Event Semantics and Adverbial Modification

Session 3: Event Structure

ESSLLI Language and Logic introductory course
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Decomposing predicates: States and ACTS

Dowty (1979) decomposes Vendler's (1957) event types into particular atomic predicates and combinations of these.

- **States**
  $\pi_n(\alpha_1, ..., \alpha_n)$.
  e.g. John knows the answer.
- **Activities**
  $\text{DO}(\alpha_1, [\pi_n(\alpha_1, ..., \alpha_n)])$.
  e.g. John is walking.

$\Box[\text{DO}(\alpha, \phi) \leftrightarrow \phi \wedge \phi$ is under the immediate control of the agent (an individual denoted by α)].

Decomposing predicates: ACCS and ACHS

- **Accomplishments**
  DO(α_1, [$\pi_n(\alpha_1, ..., \alpha_n)$])]CAUSE[BECOME $\rho_m(\beta_1, ..., \beta_n)$]]].
  e.g. John broke the window.
- **Achievements**
  BECOME[$\pi_n(\alpha_1, ..., \alpha_n)$].
  e.g. John discovered the solution.

[BECOME ϕ] is true at *I* iff there is an interval *J* containing the initial bound of *I* such that $\neg\phi$ is true at *J* and there is an interval *K* containing the final bound of *I* such that ϕ is true at *K*.

CAUSE (roughly following Lewis, 1973)

- $[\phi$ **CAUSE** $\psi]$ is true iff
  1. ϕ is a causal factor for ψ, and
  2. for all other ϕ' such that ϕ' is also a causal factor for ψ, some $\neg\phi$-world is as similar or more similar to the actual world than any $\neg\phi'$-world is.
- ϕ ***depends causally on*** ψ iff ϕ, ψ and $\neg\phi \mathrel{\Box\!\!\rightarrow} \neg\psi$ are all true.
- ϕ *is a* ***causal factor*** *for* ψ iff there is a series of sentences ϕ, ϕ_1, ..., ϕ_n, ψ(for $n \geqslant 0$) such that each member of the series depends causally on the previous member.

Different types of ACCS

- **Lexical accomplishments**:

  John kills Bill.
  [[*John does something*] CAUSE [BECOME ¬[*Bill is alive*]]]

- **Syntactically created accomplishments**, e.g. resultatives:

  He sweeps the floor clean.
  [[*He sweeps the floor*] CAUSE [BECOME [*the floor is clean*]]]

Different types of ACCS (cont.)

- Locatives: *walk, swim, fly to* NP; *drive, carry, push* NP *to* NP
- PP complements: *put, place, set* NP *into* NP; *put* NP *to sleep*, *drive* NP *to drink*, *read oneself to sleep*
- Factitive (Adjective of Result): *hammer* NP *flat*, *wipe* NP *clean*, *wiggle* NP *loose*
- Verb particle constructions: *take* NP *out*, *chase* NP *away*; *sit down*, *dry out*

The subinterval property (Bennett and Partee, 1972)

(Atelic) states, ACTS: are true at subintervals;
(Telic) ACCS, ACHS: are not true at subintervals.

- If α is a **stative predicate**, then $\alpha(x)$ is true at an interval *I* just in case $\alpha(x)$ is true at all moments within *I*.
- If α is an **activity** verb or an *accomplishment/achievement* verb, then $\alpha(x)$ is only true at an interval larger than a moment.
- If α is an **accomplishment/achievement** verb, then if $\alpha(x)$ is true at *I*, then $\alpha(x)$ is false at all subintervals of *I*.
- If α is an **activity** verb, then if $\alpha(x)$ is true at *I*, then $\alpha(x)$ is true for all subintervals of *I* which are larger than a moment.

Event decomposition

- Dowty's (1979) idea of decomposing predicates has been reformulated in event semantic terms.
- An event (the **macroevent**) can be structurally complex and decomposable into particular **subevents**.
- Subevents are associated with CAUSE, DO or BECOME predications, or related notions such as preparatory phase, initiating state, process, transition, culmination, consequent or result state and the like.

  (See Moens and Steedman, 1988; Parsons, 1990; Pustejovsky, 1991; von Stechow, 1996; Higginbotham, 2000; Kratzer, 2004; Rothstein, 2003; Beck, 2005; Ramchand, 2008, among many others)

Parsons (1990): Causatives

(1) a. Mary flew the kite.
b. (∃e)[Agent(e,Mary) &Cul(e) & (∃e')[Flying(e') & Cul(e') & Theme(e',Kite) & CAUSE(e,e')]].

