

Argument structure as soft constraints

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For there exists a great chasm between those, on the one side, who relate everything to a single central vision, one system more or less coherent or articulate, in terms of which they understand, think and feel — a single, universal, organizing principle in terms of which alone all that they are and say has significance — and, on the other side, those who pursue many ends, often unrelated and even contradictory, connected, if at all, only in some de facto way, for some psychological or physiological cause, related by no moral or aesthetic principle.

Berlin (1997:436),
cited by Minsky (1975)

1 Introduction

- (1) In search of a theory of lexical semantics that ...
 - a. ...can represent both hard and soft constraints, in some cases, at least, as different points on a continuum.
 - b. ...can accommodate semantic classes that bear only a statistical relation to certain valence choices (Bresnan et al. 2005).
 - c. ...can accommodate a 2-way interaction between distributional and semantic facts. [use determines meaning and meaning determines use]
 - d. ...is liberated from reducing an open class of concepts to a “language of thought”.

- (2) Soft semantic constraints (Bresnan et al. 2005)
 - a. ?Mary gave a headache to John.
 - b. Design? Well, unless you take pride in giving a headache to your visitors with a flashing background, no.

1.1 Problems for the language of thought view

Splits (Polysemy)

- (3) a. John rolled the ball to/under/past Mary. [caused motion (cm)]
 b. John rolled Mary the ball. [possession transfer (pt)]
 c. #John sent/gave London a letter. must be “London office” (Green 1974)
 d. John sent/# gave a letter to London. “give” retains animacy restriction, even in cm valence.
- (4) Polysemy analysis *discussed* in Hovav and Levin (2005) (cited in Beavers and Francez (2008))
 a. [x CAUSE [y HAVE z]] (**Lexical Conceptual Structure** for possession transfer)
 b. [x CAUSE [z GO TO y]] (LCS for caused motion)
- (5) A problem for the polysemy analysis (Hovav and Levin 2005, Beavers and Francez 2008)
 a. Doesn’t explain why *give* retains its transfer of possession animacy restriction in the cm-valence (3d).
 b. Nevertheless still needed for *send* (3c)!
- (6) Caused Movement → Possession transfer
 a. For an adult grammar, it’s problematic to say that the NP give NP to NP pattern exists because there is caused motion in prototypical givings, because there is no motion entailment when that pattern is used. (But a fairly plausible theory the acquisition of *give* is that at some early stage
- $$\llbracket \text{give} \rrbracket_{\text{child}} = \llbracket \text{hand} \rrbracket_{\text{adult}}.$$
- b. For the adult grammar, we have to say the NP give NP to NP pattern has a meaning compatible with simple possession transfer (call it a *caused possession* meaning).
 c. This is compatible with the idea that the preposition *to* has a possession meaning (it goes with *belong*).
 d. But for the other direction, linking caused motion with possession transfer seems to work well. The double object pattern does seem to entail possession transfer for verbs like *send* (Green’s example).
- (7) a. Therefore there are systematic polysemies — regular relationships between pieces of LCS (polysemy rules).
 b. But then this suggests there is still something more basic, more primitive, behind LCS, needed to capture what’s common between (4a) and (4b).
 c. Gropen et al. (1989), Pinker (1989) speak of the same events being classifiable in multiple ways. This suggests that’s what basic is a mapping from classes of events to classes of argument structures.

Mismatches

- (8) Fillmore 1977a
 a. John broke the vase against the hammer.
 b. John broke the vase with the hammer.

- (9) 1. In both sentences in (8), there is movement. In (a) the vase moves; in (b) the hammer.
 2. Given pyrex baking dishes breaking in ovens, windows breaking due to low air pressure in tornados, and sopranos breaking crystal with high C's, we cannot say that breaking entails movement but we can say:

A prototypical breaking event involves the collision of two bodies, one of which breaks.
--

I will say that this what licenses a sense of *break* in which *the hammer* is an oblique argument in both examples in (8).

