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Dr. Mosaik: a holistic framework for understanding the English tense–aspect system based on ontology engineering

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Introduction

Gaining mastery of the English tense–aspect system, or the appropriate use of the different verb forms, is a significant challenge for learners of ESL/EFL (English as a Second/Foreign Language) (Larsen-Freeman, Kuehn, & Haccius, 2002). Knowledge of English, an international language for communication, has also become increasingly necessary for a number of adult university learners. This is true of many learners who choose to study abroad or immigrate to countries where proficiency in English is necessary to pursue higher studies and enter the workforce. With respect to verb system understanding and mastery, it is not unusual for university learners enrolling in ESL classes to have to assimilate a substantial amount of information within a limited time frame. The reality of such classes—that bring together students of different native languages and English-learning backgrounds—is that they are subject to time and curriculum constraints; it is not always possible for them to be brought to level on this particular topic. Technology-assisted language-learning applications, for their part, need to provide many explanations on verb tense uses; at more advanced levels of practice, these can be numerous (e.g., Englishpage, 2021).

Conventional research on technology-enhanced learning has been mainly conducted on the use of technology to support learning and teaching processes (Alario-Hoyos, Rodríguez-Triana, Scheffel, Arnedillo-Sánchez, & Dennerlein 2020; Sampson et al., 2019; Taalas, Jalkanen, Bradley, & Thouëсны 2018). In contrast with this major trend, we concentrate on how to apply ontology engineering (OE) methodology to enhance clarity and coherence in understanding a set of target knowledge that is difficult to acquire and understand. Our work began as an attempt to simplify the many existing verb tense rules by reorganizing them. We eventually proceeded to thoroughly analyze the explanations provided in a number of grammar materials, in an effort to extract the fundamental meanings of each tense to reduce the number of rules where possible. We further distilled and reframed our findings in light of ontologically rooted structures of happenings and time (Galton and Mizoguchi, 2009; Mizoguchi, 2010). This

allowed us to provide language-independent understanding of tense and aspect. In so doing, it became apparent that organizing the tenses in light of the different aspects significantly contributed to coherence. This process further resulted in the structuring of a novel, holistic framework—named Dr. Mosaik—that encompasses explanations of the entire tense–aspect system, while highlighting eight comprehensive rules that explain the main workings of the system. In turn, this provides a limited number of “anchor points” on which to time-efficiently address instruction and corrective feedback. The framework was introduced in advanced-level intensive English programs as an additional option to what was offered in pedagogical materials, and was readily adopted by learners. Deployment and testing of the Dr. Mosaik framework demonstrated that most students successfully understood tense and aspect, and in far less time than with conventional methods.

We add two important considerations. The first is that we are well aware that the related learning activities are fundamental to success and that individual learner differences play an important role (Dörnyei, 2005; Ellis, 2004; Sawyer and Ranta, 2001). The second is that formal experimentation with students based on the framework is necessary. We have conducted research on both these fronts, and we address preliminary results of classroom experimentation in our discussion at the end of this paper. Due to space limitations, however, we focus on the development and description of the framework in light of challenging issues that instructors need to bear in mind when teaching the tense–aspect system. These are described in grammar teaching material addressed to pre-service teachers—among others—to which we refer. The reason is that this material is often used by instructors as a reference in the course of their careers (Larsen-Freeman and Celce-Murcia, 2015). Subsequent papers are thus foreseen with a view to addressing appropriate instructional activities with attention to learner differences, along with relevant experimentation. This said, an overview of how the framework is taught can be found at the end of our discussion.

The paper is organized as follows. In the next section, a literature review describes the English tense–aspect system as well as the main hurdles to understanding its meaning and use. The third section addresses the problem, a possible solution, the research questions, and a literature review of ontology engineering. The fourth section outlines the research methodology. The fifth section discusses the various steps that were followed and includes a semi-ontological discussion of occurments. The end of our discussion, preceding the conclusion, presents the preliminary results of experimentation with learners using the framework that resulted from this research endeavour.

Literature review

The English tense–aspect system

Let us first review the twelve English tenses. Celce-Murcia and Larsen-Freeman (1999) and Larsen-Freeman and Celce-Murcia (2015) present them within a coherent system, showing how tense and aspect converge; that is, the different verb form combinations describe situations mediated by these two grammatical means. Tense usually allows situations to be placed on a timeline relative to utterance time, that is—as in most languages—in terms of present, past, and future. Aspect generally refers to “different ways of viewing the internal temporal constituency of a situation” (Comrie, 1976). For

Table. 1 The English tense–aspect system (adapted from Celce-Murcia and Larsen-Freeman (1999) and Larsen-Freeman and Celce-Murcia (2015))

Tense	Aspect			
	Simple (inflected)	Perfect have (inflected) + past participle	Progressive be (inflected) + <i>ing</i> form	Perfect progressive have (inflected) + been + <i>ing</i> form
Present	walk/walks	has/have walked	am/is/are walking	has/have been walking
Past	walked	had walked	was/were walking	had been walking
Future	will ^a walk	will have walked	will be walking	will have been walking

^aOther modals can be used to express future time; *will* is the most common

example, aspect is what differentiates between past time *she was reading* and *she read*. The name of each tense also reflects its combination of tense and aspect, usually beginning with the tense characteristic followed by aspect. For example, *walk/walks* represents the present simple (usually called simple present), *had walked* the past perfect, and so on.¹ The following table provides a snapshot of the system (Table 1).

Challenges to verb tense use acquisition

Gaining mastery of the English tense–aspect system, or the appropriate *use* of the different verb forms, is reportedly one of the most difficult areas for learners to master. Researchers identify several factors in this respect, which include the system’s complexity, the lexical aspect of verbs, native language (L1) influence, and instructional input (Ayoun and Salaberry, 2008; Celce-Murcia and Larsen-Freeman, 1999; Chan, Finberg, Costello, and Shirai, 2012; Collins, 2002, 2009; Cowan, 2008; Roberts and Liszka, 2013).

Substantial research has been conducted with regard to the acquisition of the English verb tenses. As stated by Martinovic-Zic (2009), perhaps the most influential L2 (second language) tense–aspect research has centered on the acquisition of verb morphology and temporality, namely through the work of Bardovi-Harlig (2000), itself an investigation of the Aspect Hypothesis (Andersen, 1991), the Discourse Hypothesis (Bardovi-Harlig, 1995), and the Prototype Hypothesis (Li and Shirai, 2000). Various other studies have followed, investigating, among others, the Aspect Hypothesis and L1 influence (Ayoun and Salaberry, 2008; Collins, 2002; Munoz and Gilbert, 2011; Roberts and Liszka, 2013).

While our own work acknowledges and is inspired by the valuable and substantial research work and findings these represent, we choose to approach the issue from the point of view of verb tense–aspect system understanding as it is presented in teacher education reference material, considering these works are often used by language instructors throughout their professional careers (Larsen-Freeman and Celce-Murcia, 2015). As such, we provide an overview of some of the main difficulties encountered by students as identified by Cowan (2008), Celce-Murcia and Larsen-Freeman (1999) and Larsen-Freeman and Celce-Murcia (2015) in their grammars of English, addressed to pre-service teachers.

¹The future time “tenses” call for modals (e.g., *will*) rather than inflected (conjugated) verbs; as such, from a grammatical standpoint, they are not, technically, tenses. However, from a pedagogical standpoint and as Celce-Murcia and Larsen-Freeman point out, the system is much easier to see and learn when it includes future time verb combinations.

The main point these authors make centers on the complexity of how tense and aspect interact to express meaning, beyond conjugation. Because this will become apparent in subsequent sections, namely in the discussion of our framework development, we briefly focus here on the influence of the lexical aspect (semantic properties) of verbs, L1 influence, and instructional input.

Essentially, verbs are categorized into action (dynamic) and non-action (stative) verbs. Action verbs can be further subdivided into three categories (Vendler, 1967): activity (continuous actions; *walk, run*); achievement (instantaneous occurrence, with a possible preliminary activity; *lose, solve*); and accomplishment (duration with an endpoint; *make (a quilt); write (a letter)*). Lexical aspect matters in that it shapes our interpretations of the actions taking place and thus factors into the learning of tenses. Activity verbs, for instance, lend themselves well to progressive tenses, whereas stative verbs, short of wishing to achieve certain effects, do not (*Paul is driving now; Paul owns a car now*). To give a more specific example, simple past tense acquisition may be slowed down by lexical aspects: learners tend to use the past tense with achievement and accomplishment verbs before they do so with activity and stative verbs (Larsen-Freeman and Celce-Murcia, 2015). In other words, and as class experience has shown, many students may lean towards expressing *Yesterday, I was washing the car* over *Yesterday, I washed the car* (*wash*: activity verb).

L1 is another factor underlying some of the choices students make when expressing themselves in English. In some languages, for instance, verbs do not inflect at all. Others may have a tense that corresponds to two in English, or require different tenses with equivalent English time expressions—among other variations. As Cowan (2008) points out, courses and materials often ignore the effects of lexical aspect—or L1 influence for that matter—whereas closer attention to these effects could positively impact teaching.

Cowan further investigates considerations regarding instructional input, providing various suggestions, of which we give an example that has been relevant in our work: based on Collins (2009), he sets forth that instruction on frequently confused tenses should include activities that require students to focus on the contexts in which they occur. Students could also voice their own hypotheses about tense usage, and receive feedback. In short, these are activities that promote understanding.

This ties into what is perhaps the most important recommendation made to instructors: they “need to deal with meaning and use” (Larsen-Freeman & Celce-Murcia, 2015, p. 105). Meaning “is an exceedingly important dimension in helping students manage the tense–aspect system” (p. 109). In other words, a focus on explanations of the underlying principles that govern the system is required. This is indirectly corroborated by Ellis (2006) in a ten-point statement he makes concerning his own positions on teaching grammar. The thrust of his first three points strikes us as being especially relevant with respect to the teaching of verb tenses to adults:

1. The grammar taught should be one that emphasizes not just form but also the meanings and uses of different grammatical structures.
2. Teachers should endeavour to focus on those grammatical structures that are known to be problematic to learners...

3. Grammar is best taught to learners who have already acquired some ability to use the language... However, [it] can be taught through corrective feedback as soon as learners begin to use the language productively. (p. 102)

Ellis also defines grammar teaching as involving “any instructional technique that draws learners’ attention to some specific grammatical form in such a way that it helps them either to understand it meta-linguistically and/or process it in comprehension and/or process it in comprehension and/or production so that they can internalize it” (p. 84). In so doing, he acknowledges that there is generally limited available time in most teaching contexts for teaching grammar and that some selection is needed.

Experiential data

We would like to highlight an additional factor that, as language instructors, strikes us as another challenge: ESL grammar materials organize and convey explanations of the English verb tenses in different ways, which vary in scope, wording, and approach. When examining more than ten grammar textbooks (Additional file 1), we noted that the organization of tense and/or aspect explanations can substantially vary (as can practice exercises). Tenses may for instance be introduced in terms of aspect, single or multiple time frames, difficult tense combinations, or possibly all of the preceding, in various orders and groupings. Moreover, verb tense rules are sometimes explained using word choices that introduce nuances within these rules. Regardless of approach, they are generally presented in any given section as a series of points clarifying the use of each tense. Advanced grammar textbooks (and websites) can list as many as 50 such points—or rules—for the twelve tenses. The implication is that learners need to examine and sometimes memorize large amounts of information, and adapt to these different approaches. As some adult learners testify, attempting to master English tenses can be overwhelming.