(1) entails (2)

(2) a. The kite flies.
b. (∃e')[Flying(e') & Cul(e') & Theme(e',Kite)].

Dowty's (1979) DO, CAUSE, BECOME: sentence operators

- This is problematic because there is no evidence that the cases under discussion are bisentential (e.g. no scope ambiguities, always direct causation).
- Instead: bieventive

Modifiers with bieventives

can go with either of the underlying events

(3) a. Mary flew her kite behind the museum.
b. (∃e)[Agent(e,Mary) & (∃e')[Flying(e') & Cul(e') & Theme(e',Kite) &Behind(___,museum) & CAUSE(e,e')]].

Different status of modifiers: (4) entails (4-a) but not (4-b)

(4) Mary fell the tree into the pond with the chainsaw.
a. The tree fell into the pond.
b. The tree fell with a chainsaw.

→Instrumentals only go with the caused event.

Inchoatives

BECOME relates an event and its target state - two postulates:

- BECOME(e,s) → [Theme(e,x) = Theme(s,x)]
- BECOME(e,s) &Cul(e,t) → Hold(s,t) & ¬(∃t')[t'<t &Hold(s,t')].

(5) a. x closes the door tight.
b. (∃e)[Cul(e) &Agent(e,x) & (∃e')[Cul(e') & Theme(e',door) & CAUSE(e,e') & (∃s)[Being-closed(s) &Theme(s,door) &Hold(s) &BECOME(e',s) &Being-Tight(s)]]].

Some more examples with modifiers

(6) a. x closes the door partway.

b. (∃e)[Cul(e) &Agent(e,x) & (∃e')[Cul(e') & Theme(e',door) & CAUSE(e,e') & (∃s)[Being-Partway(closed)(s) &Theme(s,door) &Hold(s) &BECOME(e',s)]]].

(7) a. x hammered the metal flat.

b. (∃e)[Cul(e) &Agent(e,x) & Hammering(e) & Theme(e,metal) & (∃e')[Cul(e') & Theme(e',metal) & CAUSE(e,e') & (∃s)[Being-flat(s) &Theme(s,metal) &Hold(s) &BECOME(e',s)]]].

Pustejovsky (1991): States and Processes (ACTS)

- **State** (S): a single event, which is evaluated relative to no other event
  Examples: *be sick, love, know*

  S
  |
  e

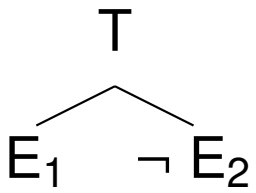
- **Process** (P): a sequence of events identifying the same semantic expression
  Examples: *run, push, drag*

  P
  $e_1 \ldots e_n$

Transitions (ACCS and ACHS)

Transition (T): an event identifying a semantic expression, which is evaluated relative to its opposition (with E as a variable for any event type)

Examples: *give, open, build, destroy*



Evidence from adverbial modification

- *again* (e.g. Pustejovsky, 1991; von Stechow, 1996)
- *almost* (e.g. Rapp and von Stechow, 1999; von Stechow, 1995)
- *for*-adverbials as modifiers of processes or modifiers of result states
- locative modifiers (modifiers of the entire event or modifiers of a result state)

again

- e.g. von Stechow (1996) (through Beck, 2005)

$$
\begin{aligned}
[\![\text{again}]\!]\ (P_{<i,t>})(e) \quad &= 1 \text{ iff } P(e)\ \&\ \exists e'\ [e' < e\ \&\ P(e')] \\
&= 0 \text{ iff } \neg\ P(e)\ \&\ \exists e'\ [e' < e\ \&\ P(e')] \\
&\text{undefined otherwise.}
\end{aligned}
$$

