# Temporal Logic and Tense/Aspect

James Pustejovsky

Brandeis University
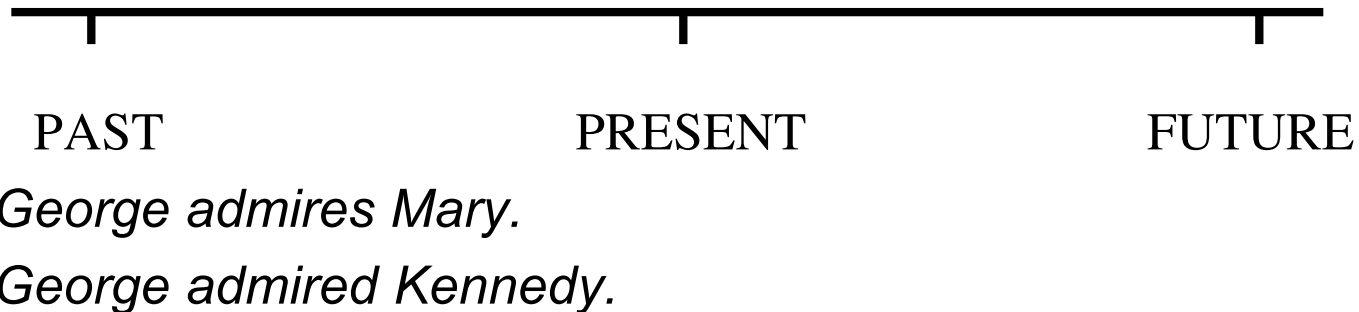
CS 112

# Tense

- Grammatical expression of the time of the situation described, relative to some other time (e.g., moment of speech)

