

Tense and aspect¹

1 English tense and aspect morphology

English verbal morphology allows for the independent specification of two features we call *tense* and *aspect*:

(1) **Tense vs aspect in English verbal morphology:**

Aspect	Tense		
	Past	Present	Future
Perfective (Simple)	<i>danced</i>	<i>dances</i>	<i>will dance</i>
Imperfective (Progressive)	<i>was dancing</i>	<i>is dancing</i>	<i>will be dancing</i>
Perfect	<i>had danced</i>	<i>has danced</i>	<i>will have danced</i>

The actual morphosyntax of tense and aspect in English is complicated, so we will simplify the syntax in some places today. (Which appears higher, tense or aspect?)

2 Mathematical preliminaries

In the beginning, there is (was?) time:

(2) **Moments:**

- a. Time is made up of infinitesimally small '*moments*' (or '*instants*').

Moments are type i ; M = the set of moments (instants) = D_i

- b. Elements of M have a dense, strict total ordering ($<$)

- If $a < b$, then it's false that $b < a$ asymmetric
- If $a < b$ and $b < c$, then $a < c$ transitive
- For all $a \in M$, it's false that $a < a$ irreflexive
- For all $a, b \in M$, either $a < b$, $b < a$, or $a = b$ total
- For all $a, b \in M$, if $a < b$, there is a $c \in M$ such that $a < c$ and $c < b$ dense

(3) **Intervals:**

- a. We also refer to spans of time, which we call '*intervals*'.

Interval I of M : $I \subseteq M$ and for all $a, b \in I$, if $a < c$ and $c < b$, then $c \in I$

- b. Subinterval: $I \subseteq I'$ iff $I \subseteq I'$ (as sets)

- c. Precedence: $I < I'$ iff for all $i \in I$ and $j \in I'$, $i < j$ (every moment in I precedes every moment in I')

¹Based on handouts by Seth Cable

3 Tense

The truth of some sentences is dependent on the time of utterance:

(4) “E-scooters are illegal (except on cycling paths).”

a. November 4, 2019, noon: false

b. November 5, 2019, noon: true

► The sentence should be evaluated *relative to an evaluation time parameter*: $\llbracket \dots \rrbracket^t$

– Just as we did when we added a world parameter w to the evaluation function, all our regular compositional rules (FA, PA, etc.) should be modified to pass the same evaluation time between mothers and daughters.

– Right now we allow the evaluation time t to be a moment or an interval of moments.

(5) $\llbracket \text{E-scooters are illegal} \rrbracket^t = \neg \text{Legal}(\text{e-scooters}, t)$ ²

a. $\llbracket \text{E-scooters are illegal} \rrbracket^{\text{November 4, 2019, noon}} = 0$

b. $\llbracket \text{E-scooters are illegal} \rrbracket^{\text{November 5, 2019, noon}} = 1$

Here in (a) and (b) (and some below), I am lazy and use $\llbracket \dots \rrbracket$ to return truth values in real life; i.e. convert to predicate logic and then also evaluate that predicate logic formula in a model M compatible with the facts of the real world.

3.1 Tense as operators

Tense appears to shift the evaluation time:

(6) a. $\llbracket \text{E-scooters are legal} \rrbracket^{\text{today}} = 0$

b. $\llbracket \text{E-scooters were legal} \rrbracket^{\text{today}} = 1$

Intuitively, (6b) is true today because there is a past time t' ($t' < \text{November 3, 2020}$) such that e-scooters are legal at t' .