- $[\![\textsc{cause}]\!]$ (e')(e) = 1 iff e' occurred, e occurred and if e hadn't occurred then e' wouldn't have occurred
- $[\![\textsc{become}]\!]$ (P)(e) = 1 iff e is the smallest event such that P is not true of the prestate of e but P is true of the result state of e

repetitive *again* with syntactically derived ACCS

e.g. *Sally hammered the metal flat again.*

- $[_{VP}$ [the metal] [1 **[**$_{VP}$ $[_{VP}$ Sally $[_{V'}$ t_1 $[_{V'}$ hammered $[_{SC}$ PRO_1 flat]]] again**]**]]
- $\lambda e''.\text{again}_{e''}\ (\lambda e.\text{hammer}_e(\text{the\_metal})(\text{Sally})\ \&$ $\exists e'[\textsc{become}_{e'}(\lambda e^{\star}.\text{flat}_{e^{\star}}(\text{the\_metal}))\ \&\ \textsc{cause}(e')(e)]$
  $\rightarrow$ Once more, Sally's hammering the metal caused it to become flat.

restitutive *again* with syntactically derived ACCS

- [$_{VP}$ [the metal] [1 [$_{VP}$ Sally [$_{V'}$ t$_1$ [$_{V'}$ hammered **[**$_{SC}$ [$_{SC}$ PRO$_1$ flat] again**]**]]]]
- $\lambda e.\text{hammer}_e(\text{the\_metal})(\text{Sally})\ \&\ \exists e'\ [\textsc{become}_{e'}\ (\lambda e''.\text{again}_{e''}\ (\lambda e^{\star}.\text{flat}_{e\star}(\text{the\_metal}))\ \&\ \textsc{cause}(e')(e)]$
  $\rightarrow$ Sally's hammering the metal caused it to become once more flat.

Lexical accomplishments

e.g. *Sally opened the door*.

$\text{open}_{TV} = \text{open}_{Adj} + \textsc{become} + \textsc{cause}$
$\oslash_V \rightarrow \lambda p \lambda x \lambda e.\exists P[P_e(x)\ \&\ \exists e'[\textsc{become}_{e'}(p)\ \&\ \textsc{cause}(e')(e)]$

- $[_{VP}$ Sally $[\oslash_V\ [_{SC}\ \text{open}_{Adj}$ [the door]]]] >
  $[_{VP}$ Sally $[[\oslash + \text{open}_{Adj}]_V\ [_{SC}$ t [the door]]]]
- $\lambda e.\exists P[P_e(\text{Sally})\ \&\ \exists e'[\textsc{become}_{e'}(\lambda e^{\star}.\text{open}_{e\star}(\text{the\_door}))\ \&$ $\textsc{cause}(e')(e)]$
  $\rightarrow$There was an action of Sally's which caused the door to become open.

Rothstein's (2004) event templates

- Verbs denote sets of events or a particular event type, where event types are considered to be lexical aspectual classes.

States	$\lambda e.P(e)$
ACT	$\lambda e.(\textsc{do}(P))(e)$
ACH	$\lambda e.(\textsc{become}(P))(e)$
ACC	$\lambda e.\exists e_1 \exists e_2[e=^S(e_1 \sqcup e_2) \wedge (\textsc{do}(P))(e_1) \wedge \mathrm{Cul}(e)=e_2]$

- These classes are seen as sets of constraints on how the grammar makes the individuation of events possible.
  - For example, the event structure associated with a given verbal predicate can be augmented by 'adding' a secondary resultative predicate, and this creates a more complex type.

Revision of the ACC template

$\lambda y \lambda e.\exists e_1,e_2[e=^S(e_1 \sqcup e_2)$
$\wedge$ ACTIVITY$_{<x>}(e_1) \wedge Ag(e_1)=x \wedge Th(e_1)=y$
$\wedge$ BECOME$_{<y>}(e_2) \wedge Arg(e_2)=Th(e_1)$
$\wedge$ INCR$(e_1,e_2,C(e_2))]$

- Let e_1 be an activity, e_2 be a BECOME event, and $C(e_2)$ be an incremental chain defined on e_2.
  INCR$(e_1,e_2,C(e_2))$ (e_1 is incrementally related to e_2 with respect to the chain $C(e_2)$) iff:
  there is a contextually available one-one function μ from $C(e_2)$ onto PART(e_1) (the set of parts of e_1) such that:
  for every $e \in C(e_2)$: $\tau(e)=\tau(\mu(e))$.

