of completing the swim. Intensional accounts address this issue by invoking inertia or reasonable worlds in which the ongoing event would culminate despite external interruptions. Landman (1992) emphasizes that the truth of a progressive sentence depends on whether completion is plausible in a hypothetical continuation of the event, guided by contextual knowledge.

Extensional accounts, focusing only on the event in progress, struggle to explain this distinction. They lack the modal resources to assess the likelihood of completion, even hypothetically. This suggests that an adequate analysis of (un)interruption requires information about the potential for the ongoing event to culminate, even if completion is not guaranteed.

Contextual influence further complicates the semantics of the progressive. Bonomi (1997) highlights the problem of underdetermination, where the truth value of a progressive sentence depends on which facts are selected for evaluation:
Bonomi (1997) uses the following example to highlight the importance of contextually relevant facts:

(8) Leo is driving to Paris.

2 Against our intuition, Dowty's theory would predict that (7a) is false if her crossing the street was interrupted by the truck hitting her. In other words, Dowty's inertia worlds are too global in the sense that they are worlds where nothing unexpected or out of the ordinary occurs given the course of events in the real world w up to the time t at stake.

At the moment of utterance, Leo may be driving towards Dijon, which lies on the route to Paris but is also on the route to several other destinations. Thus, the sentence can be judged as true or false depending on the chosen embedding set. If the speaker knows that Leo's final destination is Paris, then (8) is true. If the speaker only focuses on the fact that Leo is currently driving towards Dijon, without knowing his final destination, then (8) can be judged false (since there are other possible endpoints for his journey besides Paris).

Bonomi argues that the progressive involves a "multiple choice" situation where the truth of a sentence depends on the set of facts selected for evaluation. This selection is influenced by the speaker's perspective, background knowledge, and the overall context of the utterance. The underdetermination problem arises because the truth-conditions alone are insufficient to determine the truth value of a progressive sentence; context plays a crucial role in guiding the selection of relevant facts and resolving the ambiguity.

To dealing with the contextual contribution to the semantics of the progressive, Portner (1998) further develops the modal account of the progressive using ordering semantics. He suggests that the meaning of the progressive involves both an event and a modal component. The modal component utilizes contextually provided parameters, similar to how ordinary modals work like Kratzer (1981, 1991). The modal base for the progressive is sensitive to the sentence's description of an event, while the ordering source ensures that the event is not interrupted. This approach addresses the vagueness of "inertia worlds" by specifying how factors like the nature of the event and its description contribute to selecting the set of relevant worlds.

Consider the sentence like (7a) in a scenario where Mary was hit by a truck and didn't complete the crossing. For the interpretation of (7a), the modal base would include facts about Mary's location, direction, and the presence of the truck. And the ordering source, NI (non-interruption), would prioritize worlds where Mary is not interrupted while crossing. However, the modal base already establishes the fact of the truck, making a non-interrupted crossing impossible in the relevant worlds. Therefore, even though Mary didn't complete the crossing in the actual world, the sentence is still considered true because in the most 'normal' worlds within the modal base – those where the truck doesn't interfere – Mary would have successfully crossed the street.

In his analysis, Higginbotham (2004) emphasizes the significance of context in

determining the truth value of progressive conjunctions, particularly focusing on two contrasting types: symmetrical versus asymmetrical conjunctions, as illustrated by the following sentences:

(9) **(i) Symmetrical conjunctions**
a. John was dying of cancer, while he was dying of heart disease.
b. The oxidation of its pages was destroying book B, and Vandal V was destroying it.
(ii) Asymmetrical conjunctions
a. Mary was flying to London and to Havana.
b. Mary was drawing a circle, while drawing a triangle.

Higginbotham argues that the difference between these two types of conjunctions lies in both the causal independence of the events and their compatibility. Symmetrical progressive conjunctions represent pairs of situations described by each conjunct that are causally independent but mutually compatible. In contrast, asymmetrical conjunctions describe situations that are incompatible, even though they may also be causally independent—one event obstructs the completion of the other. Thus, symmetrical conjunctions are judged true, while asymmetrical ones are not.

Specifically, while each conjunct of (9ii-a) might be true individually, their conjunction is deemed false. This highlights that simply extending the events in each conjunct into the future does not automatically make the conjunction true. Higginbotham argues that the reason we cannot truthfully assert (9iia) and (9iib) is that they require adopting incompatible perspectives on the conjuncts. Interpreting the first conjunct involves imagining a scenario where Leo's flight continues to London, while the second conjunct requires envisioning a scenario where the flight continues to Havana. These two scenarios are mutually exclusive, hence making the conjunction false.

Similarly, Higginbotham (2004) explains that the acceptability of (9ia) and (9ib) stems from the fact that interpreting the conjunction does not require shifting perspectives between conjuncts. For example, the destruction of the book is the overarching event, and both conjuncts contribute to that event from different angles. This allows for a consistent interpretation of the conjunction within a single set of inertia worlds.

Thus, Higginbotham's analysis demonstrates how contextual considerations, particularly those relating to perspective and compatibility of scenarios, influence the truth conditions of progressive sentences involving conjunctions. His distinction between symmetric and asymmetric conjunctions sheds light on the nuanced ways in which context contributes to the interpretation of complex progressive sentences.

Thus far, we have reviewed prior accounts of the progressive, focusing on four key issues: the Imperfective Paradox, Existential Generalization, (Un)Interruption, and Contextual Influence. While some of these accounts offer partial solutions, others fail to adequately address these challenges. We contend, however, that nearly all approaches within the intensional framework encounter significant difficulties in accounting for progressive constructions related to these four issues. This is primarily because they rely on the assumption of a specific time-world pair in which the event in progress culminates.

In the following sections, we propose a process-based semantics for progressive constructions. This framework aims not only to address the four issues systematically but also to provide a unified explanation for the three distinct uses of the progressive illustrated in (1).

