Compositionality and the Theory of Argument Selection

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Lecture 4. Static vs. Dynamic Typing

Stateless and Event-based Selection

(1)a. Stateless Selection: Selection is performed independent of the operation performed over the argument. Selection is without state information.

b. Event-based Selection: Selection is performed over a trace of the operation performed over the argument. Selection is sensitive to the states the argument participates in.

Event Structure Encoding Change

(2) LEXICAL CLASSES OF CHANGE
(LEVIN, 1993)

a. CREATION AND TRANSFORMATION: build, assemble, bake, cook, construct, design.

b. DESTRUCTION: destroy, annihilate, decimate, demolish, ruin, wreck.

c. CHANGE OF STATE: break, crack, crush, rip, tear, bend, fold, cook, bake, boil.

d. CALIBRATABLE CHANGE OF STATE: climb, decline, decrease, fall, drop, increase, jump.

Qualia Structure for Causatives

$$\begin{bmatrix} \textbf{kill} \\ \text{EVENTSTR} = \begin{bmatrix} \text{E}_1 = \textbf{e}_1\textbf{:process} \\ \text{E}_2 = \textbf{e}_2\textbf{:state} \\ \text{RESTR} = <_\alpha \\ \text{HEAD} = \textbf{e}_1 \end{bmatrix} \\ \text{ARGSTR} = \begin{bmatrix} \text{ARG1} = \boxed{1}\begin{bmatrix} \textbf{ind} \\ \text{FORMAL} = \textbf{physobj} \end{bmatrix} \\ \text{ARG2} = \boxed{2}\begin{bmatrix} \textbf{animate\_ind} \\ \text{FORMAL} = \textbf{physobj} \end{bmatrix} \end{bmatrix} \\ \text{QUALIA} = \begin{bmatrix} \textbf{cause-lcp} \\ \text{FORMAL} = \textbf{dead}(\textbf{e}_2, \ \boxed{2}\ ) \\ \text{AGENTIVE} = \textbf{kill\_act}(\textbf{e}_1, \ \boxed{1}\ , \ \boxed{2}\ ) \end{bmatrix} \end{bmatrix}$$

Event Decomposition and Linking Theory
(Pustejovsky, 1995)

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a. Event Headedness: A way of indicating a foregrounding and backgrounding of sub-event. The arguments of a headed event must be expressed.

b. Argument Covering: An argument x is covered only if:

(i) x is linked to a position in s-structure; or

(ii) x is logically bound to a covered argument y; or

(iii) x is existentially closed by virtue of its type.

c. Qualia Saturation: A qualia structure is saturated only if all arguments in the qualia are $covered$.

Event Decomposition in GL

(3)a. Q_i: $R(e_1^*, x, y) \longrightarrow x$:SUBJ, y:OBJ

b. Q_j: $P(e_2, y) \longrightarrow$ shadowed

(4)a. Q_i: $R(e_1, x, y) \longrightarrow$ shadowed

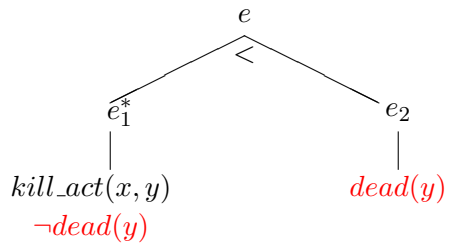
b. Q_j: $P(e_2^*, y) \longrightarrow y$:SUBJ