For the sake of illustration, we list the rules for simple present tense uses in Table 2, respectively taken from Larsen-Freeman and Celce-Murcia’s *The Grammar Book* (2015) and *Advanced Learners’ Grammar* (Foley and Hall, 2003). The first is a pre-service teacher textbook which, as previously mentioned, is often used as a reference manual by teachers throughout their careers. The second is a textbook that can also be used for self-study. Without going into a detailed analysis, some of the salient differences between both lists include references to the core meanings of the aspect and tense, a distinction between main and peripheral uses, in addition to variations/nuances in word choices, if not within the rules themselves. In short, not only are the grammar rules describing verb tense uses numerous (Table 2 presents one of twelve tenses), they are also word-dependent, without being altogether systematic.

What is not apparent in the above is that the order of rule presentation also differs (with one exception, Table 2 follows that of *The Grammar Book*). Furthermore, in the first work, the present tense rules are within a section describing simple tenses (present, past, future); in the second, the section describes “present tenses”, which excludes the present perfect, later described as a “past to present” tense. In both cases, the explanations are certainly relevant and comprehensive. However, from a learner’s perspective at least, if not that of an instructor, adaptation is required.

Table. 2 Simple present tense: rules of use (from *The Grammar Book* and *Advanced Learners' Grammar*)

<i>The Grammar Book</i>	<i>Advanced Learners' Grammar</i>
Simple aspect: describes events conceptualized as complete wholes, not allowing for further development	[Main uses]
Tense core meanings: Complete and unchanging nature, immediate factuality	
Habitual actions in the present	<i>Repeated events and actions:</i> To describe things that happen on a regular basis; Often used with adverbs of frequency
General timeless truths, such as physical laws or customs	<i>General truths and facts:</i> To state truths and to describe things which we feel are facts or permanent situations <i>Series of events/actions:</i> To describe a series of events or actions (e.g., to give directions or instructions), often with impersonal <i>you</i>
With <i>be</i> and other stative verbs to indicate states, or even the inception of states	<i>Rarely used in the continuous (= progressive):</i> Verbs expressing states are rarely used in the continuous tenses
Present speech acts (where the action is accomplished in the speaking of it)	Performative verbs (<i>apologize</i>)
In subordinate clauses of time or condition when the main clause contains a future-time verb	<i>Other uses</i> To express the future after conjunctions of time (<i>when, after, as soon as</i>)
Expresses future (scheduled event), usually with a future-time adverbial	Fixed events in the future (timetabled events)
Present event/action (sporting events or demonstrations/procedures of some sort)	To express the immediacy of an event (e.g., in sports commentaries) Newspaper headlines (more immediacy)
Conversational historical present	To give the events of a past narrative or an anecdote more immediacy (especially in speech) Formal speech or writing for certain actions (<i>look forward to</i>)

Description of the problem and research questions

Description of the problem

Gaining mastery of the English tense–aspect system, or the appropriate use of the different verb forms, is one of the key challenges of learning the English language. The main recommendation to instructors is to promote understanding of the principles governing the system.

Research shows that this understanding requires considerable effort given factors such as the complexity of the system—or its many underlying rules, the lexical aspect of verbs, L1 influence, and instructional input. We contribute the idea that the mastery of tense–aspect uses also requires a memory-intensive endeavour, at least until a certain “automaticity” sets in. For advanced adult students especially, the number of rules to remember in order to apply them is high. Let us recall that many of our adult students need to acquire proficiency in English within a relatively limited time. Moreover, adaptation is necessary when moving from one textbook to the next, instructional input notwithstanding.

Proposed solution

The set of knowledge explaining the verb tense–aspect system is altogether complex, namely because it contains a large amount of information. We hypothesized that analyzing this set of knowledge through the lens of ontology engineering methodology would not only lead to its reorganization, but to the possible extraction of some of its most fundamental governing principles. In other words, such an analysis could contribute to a shift in learning and understanding from a memory-intensive endeavour to one based on a limited number of clearly delineated principles. To our knowledge, this paper is also the first of its kind to apply OE to the study of verb tenses.

We acknowledge that we are certainly not the first to aim for principle-based learning of the system. Remarkable work has been conducted in this regard, to which several pedagogical series bear testimony: *Grammar Dimensions*, *Focus on Grammar*, *English Grammar in Use* and Azar's multi-level grammar books, among many others. This said, the amount of information to be assimilated in most series, especially at the advanced levels, remains substantial.

Ontology engineering

Ontology is a branch of philosophy concerned with studying the nature of being and existence, and can be traced back to Aristotle. With the advent of technology and artificial intelligence (AI), ontology engineering (OE) has come to the fore, namely as it investigates the fundamental conceptual structure of a particular domain or subject, with various applications in the semantic interoperability of data and knowledge (Mizoguchi, 2003); simply put, it favours the exchange of information between computer systems. This takes place through mediating ontologies, which are not unlike sophisticated road maps representing a world of knowledge that can be read and interpreted by technological agents, if not by humans. There are many applications of information exchange using OE in what is called Technology-enhanced learning (TEL) or Computer-assisted learning (CAL). Typical examples include Learning Object Metadata (LOM) projects (IEEE Standard for Learning Object Metadata, 2002; Rebaï, de la Passardière, and Labat, 2006). Metadata is data for characterizing data and is used to index such data and information for intelligent search. Ontologies are used to interoperate between metadata and LOM. In fact, researchers as well as practitioners enjoy the usefulness of LOM in searching for learning objects (LO) relevant to their needs among a huge number of LOs found on the worldwide web.

The idea behind OE, then, is to articulate seemingly chaotic situations in a principled manner, reflecting an understanding of a “world of interest” through an ontology. An often-quoted definition of ontology was coined by Gruber (1993): “An ontology is an explicit specification of a conceptualization,” where *conceptualization* refers to an abstract model of world phenomena, and an *explicit specification* comprises concepts showing the relations and constraints between them, among others (Psyché, Mendes, and Bourdeau, 2003). Borst (1997) contributes the idea that ontologies are also the reflection of a *shared* conceptualization. In other words, ontologies seek to capture the consensual knowledge of a group of people or a given community.

In AI research, ontologies serve different purposes and are classified accordingly. Broadly speaking, they can be subdivided into lightweight and heavyweight ontologies.

The above-described ontology applications to metadata belong to the former. Among the latter are upper ontologies, on which information systems communities have come to rely upon. Upper ontologies play critical roles in understanding and organizing the complexity of reality in a consistent manner. Examples of upper ontologies include Descriptive Ontology for Linguistic and Cognitive Engineering (DOLCE) (Borgo and Masolo, 2010), BFO (Arp, Smith, and Spear, 2015), and Yet Another More Advanced Top-Level Ontology (YAMATO) (Mizoguchi, 2010).

A typical educational example of a heavyweight ontology is OMNIBUS, an ontology of learning and instructional theories that was built based on YAMATO (Mizoguchi and Bourdeau, 2000, 2016). Among OMNIBUS-related projects, SMARTIES, an ontology-aware authoring system, was further developed to intelligently help its users author theory-compliant learning and instructional scenarios using the OMNIBUS ontology (Hayashi, Bourdeau, & Mizoguchi, 2009). The research endeavour described in this paper is reminiscent of research on the design of heavyweight ontologies such as OMNIBUS. This said, it is also different: OMNIBUS targets learning processes, whereas the Dr. Mosaik framework targets a set of knowledge whose acquisition proves especially challenging. In other words, the Dr. Mosaik framework fundamentally seeks to reorganize this set of knowledge so as to promote more straightforward understanding, which then has positive implications for the appropriate application of said knowledge. In short, if students have a clear, concise, and principle-based understanding of the English verb-tense aspect system, they should find it easier to apply its rules. Furthermore, the instructional strategies to achieve this aim, be they implemented in class or through technology, can be rooted in the Dr. Mosaik framework.

We have based our reorganization of the verb tense-aspect system rules on the YAMATO ontology. More specifically, we sought to explore the ontological underpinnings of time, itself an inherent component of verb tenses. One of the unique features of YAMATO is the clear separation it makes between the ideas of process and event (Galton and Mizoguchi, 2009), which we have exploited in our framework; we later explain these concepts. In addition, and consistent with ontology engineering practices, we have also strived to extract the shared conceptualizations of the many existing verb tense rules, so as to eliminate repetition where possible. In this process, we found that grounding the main rules in ontological structures of happenings and time found in YAMATO further contributed to synthesizing the verb tense–aspect system, in addition to making apparent relations that could otherwise be difficult to see.

Research questions

Our hypothesis was that decreasing the number of grammar rules (and their exceptions) would promote a comprehensive and deeper understanding of the system based on a limited number of principles. Our research questions are as follows:

1. Can grounding frequently cited tense rules in YAMATO's descriptions of temporal entities contribute to highlighting the shared conceptualizations of these rules and thus reduce their number?
2. Can relations among some of the rules be uncovered?
3. Can exceptions to “main” rules of use become apparent?

4. Can these conceptualizations promote an understanding of the four aspects?
5. Can the analysis through OE methodology result in a comprehensive model of the entire verb tense-aspect system, in which fundamental concepts stand out?

Methodology

We conducted our investigation according to the following seven steps:

1. Select ESL materials destined for students in high intermediate and advanced levels that are found in various countries and frequently used in the institutions where we teach; complement with grammar textbooks recommended to pre-service ESL teachers.
2. List all the verb tense rules and examples of use, including exceptions.
3. In accordance with ontology engineering methodology, target the essential meaning of the rules; eliminate repetitions.
4. Introduce ontologically rooted structures of happenings and time to provide a basis for the rules.
5. Organize the rules coherently and comprehensively.
6. Provide a system overview taking these ontologically rooted structures into account.
7. Upon appraisal, develop instructional strategies with evaluation through a 3-year practice of instruction (summarized in this paper due to a lack of space).

Discussion

Step 1

We selected more than ten student pedagogical grammar materials which we supplemented with two international grammar works used by pre-service language teachers (Additional file 1).

Step 2

Using the pedagogical materials listed in Additional file 1, we charted each tense rule (and exceptions) along with the provided examples. The “same” rules and exceptions were aligned next to one another with the relevant examples so that careful analysis could be carried out. This initially resulted in a daunting set of lists. An excerpt of this work featuring the rules can be found in Table 2 above.

Step 3

In accordance with ontology engineering methodology, we aimed to target the essential meaning of the rules and eliminate repetitions. As such, we focused on an analysis of the underlying time-related perspectives behind each tense because this is related to the very nature of tenses. A sample of this preliminary work follows, using once again the simple present whose rules of use are provided in Table 2.

Two overarching categories were identified: time-related and time-unrelated rules. Each was further broken down into subcategories according to the fundamental characteristics we uncovered, and illustrated through a limited number of examples, shown in Table 3. We also accounted for stative-meaning verbs in an altogether separate

Table. 3 Simple present: an extraction of essential rules**Simple present**

Time-unrelated rules (exclusive characteristic of this tense)
Series of actions and events
Instructions (directions/recipes) (<i>You go straight, turn right...</i>)
Intentionally turning the past into present (storytelling)
Story/anecdote/commentary (for liveliness) (<i>So he knocks, walks in, and...</i>)
Summary of event (for liveliness) (<i>In 1945, the war comes to an end...</i>)
Headlines (news) (<i>Investigation Sheds Light on...</i>)
Time-related rules (which derive into simple past)
Shared understanding of "now" (also occurs in past and future)
With explicit specification
Habit/recurrent action
With expressions of frequency (<i>I clean the garden every day. I usually clean...</i>)
In time clauses (<i>I clean the garden when I find time.</i>)
Set scheduled event (<i>The plane leaves at 8 p.m. tomorrow/on Tuesdays.</i>)
Event/action that prepares for future action/event
In time clauses (<i>As soon as he arrives, I will prepare dinner.</i>)
Without explicit specification
Statement of "general" truth
Generalization, fact, truth (<i>The sun rises from the east.</i>)
Long-lasting state or situation (<i>Grizzly bears live in Alaska.</i>)
Description of states (<i>stative-meaning verbs</i>)
Being/existing (<i>The beauty of this area consists in its gorgeous temples.</i>)
Cognitive/mental states
Thinking/belief/opinion/likes/dislikes (<i>I understand. I know/think he's wrong. I like sushi.</i>)
State of mind/feeling (<i>I expect you to arrive early. I am happy to help you. I love you.</i>)
Sense perception (<i>This soup tastes wonderful.</i>)
Appearance (<i>You look great.</i>)
Possession (<i>He has a beautiful car.</i>)
Scientific states/relations between concepts (<i>X depends on feedback loops. The sum equals 34.</i>)
Other (<i>This pumpkin weighs 10 kg.</i>)
Case of exception
Performative verbs (<i>I promise not to tell anyone.</i>)
Certain expressions (<i>Here comes the bus!</i>)

category. This is because such verbs do not systematically follow the same rules as action verbs and may be restricted to non-progressive tenses (seldom *I am being* but *I am*).