3. Our proposal

This study adopts a perspective akin to that of Moens and Steedman (1988), positing that the progressive denotes a process that unfolds during a reference time[3]. This view prompts several fundamental questions regarding the nature of processes. First, what precisely are processes? Second, do processes exist independently of events within the ontology? Third, how can processes be formally defined?

To address these questions, the study seeks to explore both the metaphysical characteristics of processes and events, and the algebraic structure underlying processes.

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3 Similarly to the view of the current framework, Moens and Steedman (1988: 3) make the following suggestion: the fact that … progressives coerce their input to be a process, so that any associated culmination is stripped away and no longer contributes to truth conditions, provides a resolution of the "imperfective paradox" (Dowty 1979), without appealing to theory-external constructs like "inertia worlds."

3.1 Metaphysical charateristics of process and event[4]

This study argues that the progressive denotes a process whose duration is fully contained within the reference time, in contrast to traditional event-based analyses, where the reference time is subsumed within the event's duration. To support this argument, we examine the metaphysical distinction between processes and events, building on the work of Mourelatos (1978), Stout (1997, 2016), Steward (2012, 2013), and others. In line with these scholars, this study adopts the view that processes and events are characterized by the following properties:

Processes and events are both classified as occurrents (perdurants), entities with temporal parts. However, they exhibit crucial differences. Processes are homogeneous, mass-quantified, temporally dynamic, and partially presentable at any given moment. Events, in contrast, are heterogeneous, count-quantified, temporally static, and wholly presentable. Processes, often likened to "stuff," provide the ontological foundation for events. Link (1998) also takes processes as the material that constitutes their corresponding events, much as gold constitutes a gold ring. For example, the process of constructing a house represents a continuous, dynamic sequence of house-building activities, while the event of "the house's completion" signifies the cessation of these activities.

This ontological distinction aligns with their differing linguistic properties. Processes exhibit the subinterval property, meaning that if a process is occurring over an interval, it is also true over any subinterval within that period. This property underscores their conceptual homogeneity. For instance, a process of reading a book remains identifiable as such even if interrupted by other actions (e.g., answering a phone call), as long as its defining characteristics are intact. Events, in contrast, lack this property, as their identity hinges on specific boundaries or culminations.

As Galton, A. (2007) argues, processes and events also differ structurally: Processes are composed of smaller, temporally adjacent actions or states that form a coherent whole, often characterized by continuity. This is captured in frameworks such as Link's (1998) causal flow, which describes how subprocesses combine through causal relationships, and Rothstein's (2004) incremental chain, which portrays events as

4 Most of the ideas in this section were dealt with in M. J. Kang and Y. S. Lee (2023) and N. H. Kim's forthcoming doctoral dissertation.

sequences of upper-bounded subprocesses. While both frameworks highlight the connection between processes and events, Link emphasizes the dynamic evolution of processes, whereas Rothstein focuses on the fossilized history of their culmination.

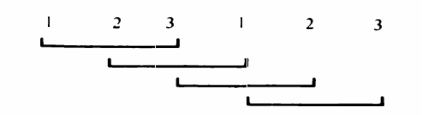
The progressive aspect inherently captures the dynamic nature of processes. It highlights their incremental, ongoing character rather than their endpoint. For example, a process such as "Mary crossing the street" includes various subprocesses—deciding to cross, assessing traffic, beginning to walk, and so on. The reference time for a progressive sentence aligns with the part of the process active at that moment, emphasizing the dynamic unfolding rather than the completed crossing.

Processes are thus central to understanding the semantics of the progressive. Their conceptual homogeneity, subinterval property, and structural continuity distinguish them from events, which are static culminations of processes. The current framework underscores the necessity of treating processes as fundamental in capturing the progressive's meaning, moving beyond traditional event-centric approaches.

3.2 The Structure of processes

As previously discussed, processes are sequences of actions or states to which particular event types apply. In the case of waltzing, Dowty (1979: 171) notes that the process of waltzing involves sequences of taking three steps. He depicts the idea that "x waltz" is true at intervals of taking three steps as follows:

(10) Intervals of waltzing:



This study posits that a sum of three actions of taking a step constitutes an atomic element for a waltzing process of a given duration. In other words, a process of waltzing over a certain length of time consists of a specific number of such sums of taking three steps.

Adopting Link (1998), the current study takes, in the case of waltz, actions of taking one step to underlie the waltz, whereas any sequence of units of taking three

steps is considered as a part of the waltz. Link would call the former sequence an *underlying* process and the latter sequence a *specified* process of the waltz.

Based on the above ideas about underlying actions, units of the specified process in question, the current study builds up a structure of process out of the strict partial order of actions of <A, < > as follows:

(11) <A, < > is a relational structure, where A is a set of actions, and < indicates the temporal precedence relation.
  a. < is a strict partial order : irreflexive and transitive: for all a, ¬ (a<a); for any actions, a, b, c, a<b∧b<c →a<c
  b. For any two actions of A, a, b, a < b → τ(a)< τ(b), where "τ" is a function that maps an action to its runtime.
  c. The actions of A are discrete.
  ∀a∈A [∃b∈A [a<b] → ∃c∈A[a<c ∧ ∀d∈A[[a<d<c]→d=c]]]

Out of the set of actions, A, we can, in turn, construct the following structure of process:

(12) <P(A), ≺, ≼, 𝒪, ⊕>
  (i) P(A) = {⋃X : X∈ ℘(A) ∧ X ≠ ∅ ∧ #(X)=μ*∧L(X)},
  a. ⋃X : the generalized sum of all actions of X
  b. μ indicates the least number of actions required to be a part of the process in question.
  c. μ* denotes the set of all multiples of μ by natural numbers $\boldsymbol{n}$, where $\boldsymbol{n}$≥1. Formally, μ*={μ · $\boldsymbol{n}$: $\boldsymbol{n}$∈ℕ⁺}, where ℕ⁺ is the set of positive integers.
  (ii) Precedence relation "≺"
  For any two processes, $\boldsymbol{p}_1$, $\boldsymbol{p}_2$, $\boldsymbol{p}_1 \prec \boldsymbol{p}_2$ → τ($\boldsymbol{p}_1$) <τ($\boldsymbol{p}_2$), where 'τ' stands for a functor which takes a process or an event to return its runtime.
  (iii) Part of or inclusion "≼"
  a. For any two processes, $\boldsymbol{p}_1$, $\boldsymbol{p}_2$, $\boldsymbol{p}_1 \preccurlyeq \boldsymbol{p}_2$ iff
  [[τ($\boldsymbol{p}_1$) ⊑ τ($\boldsymbol{p}_2$)] ∧ [U($\boldsymbol{p}_1$) ⊆ U($\boldsymbol{p}_2$)]][5]
  b. U($\boldsymbol{p}$): the set of units of the process $\boldsymbol{p}$, {u: ¬∃ $\boldsymbol{p}$'[$\boldsymbol{p}$'≼ $\boldsymbol{p}$

$\wedge$ u$\preccurlyeq$ $\boldsymbol{p}$ $\wedge$ $\boldsymbol{p}$'$\preccurlyeq$u]

(iv) Overlap "$\mathcal{O}$"

For any two processes, $\boldsymbol{p}_1$, $\boldsymbol{p}_2$, $\boldsymbol{p}_1$ $\mathcal{O}$ $\boldsymbol{p}_2$ iff $\exists$t[t$\sqsubseteq$ $\tau(\boldsymbol{p}_1)$ $\wedge$ t$\sqsubseteq\tau(\boldsymbol{p}_2)$]

(v) Sum operation "$\oplus$" between adjacent processes

For any two processes $\boldsymbol{p}_1$, $\boldsymbol{p}_2$, $\boldsymbol{p}_1\oplus$ $\boldsymbol{p}_2$=$\boldsymbol{p}_3$ iff

$\forall \boldsymbol{p}_4[[\boldsymbol{p}_1\preccurlyeq\boldsymbol{p}_4$ $\wedge\boldsymbol{p}_2\preccurlyeq\boldsymbol{p}_4$]$\wedge[\boldsymbol{p}_1\preccurlyeq\boldsymbol{p}_3$ $\wedge$ $\boldsymbol{p}_2\preccurlyeq$ $\boldsymbol{p}_3$] $\rightarrow$ $\boldsymbol{p}_3$ $\preccurlyeq$ $\boldsymbol{p}_4$]],

if p_1 and p_2, are adjacent. Otherwise, undefined.

(vi) Adjacency between two processes "∞"

For any two processes $\boldsymbol{p}_1$, $\boldsymbol{p}_2$ $\boldsymbol{p}_1\infty\boldsymbol{p}_2$ iff $\tau(\boldsymbol{p}_1)$ $\bowtie$ $\tau(\boldsymbol{p}_2)$.[6]

(vii) A set of actions, X is linear, L(X), iff

$\forall a_1$, a_2 $\in$X [$a_1\neq a_2$ $\rightarrow$ a_1 < a_2 $\vee$ a_2 < a_2 $\vee$ a_1 $\mathcal{O}$ a_2]

Since actions participating in forming units of a process are discrete and units are also discrete, processes of the P(A) are also discrete as defined as follows:

(13) P(A) is discrete iff

$\forall \boldsymbol{p}\exists \boldsymbol{p}'\in$P(A)[$\boldsymbol{p}\prec\boldsymbol{p}'\rightarrow\exists \boldsymbol{p}$, $\boldsymbol{r}\in$P(A)[Immediate Predecessor ($\boldsymbol{q}$, $\boldsymbol{p}$)

$\wedge$ Immediate Successor ($\boldsymbol{r}$, $\boldsymbol{p}$)]]

a. Immediate Predecessor ($\boldsymbol{q}$, $\boldsymbol{p}$) iff $\forall \boldsymbol{p}\exists \boldsymbol{p}'\in$P(A)[$\boldsymbol{p}'\prec\boldsymbol{p}\wedge$

$\forall \boldsymbol{r}\in$P(A)[$\boldsymbol{p}'\prec\boldsymbol{r}\prec\boldsymbol{p}\rightarrow$ $\boldsymbol{r}$=$\boldsymbol{p}'$]]

b. Immediate Successor ($\boldsymbol{q}$, $\boldsymbol{p}$) iff $\forall \boldsymbol{p}\exists \boldsymbol{p}'\in$P(A)[$\boldsymbol{p}'\prec\boldsymbol{p}\wedge$

$\forall \boldsymbol{r}\in$P(A)[$\boldsymbol{p}$ $\prec\boldsymbol{r}\prec\boldsymbol{p}$ ' $\rightarrow$ $\boldsymbol{r}$=$\boldsymbol{p}'$]

This discreteness of processes ensures that they are all discrete and linearly aligned with each other, satisfying the following linearity.

(14) For any two periods of P(A), $\boldsymbol{p}_1$, $\boldsymbol{p}_2$, $\boldsymbol{p}_1$ $\prec$ $\boldsymbol{p}_2$ $\vee$ $\boldsymbol{p}_2$ $\prec$ $\boldsymbol{p}_1$ $\vee$ $\boldsymbol{p}_1$ $\mathcal{O}$ $\boldsymbol{p}_2$

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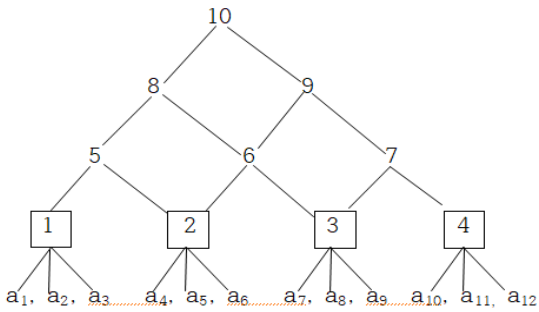
5 Due to the second condition, "[U(p1) $\subseteq$ U(p2)]", the above structure is for a single specified process. In other words, P(A) is the set of subprocesses of a specified process.