- (10) a. English doesn't have any way of encoding unspecified movement, no valence
 NP-Agent V NP1 Prep NP2
 which entails that either NP1 or NP2 is moving.
 b. So this has to be *split* into two cases, one in which NP1 is moving, one in which NP2 is moving.
 c. So arguably LCS forces a simple concept of breaking to be split into two cases.
 d. But if LCS is a language of thought which splits concepts at their natural joints, it shouldn't force simple concepts to be split into separate cases.

Simple concepts with complex representations

- (11) a. The ball rolled.
 b. The ball rolled into the corner.
 c. John rolled the ball into the corner.
 d. John rolled Mary the ball.
- (12) a.*The ball threw.
 b.*The ball threw into the corner.
 c. John threw the ball into the corner.
 d. John threw Mary the ball.
- (13) a. John did something/THROW to the ball which CAUSE the ball GO TO the corner.
 b. John did something to the ball which CAUSE the ball GO/roll TO the corner.
 c. The decomposition of *throw* makes it clear *throw* is a basic action, but it does not make it clear that throwing always causes motion (* John threw the ball flat); that is, the concept of throwing builds in (entails) the concept of caused motion, as well the concept of an agent who does the throwing. Thus, *throw* seems to correspond to a complex expression of LCS.
 d. The picture for *roll* does not generate an analagous mismatch. First, the valence possibilities of (11a-c) seem to support the pieces of the decomposition. What is also captured is the idea that rolling is a kind of motion, so motion is entailed.
- (14) General position
 a. LCS decompositions seem to work best when the root predicates correspond to basic constituents of LCS (GO > roll).

- b. Some basic concepts correspond to complex pieces of LCS (so the mapping to LCS is more complex, but I question whether the concepts are actually more complex; is throwing REALLY more complex than rolling?).
- c. There are basic states, activities, accomplishments, activities with results, activities with incorporated instruments, etcetera.
- d. Sometimes a single concept can contribute multiple pieces to the same LCS. Again, this is odd for a language of thought. Simple concepts should be, well, simple.

1.2 The translation view

- (15) Observation: All the phenomena we observed are to be expected in ordinary cases of translation
 - a. Splits (polysemy, *give*): target language has two different ways of translating expressions in source, sometimes both are appropriate.
 - b. Mismatches (adding information, *break*): Target language forces a simple expression in the source to be translated in one of two ways, because it makes distinctions not found in the source.
 - c. Mismatches (one unit \rightarrow many units, *throw*): target language language has no simple translation of source 'word'; renders one word as many.
- (16) The translation view of LCS
 - a. The overarching constraint on translation is that source and target expressions can be used to describe the same situations (events)
 - b. The relevant primitive concept is “can be viewed as”. That is, an event of type A can be viewed as an event of type B. This means descriptions A and B can be applied to the same event.
 - c. Given the facts we’ve been discussing:
 - 1. a giving event can always be viewed as a transfer of possession or equivalently a causing of possession
 - 2. a breaking event can as a matter of default be be viewed as an event in which a motion event is the means of bring about the change in two different ways:
 - i. The breaker can be moving
 - ii. The broken can be moving
 - 3. a sending event can (under some circumstances) be viewed as a transfer of possession
 - 4. a sending event can always be viewed as a causing of motion
 - d. **Circumstance type** can be viewed as **LCS construct**
 - e. Rather than seeing LCS as a scaffolding upon which all concepts must be hung, we see it as a rather restricted language into which all concepts must (sometimes not very comfortably) be translated, subject to entailment constraints, sometimes default entailment constraints, sometimes, alas, just partial mappings.
 - f. The translation to LCS is a necessity forced on us by the need linearize things in syntax — to map the rich distinctions of word meanings onto some kind of impoverished argument structure.

The key moves

The key moves are to make the central object of interest not LCS but the translation between root concepts and LCS (already a trend); and to allow defaults (not very shocking) and partial mappings (pretty scary).