The elimination of rule repetition is not convincingly demonstrated in this particular example that has been provided to highlight the reorganization of the rules listed in Table 2. Rule elimination does happen within a single tense; this is demonstrated in Step 5 (Simple present section). What nevertheless became obvious at this stage in our work is that the three tenses under a single aspect feature clear commonalities of use (as Larsen-Freeman and Celce-Murcia point out; Table 2). That is, once the rules for simple present were essentialized and then compared with those of simple past, it became clear that the "time-related rules" were common to both these tenses. The

implication, then, is that the need to “repeat” certain rules no longer becomes necessary, especially if viewed within the coherency of aspect. This will also become clear in our discussion of Step 5. Table 3, then, details the extraction of rules we conducted for the simple present.

Step 4: a semi-ontological discussion of occurrents

We first explain (1) event, an easier occurrent to understand, then move on to (2) process, followed by other relevant occurrents. The discussion is deemed “semi-ontological” because some occurrents are not entirely ontological in nature. An “occurrent” can be understood as “a thing existing in time.”

Event

In philosophy, there is no established definition of event or process (Baratella, 2020). In the daily practice of natural language, however, these terms are used in a coherent manner which suggests the existence of common definitions. Typical examples of events include *meeting*, *concert*, and *lunch*, and examples of process activities include *discussing*, *singing*, and *eating*. The YAMATO ontology is an upper ontology that supports such a common differentiation between event and process. In YAMATO, an event is defined as a unitary temporal entity spreading over an entire interval. It has explicit beginning and ending points. By unitary, we mean that a unifying condition combines each temporal part to make the whole a unity. This implies that an event is dealt with as a whole, much like a table, a unitary object. An event can be illustrated as in Fig. 1, that is, a unitary entity in the temporal space that has a clear pair of beginning and end time points.

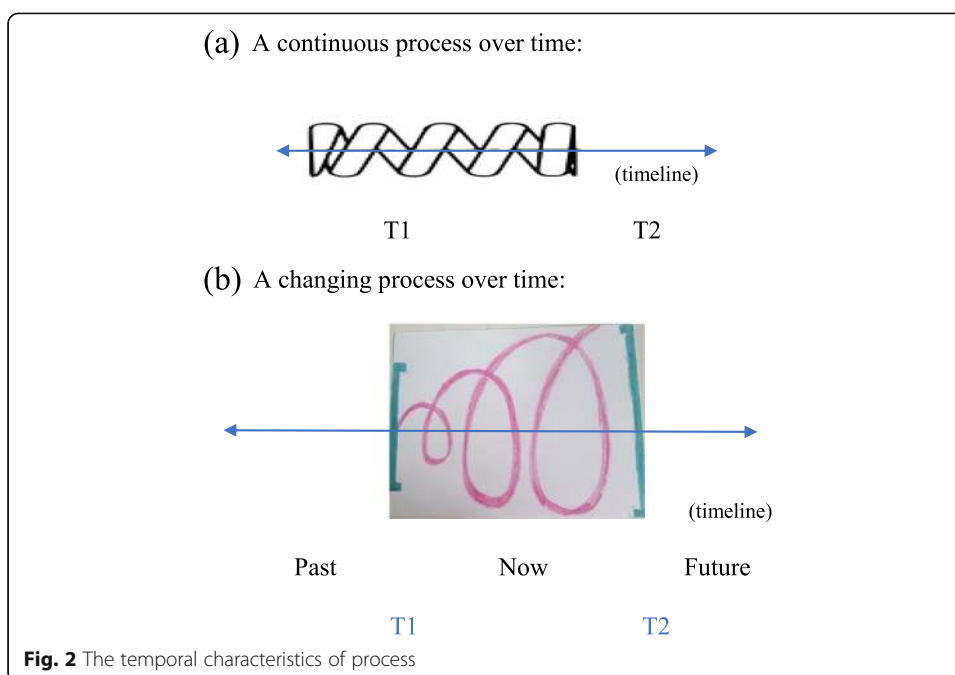
An event can take place slowly, quickly, or in an instant. It cannot be considered piecemeal: it is a whole, or indivisible. This said, it can sometimes be composed of sub-events: *Joachim gave a lecture (main) during which he explained X and answered questions (sub-events)*. Together, the sub-events form another whole event. Furthermore, even if T1 (time 1) and T2 (time 2) are not explicit, our understanding of the interval, at least, is clear. A good example is a “passing-by” event whose beginning and end points are vague in theory. However, the beginning and end points have certainly existed, and the “passing-by” event must have been completed. Consider: *A boat passed by the lighthouse*.

Process

In contrast to event, a process is defined as a non-unitary temporal entity existing at any time instance while activated. A process is ongoing, but when completed, it constitutes an event. Intuitively, a process is material of the constituted event, which can be understood through analogy: an event is made of a process like a vase is made of clay. Or imagine that you take a walk to the park and back. At any time during the walk (event), you are walking (process), while the occurrent corresponding to any partial



Fig. 1 The temporal characteristics of an event



interval is not the walk itself but a temporal part of the walk. A process thus has a strong association with the present time, informally referred to as “now,” which is either a point or period of time taking place between T1 and T2 (be they explicit or not). A unique characteristic of a process is that it can change over time, while an event cannot. Although we may say that *discussing*, *singing*, or *eating* are typical examples of processes, processes are not restricted to so-called activities: consider *increasing prices*. A process can thus be continuous (similar over time) or evolving (changing over time). To sum up, any ongoing occurring is a process, and can be illustrated on a timeline, namely in two ways, as in Fig. 2.

Floating occurrent

Any real happening takes place in time and is hence anchored in a particular portion of time. Considering that any happening requires a non-zero time interval, only three cases are possible: it happened in the past, it is happening now, or it will happen in the future. This is natural and does not seem problematic. However, if we consider the simple present tense, such as *I eat an apple*², a problem emerges. When does it happen in time? Although this suggests a happening, it does not belong to any of the above three cases. This is also found in an instruction such as *You crack an egg, add milk, then stir*. No specified action has any particular place in the temporal space before execution. We thus recognize a discrepancy between happenings expressed by the simple present tense and real happenings. Ontologically, real happenings are only events and processes.

Happenings suggested by sentences expressed by the simple present tense thus share a common characteristic in that they are not anchored in a particular time. Rather, they

²This example is intentionally provided; though it may seem grammatically correct, it is not.

are “floating” in the temporal space with a strong association with the present time (now). The notion of “floating” is not ontological. However, in the context of dealing with the temporal characteristics of verbs, it will play a significant role, as we will later see.

Now

The present time, which is the boundary between the past and the future, is called “now.” Therefore, “now” denotes the absolute time point which progresses ahead at any time. Along this line, we define a process as an ongoing occurrent. A typical example would be *I’m reading a book now*. We here note an implication: If the “now” is the absolute time point, then how do we explain the reading occurrent in *I was reading a book at 10 a.m. yesterday*. Is it a process? It is not happening “now.” The easiest way to cope with such a problem would be to extend the notion of “now” from *absolute* to *relative* by introducing the notion of role (Mizoguchi, Sunagawa, Kozaki, & Kitamura, 2007). This is not so unnatural because the time denoted by “now” is constantly evolving, that is, changing. Considering this fact, the introduction of role should be acceptable. The notion of “now” becomes a role played by a particular time instance in the context of a specified temporal perspective including the absolute “now,” that is, the time specified by the boundary between the past and the future. We call the “now” as a role a “shifted now.” Therefore, we can conclude that the reading occurrent in *I was reading a book at 10 a.m. yesterday* is a process which was ongoing at a “shifted now,” in the past.

Another extension of “now” is the enlargement of its duration. Ontologically speaking, “now” is an instance as stated above. However, in the daily use of natural language, the duration usually has a non-zero interval. Consider *we are enjoying a cup of tea* (now) or *she is studying at university* (now). In the first example, “now” might actually represent a half-hour, and in the second, a few years.

Step 5: organize the rules coherently and comprehensively

Allow us to open with a metaphor from everyday life. When a person stands in equilibrium on one leg, perhaps the most important factor to avoid losing balance is to focus one’s gaze on a steady point ahead. Once this equilibrium is secure, the position can gradually be modified to become more challenging. Similarly, there are a few fundamental rules that govern the English verb system. When students bear these in mind, they lay a foundation. Eventually, they can build upon this foundation, and integrate peripheral uses. In short, understanding and knowledge are gradually consolidated.

There has undoubtedly been a considerable amount of high-quality work by numerous researchers, teachers, and material authors in this regard. Our contribution to this important endeavour lies in our effort to make apparent and explicit some of the conceptualizations many professionals share of the English verb system, and link these to structures of happenings and time that can be identified by learners of all backgrounds. The universality of these structures is what makes them ontological in nature, and consequently language and culture independent. As we will see, they provide grounding for tense and aspect rules, while promoting some freedom from L1 influence and the lexical aspect of verbs.

Our process and findings led us to describe the English verb system within a theoretical framework. This framework was further used in advanced ESL classes; as such, we

occasionally address a few instructional considerations deemed relevant. We begin with a demonstration of our work using the present tense, which leads us to encompass the simple tenses. We continue with the progressive and perfect tenses. Our emphasis is on sharing the main insights we gained, as it would be beyond the scope of this article to describe all the work that was undertaken. Note that we do not discuss verb forms, reported speech, or conditional sentence patterns; the first essentially need to be learned, and the latter two become relatively straightforward when the tense–aspect system is clearly understood.

Simple present

Depending on the textbooks used, the following rules may be provided to explain the main uses of this tense, which we summarize through key terms. With respect to Table 2 above, note that (b), (c), and (d) are combined into one rule.

(a) Habits

Lucie plays golf every week.

(b) General truths

An apple a day keeps the doctor away..

(iii) Facts

Water boils at 100 degrees.

(iv) Long-lasting situations

Lions live in Africa.

The above examples, per Table 2, illustrate what Larsen-Freeman and Celce-Murcia (2015) identify as core meanings of the tense: “complete and unchanging nature, immediate factuality.” We also saw in Step 3 that these rules imply a shared understanding that while these actions take place over “now” (the present), they also occur in the past and the future. That is, they conceal the idea that *the time when the incident actually happens is not clearly specified*.

In a way, they can be said to be occurring at different times, over and again, even if some (such as (d)) are rather perceived as “continuing” along the time axis.³ Their iteration is also perceived as lasting over time until proven otherwise. In short, the time interval for the action (or possibly a state⁴) is not clearly grounded in a particular time. Speaker perception is that change is not expected (with tolerance for deviation). In fact,

³*Live* is an activity verb that is durative in meaning, and not as obviously “whole”. It may be helpful to consider it as an action made of sub-actions, such as *eat, breathe, sleep*.