Qualia Structure with Opposition

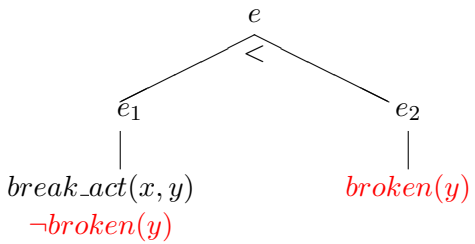
$$
\begin{bmatrix}
\textbf{kill} & \\
\text{EVENTSTR} = & \begin{bmatrix}
E_0 = \mathbf{e_0}\textbf{:state} \\
E_1 = \mathbf{e_1}\textbf{:process} \\
E_2 = \mathbf{e_2}\textbf{:state} \\
\text{RESTR} = <_{\propto} \\
\text{HEAD} = \mathbf{e_1}
\end{bmatrix} \\
\text{ARGSTR} = & \begin{bmatrix}
\text{ARG1} = \boxed{1} \begin{bmatrix} \textbf{ind} \\ \text{FORMAL} = \textbf{physobj} \end{bmatrix} \\
\text{ARG2} = \boxed{2} \begin{bmatrix} \textbf{animate\_ind} \\ \text{FORMAL} = \textbf{physobj} \end{bmatrix}
\end{bmatrix} \\
\text{QUALIA} = & \begin{bmatrix}
\textbf{cause-lcp} \\
\text{FORMAL} = \textbf{dead}(\mathbf{e_2}, \boxed{2}) \\
\text{AGENTIVE} = \textbf{kill\_act}(\mathbf{e_1}, \boxed{1}, \boxed{2}) \\
\text{PRECOND} = \neg\textbf{dead}(\mathbf{e_0}, \boxed{2})
\end{bmatrix}
\end{bmatrix}
$$

Opposition Structure: Predicate Decomposition

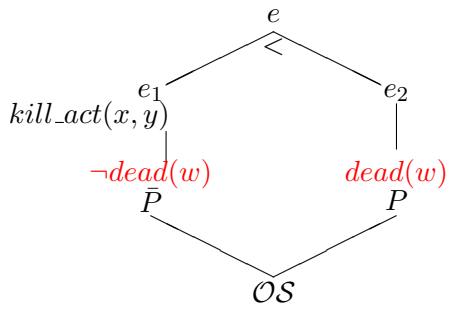
(5) kill

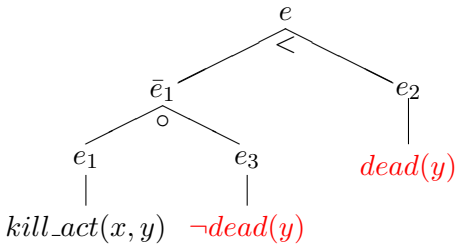


(6) break



Opposition is Part of Event Structure

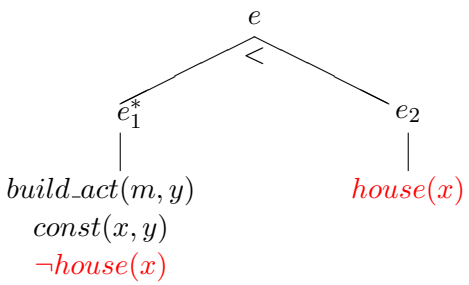




Dynamic Descriptions

What happens when the description of the argument does not properly hold throughout the event?

(7) build a house



Selecting for Change

(8)a. Mary broke the glass.

b. John built a house.

c. The child ate a cookie.

(9)a. The father comforted the crying child.

b. The woman on the boat jumped into the water.

c. Mary rescued the drowning man.

(10)a. Mary repaired every leaky faucet in the house.

b. John mixed the powdered milk into the water.

c. Nicholas fixed the flat.

Event Persistence Structure

(11) DISPLACED TEMPORAL REFERENCE

a. The President was born in 1946.

b. Tom met his wife in 1988.

c. All rich men were obnoxious children.

Tracking Descriptions in Discourse

(12)a. John escaped from the police.

b. The man escaped from the police.

c. The prisoner escaped from the police.

(13) *passenger*, *pedestrian*. *victim*

(14) DISCOURSE EPITHETS

a. Five prisoners have escaped from Huntsville Prison.

b. [. . .] The escaped prisoners are hiding out in the woods around Crawford.

(15) The audience$_i$ left the music hall.

(16)a. $*$It$_i$ then went home.

b. They$_i$ then went home.

c. It$_i$/They$_i$ had just heard Bernard Haitink's last performance.

Coherent Event Descriptions

(17)a. John comforted the crying child.

b. Cathie mended the torn dress.

(18)a. The plumber fixed every leaky faucet.

b. The plumber fixed every blue faucet.

(19)a. !Mary cleaned the clean table.

b. !John built the built house.

c. !John drank the empty glass of milk.

What Changes and What Doesn't

(20)a. Mary was hired as lecturer on Tuesday.

b. Mary painted the house green.

c. Mary showered and dried herself off.