2 Events and frames

- (17) a. John bought the book on sale
 b. $\exists e[\text{buy}'(e) \wedge \text{agent}(e) = j \wedge \text{patient}(e) = b \wedge \text{on-sale}(e, b)]$
- (18) a. A lexical predicate is associated (minimally) with two conceptual representations I will call **frames** (Fillmore 1975, Fillmore 1978, Fillmore 1977b, Fillmore 1982, Fillmore 1985).
 a. An **argument frame** with direct consequences for syntactic valence
 b. A **circumstance frame** which captures the predicate situation type
 b. There are three kinds of mappings from circumstance frames to argument frames
 (a) total (\rightarrow): The argument frame is entailed by the circumstances. \rightarrow is used because it is a bijective mapping.
 (b) default (\rightsquigarrow): Prototypical circumstance frame events map to to argument frame events. As a default, the circumstances entail the argument frame.
 (c) partial (\dashrightarrow): A “significant” subset of the circumstance events map to argument frame events. Obviously overgenerates wildly. Must be constrained by something outside the representational system. [distributional facts?]
- (19) ACTION : **action** \rightarrow **truth-values**
 agent : **action** \rightarrow **animate**
 patient : **action** \rightarrow **entity**
 source : **action** \rightarrow **entity**
 goal : **action** \rightarrow **entity**

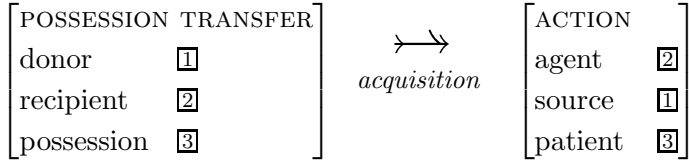
Here \rightarrow indicates a partial function, so that the *patient*, *source*, and *goal* roles are optional.

- (20) $\left[\begin{array}{ll} \text{ACTION} & \\ \text{agent} & \mathbf{animate} \\ (\text{source}) & \mathbf{entity} \\ (\text{goal}) & \mathbf{entity} \\ (\text{patient}) & \mathbf{entity} \end{array} \right]$

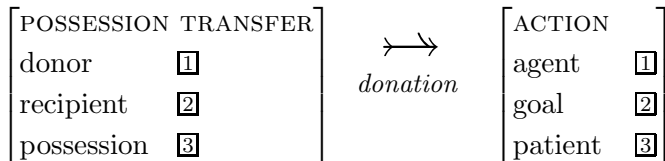
- (21) a. $\left[\begin{array}{ll} \text{POSSESSION TRANSFER} & \\ \text{donor} & \mathbf{animate} \\ \text{possession} & \mathbf{entity} \\ \text{recipient} & \mathbf{animate} \end{array} \right]$

b. *give, get, take, receive, acquire, bequeath, loan ...*

- (a) *acquisition* : **possession_transfer** \rightarrow **action**
- (b) *agent* \circ *acquisition* = *recipient*
- (c) *patient* \circ *acquisition* = *possession*
- (d) *source* \circ *acquisition* = *donor*



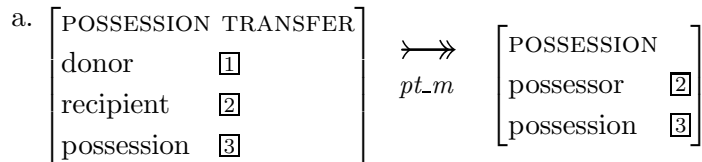
- (22) a. *get, take, acquire ...*
- b. $\llbracket \text{acquire} \rrbracket \ni \text{possession-transfer} \circ \text{acquisition}^{-1}$



acquisition and *donation* have been represented as partial functions from POSSESSION TRANSFER to ACTION, meaning, for example that not all possession transfers need have agentive donors or agentive recipients. Nothing precludes possession transfers that have both.

- (23) a. *give, donate, acquire*: POSSESSION TRANSFER circs
- b. Specializations: GIVE \geq POSSESSION TRANSFER
DONATE \geq POSSESSION TRANSFER
ACQUIRE \geq POSSESSION TRANSFER
- c. $\llbracket \text{give} \rrbracket \ni \text{GIVE} \circ \text{donation}^{-1}$
- d. $\llbracket \text{acquire} \rrbracket \ni \text{ACQUIRE} \circ \text{acquisition}^{-1}$

(24) The other possibility



b. This will license a caused possession valence (NP V NP to NP), along the lines shown below.