6 '$\bowtie$' is a two place relation to indicates that two eventualities are adjacent with each other. It is defined as follows: p$\bowtie$q =def $\forall$t [(p<t<q$\vee$q<t<p) $\forall$t'(t'$\sqsubseteq$t$\rightarrow$t'=t)].

As the following diagram shows, the process structure built up by the sum operation, "⊕", on these subprocesses are a join semilattice.

(15) The structure of a process[7]



The sequence of ten numbers, which are linearly ordered, makes a sequential structure. If the number of units involved in constructing a process p is known as n, the total number of subprocesses within p can be determined. This is given by the formula $n(n+1)/2$. For instance, if a process comprises 5 units, it encompasses 15 subprocesses; if it comprises 6 units, it encompasses 21 subprocesses, and so on and so forth.

Another point worth mentioning is that units are minimal elements of the process structure, even though they can be further decomposed into underlying actions. In this sense, these units start to gain the status of being parts of the specified process. Given that they are taken as minimal elements of the process structure, they form an **atomic*** join-semilattice.

(16) a. <P(A), ⩽ > is **atomic*** iff $\forall \boldsymbol{p}[\boldsymbol{p} \in P(A) \rightarrow \exists \boldsymbol{p}'[\boldsymbol{p}' \in P(A) \wedge \boldsymbol{p}' \leqslant \boldsymbol{p} \wedge$ **atomic*** $(\boldsymbol{p}')]$

b. $\boldsymbol{p} \in P(A)$ is **atomic*** $(\boldsymbol{p})$ iff $\forall \boldsymbol{p}'\ [\boldsymbol{p}' \in P(A) \wedge \boldsymbol{p} \leqslant \boldsymbol{p}' \rightarrow \boldsymbol{p}' = \boldsymbol{p}]$[8]

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7 Each of the units is constituted by 3 underlying actions as in the case of waltz. The numbers from 1 to 4 stand for the four units, and the other numbers denote subprocesses constructed by the sum operation "⊕" on those units.

8 P(A) does not contain the atom usually denoted by '0' in the literature. Thus, if any $p \in P(A)$ has no other p' such that p includes p', then it is a minimal element but not a real atom.

These subprocesses are crucial for determining whether a sequence of actions constitutes part of a specified process. For example, consider the process of someone walking to the station. Determining whether a sequence of actions, such as taking steps, forms part of this process depends on its spatiotemporal extent and our contextual knowledge and common sense about the specified process.

To truthfully assert, "John was walking to the station," it is necessary to establish that the observed sequence of actions corresponds to a subprocess whose spatiotemporal extent is sufficient to be considered part of the specified process within the given context. This understanding allows for an accurate mapping of the sequence of actions to the specified process, ensuring that the subprocess in question is a coherent and integral part of the overall process.

Let us reconsider the relationship between the subprocesses of a specified process and the event in question. The process structure consists of subprocesses that are included within the overarching process, which, for example, is the process 10 of the structure given in (15). Given that the process of "10" does not evolve or extend further, the entire structure describes the event in question. In other words, each subprocess contributes to the realization of the overall event. In this sense, subprocesses can be considered as propositions of the event as periods play a similar role in defining a durationless point-like period or a moment of time. Therefore, an event can be represented as a set of these subprocesses, formally expressed as $\lambda p[p(e)]$, where p is a subprocess and e indicates the event in question. This idea can be alternatively expressed by stating that the process structure constitutes a maximal filter[9] capturing the event in question.

By viewing an event as a set of subprocesses, we align with the formal semantic approach where events are seen as structured entities composed of smaller, temporally ordered parts. Viewing an event as a set of linearly ordered subprocesses reminds us of Rothstein's Incremental Chain[10]. In this context, the upper bound of each

9 The notion of a maximal filter is consistent with the idea that the process structure captures all relevant subprocesses leading up to the event. This ensures that the event is fully described by the subprocesses within the structure, without extending beyond the defined process.

10 Rothstein (2004:109) defines the culmination of an event in terms of upper bounds of its subevents as follows:

> Let C(e) be an incremental chain in e
> ub(C(e)) = {ub(e'): e'∈C(e)} (the set of upper bounds)
> The culmination of e is defined as follows:

subevent corresponds to a boundary between subprocesses.

However, the current method of describing the structure of an overarching process is considerably richer than Rothstein's Incremental Chain. In other words, Rothstein's chain captures a limited sequence within the process structure, such as the sequence of 1, 5, 8, and 10 in the process structure given in (15). This sequence, however, excludes several subprocesses like 2, 3, 4, 6, 7, and 9, which are also part of the process. If we consider "10" as an entire process, then the process structure transforms into the subevent structure of the event in question. In this sense, the structure of an entire specified process is isomorphic to that of its corresponding event.

Thus, the current method of representing the structure of subprocesses or subevents is significantly more expressive and comprehensive. It accommodates a wider array of subprocesses, offering a more nuanced and detailed representation of the event structure. This enhanced capacity allows for a more precise and thorough understanding of the relationships and hierarchies within the overarching process, reflecting the complex nature of events more accurately.

Let us reconsider the subinterval property or homogeneity of processes. This property suggests that every subinterval of the runtime of an overarching process shares the same characteristics as the overarching process itself. Although some irrelevant processes may occur within the runtime of a specified process, our epistemology guides us to interpret those intervals as still bearing the same properties as the specified process.