(21)a. Situations: s, how the world may be described;

b. Fluents: f, time-varying properties of individuals;

c. Actions: a, operators that change the value of fluents.

(22)a. Effect Axioms: take into account the preconditions of an action for it to happen;

b. Frame Axioms: take into account what does not change with an action

c. Order of $f \times a$ frame axioms for a given domain.

Tense Interpretation

Tense is a function over event descriptions, $\mathcal{E}$, which are of type $e^{\sigma} \rightarrow t$, and is itself of type $(e^{\sigma} \rightarrow t) \rightarrow t$. The anchoring relation $anch$ embeds an event within an interval structure (Pustejovsky, 1995).

(23) $[\![Tns_{\alpha}]\!] = \lambda\mathcal{E}\exists i\exists e[\alpha(i,n) \wedge anch(i,e) \wedge \mathcal{E}(e)]$

English tenses where n is Kamp's now operator:

(24)a. $[\![PAST]\!] = \lambda\mathcal{E}\exists i\exists e[i \leq n \wedge anch(i,e) \wedge \mathcal{E}(e)]$

b. $[\![FUT]\!] = \lambda\mathcal{E}\exists i\exists e[n \leq i \wedge anch(i,e) \wedge \mathcal{E}(e)]$

c. $[\![PRES]\!] = \lambda\mathcal{E}\exists i\exists e[i \subseteq n \wedge anch(i,e) \wedge \mathcal{E}(e)]$

Tense and Ordering in Discourse

(25)a. Sophie$_i$ walked in wet.

b. Cathie dried her$_i$ off.

(26) a. $\exists i_1 \exists e_1 [wet(e_1, s) \wedge anch(i_1, e_1)]$

b. $\exists i_2 \exists e_1 [dry(e_2, s) \wedge anch(i_2, e_2)]$

c. $i_1 \leq i_2$

(27)a. Sophie's hamster$_i$ died today.

b. He$_i$ had been sick.

(28) a. $\exists i_1 \exists e_1 [die(e_1, oreo) \wedge anch(i_1, e_1) \wedge i_1 \leq n]$

b. $\exists i_2, i_3 \exists e_1 [sick(e_2, oreo) \wedge anch(i_2, e_2) \wedge i_2 \leq i_3 \wedge i_3 \leq n]$

c. $i_2 \leq i_1$

(29)a. John$_i$ walked in.

b. He$_i$ sat down.

(30) a. $\exists i_1 \exists e_1 [walking(e_1, j) \wedge anch(i_1, e_1)]$
$\models \exists i_1 \exists e_1 [standing(e_3, j) \wedge anch(i_1, e_3)]$

b. $\exists i_2 \exists e_2 [sitting(e_2, j) \wedge anch(i_2, e_2)]$

c. $i_1 \leq i_2$

Argument Selection and Argument Description

For a description, D, in a situation, s, with the application of an action, a, D can be characterized in one of two ways:

- Persistent Description: The descriptive force of D in s holds persistently throughout the action, a;
- Dynamic Description: The descriptive force of D in s is altered by virtue of the action, a, rendering D unsatisfiable with the resulting situation, s'.

Principles of Adjectival Selection

Every Phrase, X, occurring as modifier to a head, N, is associated with a specific quale for N. If X modifies:

i. FORMAL: then the event corresponds to overlap, '$\circ$', with the head N;

ii. TELIC: then the event corresponds to either '$>$' relation or a generic interpretation. $\circ_g$;

iii. AGENTIVE: then the event corresponds to the '$<$' relation relative to N;

iv. CONST: then the event corresponds to overlap, '$\circ$', relation with the head N.