- (25) a. an argument frame ACTION, with direct consequences for syntactic valence (agent becomes subject; goal can become first object or oblique; patient first or second object; source oblique).
- b. a circumstance frame POSSESSION TRANSFER, which captures the circumstances of possession transfer.

- c. **perspectivalizing** functions *acquisition* and *donation* which map participants in the circumstances to argument structure.
- d. Multiple perspectivalizations of the same circumstances license multiple valences.

3 Valence theory

Sometimes different valence patterns available to related verbs; sometimes there are robust patterns.

- (26) vase: *broken*, hammer: *breaker*
- a. The vase broke.
 - b. The hammer broke the vase. [either moving!]
 - c. The vase broke on/against the hammer.
 - d. * The vase broke with the hammer
 - e. John broke the vase with the hammer.
 - f. * John broke the hammer (against the vase). [intended interp]
 - g. * John broke at the vase with the hammer. (conation)
 - h. * John broke the vase into the next room. (caused motion)
- (27) carrot: *incised*, knife: *cutter*
- a.*The carrot cut.
 - b. The knife cut the carrot.
 - c.?The carrot cut on/against the knife.
 - d.*The carrot cut with the knife.
 - e. John cut the carrot with the knife.
 - f.*John cut the knife (against/on the carrot). [intended interp]
 - g. John cut at the carrot with the knife. (conation)
 - h. John cut the carrot into the bowl. (caused motion)
- (28) ball: *impingee*, bat: *impinger*
- a.*The ball hit. (intended interp) [The ball hit \emptyset OK; ball = impinger]
 - b. The bat hit the ball. [cf. The ball hit the bat.]
 - c.*The ball hit against the bat. (intended interp)
 - d.*The ball hit with the bat.
 - e. John hit the ball with the bat.
 - f. John hit the bat (against the ball).
 - g. John hit at the ball with the bat. (conation)
 - h. John hit the ball over the fence. (caused motion)
- (29) P = Patient, F = Force, A = Agent

Pattern	break	hit	cut
a. P V	yes	no	no
b. F V P	yes	yes	yes
c. P V against F	yes	no	no?
d. P V with F	no	no	no
e. A V P with F	yes	yes	yes
f. A V F against P	no	yes	no
g. Conation	no	yes	yes
h. Caused motion	no	yes	yes

- (30) Which of these contrasts are due to deep (or even language particular) patterns and which are idiosyncratic?
- (31) Needed: Principles governing the mappings between circumstances and argument structure (largely entailment based)
- (32) Components of Valence Theory
- a. Frames
 1. Circumstance frames
 2. Argument frames
 - b. Principles
 1. Linking principles
 2. Preposition meanings
 3. Constraints on mappings from circumstance frames to argument frames

3.1 Circumstance frames

- (33) $\left[\begin{array}{l} \text{ROLLING} \\ \text{roller} \quad \mathbf{entity} \end{array} \right]$
 AT \circ roller : a function from ROLLING eventualities to functions from times to locations (of the roller)
- (34) a. THROWING: *throw, fling, hurl, launch, sling, pitch, lob, chuck, heave*
 b. $\left[\begin{array}{l} \text{THROWING} \\ \text{projectile} \quad \mathbf{entity} \\ \text{thrower} \quad \mathbf{animate} \\ \text{(recipient)} \quad \mathbf{animate} \end{array} \right]$
 AT \circ projectile : a function from THROWING eventualities to functions from times to locations (of the projectile)
- (35) a. bang.v, bump.v, chatter.v, clang.v, clash.v, clatter.v, click.v, clink.v, clunk.v, collide.v, collision.n, crash.n, crash.v, crunch.v, glancing.a, graze.v, hiss.v, hit.n, hit.v, impact.n, impact.v, patter.v, splash.v, plop.v, plough.v, plunk.v, rap.v, rattle.v, run.v, slam.v, slap.v, smack.v, smash.v, strike.v, thud.v, thump.v, tinkle.v, touch.v
 b. $\left[\begin{array}{l} \text{IMPINGEMENT} \\ \text{impinger} \quad \mathbf{entity} \\ \text{impingee} \quad \mathbf{entity} \\ \text{(manipulator)} \quad \mathbf{animate} \end{array} \right]$
 AT \circ impinger : a function from IMPINGEMENT eventualities to functions from times to locations (of the impinger)
 AT \circ impingee : a function from IMPINGEMENT eventualities to functions from times to locations (of the impingee)