For example, consider a scenario where a house is halfway completed, but construction ceases for a period. Despite this interruption, is it still valid to assert, "The owner is still building the house"? During this reference period, the house is left under no construction, yet we can say that the process in question is still ongoing. Similarly, Stout (1997) provides an example of an apple decaying, which is interrupted by placing the half-rotten apple into deep freeze. In both scenarios, the processes are interrupted or ceased mid-way. The question arises: can these two processes still be considered ongoing?

Stout (1997: 21) argues that the process of the apple decaying is not affected by the interruption of freezing, stating, "What was happening before the interference is not affected by whether or not the interference occurred." This determination relies

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Cul(e)def = ub(e)

on our contextual knowledge and common sense regarding the processes of house construction and apple decay. If it is expected that the processes will continue based on our epistemology, we can judge them as ongoing after the reference time. Otherwise, we consider that an event where the apple was half-decayed happened before the reference time, or an event where the house was half-built happened before the reference time.

Within the framework of this study, if more units of a process are expected to occur, these processes are treated as being alive or ongoing. Otherwise, we recognize that two half-completed events—house construction and apple decay—happened.

3.3 A theory of the progressive

As mentioned above, the current study posits that the progressive denotes ongoing processes, but not a relation between an event in progress and its future completion in inertia worlds. Without requiring reference to possible worlds or conditions for hypothetical event completion, the current study grounds the interpretation of the progressive in observable subprocesses and their relationships within the process structure. Thus we achieve a more direct and less complex semantic representation of the progressive. Below is the discussion on how to build up such a theory.

To begin with, let us think of our memorizing words, an abstract process. This process involves the cognitive activities such as encoding, storage, and retrieval. (17) asserts that one of the three mental activities is in progress.

(17) John was memorizing the words when I saw him.

Which part of the memorization is being asserted by (17) is dependent on which part of the cognitive activities the reference time covers. The reference time of (17) is determined by *when*-clause, and it is anchored at a specific time by context. This reference time decides on which part of the cognitive activity of memorizing the words. Specifically, if it covers the encoding part, the speaker asserts that there was a process which includes various activities such as attention, perception, interpretation, and making connections or associations with existing knowledge.

The progressive of (1a) or (7a) denotes the process of Mary crossing the street.

It might be said to consist of making a decision to cross the street, looking for a suitable crossing point, and assessing the traffic conditions on the street, starting to walk, keeping walking to the other side, and reaching the other side of the street. If the reference time falls on the midst part of the process, the speaker asserts that there is a process of walking. However, it is not just walking on the street but walking for crossing the street.

In the case of the futurate progressive, the reference time is understood to align with the initial stages of the relevant process. For example, sentence (1b) asserts that there was a plan for Mary to leave town in the following month. Much like the process of Mary crossing the street in example (7a), the process of Mary leaving town begins with the formulation of that plan. Importantly, the plan does not have to originate from Mary herself; it could just as well be made by someone else, such as a parent with decision-making authority (Copley 2008).

It is crucial to recognize that futurate progressives involve two distinct reference times: one corresponding to the ongoing process, and the other to the future event described by the verb phrase. In (1b), for instance, "Mary was leaving town in the following month" describes a past interval during which the speaker observed some process related to the event of Mary leaving. The phrase "the following month" specifies the time within which the future event (i.e., Mary's departure) happens. During the former interval, the speaker witnesses preparatory procedural events connected to Mary's upcoming departure. These preparatory events can be thought of as the initial phases of the process leading up to the eventual event of leaving town. Such events might include the following series of actions or events:

(18) a. **Decision to leave**: The initial decision to depart, perhaps for work, relocation, or a personal matter.
b. **Setting a departure date**: Selecting a specific date or timeframe for the departure.
c. **Making travel arrangements**: Booking transportation, such as flights or trains, or planning a car trip.
d. **Sorting out finances**: Handling bills, closing local accounts, or notifying financial institutions of the move.
e. **Organizing packing**: Deciding what belongings to take, store, or discard.
f. **Cancelling services**: Ending utility or other services and

arranging for mail forwarding.

If an observer noted some of these actions during the relevant reference time, they could reasonably interpret them as signs of Mary's planned departure in the coming month.

To fully understand the meaning of futurate progressive constructions, it is important to note that the reference time for the ongoing process is not explicitly stated. The "sense of plan" associated with futurate progressives arises from the interaction between the process observed during the preparatory phase and the future event specified by the overt time adverbial. Essentially, the futurate progressive indicates that the process is already in motion, while the event itself is scheduled to take place at a specified future time. In short, futurate progressive constructions denote processes from the preparatory phase of a future event, ongoing at unspecified reference times. These processes and contexts together make the speaker expect the target situation to happen in a near future[11].

As for the characterizing reading (subject-oriented), (1c) describes Mary's habitual behavior or characteristic during the reference time, specifically her regular biking to work. In contrast to the reference times associated with the progressive event-in-progress reading or the futurate progressive, following Deo (2009, 2015, 2020), this study assumes that the reference time for the characterizing reading must be significantly longer.

For the event-in-progress reading, the underlying process refers to a single event or series of actions, which are viewed as homogeneous. For example, in *John is walking in the park*, all of John's walking actions in the park are perceived as forming a homogeneous sequence.