⁴*A meter measures 100 cm.*

one rule becomes enough: the above examples illustrate a commonly shared perception of time, that is, a floating occurrent.

Adaptations of the following timeline are sometimes used to illustrate the main use of the simple present.⁵ The timeline also aptly represents floating occurrents (Fig. 3).

Such an occurrent is recognizable the world over, regardless of language or culture. It sails through time, including the present, without clearly staying or stopping on the time axis. While it is not, strictly speaking, ontological, this occurrent reflects an aspect of the nature of existence as we perceive it (semi-ontological).

To the above list, we can add more rules pertaining to the simple present: (Table 2)

(e) Instructions

To fry eggs, you first crack them...

(f) Narrative present

He sees her, and says...

(g) Newspaper headlines

Satellite Reaches the Moon.

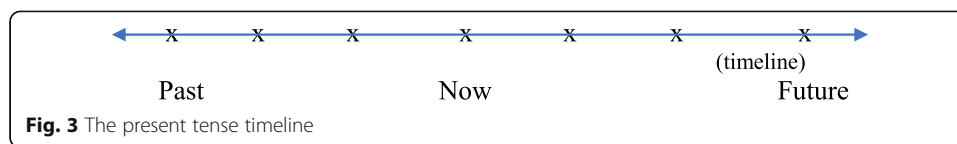
(h) Set schedules

The train leaves at 6 p.m.

These are also floating occurrents:

- (e) Instructions (recipes, directions) are neither specified in time nor expected to change, at least for some time.
- (f) English allows for the intentional turning of the past into present, which we identified in Step 3 (Table 3). This said, the content of a given story/summary is not (theoretically) expected to change. As such, it can be seen as a form of general truth expressed at various times.
- (g) This is also an intentional turning of the past into present (Table 3). We could also consider that current events are “true” and can be expressed in terms of yesterday, today, and tomorrow, though their time frame is usually recent and limited; the point of focus is usually the content, rather than when they take place.
- (h) Set schedules are decided ahead of time, and are predictable. They are “true” yesterday, today, and tomorrow.

⁵Among others: Azar (2002), Fuchs, Bonner, and Westheimer (2006).



Floating occurments, then, contribute to “defining” the simple present tense, with the above eight examples being illustrations of their different manifestations. Grounding the rules in floating occurments also eliminates the need to distinguish between time-related and time-unrelated rules, identified during Step 3. While textbooks may feature examples such as (a), (b), (c), and possibly (d) in relation to the timeline describing a floating occurrence, we have not seen any extend these to the eight we have listed. Textbooks do not give a particular name to this timeline (or temporal entity) either.

Instructional note. Floating occurments can also be illustrated using the symbol of infinity, which some students say is easier to remember (Fig. 4).⁶ The green bags can be used to represent (ontological) events. The reason is to convey the ideas of “indivisible whole” and “time interval” (through the width of the bag).⁷

Our students have little difficulty understanding what floating occurments entail. However, they do not relate as easily to its name. We therefore give it a different name in class: PURE (Perceived as Unending and Repeating [temporal] Entity).

Simple past

In contrast to a floating occurrence, a given action that has already been completed inevitably requires that the time of the occurrence (or its interval) be specified. This does not mean that a particular time is necessarily expressed within a sentence, but rather that the sentence would not quite make sense unless a time specification was at least implied. In English, the simple past is used for this purpose. It is linked to events we feel “are over and done with” (Larsen-Freeman and Celce-Murcia, 2015, p. 111). More specifically, an event can be single, or events can be multiple (sequence of different events, repetition of a similar-type event, or different events taking place at the same time). Following are examples of each:

- Kitty went to the library yesterday.* (single)
- He came, he saw, he conquered (Caesar).* (sequence)
- Isabelle picked apples when Eduardo came home.*⁸ (sequence)
- Marie applied three times before being accepted.* (repetition)
- Gaspare turned right and Lawrence turned left.* (same time)

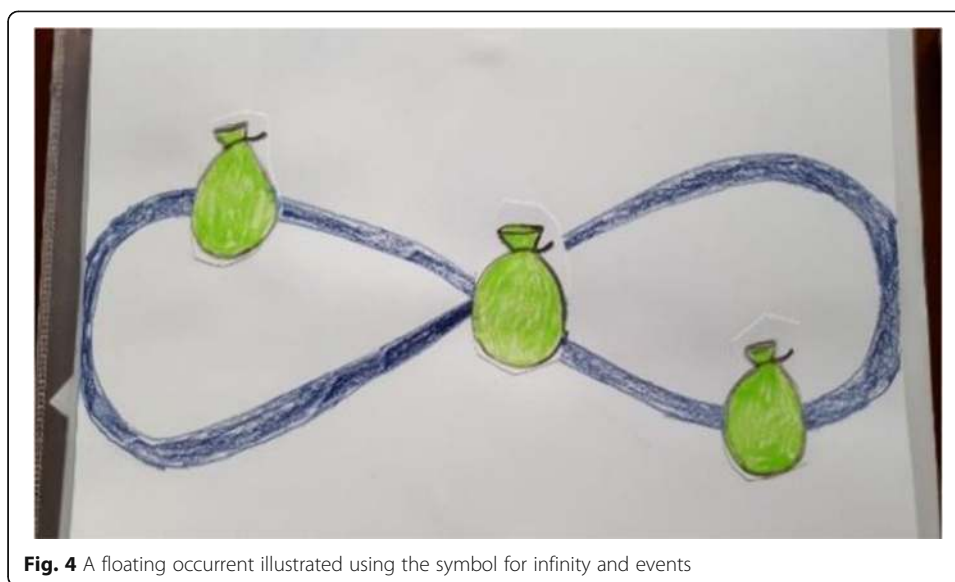
The above contain a reference to time in the past, even though it may only be implied (that is, clear in the minds of the interlocutors). Once again, time specification is a necessary condition for simple past use.

“Grammatical” events characteristic of simple past and ontological occurrence events (described in Step 4) within a past time frame share fundamental characteristics: a *whole* temporal entity taking place slowly or quickly, over a time interval, with implicit

⁶Using the infinity symbol came as a result of a class discussion and from a student (Tommy Dupuis).

⁷Note that the “x” on the present timeline (Fig. 4) could be replaced with green bags.

⁸The action in the *when* clause is considered, in English, to happen first.



or explicit beginning and end times. That is, the above grammatical rules pertaining to simple past can be grounded in the concept of ontological occurrent events. As such, we can then state that the simple past is used to express (ontological) events that took place in the past, be they single, multiple, or broken down into sub-events.

Instructional note. We explain the characteristics of ontological events to our students, which they recognize as being part of their common experience. While we do not use the word “ontological,” we further explain that the “definition” we provide in class is directly related to verb tense use understanding; as such, event characteristics are important to remember.

The simple past tense can also be used to restrict to the past all floating occurrents that have come to a stop and are no longer true in the present:

- (a) *Lucie played golf every week as a teenager.* (habit)
- (b) *People once believed that lightning never struck the same place twice.* (general truth)
- (c) *Dinosaurs roamed this land for centuries.* (fact)
- (d) *Native tribes lived all over North America.* (long-lasting situation)
- (e) *The school bus picked us up at 8 a.m. last year.* (past schedule)

In other words, the simple past is used in English for two main reasons: to describe past events, and to restrict previous floating occurrents to the past. Similar statements can be made of the simple future.

Simple future

The simple future in English is essentially used to predict future events (intentions, requests, commitments, expectations, guesses, plans), as well as habits, long-lasting situations, and states. That is, after careful analysis, future ontological events, floating occurrents and states that are restricted to a future time frame. For example:

<i>I will erase the board!</i>	(intention/event)
<i>Shall I meet you there tomorrow?</i>	(request/event)
<i>Aika is going to plant rose bushes on Saturday.</i>	(plan/event)
<i>Eric will play golf every weekend this summer.</i>	(habit/floating occurrent)
<i>Your donation will change lives.</i>	(long-lasting/floating occurrent)
<i>Cathy will own a Ferrari one day.</i>	(state/state)

The different modals (*will/be going to/shall*) express nuances within each of these temporal entities that are particular to the English language and that learners need to distinguish between. The nuances between the modals are not described here as these are a matter of form; our focus lies in the fundamental workings of the “tense.”⁹ While the simple present and progressive are also used to express futurity, these are particular uses of these tenses, as the following section indicates.

Simple tenses

It may now become apparent that fundamental rules governing the simple tenses reflect aspect. This has been exposed before.¹⁰ We contribute the idea that the simple present is primarily used to express floating occurrents, or—as renamed for students—PURE. When these are no longer true in the present and become restricted to past time or projected into the future, the simple past and future are used. In addition, single or multiple events (that are not PURE), are expressed in simple past and future, whether time of occurrence is stated or implied.

We can thus identify common denominators of the simple aspect: PURE and completed events. We have also demonstrated that several rules traditionally describing simple tense use are illustrations of these denominators. The number of rules can then be reduced, while reflecting ontological (universal) structures of time with which students can identify. The simple tenses become easier to encapsulate and remember.

Furthermore, the peripheral uses of tenses—largely exceptions to the fundamental rules of use—become easier to identify. Considering that we can include the intentional use of the present tense over the past tense for narrative uses (storytelling/newspaper headlines) in floating occurrents, the three “exceptions” in the uses of simple tenses are that the simple present is used in time clauses of future sentences (see Table 3, midway) as well as with certain expressions and performative verbs (rather than present progressive, as in *I promise*) (Table 3 [cases of exception]).¹¹ In other words, exceptions (RQ3, or Research Question 3) have two features: they are not clearly characteristic of aspect and don’t pertain to all time frames. We add that the above demonstration also begins to provide a positive answer to RQs 1 and 2: grounding tense rules in temporal entities contributes to highlighting shared conceptualizations while reducing the number of rules, and relations among the rules across time frames are uncovered.

We acknowledge that we have not discussed states in relation to the simple tenses. We do so after discussing progressive tenses.

⁹The future simple is not technically a tense.

¹⁰Among others: *The Grammar Book* (2015).

¹¹The present progressive is also used to express the future, in both main and time clauses.

Simple progressive tenses

The progressive tenses lend themselves well to the introduction of another fundamental ontological structure of time and happening—process—described in Step 4. Further note that a process can never be a floating occurrent.

When examining progressive tenses and their main rules of use, we make the following observations:

- Processes that happen “now” (whether a short or extended *now*) are expressed in the present progressive.
- Processes that are anchored in the past (not happening *now*; “shifted now,” or *now* becomes a *then*) are expressed in the past progressive.
- Processes that are predicted in the future (not happening *now*; “shifted now” or *now* becomes a *later*) are expressed in the future progressive.

Examples:

(short time process; continuous)

Sylvie is drinking a cup of tea. At 6 p.m. last/tomorrow night, Jack was/will be preparing dinner.

(longer time process; continuous)

Nathalie is studying in college.. Nathalie was/will be studying at university for three years.

(changing process)

Food is becoming expensive. Prices were/will be rising because of the war.

(simultaneous processes)

*Jade is/was/will be playing soccer **while** Cedrik is/was/will be building a treehouse.*

Let us point out that in English, the use of the past or future progressive either imply *a shared understanding of the past or future context*, or requires some contextual information. Otherwise, the default perspective is usually that of an event. For example, if the only information available is *Jack (prepare) dinner last night*, the commonly expected form would be *prepared*. In contrast, if interlocutors are wondering *What was Jack doing last night? He was preparing dinner*. Another way of viewing processes is to “zoom in” on an action, in the context of either a short period (e.g., *right now*) or an “extended now” (e.g., *this year*).