(31)

Adjective	Qualia Selection
well-built	Agentive
unbaked	Agentive
red	Formal
stone	Constitutive
wooden	Constitutive
useful	Telic
carved	Agentive
effective	Telic
fast	Telic
heavy	Formal
dense	Const
large	Formal

Table of Qualia Selection Properties

(32)a. a well-built (A_1) house ($[F, C, A_1, T]$)

b. a two-story (F_1) house ($[F_1, C, A, T]$)

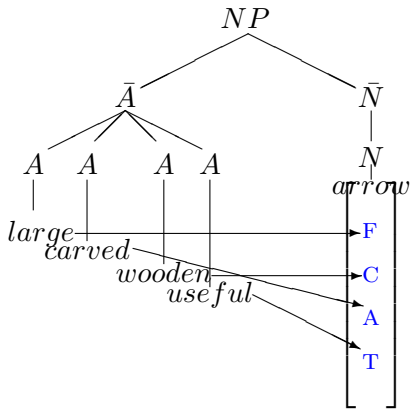
c. a vacation (T_1) house ($[F, C, A, T_1]$)

d. a brick (C_1) house ($[F, C_1, A, T]$)

(33)a. a large carved wooden useful arrow

b. a large (F_1) carved (A_2) wooden (C_3) useful (T_4) arrow
($[F_1, C_3, A_2, T_4]$)

(34)



Events and the Arguments they Select

(35) a. John kissed Mary.

b. $\exists e[kiss(e, j, m)]$

c.

(36) Mary broke a glass.

(37) a. $\exists i_0 \exists e_0 [breaking(e_0) \wedge anch(i_0, e_0)]$

b. $\exists x \exists e_1 \exists e_2 [glass(x) \wedge \neg broken(e_1, x) \wedge broken(e_2, x) \wedge e_1 < e_2]$

c. $\exists i_1 \exists i_2 [anch(i_1, e_1) \wedge anch(i_2, e_2)] \wedge i_1 < i_2$

d. $i_1 \subseteq i_0, i_2 \subseteq i_0$

e.

$$\overbrace{\exists x \overbrace{glass(x)}^{break\_act} \quad \overbrace{\neg glass(x)}^{broken}}^{John}$$

(38) a. John died.

b. $\exists i_0 \exists e_0 [dying(e_0) \wedge anch(i_0, e_0)]$

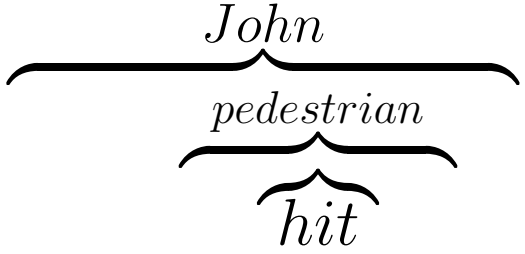
c. $\exists e_1 \exists e_2 [alive(e_1, j) \wedge dead(e_2, j) \wedge e_1 < e_2]$

d. $\exists i_1 \exists i_2 [anch(i_1, e_1) \wedge anch(i_2, e_2)] \wedge i_1 < i_2$

e. $i_1 \subseteq i_0, i_2 \subseteq i_0$

(39) a. John hit a pedestrian.

b.



(40) a. $\exists x, e_1[john(e_1, x) \wedge anch(i_0, e_1)]$

b. $\exists y, e_1[pedestrian(e_2, y) \wedge anch(i_1, e_2)]$

c. $\exists e_3[hitting(e_3, x, y) \wedge anch(i_2, e_3)]$

d. $i_2 \subseteq i_1 \subseteq i_0 \wedge i_2 < n$

Types of Opposition

(41)a. Bill is healthy

a'. Bill is not healthy.

b. Bill is sick.

b'. Bill is not sick.

(42)a. Jan is male.

a'. Jan is not male.

b. Jan is female.

b'. Jan is not female.

Types of Opposition: II

(43)a. For a binary predicate, P, the opposition is $\neg P$.

b. If the language lexicalizes both forms, then $\langle P, \neg P\rangle$, $\langle P, Q\rangle$, $\langle \neg Q, Q\rangle$.

c. For a binary adjective, $\lambda x \lambda e[dead(e, x)]$ is equivalent to $\lambda x \lambda e[\neg alive(e, x)]$.

(44)a. Polar Opposites over Scale: $sick/healthy$ and $tall/short$:

b. defined in terms of a sortal array with distinguished elements.

Principle of Sortal and Property Inertia

(45) 1. A sortal fluent f_S is not affected by the matrix predicate, unless explicitly asserted by the predication in the sentence.

2. A property fluent f_D is not affected by the matrix predicate, unless explicitly asserted by the predication in the sentence.