Culminations and incremental chains

- The **culmination** is the final minimal event in an incremental process. It is the event which is the final part of a BECOME event; the upper bound of the BECOME event. The argument of the culmination event is the argument of the BECOME event (i.e. the affected object or theme).
- Let e be a BECOME event.
  An **incremental chain** C(e) is a set of parts of e such that:
  1. the smallest event in C(e) is the initial bound of e
  2. for every e_1,e_2 in C(e) $e_1 \sqsubseteq e_2$ or $e_2 \sqsubseteq e_1$
  3. $e \in C(e)$

Culminations and incremental chains (cont.)

- Let C(e) be an incremental chain in e.
  ub(C(e))={ub(e'): e' $\in$ C(e)} (the set of upper bounds)
  The **culmination** of e is defined as follows:
  $\mathrm{Cul}(e)_{def}$=ub(e).

- $\mathrm{Cul}_{C(e2)}(e_1)$=ub({$\mu$(e): e $\in$ C(e_2)})

Telicity

The distinguishing property between telic and atelic event types is the property of **S-cumulativity**, which holds if two events of the same type can be summed to form a singular (singleton) event.

- X is **S-cumulative** iff:
  $\exists e \exists e'[X(e) \wedge X(e') \wedge \neg e \sqsubseteq e' \wedge \forall e \forall e'[X(e) \wedge X(e') \wedge R(e,e') \rightarrow X^S(e \sqcup e')]]$
- *In words*: X is S-cumulative if it is not a singleton predicate, and if for any two elements x and y in X which stand in the appropriate relation, the singular element which is formed out of the sum of x and y is also in X.

S-cumulativity: examples

- Two activity events of running, if they are temporally adjacent and involve the same participants, can be viewed as one event of running and so an event of running is S-cumulative.
- Two accomplishment events of e.g. drawing a circle cannot refer to a single event if they involve the same participants and are temporally adjacent, since it would rather involve a re-drawing of the same circle (i.e. the circle would be drawn at least twice).

Telicity principle

A VP is telic if it denotes a set of events X which is atomic, or which is a pluralisation of an atomic set (i.e. if the criterion for individuating an atomic event in X are fully recoverable).

- A change from α to β determines an atomic function.
- An event of change from $\neg\phi$ to ϕ is a minimal event of change, which is associated with achievements.

- An accomplishment is an extended event of change from ψ to ϕ, which takes place over an interval which is long enough to get from ψ to ϕ, and which is 'held together' by an incremental chain, as defined in the previous section.

Telicity principle (cont.)

- Accomplishments and achievements are definite changes from $\neg\phi$ to ϕ (achievements) or from ψ to ϕ where ψ always entails $\neg\phi$ (accomplishments).
- Such changes determine an atomic function: The events involved are telic by default unless additional factors (such as a mass or bare plural internal argument) play a role.
- Only if the verb is already specified as being composed of atomic segments (i.e. if it is a lexical accomplishment), particular properties of the internal argument can induce telicity.

Some syntactic issues concerning event structure

Syntactically complex events, in particular accomplishments that are created syntactically by adding a non-verbal secondary resultative predication.

(8) *Secondary resultative predicates*

a. He took off his hat.
b. She hammered the metal flat.
c. They danced into the house.

(9) *Non-resultative secondary predicates*

a. She ate the fish raw.
b. He walked towards the store / along the river.

Secondary predication

- The main and the secondary predicate together form a complex predicate (semantically), which specifies a single event.
- Simpson's Law (Simpson, 1983): The external argument of the secondary predicate functions as the internal argument of the verbal predicate.
- A secondary predicate can license this argument even if it is not licensed by the verb, which is not possible with secondary depictive predicates.

(10) She drank him under the table.

Syntax of secondary predication

- **Small clause approaches:**
  Focus on the close tie between an argument of the verb and the secondary predicate.
  (e.g. Stowell, 1981; Chomsky, 1981; Kayne, 1985; den Dikken, 1995; von Stechow, 1995, 1996; Doetjes, 1997; Beck, 2005).
- **Complex predicate approaches:**
  Stress the close connection between the two predicates, i.e. between the verb and the secondary non-verbal predicate (e.g. the particle or the adjective).
  (e.g. Williams, 1980; Baker, 1988; Johnson, 1991; Neeleman, 1994; Ackema, 1995; Zeller, 2001)

Small clause approach

Hoekstra (1988, and subsequent work): The verb takes a **small clause** (SC) complement with all change-of-state or position verbs, also where no overt secondary predicate is visible.