1. Verbs of contact by impact in Levin (1993)
2. IMPACT and CAUSE-IMPACT frames in FrameNet
3. Fillmore (1967), Fillmore (1976), Fillmore (1977)a, Richardson (1983), Guerssel et al. (1985), Beavers and Francez (2008)

(36) a. break, shatter, smash, cut (!), ...

b. $\left[\begin{array}{ll} \text{LOSS OF PHYSICAL INTEGRITY} & \\ \text{broken} & \mathbf{entity} \\ \text{(breaker)} & \mathbf{entity} \\ \text{(manipulator)} & \mathbf{animate} \end{array} \right]$

AT \circ broken : a function from LOSS OF PHYSICAL INTEGRITY eventualities to functions from times to locations (of the broken)

AT \circ breaker : a function from LOSS OF PHYSICAL INTEGRITY eventualities to functions from times to locations (of the breaker)

3.2 Argument frames

Actions

(37) $\left[\begin{array}{ll} \text{ACTION} & \\ \text{agent} & \mathbf{animate} \\ \text{(patient)} & \mathbf{entity} \\ \text{(goal)} & \mathbf{entity} \end{array} \right]$

Means or Change

(38) $\left[\begin{array}{ll} \text{MOVEMENT} & \\ \text{mover} & \mathbf{entity} \\ \text{path} & \mathbf{function} \\ \text{(X_goal)} & \mathbf{entity} \end{array} \right]$

path = AT \circ mover : a function from MOVEMENT eventualities to functions from times to locations (of the mover)

X_goals (spatial goals) may be any of the following types:

allative to(<i>e</i>)	the entity at the end of the path of <i>e</i>	
illative to(<i>e</i>)	the entity inside of which the path of <i>e</i> ends	
s_goal(<i>e</i>)	the entity on whose surface the path of <i>e</i> ends, usually with some velocity	
l_goal(<i>e</i>)	the entity just at or beyond the end of the path of <i>e</i>	

Changes

(39) $\left[\begin{array}{ll} \text{CHANGE} & \\ \text{patient} & \mathbf{entity} \\ \text{(force)} & \mathbf{entity} \end{array} \right]$

Multi scene frames (for most obliques, including resultatives, resultant motion constructions)

$$(40) \left[\begin{array}{ll} \text{COMPOSITE_SCENE} & \\ (\text{action}) & \mathbf{action} \\ (\text{means}) & \mathbf{eventuality} \\ (\text{change}) & \mathbf{eventuality} \\ (\text{result_loc}) & \mathbf{eventuality} \end{array} \right]$$

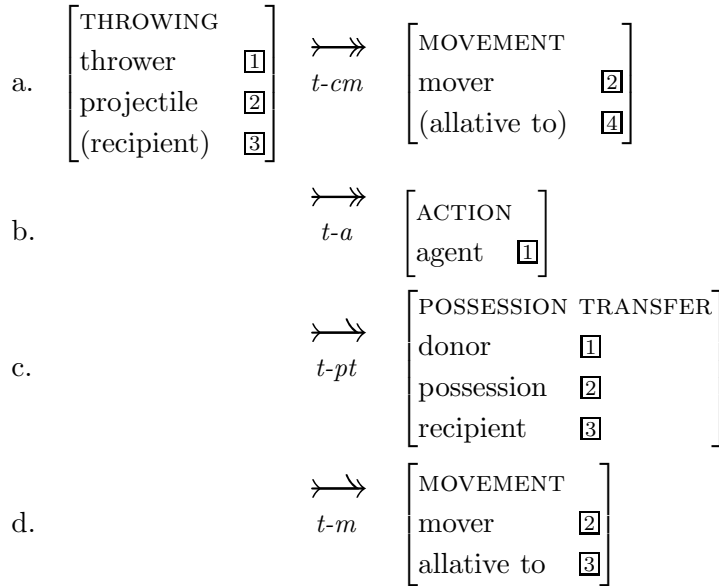
- (41) a. Change is an attribute which will host patients underdoing changes of states and result scenes in resultatives
 b. Johan cut the carrots into the bowl. [why change and result loc are distinct; who has discussed examples like this?]