Similarly, the characterizing reading, as in *Mary was biking to work until she bought a car*, refers to a series of events of the same type, biking to work that occurred during the reference time interval. Ferreira, M. (2021), building on Kratzer (2007), explains this type of reading using plural event predicates. For example, the bare verb

11 As the following examples illustrate, the futurate reading requires a near-future timeframe, but not one too far in the distant future:

(i) a. The Red Sox are playing the Yankees tomorrow/next Friday.
b. ?The Red Sox are playing the Yankees two months from now.
c. ??The Red Sox are playing the Yankees ten years from now.

phrase *John smoke* can be interpreted in two ways, depending on its object. If it refers to plural entities like "10 cigarettes," the bare VP denotes a sum of events of smoking a single cigarette. Ferreira formalizes the plural interpretation of *John smoke* as follows:

(19) Plural predicate
a. PL(VP) = $\lambda P \lambda e$ sum(e, P)
b. sum(e, P) $\Leftrightarrow$ $P(e) \wedge \exists e_1, e_2, \ldots e_n, < e$ [$P(e_1) \wedge P(e_2) \wedge \ldots \wedge P(e_n)$]
c. $e = e_1 \oplus e_2 \oplus \ldots \oplus e_n$

Ferreira, M. (2021) argues that habitual or characterizing (subject-oriented) readings denote the existence of plural P-events within the given reference time, meaning there is a series of repeated events of type P. Within the current framework, characterizing readings triggered by progressive constructions are understood to represent processes consisting of homogeneous events. Deo (2009, 2015, 2020) supports a similar view, noting that progressives with habitual readings denote intervals whose regularly partitioned sub-intervals are characterized by homogeneous events. Hence, she gives the semantics of the progressive operator as follows:

(20) $[\![\text{PROG}]\!] = \lambda P \lambda i \forall h[h \subseteq H_{i\text{-}iner} \rightarrow \exists j[i \subset_{nf} j \subset h \wedge \forall k[k \subseteq R_j \rightarrow$ CON(P, k, h)]]]

(20) is read as the semantics of the progressive operator is a relation between a predicate P denoted by the bare VP and a reference time interval i such that at all cells of the partition of interval j(a superinterval of the referent time i and part of a history or extension of the reference time i), P is instantiated. By the definition given in (20), a progressive sentence being true requires the existence of the extension of the reference time of which contextually induced partition provides equidistant intervals at which an event of P denoted by the VP happens.

Let us consider the nature of processes in progressive readings depends on the inherent lexical semantics of the verbs involved. For instance, progressive constructions with activity verbs denote processes consisting of homogeneous actions. In contrast, progressive constructions with other verb types, such as accomplishment verbs, involve processes made up of diverse actions. Although these actions may vary physically, they can be viewed as conceptually uniform since they all fall under the property

expressed by the verb phrase. Essentially, processes are conceptually composed of uniform events or actions. Notably, all three interpretations of the progressive—event-in-progress, futurate, and habitual—center on processes, regardless of whether their individual actions are uniform or varied. This insight supports a unified analysis of the progressive in English[12].

To assign interpretations to the progressive expressions discussed thus far, we can adopt the following model for interpreting progressive expressions:

(21) Model **M** is a tuple < **D, E, P, T, W, R, I** >,
  a. **D, E**, and **P** are sets of individuals, events, and processes, respectively.
  b. **T** and W are sets of times and possible worlds, respectively.
  c. **R** is a set of thematic relations (e.g., agent, experiencer, theme, etc.).
  d. **I** is the interpretation function for progressive expressions.

As with previous analyses in the literature, this study assumes that progressive constructions are represented in a traditional type-theoretic language with lambda abstraction, enriched by a Neo-Davidsonian framework. The semantics specifies the extension of every expression α with regard to Model M, the possible world w, variable assignment g. This idea is conventionally represented as $[\![\alpha]\!]_{M,w,g}$.
Within this formalism, the following definition of the progressive operator is proposed:

(22) $[\![\text{prog}]\!] = \lambda P \lambda x \lambda i \exists e[\text{Process}(e)(i) \wedge \text{PROG}(e, P(x), i)]$[13]
  a. $[\![\text{PROG}(e, P(\text{x}), i)]\!]_{w,t} = 1$ iff $(\cap F_{i,w}(e)) \cap (\cap K_{t,w}) \vDash P_{i,w}$
  $P_{i,w}$: $\lambda w[e$ underlies an e' of P at $<i, w>]$[14]

12 A reviewer asked how the characterizing and event-in-progress readings of the progressive are distinguished within this study's framework, particularly regarding the involvement of heterogeneous subintervals within the reference time. The formal semantics proposed here does not explicitly differentiate the two readings. However, following Deo (2009), this study assumes the distinction lies in reference time length: characterizing readings allow for more heterogeneous subintervals due to their typically longer reference times compared to event-in-progress readings.

13 This definition and its explication below are adopted from Kim, N.H.'s forthcoming doctoral dissertation.

14 If the proposition $P_{i,w}$: $\lambda w[e$ underlies an e' of P at $<i, w>]$ holds, then for all subintervals i' of i, e also underlies e' at i'. This corresponds to the subinterval property, which states that if a state or process holds at interval i, it must also hold at all subintervals of i. This property is expressed through universal quantification over the cells of the regular partition of the reference time, as detailed in Deo (2009, 2015, 2020). See her work for further discussion.

b. $F_{i,w}(\boldsymbol{e})$: the set of all facts characterizing $\boldsymbol{e}$ at $\langle i, \boldsymbol{w} \rangle$
$\cap F_{i,w}(\boldsymbol{e})$: the set of worlds where all such facts hold

c. $K_{t,w}$: The speaker's knowledge at <t, w> with regard to eventualities relevant with the ongoing process $\boldsymbol{e}$, or the set of facts concerning eventualities relevant with $\boldsymbol{e}$
$\cap K_{t,w}$: the set of worlds where all facts about eventualities relevant with $\boldsymbol{e}$ hold.