- The SC complement denotes the (path towards an) end-state of the (deep) object: $[_{SC}$ DP ... PRED]
- The DP in subject position of the SC is combined with some XP (e.g. AP or PP), which it is the subject of.
- From a semantic point of view, the denotation of this XP (AP or PP) is predicated over its subject, so that it is a secondary predicate in addition to the verbal predicate.

Two versions of SC approaches

SC analyses come in two main versions, depending on the nature of the subject of the SC.

- **Control**: The subject of the SC is filled by a PRO which is bound by the object of the VP (von Stechow, 1995; Beck, 2005)
- **Raising**: The DP in subject position of the SC (Spec SC) raises and moves to some argument position within the VP (Hoekstra, 1988; den Dikken, 1995; Doetjes, 1997).

Control versions

- capture the fact that the subject of the secondary predicate is identical to the internal argument of the verbal predicate: It is the argument which controls the PRO-subject of the SC.
- One problem of the control analysis: The internal argument of the verbal predicate often does not play the same thematic role in secondary resultative predicates:

(11) a. She drank a glass of water.
b. She drank her brother under the table.

Raising analyses

- capture the fact that the internal argument is always the subject of the secondary predicate but not always the object of the verbal predicate, which can then play a different role in the resultative version.
- do not capture directly that it is not just any random e.g. hammering event that brings about the state of the metal being flat, at least not when combined with the SC structure above.

  Session 5: A raising approach enables an analysis of intransitive motion verbs that combine with a directional PP in terms of secondary resultative predication, where an argument of the PP (the subject of the SC) raises to the subject position of the verb.

Semantic approaches with SCs

e.g. von Stechow (1995); Beck (2005): combine the SC analysis with an event semantic reformulation of Dowty's (1979) approach to the decomposition of predicates

- Sally hammered the metal flat.
  [[the metal] [$_1$[$_{VP}$ Sally [$'_V$ t$_1$ [$'_V$ hammered [$_{SC}$ PRO$_1$ flat]]]]]]
- [$_{V'}$ hammered [$_{SC}$ PRO$_1$ flat]] $\rightarrow$
  λxλyλe.hammer$_e$(x)(y) & $\exists$e'[BECOME$_{e'}$(λe".flat$_{e''}$(x$_1$)) & CAUSE(e')(e)]

Problems with SC approaches

- The phrase associated with the secondary predicate is treated as a separate clause, but it does not behave like a separate clause:
  - Resultatives always involve direct causation, which is a general trait of clause union. SC approaches cannot exclude indirect causation.
  - Alleged SCs do not pass constituency tests and do not behave like other constructions which are analysed as SCs (e.g. ECM constructions).
  - The verb and the secondary predicate behave like a a constituent.

(see Neeleman and van de Koot, 2002, for relevant data)

Complex predicate approaches

The verb and the secondary predicate form a complex head and jointly predicate over the argument(s).

- Complex predicates in syntax: Modification facts
  He hammered the metal ***completely*** *flat*.
- Complex predicates in other components:
  e.g. Neeleman and Weerman (1993): Parametric variation
  - English verb-particle constructions: complex predicates in syntax
  - Dutch verb-particle constructions: complex predicates in morphology

Neeleman and van de Koot (2002)

- External arguments are generated outside the maximal projection of the predicative head.
- Predication is possible in the projection of any head.
  - The external argument of a verb is generated not internally to V but in Spec, vP.
  - The external argument of a secondary predicate is generated in Spec, VP or Spec, vP (the latter is only possible with depictives).

Depictives

Depictive secondary predicates: adjuncts that can be adjoined to either VP (12) or vP (13)

(12) $[_{\mathrm{v}}$ John $[_{\mathrm{v}}$ met-v $[_{\mathrm{V}}$ Mary $[_{\mathrm{V}}$ t_v drunk$_A$]]]]

→ Its external argument is the DP in Spec, VP (the internal argument of the verb).

(13) $[_{\mathrm{v}}$ John $[_{\mathrm{v}}$ $[_{\mathrm{v}}$ met-v $[_{\mathrm{V}}$ Mary]] $[_{\mathrm{V}}$ t_v drunk$_A$]]

→ Its external argument is the DP in Spec, vP (the external argument of the verb).

Resultatives

Resultative secondary predicates: form a complex predicate with the verb; together as one predicate they select an object.