(46) a. $\lambda x \lambda e[man(e, x)]$

b. $\lambda x \lambda e[rock(e, x)]$

c. $\lambda x \lambda e \lambda e'[fall\_act(e', x) \wedge fall\_result(e, x) \wedge e' < e]$

Computing Event Persistence Structure

(47)a. The Principle of Inertia; objects and their properties tend to remain as they are unless explicitly affected;

b. Qualia Selection Thesis; modifiers selectively bind to specific qualia of the head noun.

(48)a. Assign each predicate an event description; $\{\delta_i\}$. The set of event descriptions will be referred to as Δ.

b. We denote the event description assigned to the matrix predicate of the clause, P, as the *core event*

structure.

Given Δ, and the construction of the core event structure, for each event-denoting predicate in the expression, we apply a single test, *gate*, defined as follows.

(49)a. GATE: For an event description, $\delta \in \Delta$, in the domain of the matrix predicate P, δ is *gated* by P only if the property denoted by δ is either *initiated* or *terminated* by successful assertion of P.

b. PERSIST: If δ is not gated, then it is said to *persist* relative to the matrix predicate, P.

(50)a. Associate each event description to the event introducing it.

b. If an event description does not take wide scope (such as all those that are gated), then it is narrow scope, and is associated only with the appropriate subevents.

c. All persisting events are factored out of the expression in the event structure. They will be said to take wide $persistence$ scope (p-scope) over the event description.

Examples of Event Persistence Structure

(51)a. The argument persists;

b. The head of the argument does not persist;

c. The head of the argument persists, but there are properties of the head introduced by predication that do not persist.

d. The head of the argument persists, but there are inherent properties of the head expressed in the referring expression that do not persist.

(52)a. Mary saw John.

b. A man sat on a bench.

(53)a. Mary built a house.

b. Mary ate a cookie.

(54)a. John closed the door.

b. Mary cleaned the table.

c. John painted the house.

d. A man sat down on a bench.

(55)a. People filled the empty hall.

b. Mary cleaned the dirty table.

(56)a. Mary fixed the tire.

b. Mary fixed the flat tire.

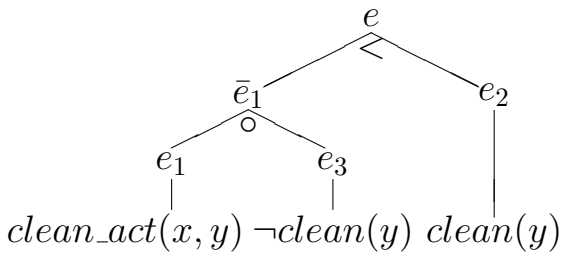
Example 1

(57) Mary cleaned the table.

(58) $\Delta = \{$mary(e_1,x), table(e_2,y), clean_act(e_3,x,y),
¬clean(e_4,y), clean(e_5,y)$\}$

From Δ, we construct an event structure associated with the matrix predicate of the sentence, shown in (97):

(59)

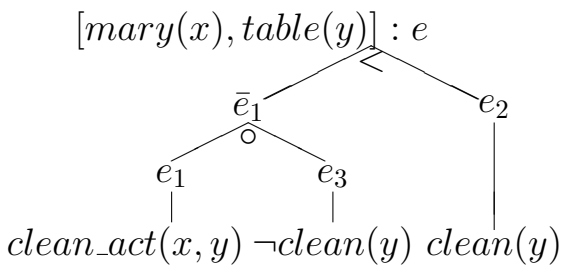


Then we apply the operation $gate$:

(60)a. $gate$(mary) fails;

b. $gate$(table) fails;

(61)



Example 2

(62) Mary cleaned the dirty table.

(63) $\Delta = \{$mary(e_1,x), table(e_2,y), clean_act(e_3,x,y),
¬clean(e_4,y),
clean(e_5,y), dirty(e_6,y)$\}$

Again, we apply the operation $gate$:

(64)a. $gate$(mary) fails;

b. $gate$(table) fails;

c. $gate$(dirty) succeeds;

There are two opposition structures for an adjective like *dirty*:

(65)a. $\langle dirty, \neg dirty \rangle$: Binary opposition

b. $\langle dirty, clean \rangle$: Polar opposition

(66)