(7) Right after the ban was announced:

a. $\llbracket \text{E-scooters are illegal} \rrbracket^{\text{November 4, 2019}} = 0$

b. $\llbracket \text{E-scooters will be illegal} \rrbracket^{\text{November 4, 2019}} = 1$

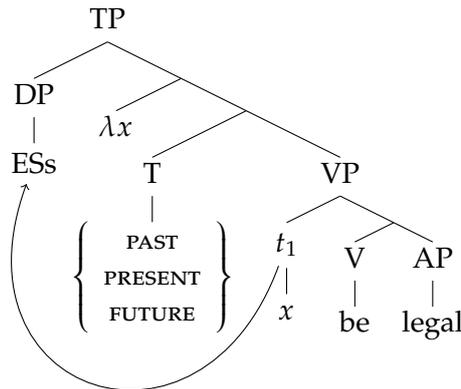
Similarly, (7b) is true because there is a future time t' ($\text{November 4, 2019} < t'$) such that e-scooters are illegal at t' .

²Since we have not discussed the analysis of plurals, we will be sloppy and discuss “e-scooters” as if it is simply an individual in D_e .

(8) **Past and future as existential quantifiers:**

- a. $\llbracket \text{E-scooters are legal} \rrbracket^t = \text{Legal}(\text{e-scooters}, t)$
- b. $\llbracket \text{E-scooters were legal} \rrbracket^t = \exists t' [t' < t \wedge \text{Legal}(\text{e-scooters}, t')]$
- c. $\llbracket \text{E-scooters will be legal} \rrbracket^t = \exists t' [t < t' \wedge \text{Legal}(\text{e-scooters}, t')]$

We assume the VP-internal subject hypothesis and that tense semantics is in T. Auxiliary verbs in English (including the copula *be* in the sentences above) are pronounced in T (via head-movement) but this has no semantic effect. Let's assume the verb simply stays low at LF.



- PAST.PL + *be* = *were*
- PRES.PL + *be* = *are*
- FUT + *be* = *will be*

(9) $\llbracket \text{legal} \rrbracket^t = \lambda x_e . \text{Legal}(x, t)$

(10) $\llbracket \text{illegal} \rrbracket^t = \lambda x_e . \neg \text{Legal}(x, t)$

(11) **Special tense rules:**

- a. $\llbracket \begin{array}{c} \wedge \\ \text{PRES} \quad \text{XP} \end{array} \rrbracket^t = \llbracket \text{XP} \rrbracket^t$
- b. $\llbracket \begin{array}{c} \wedge \\ \text{PAST} \quad \text{XP} \end{array} \rrbracket^t = \exists t' [t' < t \wedge \llbracket \text{XP} \rrbracket^{t'}]$
- c. $\llbracket \begin{array}{c} \wedge \\ \text{FUT} \quad \text{XP} \end{array} \rrbracket^t = \exists t' [t < t' \wedge \llbracket \text{XP} \rrbracket^{t'}]$

Exercise: Compute a time-sensitive predicate logic formula for *E-scooters were legal*.

3.2 Tense as anaphors (pronouns)

Consider this classic example from Partee 1973:

- (12) Context: You've just baked some cookies, and are driving them over to a friend's house. While you're on the road, you suddenly realize that you left the stove on.
 "(Oh no!) I didn't turn off the stove!"

(13) **Predictions of our existential quantifier semantics for PAST (11b):**

a. If PAST > NEG, we predict:

$$\exists t' [t' < t \wedge \neg[\text{TurnOff}(I, \text{stove}, t')]]$$

This truth-condition is *too weak*: it is made true by the fact that I've been driving for the past few minutes.

b. If NEG > PAST, we predict:

$$\neg[\exists t' [t' < t \wedge \text{TurnOff}(I, \text{stove}, t')]]$$

This truth-condition is *too strong*: it requires that I've never turned off the stove in the past.

Intuitively, (12) is referring to a particular time (span) in the past. Roughly, *at the time when you took out the cookies*, it's false that you turned the stove off.

- Past tense sentences are (often) not generic statements about the entire “past,” but instead about a specific time made salient by the conversation. In this way, tenses behave a little bit like pronouns (Partee, 1973).

4 Aspect

Tense and aspect can be thought of as relating three different times (or time intervals):

(14) **Three times to care about:** (Reichenbach, 1947; Klein, 1994; a.o.)