Much like the simple tenses, the progressive tenses can be understood with respect to aspect. Furthermore, grounding their rules in temporal entities highlights shared conceptualizations of the tense rules (RQ1) while showing the relations between them (RQ2). Given space restrictions, we do not delve into the exceptions to the rules (RQ3), but these do begin to stand out.¹²

Tense combination

Consider the following examples:

- a. *Isabelle was picking apples when Eduardo came home.*

¹⁰Among others: *The Grammar Book* (2015).

¹¹The present progressive is also used to express the future, in both main and time clauses.

- b. *While Isabelle was picking apples, Eduardo came home.*

Was picking: a process, unfolding between T1 and T2.

Came home: an event; whole.

One action is in progress and the other becomes completed during this time; they aren't related to each other. The two temporal entities can be contrasted with respect to aspect (progressive and simple), but they otherwise share the same time frame (past). Note that in (a), the time clause associated with the main clause in the past progressive reflects the "shifted now" during which the process is ongoing. In (b), the time clause provides a time implication/specification for the event.

This is a tense combination that initially proves confusing to ESL learners. It is sometimes explained in light of additional "rules" of use. For example, an action in the simple past "interrupts" the "background" action described in the progressive. Once students gain a good grasp of the ontological structures underlying these tenses and aspects, additional "combination rules" are not necessary, though they can be useful reformulations. This is because students can make this assessment themselves.

To summarize, the simple progressive tenses are used to describe processes. There are a few other uses to progressive tenses, which represent exceptions to this fundamental rule of aspect.

States

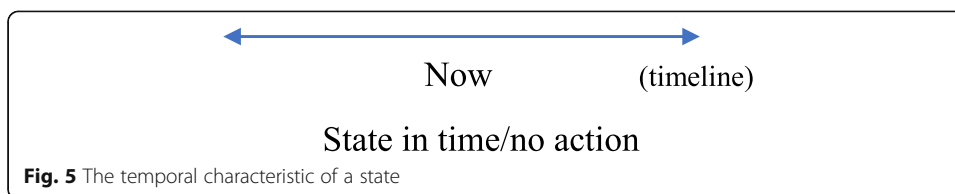
Let us now address states, beginning with an ontological description.¹³ A state refers to a non-action that could, possibly, change over time. It is considered stable (until and if a change occurs), and anchored in an extended "now." T1 and T2 are usually vague, though they may exist. A verb expressing a state is necessarily a *non-action* verb. The idea of state, or extended "now," can shift into the past or the future. Figure 5 shows that a state does not abide by a clear beginning and end point, and that its illustration is not altogether telling.

In English, states are generally expressed through simple tenses. They are conveyed through stative verbs, or verbs used with a stative meaning. The use of these verbs appears to be expanding towards greater use with progressive tenses.¹⁴ Certain effects can then be achieved (Larsen-Freeman & Celce-Murcia, 2015), especially when speaking. For example, to intensify emotions, one might say: *I am hating this!* Conjugating state-representing verbs in non-progressive tenses nonetheless helps students avoid making mistakes, namely in writing. In addition, as students become more proficient in verb tense use, they can purposely achieve such effects.

The distinction between what is action and non-action can often be confusing. One reason is that the perception of non-action can vary from one language and culture to

¹³A state, in ontological research, is a delicate issue. We present some of its essential components, for the purposes of language learning.

¹⁴For instance, a section explaining stative verbs and their use in relation to simple tenses, found in Azar's third edition of *Understanding and Using English Grammar*, has been significantly reduced in the fourth edition. Another example is that natives of India appear to regularly use the progressive with English stative verbs.



another (thus resulting in L1 influence). For example, students in our advanced levels sometimes say: *I'm needing, I'm wanting*, because—as they explain—they perceive these as short-term processes.

English stative verbs, then, are in some instances language specific. This particular lexical aspect tends to create hurdles for ESL learners, which likely explains why various textbooks introduce stative verbs in conjunction with the present tenses. We place the use of states, in our framework, under the non-progressive aspects. In other words, the “default” for a state in English is a non-progressive tense (simple or perfect). This is because it is helpful to work with a “solid enough” general rule that prevents students from making unnecessary mistakes. As fluency increases, some “rules” can eventually be broken, with awareness. We nevertheless include progressive uses of stative-meaning verbs in spoken language in our framework under particular cases.¹⁵

Additional considerations

It is worth noting that ontological structures are in fact much more sophisticated than how they have been described in previous sections, having other essential features in addition to time. Time is emphasized in these descriptions because tense and aspect are intrinsically related to it. Vendler's (1967) verb categories—activity, accomplishment, achievement, and state—themselves relate to deeper philosophical concepts. These include, among others, ideas related to the presence or absence of an object, to conditions, or to intentions. Vendler explains that the time element underlying these concepts is nevertheless important enough to be discussed separately, and related to what he has also termed the “time schemata” presupposed by various verbs.

Collins (2004) supports the hypothesis that the “influence of lexical aspect on the acquisition of grammatical morphology is a language learning universal” (p. 251). This helps clarify why addressing the issue when teaching the English verb system should prove helpful (Cowan, 2008). We have not explicitly included lexical aspects in our framework, because they are reflected in the ontological structures we present. Processes, as described in Galton and Mizoguchi (2009, p. 74), “correspond to Vendler's activities, while events correspond to his achievements and accomplishments.”

Let us recall that processes are intrinsically “ongoing,” but events are by nature “completed.” Any process also constitutes a (unique) event: Mary (an “object”) participates in a walking process as well as the walk event that is constituted by that walking process. This is reminiscent of Vendler's description of accomplishments, in which a durative activity culminates in a well-defined

¹⁵See Overview Charts at <https://sites.google.com/view/dr-mosaik/>

endpoint (*They built a house*). Galton and Mizoguchi (2009) further state that “some events occur over intervals and others at instants” (p. 85); achievements, which reflect a change of state with an endpoint, may then be perceived as an instantaneous event (*He won the tournament*).

Larsen-Freeman and Celce-Murcia (2015) provide several examples as to how the lexical aspects of verbs interact with the different tenses/aspects. With the exception of stative-meaning verbs that do not follow the same rules as action verbs, we have noticed that the grounding of tense rules in ontological structures of happening and time allows learners to implicitly consider the lexical aspects of verbs. The authors explain for instance that activity verbs are durative and describe an ongoing action; as such, these readily take the progressive. An example is provided: *Meg is washing the window* (p. 118). Their point is valid. We could also consider that if the action takes place in a present time frame and that learners need to decide on the appropriate tense in *Meg (wash) the window*, they are likely to infer that the action is a process taking place “now.” Knowing that the present progressive is used to describe present time processes, the tense choice must be *is washing*. A similar assessment in a present time frame would also be made with an accomplishment verb, as in *The contractors are building [to build] the new civic center* (p. 118), or an achievement verb: *He is nodding [to nod] his head in agreement* (p. 118). With respect to the two preceding examples, the authors point out that the understanding of what takes place in using the progressive is nuanced by the type of lexical verbs: *are building* “focuses on process leading to a particular end,” (p. 118), and *nodding* “gives the meaning of iteration” (p. 128). As was explained, processes are occurrents that exist at any time instance during a given interval (stated or not); they are ongoing or evolving (Fig. 2). With this understanding, learners can infer that a “building process” is likely to lead to an end, and that a “nodding process” must be repetitive. In other words, the understanding of process in conjunction with the meaning (definition) of the verb allows them to take into account the lexical aspect of verbs, even though they may not be consciously aware of lexical aspects per se. This further links to the notion that, being ontological in nature, occurrents are language and culture independent. In other words, language learners may express processes differently in their respective native languages, but they can relate to what they represent.

With respect to the idea that learners tend to delay the use of activity verbs with the simple past (literature review), we have also found that reinforcing the idea that past processes seldom stand on their own is helpful. In the absence of contextual information, or accompanying events ([Tense combination](#) section), the default perspective in English for *Yesterday, Meg (wash) the window* is usually an event (not *was washing*, but *washed*). This to say, ontological structures not only contribute to grounding the functioning of the English verb tense system, they also enable learners to compose with the lexical aspect of verbs and begin to overcome one of the potential hurdles to verb tense acquisition.

Present perfect

Using the present perfect can be challenging for ESL learners. One main difficulty lies in distinguishing the differences between present perfect and simple past. What

students need to understand—which experience has confirmed—is that the present perfect has two distinct categories of use, themselves reflected in different ontological structures. Let us elaborate.

The first use is to describe past events (completed actions, single or repeated) and states that have taken place at a *non-specific time* in the past:

I have eaten lunch.

I have seen an eagle before.

The simple past, in contrast, is necessarily *anchored at a specific time*, whether overtly stated or not:

I ate lunch (around noon).

I saw an eagle last week.

Another way of explaining this use of the present perfect is to highlight that, irrespective of time—or in direct relation to now—the occurrence itself is what matters. We call this use present perfect 1 (PP1), or the “perfect use.” That is, it often expresses “perfect” actions, which means “completed, finished” actions (deriving from the Latin term *perfectus*).

Subcategories of PP1 can be identified:

1. Completion at a non-specific time in the past

They have painted the wall purple.

This category also includes events that affect one in some way; that is, “experiences” connected to emotions and/or a memory of actions in relation to one’s life history).

They may be expressed with ever/never: *Have you ever painted a wall purple?*

2. Recent completion, or just before now¹⁶

Yves has just started a new job.

The second use of the present perfect is to describe *states* and *open-ended events that began in the past and continue to the present*. We call this PP2, or “continuing present” use. An open-ended event, ontologically, has a clear beginning, but an unclear

¹⁶Increasingly, especially when speaking, the simple past is also used for this purpose: *Tim just started a new job*. We point this out to students, but recommend that they default to present perfect, which is generally preferable in writing.

end (it continues into the future). In other words, it started at T1, but T2 is *open*, and undefined. Figure 6 represents an open-ended event on a timeline.

There are thus two subcategories to PP2:

1. State: *This possibility has existed since 2010.* (it still exists, and will continue existing)
2. Open-ended event: *Ikuo has worked here for 10 years* (and still works here).

Note that an open-ended event could also turn into a process: *Ikuo is working here.* In contrast, the simple past is used for *completed*, whole events:

Ikuo worked here for 20 years (and no longer works here).

Technology has changed (and is still changing) *since you started working here.* (completed event)

The default perspective for PP2 in English is that states and open-ended events continue into the future. Should they stop “now,” or soon before, additional information to this effect is provided. For example: *Irma has feared spiders most of her life, but she can somehow tolerate them now.* *The soup has simmered for 2 h. It is ready, let’s eat!* Such cases are less frequent.

Open-ended events can also imply a series of similar-type events that began at a particular time in the past, but will continue in the future. For example:

The team has played two games this season (and will play more).

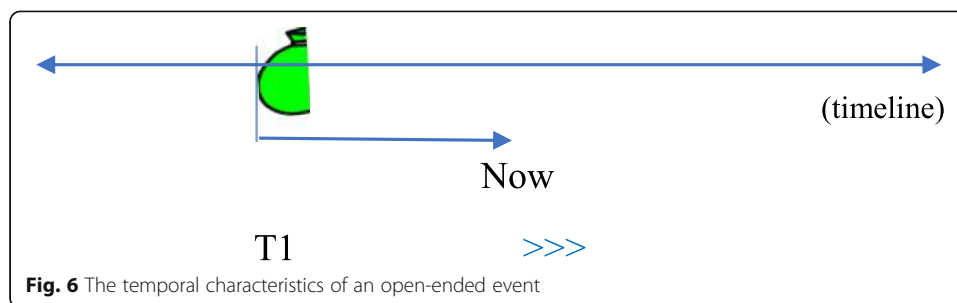
Instructional note. Once students gain a clear grasp of the two distinct uses of present perfect and of time unspecific/specific related properties (PP1/simple past), they are able to contrast present perfect with simple past (provided they understand simple past use). There is little need for additional explanations of contrast.