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|————————|————————————————|——————————————|
     |                    |                  |
   PAST              PRESENT            FUTURE
```

*George admires Mary.*
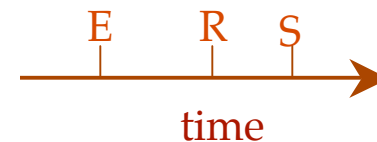
*George admired Kennedy.*

# Reichenbach

- Tensed utterances introduce <u>references</u> to 3 'time points'
  - Speech Time: S
  - Event Time: E
  - Reference Time: R

  $_S$*I had [mailed the letter]$_E$ [when John came & told me the news]$_R$*

  *E < R < S*

$$E \quad R \quad S$$

time

- The concept of 'time point' is an abstraction –- it can map to an interval
- Three temporal relations are defined on these time points
  - at, before, after
- 13 different relations are possible

# Reichenbachian Tense Analysis

| Relation | Reichenbach's Tense Name | English Tense Name | Example |
|---|---|---|---|
| E<R<S<br>E=R<S | Anterior past<br>Simple past | Past perfect<br>Simple past | I had slept<br>I slept |
| R<E<S<br>R<S=E<br><br>R<S<E | Posterior past<br>E>R<S | | I would sleep |
| E<S= R<br>S= R= E<br>S= R<E | Anterior present<br>Simple present<br>Posterior present | Present perfect<br>Simple present<br>Simple future | I have slept<br>I sleep<br>I will sleep<br>*Je vais dormir* |
| S<E<R<br>S=E<R<br><br>E<S<R | Anterior future<br>E<R>S | Future perfect | I will have slept |
| S<R=E<br><br>S<R<E | Simple future<br><br>Posterior future | Simple future | I will sleep<br>*Je dormirai*<br>I shall be going to sleep |

- <u>Tense</u> is determined by relation between R and S
  - R=S, R<S, R>S
- <u>Aspect</u> is determined by relation between E and R
  - E=R, E < R, E> R
- Relation of E relative to S not crucial
  - Represent R<S=E as E>R<S
- Only 7 out of 13 relations are realized in English
  - 6 different forms, simple future being ambiguous
  - Progressive no different from simple tenses
    - But I was eating a peach ≠> I ate a peach

# Tense as Operator: Prior

| Relation | Reichenbach's Tense Name | PRIOR | English Tense Name | Example |
|---|---|---|---|---|
| E<R<S<br>E=R<S | Anterior past<br>Simple past | PPp<br>Pp | Past perfect<br>Simple past | I had slept<br>I slept |
| R<E<S<br>R<S=E<br><br>R<S<E | Posterior past | PFp | | I would sleep |
| E<S= R<br>S= R= E<br>S= R<E | Anterior present<br>Simple present<br>Posterior present | Pp<br>p<br>Fp | Present perfect<br>Simple present<br>Simple future | I have slept<br>I sleep<br>I will sleep<br>*Je vais dormir* |
| S<E<R<br>S=E<R<br><br>E<S<R | Anterior future | FPp | Future perfect | I will have slept |
| S<R=E<br><br>S<R<E | Simple future<br><br>Posterior future | Fp<br><br>FFp | Simple future | I will sleep<br>*Je dormirai*<br>I shall be going to sleep |

- Free iteration captures many more tenses,
  - *I would have slept PFP$\phi$*

- But also expresses many non-NL tenses
  - PPPP$\phi$ *[It was the case][4] John had slept*

# Aspect

- Two Varieties
  - Grammatical Aspect
    - Distinguishes viewpoint on event
  - Lexical Aspect
    - Distinguishes types of events (situations)(eventualities)
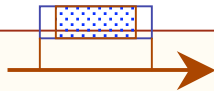    - Also called Aktionsarten

# Grammatical Aspect

- ## Perfective – focus on situation <u>as a whole</u>
  - John built a house

  built.a.h
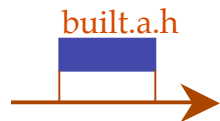
- ## Imperfective – focus on <u>internal phases</u> of situation
  - John was building a house

  was building.a.h

# Aktionsarten

- STATIVES  *know, sit, be clever, be happy, killing, accident*
    - can refer to state itself (ingressive) *John knows* , or to entry into a state (inceptive) *John realizes*
    - *\*John is knowing Bill, \*Know the answer, \*What John did was know the answer*
- ACTIVITIES  *walk, run, talk, march, paint*
    - if it occurs in period t, a part of it (also an activity) must occur for every/most sub-periods of t
    - X is Ving  entails that X has Ved
    - *John ran for an hour,\*John ran in an hour*

- ACCOMPLISHMENTS  *build, cook, destroy*
    - culminate (telic)
    - x Vs for an hour does not entail x Vs for all times in that hour
    - X is Ving  does not entail that X has Ved.
    - *John booked a flight in an hour, John stopped building a house*
- ACHIEVEMENTS  *notice, win, blink, find, reach*
    - instantaneous accomplishments
    - *\*John dies for an hour, \*John wins for an hour, \*John stopped reaching New York*

| | Telic | Dynamic | Durative | E.g. |
|---|---|---|---|---|
| **Stative** | - | - | + | know, have |
| **Activity** | - | + | + | walk, paint |
| **Accomplishment** | + | + | + | destroy, build |
| **Achievement** | + | + | - | notice, win |

# Different types of tense systems across languages

- Using verbal inflection:
  - Languages with a two-way contrast:
    - <u>English</u>: Past (before the moment of speaking) vs. Nonpast

      past *-ed:*          *She worked hard.*
      nonpast (unmarked):   *We admire her. I will leave tomorrow.*