- a. Utterance Time (UT): When a sentence is asserted.
- b. Topic Time (TT): The time “under discussion” in the sentence.
- c. Event Time (ET): The time of the event/state described.

Above, we had collapsed TT and ET, and took PAST/PRES/FUT to relate TT/ET to UT. Instead, we have to consider the role of *Topic Times*:

(15) a. At 3pm, I was washing my car.

- TT = 3pm

b. When Cara was in the kitchen, Dana ate a sandwich.

- TT = the time when Cara was in kitchen

c. I didn't turn off the stove!

- TT = the time between removal of cookies and when I left the house

► *Tense* relates UT and TT; *aspect* relates TT and ET.

(16) **Tense:**

- a. Present: $UT \subseteq TT$
- b. Past: $TT < UT$
- c. Future: $UT < TT$

(17) **Aspect:**

- a. Perfective: $ET \subseteq TT$
- b. Imperfective: $TT \subseteq ET$
- c. Perfect: $ET < TT$

Some examples:

(18) When Cara was in the kitchen, Dana **was eating** a sandwich.

- a. $TT =$ the time when Cara was in the kitchen
- b. Past Tense: $TT < UT$
- c. Imperfective Aspect: $TT \subseteq ET$

Thus, we capture the observations that:

- (18) places Cara's being in the kitchen inside the sandwich-eating.
- (18) is consistent with the sandwich-eating still continuing at present.

(19) When Cara was in the kitchen, Dana **ate** a sandwich.

- a. Past Tense: $TT < UT$
- b. Perfective Aspect: $ET \subseteq TT$

Thus, we capture the observations that:

- (19) places the sandwich-eating inside Cara's being in the kitchen.
- (19) entails that the sandwich eating does not continue into the present.

(20) When Cara was in the kitchen, Dana **had** (just) **eaten** a sandwich.

- a. Past Tense: $TT < UT$
- b. Perfect Aspect: $ET < TT$

Thus, we capture the observations that:

- (20) places the sandwich-eating before Cara's being in the kitchen.
- (20) entails that the sandwich eating does not continue into the present.

5 Lexical aspect / Aktionsarten

Different predicates (VPs) have their own, lexically-determined temporal classification, often called *lexical aspect* or *Aktionsart* (action type).

(21) The hierarchy of Aktionsarten:

- States:
Involve no change over their duration; e.g. *hate, know, tall*
- Events:
Involve some change.

Events be further classified by *telicity* (whether there is a defined ‘culmination’ or not) and whether it is punctual or durative:

	Telic	Atelic
Punctual	achievement <i>die, win, arrive</i>	semelfactive <i>sneeze, jump, kick</i>
Durative	accomplishment <i>build a house, cross the street, eat the cookie</i>	activity <i>run, eat cookies, think about semantics</i>

This classification is interestingly and importantly also observed across languages of the world, although they may have different morphosyntactic properties in different languages.

Some observations about the Aktionsarten:

- States:

‘Sound funny’ or get a special, non-stative interpretation in the imperfective:

(22) ??loving curry rice; ??being tall

- Telicity:

– Telic predicates combine with modifiers of the form ‘in X time’:

- (23) a. Dana built a house/crossed the street/ate the cookie in an hour. *telic*
 b. ?? Dana built houses/danced/sneezed in an hour. *atelic*

– Atelic predicates combine with modifiers of the form ‘for X time’:

- (24) a. Dana built houses/danced/sneezed for an hour. *atelic*
 b. ?? Dana built a house/crossed the street/ate the cookie for an hour. *telic*

- Semelfactives:

Semelfactives have no culmination, and yet they inherently take a very short time interval. Therefore their imperfectives are necessarily interpreted as involving repetition:

- (25) a. Dana was sneezing/jumping/kicking. *semelfactive*
(entails multiple sneezing/jumping/kicking events)
- b. Dana was dancing/cooking. *activity*
(does not entail multiple events)

References

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Reichenbach, Hans. 1947. The tenses of verbs. In *Elements of symbolic logic*, 287–98. The Macmillan Company.