Past and future perfect

Upon close analysis, we realized that both past perfect (Fig. 7) and future perfect (Fig. 8) could be seen to derive from PP1 (perfect use). As previously mentioned, PP1 is used to describe past events or states completed at a non-specific time in the past, that is, in relation to now. Let us illustrate.

When PP1’s “now” is moved back on a timeline (a new “now” is thus introduced) and becomes either (a) a time limit/specification in the past or (b) another event in the past, PP1 then becomes a past event (or state) taking place prior to (a) or (b): it becomes a past perfect (Fig. 7). A reference point to which the past perfect relates, *marking a different time in the past*,¹⁷ also becomes apparent. This reference point can also be viewed as a “shifted now.”

The present perfect is thus related to now, and the past perfect is more closely related to a time limit/specification or another event in the past, itself related to now.



In the same way, the future perfect also derives from PP1 (Fig. 8): it expresses a state or event that takes place before another time limit/specification or event in the future.

Correlations across the time frames in the perfect aspect thus become noticeable. PP1 is related to now, and the past and future perfect tenses deriving from PP1 relate to a reference point (PP1's previous "now" or "shifted now"). Furthermore, all actions expressed in the perfect aspect describe "perfect" actions (= events).

We summarize the uses of the perfect tenses when summarizing those of the perfect progressive tenses.

Instructional note. We focus on the idea that the perfect tenses take place "before/prior to" (which we are not the first to do) and emphasize *perfect* (completed) actions (with the exception of PP2). Thus, the past perfect is used for an event or state that takes place *before a reference point*, which is another event or a past time. Similarly, the future perfect needs a reference point, also another event or future time. As a result, our students have come to call the past perfect tense the "before before (now)" tense and the future perfect tenses the "before then" tense. This appears to help them, namely during practice exercises calling for noticing and attention. As for PP1, students commonly understand it as taking place at an *unspecific* time in the past (before "now").

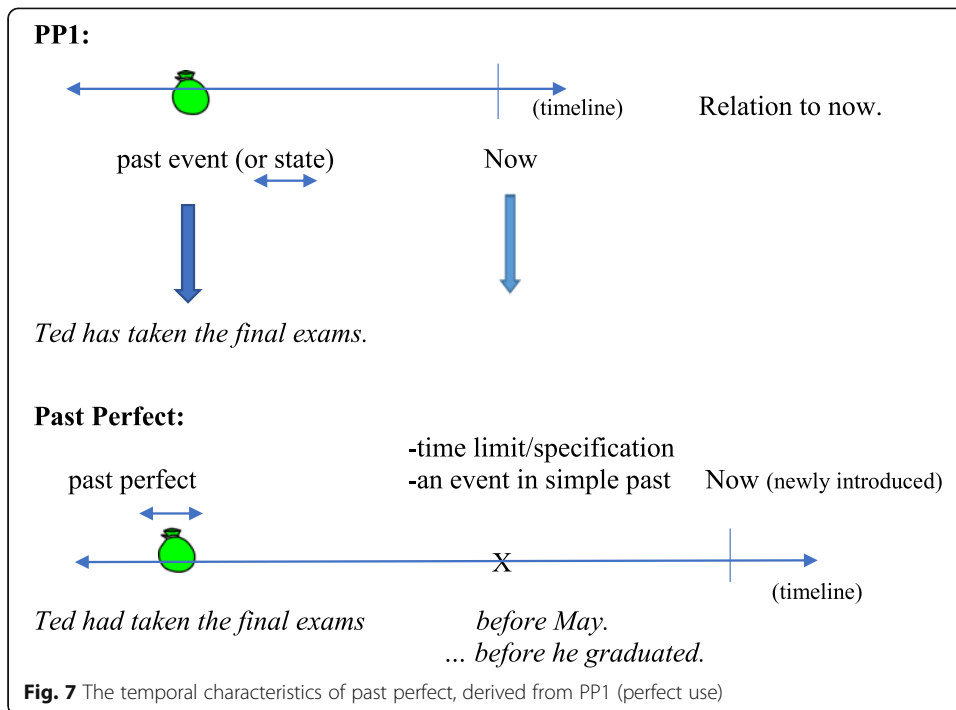
Perfect progressive tenses

Interestingly, correlations can be seen across the perfect progressive time frames as well. We noticed that these tenses are reminiscent of PP2 (present use): an action that started in the past and continues up to the present. The difference, however, is that the action in perfect progressive relates to the idea of process rather than that of event. Let us recall that a process is a continuous or evolving temporal entity existing at any time instance while activated, whereas an event is considered as unitary (whole).

A typical example of present perfect progressive might be: *I have been reading a book*. The implication is that the action is in progress, but not yet completed. This, then, is what we identify as an open-ended process. Figure 9 below shows that T1 for an open-ended process is clear, whether stated or implied, but T2 is *open* and undefined.

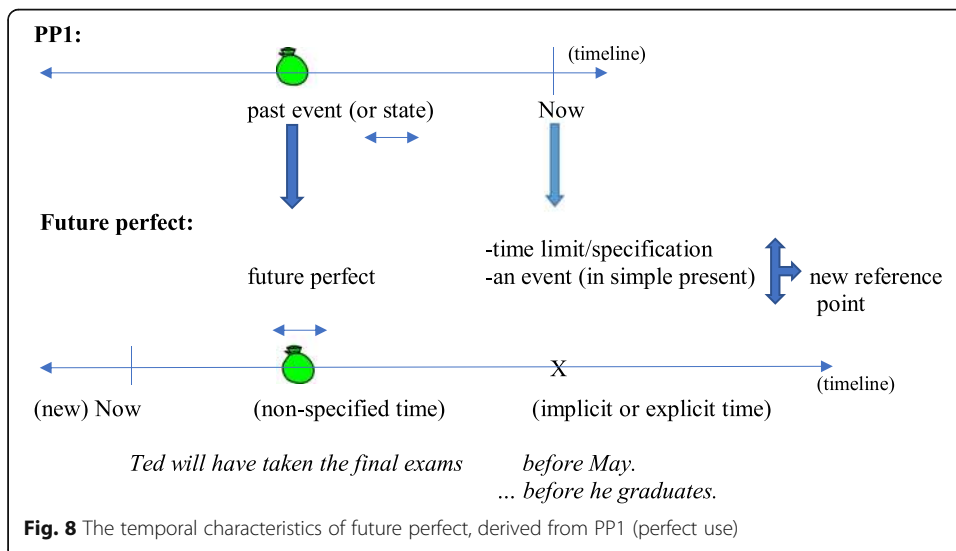
Open-ended processes are far more common in present perfect progressive than are processes, because the latter, which may appear to come to an end, usually result from an intentional or artificial stop to an action otherwise in progress. Consider:

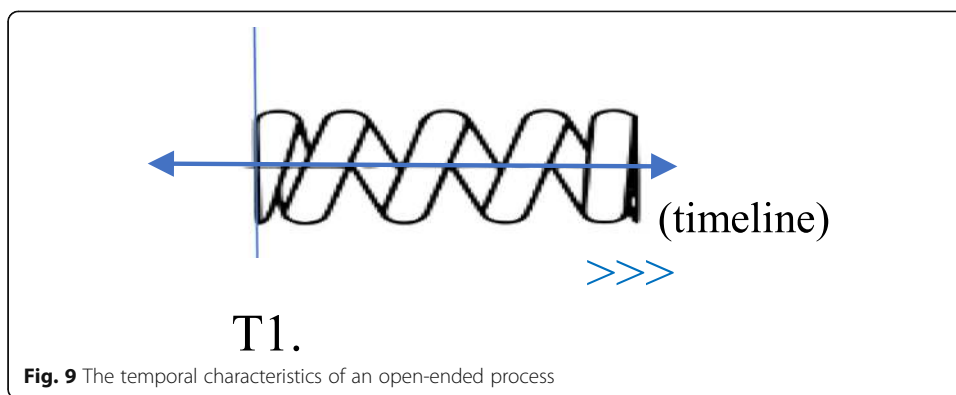
¹⁷These two events are not in sequence to one another: they are perceived to take place at different times in the past.



I have been running, that's why I look hot. (process) (decision to pause/stop)
Nancy has been training for years. (open-ended process) (she will continue to train)

We know that PP2 (present use) describes an action that started in the past and continues up to the present. Now the choice of using present perfect simple or progressive is often a matter of perspective and/or emphasis: to describe an open-ended event in contrast to an open-ended process. A comparative example can be found in the following (Fig. 10).



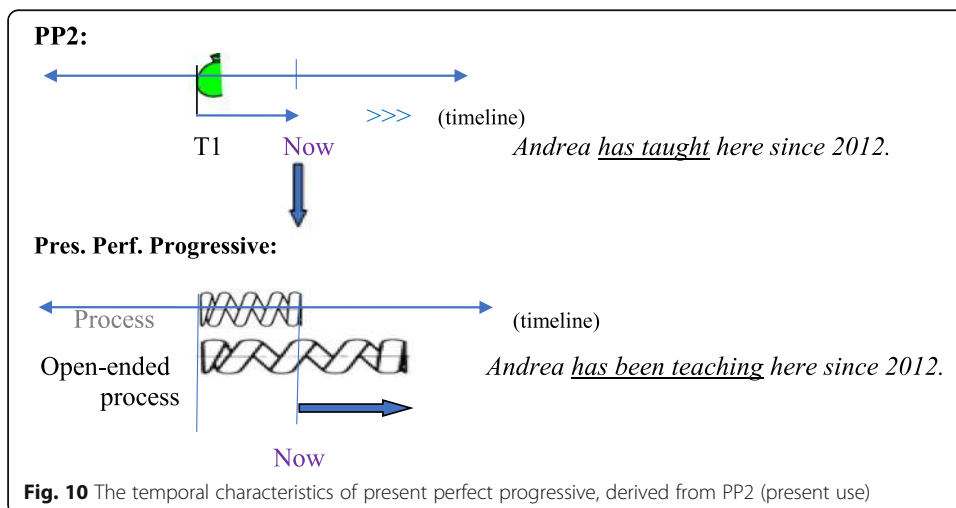


There are nevertheless times when a choice between present perfect simple and present perfect progressive makes a difference in meaning. This is when the present perfect is not used in PP2 fashion, but rather in PP1, namely because of the lexical aspects of verbs.

- a. *Louis has decorated the wedding cake.* (accomplishment verb; completed event) (PP1)
- b. *Louis has been decorating the cake all morning.* (activity verb; open-ended process) (PP2)

These examples further reflect how the difference between events and processes mirrors the differences in the lexical aspects of verbs.