    - <u>Dyirbal</u> (Australian language): Future vs. nonfuture:

      future *-ñ*:       *bani-ñ*        'will come'
      nofuture *-ñu*:     *bani-ñu*       'came, is coming'
  - Languages with a three-way distinction:
    - <u>Catalan, Lithuanian</u>: Past vs. Present vs. Future

      | (Cat.) | past: | *treball-à.* | (Lit.) | *Dirb-au.* | 'I worked' |
      | | present: | *treball-a.* | | *Dirb-u.* | 'I work' |
      | | future: | *treball-arà.* | | *Dirb-siu.* | 'I will work' |

# Different types of tense systems across languages

- A much richer distinction:
    - <u>ChiBemba</u> (Bantu language):

    For past:
      - Remote past (before yesterday)     *Ba-àlí-bomb-ele*     'they worked'
      - Removed past (yesterday)     *Ba-àlíí-bomba*     'they worked'
      - Near past (earlier today)     *Ba-àcí-bomba*     'they worked'
      - Immediate past (just happened)     *Ba-á-bomba*     'they worked'

    For future:
      - Immediate future (very soon)     *Ba-áláá-bomba*     'they'll work'
      - Near future (later today)     *Ba-léé-bomba*     'they'll work'
      - Removed future (tomorrow)     *Ba-kà-bomba*     'they'll work'
      - Remote future (after tomorrow)     *Ba-ká-bomba*     'they'll work'

# Aspect

- Internal temporal organization of the situation described by an event.
- Most common:
  - **Perfective:** Situation viewed as a bounded whole.
  - **Imperfective:** Looking inside the temporal boundaries of the situation.
    - **Habitual**
    - **Progressive**
- Other related aspectual distinctions:
  - **Iterative:** The action is repeated.
  - **Inceptive:** The action is began.
  - **Inchoative:** Entering into a state.

# Different types of aspect systems across languages

- Some languages use auxiliaries and particles associated with the verb:

  English:
  - **Perfective:** *have* + Past Participle        *I have eaten.*
  - **Progressive:** *be* + Present Participle     *I am eating.*
  - **Habitual:** *use to* + Base form          *I used to sing.*

  Catalan:
  - **Habitual:** *soler* + Infinitive

    *Sol parlar.*                                'She generally talks.'
    *Solia cantar.*                               'She used to talk'

  - **Iterative:** $anar_{(past)}$ ('to go') + Present Part
    *Va    tornant* 'She keeps coming back'
    $go_{past}$  coming_back

# Different types of aspect systems across languages

- **Other languages use a derivational component:**

  <u>Russian</u>: by means of a system of verbal prefixes
  - **Imperfective:** simple verbs      *Ja ˇcitál*      *'I was reading'*
  - **Perfective:** prefixed verbs      *Ja proˇcitál*      *'I (did) read'*

  <u>Finnish</u>: by means of the case of the object
  - **Perfective:**      *Hän luki kirj**an**$_{(acc.)}$* 'He read the book'
  - **Imperfective:**   *Hän luki kirj**aa**$_{(part.)}$* 'He was reading the book'.
    Basic meaning: only part of the object being referred to is affected by the situation.

# Tense and Aspect

- ## Aspect and Tense generally cross-classify:
  - ### Russian:
    - #### Present:
      - Only imperfective: *čitáju*                    *'I read'*
    - #### Past:
      - Imperfective:          *Ja čitál*          *'I was reading'*
      - Perfective:            *Ja pročitál*      *'I (did) read'*
    - #### Future:
      - Imperfective:          ??
      - Perfective:            *Ja pročitáju*      *'I shall read'*

# Tense and Aspect

– <u>Basque</u>:
- Present:
  - Imperfect (Gerund + Present tense auxiliary)     *ekartzen du*   'he is bringing it'
  - Perfect (Past Participle + Present tense aux.)     *ekarri du*      'he has brought it'
- Past:
  - Imperfect (Gerund + Past tense aux.)     ekartzen zuen  'he brought, used to bring'
  - Perfect (Past Participle + Past tense aux.)   ekarri zuen  'he brought, had brought'
- Future:
  - Simple (Future Participle + Pres. tense aux.)       ekarriko du     'he will bring it'
  - Past Future (Future Participle + Past tense aux.)  ekarriko zuen  'he would bring'

# An interesting case

- Tense and Aspect in 2 different creoles, evolved independently from each other:

| | Hawaiian Creole | Haitian Creole |
|---|---|---|
| **Base Form** (he walks, he walked) | He walk | Li maché |
| **Progressive** he is walking, he was walking | He stay walk | L'ap maché (Li ap maché) |
| **Perfective** he has walked, he had walked | He bin walk | Li té maché |
| **Perfective Progressive** (he has/had been walking) | He bin stay walk | Li t'ap maché (Li té ap maché) |
| **Irreal** (he would walk, he will walk) | He go walk | L'av maché |
| **Irreal Progressive** (he would/will be walking) | He go stay walk | L'av ap maché (Li av ap maché) |
| **Irreal Perfective** (he would/will have walked) | He bin go walk | Li t'av maché (Li té av maché) |
| **Irreal perfective Progressive** he would/will have been walking | He bin go stay walk | Li t'av ap maché (Li té av maché) |