d. If $\boldsymbol{e}$ is a process underlying an event $\boldsymbol{e}$' at $\langle i, \boldsymbol{w} \rangle$, the following conditions must hold:
(i) $\exists \boldsymbol{x}, \boldsymbol{R}[\boldsymbol{R}(\boldsymbol{e}, \boldsymbol{x})$ and $\boldsymbol{R}(\boldsymbol{e}', \boldsymbol{x})]$, where $\boldsymbol{R}$ is a variable for theta roles that $\boldsymbol{x}$ can play in $\boldsymbol{e}$ and $\boldsymbol{e}$'
(ii) $\tau(\boldsymbol{e}) \sqsubseteq \tau(\boldsymbol{e}')$;
(iii) $\exists \boldsymbol{e}''[\boldsymbol{e}'' \preccurlyeq \boldsymbol{e}' \wedge \tau(\boldsymbol{e}'') \sqsubseteq i \wedge \boldsymbol{e}'' \equiv \boldsymbol{e}]$

The progressive marker 'prog' (morphologically, *be_V-ing*) is thus defined as a functor that takes an event property and returns a set of intervals where a process is ongoing. Additionally, the process is evaluated based on the speaker's knowledge ($K_{t,w}$) at time $\boldsymbol{t}$ and world $\boldsymbol{w}$, where the process serves as an underlying precursor to an eventual event corresponding to the event property. The relation between a process and its corresponding event is treated as a primitive notion, meaning it cannot be explicitly defined. Instead, (22d) outlines key properties that this relation should satisfy. Specifically, for a process $\boldsymbol{e}$ to stand in an underlying relation with an event $\boldsymbol{e}$', they must share some substance, in line with Kim, J.G. (1976), and the runtime of the process must be contained within that of the event. Moreover, the process $\boldsymbol{e}$ and the event $\boldsymbol{e}$", a subevent of $\boldsymbol{e}$', are considered loosely identical ($\equiv$) within the interval $\boldsymbol{i}$ in question. This notion of loose identity is adopted from Link's (1998: 275) weakened form of identity:

(23) **Loose identity between processes**
$a \equiv b \rightarrow \varphi[a] \leftrightarrow \varphi[b]$

In this definition, $\varphi[a] \leftrightarrow \varphi[b]$ signifies that a and b are identical with respect to some property φ. Link's approach avoids the strict interpretation of identity as in

Leibniz's Law, instead employing relevant congruence classes. Although Link applies this loose identity to objects rather than events, this study extends his notion to eventualities, as he effectively considers conventional objects as processes. As discussed earlier, this study proposes that the structure of a process is homomorphic to that of its corresponding event. Therefore, if properties such as temporal length, spatial region, or spatio-temporal region apply to the components of a process, they yield values similar to those of the corresponding event. Consequently, the congruence relation between processes and events can be understood as a form of loose identity conditioned by spatio-temporal properties and substance in Kim, J.G.'s sense.

The following formalizes the proposed congruence relation between processes and events:

(24) **Loose identity between eventualities**
$e \equiv e' \Leftrightarrow \forall e, e' \exists x, \theta[\text{Process}(e) \wedge \text{Event}(e') \wedge \rho(e)=\rho(e') \wedge \theta(e, x) \wedge \theta(e', x)]$,
where ρ denotes the spatio-temporal region, and θ represents a thematic relation.

In essence, the loose identity relation between processes and events specifies the conditions under which they can be regarded as congruent or identical. Specifically, they must occupy the same spatio-temporal region and share some substance x, which may assume different thematic roles or the same role across the process and event. For example, the process of Mary crossing the street and the event of her successfully crossing it share Mary as the agent and maybe the street as the goal, thereby satisfying the loose identity relation.

This study departs from traditional views that analyze the progressive as involving a relationship between the time at which an event is in progress and a world in which the ongoing event culminates. Instead, it focuses on the underlying process itself, shifting attention from culmination to the dynamics of the process. This shift allows the framework to address four key issues in the semantics of the progressive: the Imperfective Paradox, Existential Generalization, (Un)interruption, and Contextual Influence.

Let us see how the current framework deals with progressive constructions relevant with these four issues. First, the truth of a progressive sentence depends on whether

the described process occurs at the reference time, without requiring that the event culminates or that the object involved in the culmination exists. This directly addresses the Imperfective Paradox, as the progressive does not entail the completion of the described event. For instance, "Mary was swimming across the Atlantic" can be true even if Mary never reaches the other side, provided that a series of her observed actions can be taken as underlying an event of the type denoted by the VP in question.

Second, the framework resolves issues related to Existential Generalization, as it does not presuppose the existence of a completed object. Since the progressive refers to an ongoing process rather than a completed event, the existence of the culmination is irrelevant. For example, "John was building a house" does not entail the existence of a completed house but rather an ongoing construction process consistent with the predicate. So the discussion does ot matter on whether a comple house exists or not.

Third, this framework naturally accounts for cases of (un)interruption, as a process can remain valid even if it is interrupted before reaching its culmination. For instance, in the scenario where Mary was hit by a truck while crossing the street, the process of "crossing the street" was ongoing at the relevant reference time. Similarly, "Mary was swimming across the Atlantic" is true if her observed swimming during the reference time corresponds to the process of attempting to swim across the Atlantic, regardless of whether she completed the journey. Since this framework requires only the presence of a process underlying the event described by the verb phrase for a progressive construction to hold, the question of interruption is irrelevant.

Finally, this approach accommodates Contextual Influence on the interpretation of the progressive. Consider the example introduced by Higginbotham, involving a hijacked flight: Mary was taking her flight to London, but after an hour, the plane was hijacked to Havana, where it ultimately landed.

(25) a. Mary was (then) flying to London.
b. Mary was (then) flying to Havana.
c. Yesterday, Mary thought she was flying to London, but in fact she was flying to Havana.

The truth values of these sentences depend on the speaker's contextual knowledge of the situation at the time referred to by *then*. If *then* refers to a time before the flight was hijacked, (25b) is judged false, while (25a) is judged true. However, when

the speaker retroactively utters (25c) with knowledge of the entire hijacked flight event, both (25b) and (25c) can be judged true.