The past and future perfect progressive, as one might begin to surmise, are then mainly used to express open-ended processes that take place before a time limit or another event. This other event is respectively expressed in simple past or simple present. Furthermore, much as with perfect tenses, if the “now” of PP2 moves backward or forward on the timeline and transforms into a time limit/specification or an event (“shifted



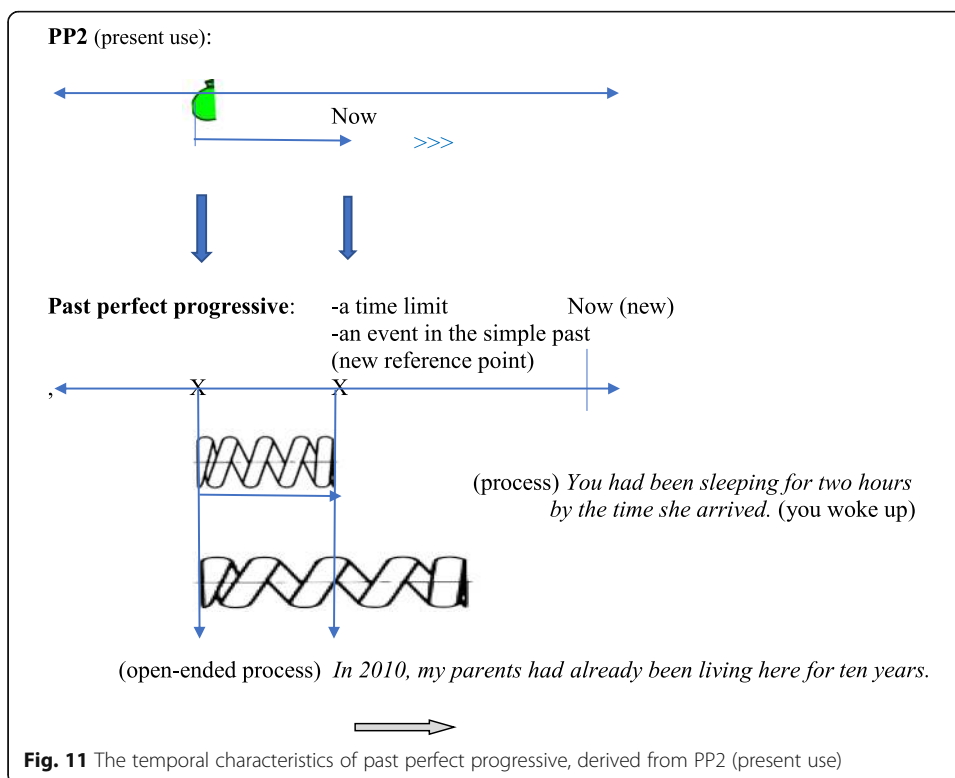
now”), and a “new now” is introduced, we find ourselves with a representation of the past and the future perfect progressive. Our last figure (Fig. 11), using the past perfect progressive tense, illustrates what happens.

Instructional note. We proceed much in the same way with explanations concerning the perfect progressive tenses as we did with the perfect ones: we explain the need for a reference point in the past and in the future; in the present, allusion is often made to a period or start time (*for/since*). Here too, the students relate to these tenses as “before before,” but with a focus on (open-ended) process, rather than (open-ended) event.

To summarize, the perfect tenses, simple and progressive, are used in relation to now. The present perfect tense has two distinct categories of use:

- PP1 (perfect use): to express past events at a non-specific time in the past;
- PP2 (continuing use): to express states or open-ended events that begin in the past and continue to the present.

The past and future perfect derive from PP1 and express a state or event completed *before* another time or event in the past or the future. The present, past, and future perfect progressive are reminiscent of PP2. The present progressive expresses open-ended processes that began before the moment of speaking; the past and future progressive express these *before* another time or event in the past or future. Note that while PP2 and the perfect progressive tenses may express events or processes that have come to an end, this is primarily the result of an artificial stop; as such, the fundamental meaning of these tenses focuses on “open-ended” entities.



In light of our findings, and in answer to RQ4, which was whether an understanding of the four aspects could be promoted, as well as RQ5, which focused on a comprehensive model of the system, we developed a theoretical framework in chart form: each aspect is presented in relation to its three time frames, highlighting fundamental rules of use in addition to exceptions to these rules (RQ3). This ultimately results in a comprehensive approach to the English tense-aspect system that also shows how inherently coherent this system is. Due to space limitations, we cannot present the charts for each aspect in this paper, but these can be consulted online at Allard and Mizoguchi (2020a) (<https://sites.google.com/view/dr-mosaik/>).

In advanced-level textbooks, it is not unusual to find between 40 and 50 rules of tense use, including peripheral uses. Some *synoptic* tables can even include as many as 30. This said, not all advanced textbooks fully enter into the peripheral uses and exceptions to the main rules. We have essentially managed to reduce the total number by approximately half. More importantly, there are far fewer fundamental rules of use in comparison to several of the textbooks we have examined: we have reduced them to *eight* (Step 6). Comparing numbers is not a straightforward affair, considering that our framework emphasizes an understanding of aspect with respect to time frames, which is not the case in various materials.¹⁸ This said, we can claim that if students understand and remember the eight fundamental “rules” of use we have circumscribed and understand how these apply across the time frames, they have essentially understood the main workings of the English verb system. Preliminary experimentation in class with the Dr. Mosaik framework has confirmed this (Step 7, section on [Notes on classroom experimentation](#)).

Step 6: provide a system overview taking ontologically rooted structures into account

Analysis of the system using OE allowed us to extract a limited number of main principles explaining how it works, which we state in eight overarching rules that reflect the nature of ontological entities such as event, process, and “floating occurrent” (or PURE). This results in the most succinct explanations of the entire system that we know. We acknowledge that our rules may contain more than one element of knowledge. For the sake of coherence within aspect considerations, we did this purposefully. Moreover, the fact remains that several main rules of use for different tenses as they are currently presented in textbooks may well present more than one element of knowledge (see Table 2). Finally, our eight rules are grounded in Celce-Murcia and Larsen-Freeman’s tense-aspect chart (Celce-Murcia & Larsen-Freeman, 1999; Larsen-Freeman & Celce-Murcia, 2015).

Eight main rules

1. The rules must be considered in light of the different aspects.

Simple aspect:

¹⁸The *Grammar Dimensions* series, edited by Diane Larsen-Freeman, presents fewer rules than other series. It also places strong emphasis on understanding aspect as well as commonalities across time frames.

2. The main reason for using the *simple* present in English is to express floating occurments (called PURE [Perceived as Unending and Repeating (temporal) Entity] for students). It is also used to express states that are currently true.
3. When PURE and states become strictly restricted to the past or the future, they are respectively expressed in the *simple* past or future. The *simple* past and future are otherwise used to describe events (anchored in time).

Progressive aspect:

4. The progressive tenses are all used to express processes:
 - The present progressive is used for processes that happen “now.”
 - The past progressive is used for processes that happen in the past (shifted “now”).
 - The future progressive is used for processes happen in the future (shifted “now”).

Perfect aspects:

The perfect tenses derive from the two categories of use of the present perfect.

5. Present perfect 1 (PP1), which refers to *completion*, is used to express states and past events at an indefinite time in the past (*before now*).
6. Present perfect 2 (PP2), which refers to *continuation*, is used to express states or open-ended events that begin in the past and continue up to the present (and beyond now, unless otherwise stated).
7. The past and future perfect (deriving from PP1) express a state or event completed before another time or event in the past or the future (before *before now*/before *then*).
8. The perfect progressive tenses (deriving from PP2) express open-ended processes (unless otherwise stated):
 - In present progressive, they start before the time of speaking.
 - In past and future progressive, they start before another time or event in the past or future (before *before now*/before *then*).

We believe that the above eight rules demonstrate that the analysis of the English verb tense–aspect system through OE methodology results in a comprehensive model of the entire system, in which fundamental concepts stand out (RQ5).

Step 7: develop instructional strategies and evaluate through the practice of instruction

An overview of instructional strategies

We mainly work with students enrolled in advanced ESL classes. This level offers them an opportunity to engage in a final review of the verb tense-aspect system while being exposed to more particular verb tense cases. Often times, this is the last ESL class students take. Subsequently, they enroll in curriculum classes that are entirely held in English or possibly become involved in self-study, namely because they enter the workforce. For these reasons, we strive to ensure that they leave the advanced ESL class

with a solid comprehension of the tense-aspect system so that they will be proficient in English verb tense use.

We first proceed with a review of the simple present and present progressive tenses, which are two tenses that ESL students initially tend to confuse. More specifically, students are asked to prepare an exercise that features examples of use of nearly all the possible cases. A good example of such an exercise can be found in the diagnostic test section of the Foley and Hall (2003) grammar textbook. Furthermore, students are asked not only to provide answers but also to justify them, that is, to state what rules of use explain the choices they have made. In so doing, they are invited to consult reference material on tense and aspect if needed and to which they have access. The exercise is corrected as a group and students are provided with feedback. It is also an opportunity for in-depth review of these two tenses.

Students are then asked if they can illustrate the main uses of the simple present and of the present progressive using timelines. This not only promotes reflection, it cuts across language and paves the way to the introduction of PURE and process (Figs. 2 and 3). It also allows the instructor to demonstrate how these two temporal entities mirror a number of the rules that have just been reviewed (Simple present and Simple progressive tense sections). Differences between English stative and action verbs are concurrently highlighted. Students are also taught to distinguish between main clauses and time clauses, the reason being that they can thus call upon other useful shortcuts to guide some of their tense choices, which are detailed in Allard and Mizoguchi (2020).

Distinctions between the simple past and the past progressive are reviewed next. These two tenses are also commonly confused. Once again, students are asked to prepare an exercise featuring most of the possible cases and justify their answers. They can either provide the rules of use that they remember, quote those found in reference materials, or illustrate the use of the tense with a timeline (e.g., Azar, 2002), and they are welcome to use temporal entities, either by name or with the help of a figure. The review of these two past tenses consequently allows the instructor to introduce events, as well as highlight commonalities across aspect (Simple past and Simple progressive tense sections). At this stage, a number of students have already inferred that the present and past progressive tenses are both used to illustrate processes.

Throughout the class, students are encouraged to pay attention to the reasons a given tense is used as they work on different skills: reading, listening, speaking, or writing. As Collins (2009) and Cowan (2008) point out, activities that require students to pay attention to the context in which verb tenses are used and that allow them to voice hypotheses about usage while receiving feedback indeed appear to be beneficial.

Much in the same way, other tenses and rules of use are gradually reviewed, with a focus on tense combinations that create confusion (simple past/present perfect; simple past/past perfect; etc.). Explanations are provided according to the information found in published textbooks, but also using temporal entities and by highlighting commonalities within aspect. As the class progresses, verb tense practice exercises (in addition to other skill-based activities) require students to pay attention to an increasing number of tenses, until all twelve tenses become regularly mixed (examples of such activities can be found in Hartmann, Zarian, and Esparza (1998)).

We acknowledge that class time available for grammar explanations and practice is often limited (Ellis, 2006) and that asking students to consistently justify their choices requires time. However, this time is essentially dedicated to the process of understanding the tense-aspect system, which Larsen-Freeman and Celce-Murcia (2015) have deemed to be “exceedingly important” (p. 109). Furthermore, experience shows that students begin to develop self-correcting skills along with a degree of automaticity when choosing tenses; in other words, their “informed” reflexes sharpen. This to say that the time invested to thoroughly understand the system seems to cut down on later instruction and learning time.

These instructional practices are also reminiscent of corrective feedback practices. While there are diverging pedagogical positions with regard to this topic, Nassaji and Kartchava (2017) suggest that from a cognitive perspective on learning—to which we adhere given our involvement with university learners—corrective feedback becomes essential because it has a direct influence on the mental representation students have of a second language. As Yilmaz (2011) also explains, learning is (1) “an active process ‘involving the acquisition or reorganization of the cognitive structures through which humans process and store information’ (Good and Brophy, 1990, p. 187) and (2) the learner (is) an active participant in the process of knowledge acquisition and integration” (p. 205). Furthermore, effective language learning takes place as a result of noticing and attention (Ellis, 2006). Though many questions remain unanswered with respect to the timing and manner of providing corrective feedback, considerable research suggests that L2 learners, particularly adults, “cannot develop native-like accuracy based on mere exposure to models of grammatical input and that they need corrective feedback in order to acquire an L2 successfully” (Nassaji & Kartchava, 2017, p. xii).