In a COMPOSITE SCENES σ , ...

1. ACTION events are the **action** of σ ;
2. CHANGE events are the **change** of σ ;
3. At least two of the following four basic attributes of σ must be realized: **action**, **means**, **change**, **result_loc**. (consequence: *the ball rolled into the hole* is not a composite scene, just a simple movement)
4. A scene that bears a *means* relation to some other subscene of σ must be a **means** of σ ; a scene that bears a *resultant location* relation to some other scene must be a *result_loc* of σ

3.3 Mappings

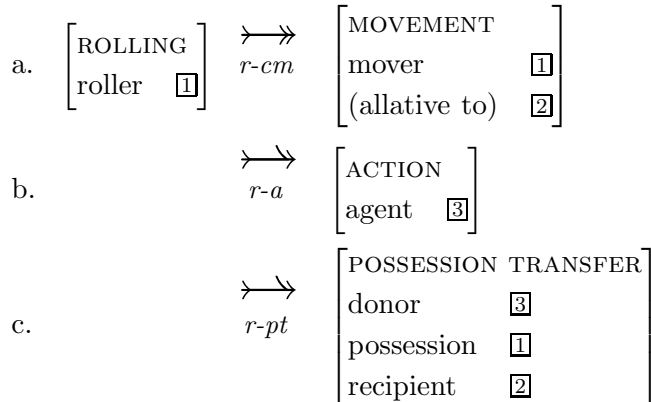
(42) fling, throw



Note that $t\text{-}pt$ is partial (\rightsquigarrow), indicating that not all throwings correspond to possession transfers. Note also that it HAS to be partial, since *recipient* is only a partial function. Ditto for the highly questionable $t\text{-}m$ mapping.

- (43) a. Mary threw the ball. (42a,42b)
 b. Mary flung the ball to John. (42a,42b)
 c. Mary flung John the ball. (42c)
 d. Mary flung John with the ball. (42d, South Africa? Fillmore 1977b)

(44) roll



The $r\text{-}a$ mapping has two significant properties. It is partial (not every rolling has an agent), and it introduces a participant that does not appear in the circumstance frame.

(45) hit

a.	$\left[\begin{array}{l} \text{IMPINGEMENT} \\ \text{impinger} \quad \boxed{1} \\ \text{impingee} \quad \boxed{2} \\ \text{(manipulator)} \quad \boxed{3} \end{array} \right]$	\rightsquigarrow	$i-m$	$\left[\begin{array}{l} \text{MOVEMENT} \\ \text{mover} \quad \boxed{1} \\ \text{s_goal} \quad \boxed{2} \end{array} \right]$
b.	$\left[\begin{array}{l} \text{IMPINGEMENT} \\ \text{impinger} \quad \boxed{1} \\ \text{impingee} \quad \boxed{2} \\ \text{(manipulator)} \quad \boxed{3} \end{array} \right]$	\rightsquigarrow	$i-cm$	$\left[\begin{array}{l} \text{MOVEMENT} \\ \text{mover} \quad \boxed{2} \\ \text{s_goal} \quad \boxed{4} \end{array} \right]$
c.	$\left[\begin{array}{l} \text{IMPINGEMENT} \\ \text{impinger} \quad \boxed{1} \\ \text{impingee} \quad \boxed{2} \\ \text{(manipulator)} \quad \boxed{3} \end{array} \right]$	\rightsquigarrow	$i-a$	$\left[\begin{array}{l} \text{ACTION} \\ \text{agent} \quad \boxed{3} \end{array} \right]$