As defined earlier, the speaker's knowledge—represented as $(\cap F_{i,w}(\boldsymbol{e})) \cap (\cap K_{t,w})$—about the ongoing process and its relevant concomitant facts allows the speaker to truthfully assert (25a), (25b), and ultimately (25c). Specifically, (25a) is truthfully asserted if, at time t, the speaker knows that Mary's flight to London is proceeding normally. For (25b) to be so, at time t, the speaker's knowledge must align with the fact that her flight has been hijacked. Finally, for (25c) to be evaluated as true, time t must be a point when the speaker knows the complete sequence of events, and the speaker's knowledge $(\cap F_{i,w}(\boldsymbol{e})) \cap (\cap K_{t,w})$ supports the truthful assertion of (25c).

From this discussion, it is evident that the current process-based semantics of the progressive can account for the four key issues explored in this study: the Imperfective Paradox, Existential Generalization, (Un)interruption, and Contextual Influence.

Finally, let us examine how the formal representation of the progressive operator and its semantics contribute to the compositional derivation of meaning in progressive constructions. For example, consider the formal derivation of the meaning of (1b) under its characterizing reading.

(26) Mary was walking to work until she bought a car.

$\llbracket$ prog $\rrbracket$ = $\lambda P \lambda \boldsymbol{x} \lambda i \exists \boldsymbol{e}[\text{Process}(\boldsymbol{e})(i) \wedge \text{PROG}(\boldsymbol{e}, P(\boldsymbol{x}), i)]$

|

| walk_to_work' : $\lambda \boldsymbol{e}', \boldsymbol{x}[\text{walk\_to\_work}(\boldsymbol{e}')(\boldsymbol{x})]$[15]

|/

was_walking_to_work': $\lambda \boldsymbol{x} \lambda i \exists \boldsymbol{e}[\text{Process}(\boldsymbol{e})(i) \wedge i \prec \textbf{now} \wedge$

| $\text{PROG}(\boldsymbol{e}, \lambda \boldsymbol{e}'[\text{walk\_to\_work}(\boldsymbol{e}', \boldsymbol{x})], i)]$

| Mary= $\lambda P.P(m)$

|/

= $\lambda i \exists \boldsymbol{e}[\text{Process}(\boldsymbol{e})(i) \wedge i \prec \textbf{now} \wedge \text{PROG}(\boldsymbol{e}, \lambda \boldsymbol{e}'[\text{walk-to work}(\boldsymbol{e}', m)], i)]$

| until : $\lambda \boldsymbol{q} \lambda \boldsymbol{p} \exists \boldsymbol{t}[\neg \boldsymbol{q}(\boldsymbol{t}) \wedge \forall \boldsymbol{t}'[\boldsymbol{t}' \sqsubseteq \boldsymbol{t} \rightarrow \boldsymbol{p}(\boldsymbol{t}')]$[16]

15 For an expression X Y, X_Y' stands for the meaning of X Y. For example, the meaning of verbal phrase 'walk to work' is represented as walk_to_work'

| | she_bought_a_car: $\lambda i \exists e[$ buy_a_car(e)(m)(i)$\wedge i \prec$ **now**]
| |/
| =λp $\exists t[\neg \exists e[$ buy_a_car(e)(m)(t)$\wedge t \prec$ **now**] $\wedge \forall t'[t' \sqsubseteq t \rightarrow$ p(t')]
|/
= $\exists t[\neg \exists e[$ buy_a_car(e)(m)(t)$\wedge t \prec$ **now**]$\wedge \forall t'[t' \sqsubseteq t \rightarrow$
$\lambda i \exists e$[Process(e)(i) $\wedge$ $i \prec$ **now** $\wedge$ PROG(e, $\lambda e'$[walk-to work(e',m), i)](t'))]]
= $\exists t \neg \exists e$[buy_a_car(e)(m)(t)$\wedge t \prec$ **now**]$\wedge \forall t'[t' \sqsubseteq t$
$\rightarrow$ $\exists e$[Process(e)(t') $\wedge$ $t' \prec$ **now** $\wedge$
PROG(e,$\lambda e'$[walk_to_work(e',m)], t')]]

The result of the formal derivation tells that there is an interval of time t at which Mary does not buy and for all sub intervals t' of t, Mary's walking to work is happening. This is exactly what (26) delivers.

4. Concluding remarks

This study has primarily argued that the progressive aspect denotes an ongoing process rather than expressing a counterfactual relationship between an event in progress and its potential future culmination. We have demonstrated that this process-based framework effectively addresses four key issues related to progressive constructions. Except Contextual Influence, the other three issues—the Imperfective Paradox, Existential Generalization, and (Un)Interruption—stem from the assumption of previous analyses about the hypothetical culmination of events. Within the current framework, these issues are either spurious or irrelevant, as they are not intrinsic to the semantics of the progressive.

Additionally, we have shown that this analysis accounts for the three primary readings of the progressive in English—the event-in-progress reading, the futurate reading, and the characterizing reading—within a unified framework. For the event-in-progress reading, the process corresponds to a single ongoing event. For the

16 The domain of t' should be restricted to the minimal size of time, but long enough to contain a process of Mary's walking to work. A similar idea is found in Link (1998: 290). He employs a spatial "gauge region" that gives the minimal size of an object falling under a particular type.

characterizing reading, it encompasses a series of homogeneous events. In the case of the futurate reading, a sequence of heterogeneous events, construed as a process, anticipates the future event described by the verbal phrase. Crucially, this analysis demonstrates that all three readings of the progressive are grounded in the underlying structure of relevant processes.

To support this process-based approach, we have examined the ontological distinction between events and processes alongside the structural properties of processes. Events introduce change but do not constitute change itself, whereas processes inherently embody change. Events are presented as discrete wholes, while processes are inherently ongoing and partially observable. Despite these differences, both events and processes can be analyzed in terms of their temporal parts. Structurally, processes align algebraically with an atomic join semilattice, revealing their internal compositionality.

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