(14) $[_{\mathrm{v}}$ The cat $[_{\mathrm{v}}$ miaows-v $[_{\mathrm{V}}$ Frank $[_{\mathrm{v}}$ t_V awake$_A$]]]]

- The complex predicate inherits properties of both predicates.
  - Complex predicate formation preserves the semantic argument structure of both predicates and amalgates them into one syntactic argument structure by various operations (e.g. argument suppression, theta identification, late mapping and others).

Compositionality issue with resultatives

(15) Boban hammered the metal flat. [ACC]

a. *hammer*: activity
b. *flat*: state

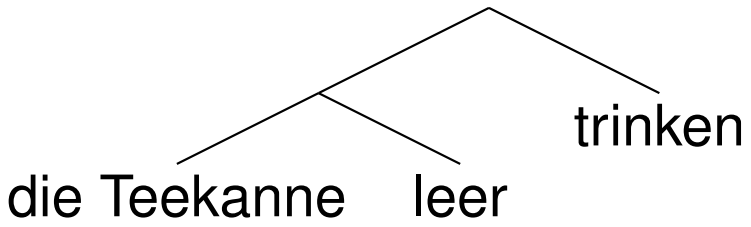
Different proposal how to link activities with secondary predicates into a complex accomplishment event:

- Something extra is added to the semantic and/or syntactic structure.
- Semantic type shift operation

Kratzer (2004): Building resultatives

- An argument of the resultative predicate becomes a derived internal argument of the verb through raising (to receive case).
- *Claim*: Only verbs that lack an internal argument (are unergative or can be used intransitively).

(16) die Teekanne leer trinken
the teapot empty drink
'to drink the teapot empty' GERMAN



The adjective forms a compound with the verb through head movement.

Causation

- **Bittner's Generalisation**: If a causal relation is syntactically concealed (only its arguments are overtly expressed), then it is semantically direct (no intermediate causes).
- **Direct causation:**
  c is an event of *causing* other events iff c is the sum of all the members of some causal chain with maximal element e
- **Intermediate causation:**
  c is an event that *causes* other events iff c is the minimal element of some causal chain with maximal element e

The semantic composition

- Generally available semantic composition operations:
  - functional application, predicate abstraction, predicate conjunction operations (e.g. event identification)
- Event identification does not to work: Two eventualities of different kinds (state, activity) have to be combined; A state cannot be an activity at the same time.
- First try: Resultatives involve a causative shift
  - $P_{<st>} \Rightarrow \lambda e_s \exists e_s$ [state(s) & event(e) & P(s) & CAUSE(s)(e)]

Causative shift & event identification

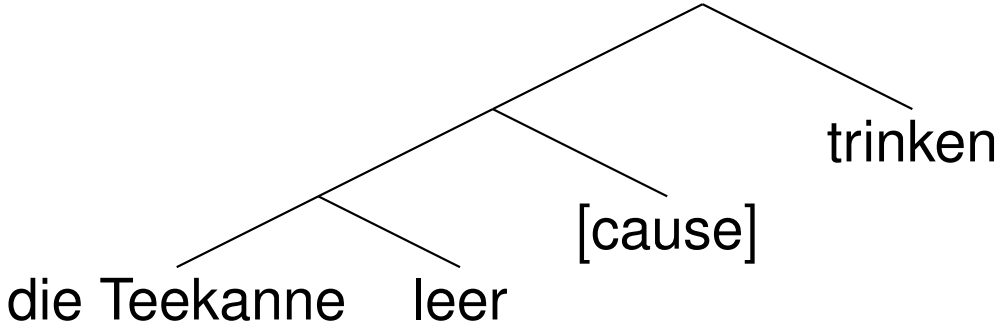
(17) $\lambda e_s \exists s_s$ [action(e) & drink(e) & state(s) & empty(the teapot)(s) & CAUSE(s)(e)]

- CAUSE defined as direct causation: s
  - Solves the problem that it is not just any random drinking event that causes the state of the teapot being empty.
  - The activity of drinking is identified with a 'completed event of causing the teapot to be empty [...] if an action of drinking is identical to a completed action of causing the teapot to be empty, then what was drunk is bound to be the content of the teapot' (Kratzer, 2004, 29).