(46) break (broken undergoes change of state)

a.	$\begin{array}{l} \text{CHANGE} \\ \left[\begin{array}{l} \text{LOSS OF P I} \\ \text{breaker} \quad \boxed{1} \\ \text{broken} \quad \boxed{2} \end{array} \right] \end{array}$	\rightsquigarrow	$li-m_{er}$	$\left[\begin{array}{l} \text{MOVEMENT} \\ \text{mover} \quad \boxed{1} \\ \text{i_goal}_{\geq} \quad \boxed{2} \end{array} \right]$
b.	$\left[\begin{array}{l} \text{LOSS OF P I} \\ \text{breaker} \quad \boxed{1} \\ \text{broken} \quad \boxed{2} \end{array} \right]$	\rightsquigarrow	$li-m_{en}$	$\left[\begin{array}{l} \text{MOVEMENT} \\ \text{mover} \quad \boxed{2} \\ \text{s_goal} \quad \boxed{1} \end{array} \right]$
c.	$\left[\begin{array}{l} \text{LOSS OF P I} \\ \text{breaker} \quad \boxed{1} \\ \text{broken} \quad \boxed{2} \end{array} \right]$	\rightsquigarrow	$li-a$	$\left[\begin{array}{l} \text{ACTION} \\ \text{agent} \quad \boxed{3} \end{array} \right]$
d.	$\left[\begin{array}{l} \text{LOSS OF P I} \\ \text{breaker} \quad \boxed{1} \\ \text{broken} \quad \boxed{2} \end{array} \right]$	\rightsquigarrow	$li-c$	$\left[\begin{array}{l} \text{CHANGE} \\ \text{patient} \quad \boxed{2} \end{array} \right]$

(47) Constraint (i_goal_{\geq})

- a. $\forall e, e' [li-m_{er}(e) = e' \rightarrow \text{through}(\text{path}(e'), \text{surface}(\text{broken}(e)))]$
- b. If there is a motion event related to e in which the *breaker* is moving, the breaker's path always goes through the surface of the *broken*.
- c. inconsistent with:
 - allative to($\text{path}(li-m_{er}(e)), \text{broken}(e)$)
 - s_goal($\text{path}(li-m_{er}(e)), \text{broken}(e)$)
 - l_goal($\text{path}(li-m_{er}(e)), \text{broken}(e)$)
- d. consistent with:
 - through($\text{path}(li-m_{er}(e)), \text{broken}(e)$)
 - illative to($\text{path}(li-m_{er}(e)), \text{broken}(e)$)
- e. The hammer broke against the vase (* reading on which vase is broken)
- f. * The hammer broke at the vase (reading on which vase is broken ruled out)
- g. The finch's beak broke into the egg.
- h. The point of the quill broke through the paper.[corpus example]

(48) cut (incised undergoes change of state)

a.	CHANGE	LOSS OF P I cutter [1] incised [2]	\rightsquigarrow <i>li-m_er</i>	MOVEMENT mover [1] i_goal _≥ [2]
b.			\rightsquigarrow <i>li-m_en</i>	MOVEMENT mover [2] s_goal [1]
c.			\rightsquigarrow <i>li-a</i>	ACTION agent [3]
d.			\rightsquigarrow <i>li-c</i>	CHANGE patient [2]

(49) Constraints

1. $\forall e, e' [li-m_er(e) = e' \rightsquigarrow \text{through}(\text{path}(e'), \text{surface}(\text{incised}(e)))]$
2. If there is a motion event related to e and it is one in which the *cutter* is moving, the path — by default — goes through the surface of the *incised*.
3. The rock cut at my foot. [foot is l_goal because marked that way, overruling default]
4. The rock cut into my foot. [foot is illative goal, compatible with constraint.]
5. incised is a change of state participant and must always be patient.

3.4 Valence Theory

(50) Linking principles

- a. The subject is chosen so as not to conflict with the following hierarchy:

$$\text{Agent} \geq \text{Mover} \geq \text{Patient}$$

- b. The object is chosen so as not to conflict with the following hierarchy:

$$\left\{ \begin{array}{l} \text{Patient} \\ \text{Mover} \circ \text{result_loc} \end{array} \right\} \geq *$$

- c. A mapping to a change always shows up in the argument frame, either as the sole scene or as a subscene (change).