One of the reason why most of our students adopt the Dr. Mosaik framework is that not only is it easier to remember in comparison to a long set of rules, but it is presented in gradual stages. In addition, students can always rely on the rules found in published reference material if they prefer. Finally, students are asked to take their own notes on the framework to promote their understanding. In other words, they have not been given the charts presented in the website accompanying this article (Allard and Mizoguchi, 2020a). All the same, the charts do reflect how the framework looks in student notes by the time they finish the class.

Notes on classroom experimentation

We have been collecting data with regard to student progress over three years, comparing teaching with and without the Dr. Mosaik framework, in 5-week academic ESL immersion programs for adults at a Canadian university. We chose to conduct experimentation in this type of program for two main reasons: it allows sufficient time for a thorough review of the twelve English tenses and students have many opportunities to practise and consolidate learning. It is beyond the scope of this paper to proceed to a detailed analysis, but we find it relevant to provide preliminary results, which suggest that the use of Dr. Mosaik is both successful and efficient.

Participants came from various institutions to take part in an intensive in-person spring/summer program. Approximately, a third were either born in Canada or had

completed high school in this country; age varied between 18 and 24. Others had immigrated as adults, with most between the ages of 25 and 30 (a few over 30). Approximately two thirds of the learners were women, except in the second treatment group, where they accounted for just over half. English backgrounds varied, as did native languages. The common denominator is that all learners scored 80% or more on the university's language placement test.

On the first and last days of classes, they took the same pre- and posttest concerning the appropriate use of the twelve tenses within a set text (cloze-type exercise; 36 choices). Group 1 (control) was not exposed to our framework and underwent 89 h of classroom instruction. Groups 2 and 3 (Dr. Mosaik approach) received 72 h of instruction (an unexpected program constraint). All students had the same course material, with verb tense explanations and exercises taken from Azar (2002), Englishpage.com (2021), Foley and Hall (2003), and Hartmann, Zarian and Esparza (1998). The first two publications are commonly used in the institution where the program is given, the third is a long-standing and easily accessible website with explanations, practice exercises and answer keys, and the fourth presents challenging mixed verb text-level exercises that allow for in-depth review. Learners could also refer to summary PowerPoint presentations reviewing the tense rules.¹⁹

In Group 1, instruction on the tense–aspect system aligned with the pedagogical materials at hand. In Groups 2 and 3, the framework was gradually presented to learners as an *optional* alternative to the rules found in their materials. Throughout the program, all students were also invited to provide a rationale for verb tense choices when doing grammar exercises, whether in words or using visuals (timeline/temporal entity). In oral activities and written compositions, they consistently received corrective feedback with respect to verb tense choices. Mandatory weekly tests included a section on verb tenses.

Paired sample statistical testing highlighted a difference between the pre- and posttest results in all three groups (p value < 0.05). The increase in means between both tests was 10% for Group 1, 20% for Group 2, and 26% for Group 3. ANOVA testing in between groups provided an f value of 9.93. Using an α of 0.05, $f_{0.05; 2.45} = 3.20$. There is thus a statistically significant difference among the group means, confirmed by a p value for $9.93 \approx 0.00$. Multiple comparisons using a Scheffe test further showed significant differences between the contrast group and the treatment group means ($p < 0.05$) while highlighting that there was no significant difference ($p > 0.05$) between the two treatment groups. Effect sizes for the treatment groups were respectively 0.88 and 1.16, suggesting that the difference resulting from the use of the Dr. Mosaik framework is significant. In short, student scores in pre- and posttests show improvement in all cases. Following are the statistical results in table form (Table 4).

Note that the second treatment group was smaller than the others because fewer learners were admitted into the advanced-level class, and three students left the program midway for personal reasons.

We see that though the posttest scores in treatment groups are not remarkably better than those of the control group, their learning gains are significantly better than in the

¹⁹These were designed by two ESL professors; they have been used in four institutions for over 10 years and are based on materials such as those found in Additional file 1.

Table 4 Pre- and posttest results and related statistical data

	Range	Mean	Standard deviation	Mean difference	t	P	η^2	Effect size
Traditional rules (control group) n = 17 (17 students)								
Pretest	45% to 97%	77%	15.25	10%	- 4.98	.000	0.61	
Posttest	53% to 100%	87%	12.55					
Dr. Mosaik 1 n = 20								
Pretest	56% to 100%	66%	8.46	20%	- 9.21	.000	0.82	0.88
Posttest	67% to 97%	86%	8.46					
Dr. Mosaik 2 n = 11								
Pretest	56% to 86%	64%	16.7	26%	- 8.94	.000	0.89	1.16
Posttest	72% to 100%	90%	8.5					

control group. What was impressive was the time efficiency factor. The two Dr. Mosaik groups received 15 h less of program instruction time. It also became clear that within a similar amount of time, more text-level tense practice could be covered in class, and weekly test difficulty could be raised because students progressed more rapidly.

Among the comments concerning verb-tense review in class evaluations and questionnaires, several treatment group students reported a sense of satisfaction: "This class was a valuable investment of my time." "I feel I have become my own teacher; I can self-correct." "I understand subtle text nuances I had never grasped before." "I don't think I need another English class for the time being; I just need to keep paying attention." In comparison, a number of contrast group students reported satisfaction, but at the price of a notable toll on time and memory in working towards mastering the tenses (= hard work). Several also reported a need for additional practice in the future. Four learners (all groups) expressed a lack of interest in understanding the grammatical workings of tenses; regular exposure to English should be enough. Upon seeing a 33% improvement between his pre- and posttest results, one such (treatment group) learner nevertheless exclaimed: "I can't believe this difference! I hadn't realized I was learning so much. Thank you!"

We also observed that treatment group students quickly took to using temporal entities when explaining their verb tense choices, even though they could always refer to traditional rules instead; that is, the temporal entities not only appear to have been well understood, they were usually chosen over traditional rules of use, which further reduced the time spent on instruction and corrective feedback.

Regardless of approach, sustained and intensive practice over a relatively short period within a program emphasizing reading, writing, speaking, listening, and interpersonal skills seems to be especially helpful (Ellis, 2006). We observed significant improvement for many, as well as a surge in confidence with respect to correct tense choices. Any approach further requires focused effort, attention to keywords, sentence structures (discerning time clauses), and text analysis (time shifts in texts, for instance).

Over the last three years, we have also used temporal entities to clarify or explain the use of verb tenses in other classes and contexts. We were told: "Why hasn't anybody

explained it to me this way before?" One learner even kindly stood up to clap his approval.

To summarize, using the Dr. Mosaik framework appears to be a worthwhile alternative. It seems to promote ease in learning, build confidence, and deepen understanding of the tense–aspect system. Although some adjustment is initially required to become accustomed to a different approach, the use of the framework appears to save both teaching and learning time, while facilitating instruction and feedback. It could also be easily integrated in technological applications, namely with exercises generated from databases with answers linked to specific temporal entities. What has certainly been rewarding has been to witness significant leaps in appropriate tense use for *all* our students over relatively short periods, and especially in the treatment groups.

Conclusion

Our work has been based on several years of university teaching experience with adults and our perception of their needs. More specifically, it has been an endeavour to extract the shared conceptualizations of the English verb tense system using ontology engineering methodology and to organize them in a principled and holistic manner, in an attempt to help our students tackle the challenging task of progressing towards verb tense use mastery in ESL. The ontology engineering methodology we applied to a complex set of knowledge shows definite promise with respect to enhancing the understanding of a topic that has proven challenging for learners in many countries.

We have found that the fundamental rules pertaining to tense and aspect can be grounded in ontological structures of happenings and time that cut across language (RQ1) and also reflect the inherent lexical aspect of verbs. The use of the Dr. Mosaik framework further marks a departure from a rather complex theory of the verb system that is presented using potentially lengthy lists of rules and moves towards a comprehension-based theory, in which tenses align with aspects (RQ4), and clear commonalities can be seen across time frames (RQ2). As a result, exceptions to the fundamental rules of use begin to stand out (RQ3). The reduction in number of rules (RQ1) in comparison to those featured in various instructional materials simplify instruction, and requires less time to teach and learn. It also provides a limited number of handles as a support to corrective feedback, and substantially reduces the toll on memory for students. In short, it appears to be more time-efficient.

This said, adopting the framework does imply a number of adjustments. This is namely true for language instructors who have developed teaching approaches to the study of the verb tense–aspect system based on other valuable paradigms that are further supported by carefully designed pedagogical materials. They may simply wish to continue with approaches that they already master and adhere to what is found in published (and widely recognized) materials. Students, for their part, could be exposed to the framework as they progress through ESL classes, and may then need to return to a rule-based approach, depending on the instructional approaches set forth in a subsequent class.

To conclude, while further research is warranted, we believe the Dr. Mosaik framework (RQ5) shows promise for the understanding and possible mastery of the English verb system. The use of temporal entities and ontology engineering could also,

we believe, prove useful in the study of other languages. Future plans include further investigation of the use of the framework with learners in relation to instructional practices and activities, use of the framework by different instructors of ESL/EFL, and the organization of courseware based on our three-year experience teaching the framework, to make it available through technology-enhanced learning applications.

Abbreviations

AI: Artificial intelligence; BFO: Basic Formal Ontology; CAL: Computer-assisted learning; DOLCE: Descriptive Ontology for Linguistic and Cognitive Engineering; EFL: English as a Foreign Language; ESL: English as a Second Language; IEEE: Institute of Electrical and Electronics Engineers; L1: Language one (= native/first language); L2: Language two (= second language); LO: Learning Object; LOM: Learning Object Metadata; OE: Ontology engineering; PPT: Present perfect (use) 1; PP2: Present perfect (use) 2; PURE: Perceived as Unending and Repeating (temporal) Entity; RQ: Research question; T1: Time 1; T2: Time 2; TEL: Technology-enhanced learning; YAMATO: Yet Another More Advanced Top-Level Ontology

Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s41039-021-00163-x>.

Additional file 1. Partial List of ESL Grammar Materials Analyzed for the Development of the Dr. Mosaik Framework (Bland, 2003, Frodesen & Eyring, 2007, Maurer, 2005, Murphy, 2012, Thewlis, 1993, Van Zante et al, 2003, Vince, 2009, Yule, 2012).

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Authors' contributions

This paper is the result of a joint collaboration. Both authors have approved the submitted version and are accountable for each other's contributions. DA conducted research of the English verb tense-aspect system from an English-as-a-second-language perspective, and RM contributed his expertise in ontology engineering.

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Availability of data and materials

The data concerning the preliminary results of experimentation is currently in the possession of the main author and can be submitted to a repository if required.

Declarations

Ethics approval and consent to participate

The preliminary experimentation described in the manuscript involved human participants. Please know that all ethical standards in this regard have been thoroughly followed. Confirmation may be obtained through the Bishop's University (Canada) Research Ethics Board. To this effect, you may contact Julie Fredette, Research Officer, at julie.fredette@ubishops.ca and inquire about REB102195 (2019), REB101764 (2018), and R2016-31 (2017).

Consent for publication

The manuscript contains the name of one student in a footnote (a student, Tommy Dupuis). Consent to publish his name has been secured. One of the included figures (Fig. 3) resembles one that was published in a textbook written by Azar (2002). Permission to reproduce Ms. Azar's original figure—if necessary—has been secured. There is otherwise no third-party material in this paper.

Competing interests

There are no competing interests to report.

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