Problems with the causative shift

- The causative shift adds lexical meaning which is an illegitimate type shift operation in a 'restrictive systems of composition principles' (Kratzer, 2004, 32).
- Second try: **Causative morpheme** in resultatives
  T([cause]) = $\lambda P_{<st>} \lambda e_s \exists s_s$ [state(s) & event(e) & P(s) & CAUSE(s)(e)]
  The feature [cause] introduces an event argument but not other arguments.

The complete derivation

- 

  - Merge *leer* STAGE 1
    Merge *die Teekanne*
    Interpretation: Combine the translations of *die Teekanne* and *leer*:
    λs empty(the teapot)(s)

The complete derivation (cont.)

- Merge [cause] STAGE 2
  Interpretation: Combine the translations of [cause] and its sister node:
  λe$\exists$s [empty (the teapot)(s) & CAUSE(s)(e)]
  Head movement: [cause] attracts *leer* to satisfy its affixal need
- Merge *trinken* STAGE 3
  Interpretation: Combine the translation of *trinken* and its sister node:
  λe$\exists$s [empty (the teapot)(s) & drink(e) & CAUSE(e)(e)]

Need of complex predicate formation

- To ‘eliminate an illicit embedding configuration via ‘clause union”
- This results in overt or covert head movement adjoining *leer*+[cause] to the left of *trinken*.

  ‘The adjective’s object needs case, and this prevents the verb from taking a direct object of its own. The adjective’s object becomes the joint object of the verb-adjective pair. Being unergative, the verb can’t embed the phrase projected by its adjectival mate. This forces clause union, and a complex predicate is born. Both parties have to pay a price, though. The verb can’t be transitive or unaccusative. The adjective must be bare.’ (Kratzer, 2004, 46)

Beck (2005)

(Building on von Stechow, 1995, 1996)

- $[_{V'}$ hammered $[_{SC}$ PRO_1 flat]] $\rightarrow$ $\lambda x \lambda y \lambda e.hammer_e(x)(y)$ & $\exists e'[\textsc{become}_{e'}(\lambda e''.flat_{e''}(x_1))$ & $\textsc{cause}(e')(e)]$
- The transitive verb *hammer* looks for an argument of type e but finds instead a propositional category (the SC).
- A special principle of interpretation, Principle (R), solves this type mismatch.

Principle (R)

(18) If α=[$_{V\gamma SC}\beta$] and β' is of type <i,t> and γ' is of type <e, ... <e,<i,t>>> (an n-place predicate), then
$\alpha' = \lambda x1 \ldots \lambda xn \lambda e.\gamma'_e(x1) \ldots (xn)$ & $\exists e'$ [BECOME$_{e'}(\beta')$ & CAUSE(e')(e)]

- This principle combines a verb and a SC by inserting a CAUSE BECOME component.
- The resultative is true iff an event of the kind denoted by the verb causes a becoming of the small clause proposition.

Accomplishments in Beck's system

- Syntactically derived accomplishments, e.g. resultatives
  - [[the metal] [$_1$[$_{VP}$ Sally [$_{V'}$ t$_1$ [$_{V'}$ hammered [$_{SC}$ PRO$_1$ flat]]]]] $\rightarrow$ λe.hammer$_e$(the_metal)(y) & $\exists$e'[BECOME$_{e'}$(λe".flat$_{e''}$(the_metal)) & CAUSE(e')(e)]
    Sally's hammering the metal caused it to become flat.
- Lexical accomplishments (associated with the verbal predicate)

  open$_{TV}$ = open$_{Adj}$ + BECOME + CAUSE
  $\oslash_V \rightarrow \lambda p \lambda x \lambda e.\exists P[P_e(x)$ & $\exists e'$[BECOME$_{e'}$(p) & CAUSE(e')(e)]

Lexical accomplishment: Full analysis

(19) Sally opened the door.

a. $[_{VP}$ Sally $[\oslash_V$ $[_{SC}$ open$_{Adj}$ [the door]]]] >
$[_{VP}$ Sally $[[\oslash$ + open$_{Adj}]_V$ $[_{SC}$ t [the door]]]]

b. λe.$\exists$P[P$_e$(Sally) & $\exists$e'[BECOME$_{e'}$(λe*.open$_{e\star}$(the_door)) & CAUSE(e')(e)]

There was an action of Sally's which caused the door to become open.

Rothstein (2003, 2004)

- Integrating a secondary resultative predicate: Specifying culminations or properties of culminations.
- A secondary resultative predication provides the possibility to measure quantities of an activity.
- When a secondary resultative predicate is combined with an activity, it allows the construction of a BECOME event which stands in an incremental relation with the activity.

Secondary predication

Secondary predicates introduce a new event.

- *Depictives*: He drinks his coffee **black**.
- *Resultatives*: She hammered the metal **flat**.

The new events: states associated with the coffee being black and the metal being flat.

Summing of subevents

- A summing operation treats the two events as subevents of a single macroevent.
- Constraint on the summing operation with secondary predicates (depictives and resultatives):
  - Time-participant connectedness (TPCONNECT)
  - Both events share a participant and the run time of the first event has to be the same as the run time of the second event
  - TPCONNECT(e_1, e_2, y) iff:
    (i) $\tau(e_1) = \tau(e_2)$ (i.e. the run time of e_1 is the same as the run time of e_2);
    (ii) e_1 and e_2 share a participant y.

Summing of subevents (cont.)

- Depictives: TPCONNECT holds between e_1, e_2 and one of the arguments of the main predicate.
- Resultatives: TPCONNECT holds between the culmination of the first event Cul(e_1) and e_2.
  - Since the culmination of an accomplishment predicate is assumed to be determined by what happens to its theme, this is the participant that has to be shared.
  - RSUM $[\alpha, \beta] = \lambda y \lambda e. \exists e_1, \exists e_2\ [e = {}^{S}[e_1 \sqcup e_2] \wedge \alpha\ (e_1, y) \wedge \beta\ (e_2, y) \wedge$ TPCONNECT $(\mathrm{Cul}(e_1), e_2, y)]$

Resultatives with lexical accomplishments

(20) Mary painted the house red.

- The resultative rule cannot itself ‘add’ a culmination.
- A lexical accomplishment can combine with a secondary resultative predicate, and this predicate does not specify the culmination itself (which is already lexically supplied), but ascribes a property to the culmination.

Resultatives with lexical activities

(21) Mary hammered the metal flat.

- The grammar must allow to ‘add’ a culmination to an activity.
- The resultative predication operation can trigger an aspectual type-shifting operation which adds a culmination to an activity.

Accomplishment shift with resultatives

$$\textsc{shift}(\lambda y \lambda e.\textsc{activity}_{<x>}(e) \wedge Ag(e)=x \wedge Th(e)=y)$$
$$= \lambda y \lambda e.\exists e_1,e_2[e=^{S}(e_1 \sqcup e_2) \wedge \textsc{activity}_{<x>}(e_1) \wedge Ag(e_1)=x \wedge Th(e_1)=y$$
$$\wedge \textsc{become}_{<y>}(e_2) \wedge Arg(e_2)=y$$
$$\wedge \textsc{incr}(e_1,e_2,C(e_2))]$$

- Adding a culmination to an activity involves imposing a developmental (incremental) structure on the activity.
- Since states cannot have a developmental structure resultative secondary predication is correctly predicted to be impossible with states, and the verb expressing the main predicate is necessarily at least an activity.

Problems of overgeneration

Problem with Kratzer (2004), Beck (2005):

- They do not spell out conditions under which secondary predicates can be integrated as resultatives and derive accomplishments.
- They take the fact that the overall structure is associated with this interpretation as a given and postulate that therefore there has to be a causative morpheme or a SC structure.
- It is not clear what actually regulates the availability of this causative morpheme or whether there are any restrictions on Principle (R) to work other than an underlying SC structure.

Some problems for Kratzer's account

In Kratzer's system the internal argument and the secondary resultative are in complementary distribution, and the shared argument starts out as an argument of the secondary predicate. This predicts that only verbs lacking an internal argument can combine with secondary resultative predicates.
But: there are obligatorily transitive verbs that allow resultatives and where the shared argument plays the same semantic role with or without the resultative (e.g. *hammer the metal flat*).

Problems of Rothstein's account

- It is not necessarily the internal argument of the verb that is the argument of the secondary predicate.
- Rothstein's approach does not allow to integrate certain verb-PP combinations into the account, which pattern with resultatives in many respects.
- The external argument of the secondary predicate can become a derived internal argument of the verb when both predicates are combined into one complex predicate.
  - This will allow us to integrate particular verb-PP constructions as well.

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