(51) Movement specific senses of some prepositions

- a. Meaning of spatial preps are properties of path, e. g.

Functional	allative to(e)	$AT^{-1} \circ [\text{path}(e)](e_{\text{end}})$
Relational	down(e)(m)	DOWN(path(e), m)

- b. $[[\textit{with}']] \ni \text{mover} \circ \text{means}$
- c. $[[\textit{against}']] \ni \text{s_goal}$
- d. $[[\textit{at}']] \ni \text{l_goal}$

- e. $\llbracket into' \rrbracket \ni$ illative goal
 f. Prep meanings generally can associate with action/means/change eventualities in composite scenes For example:

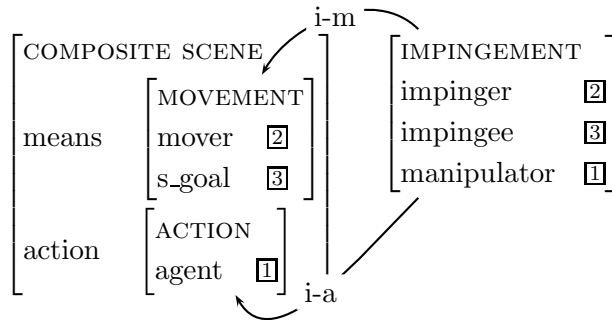
$$\llbracket against' \rrbracket \ni \begin{cases} s_goal \\ s_goal \circ action & \leftarrow coercion \\ s_goal \circ means & \leftarrow coercion \\ s_goal \circ result_loc & \leftarrow coercion \end{cases}$$

(52) Constraints on mappings (entailment based)

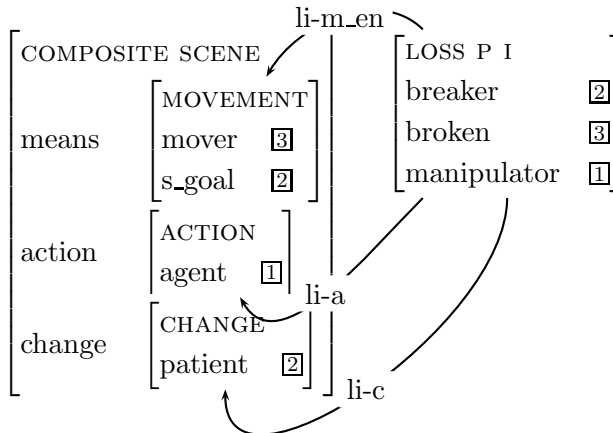
1. If a participant changes state, it is mapped to patient Dowty (1991) (*cut, break*).
2. A prototypically moved participant is mapped to the mover of a movement.
3. Obligatory initial members of force dynamic chains (Croft 1991) can't be left out of argument structure. (*The ball threw over the wall, *The fence hit.)
4. Other Dowty (1991) principles (ProtoAgent \rightarrow agent, ProtoPatient \rightarrow patient)

4 Examples

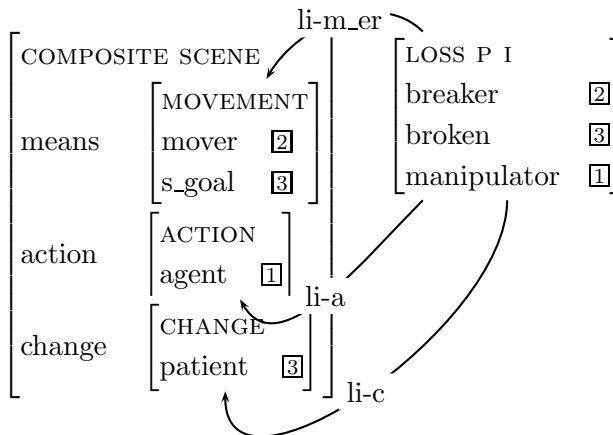
- (53) a. John₁ hit the hammer₂ against the vase₃.
 b. John₁ hit the vase₃ with the hammer₂.
 c. John₁ hit against the vase₃ with the hammer₂.

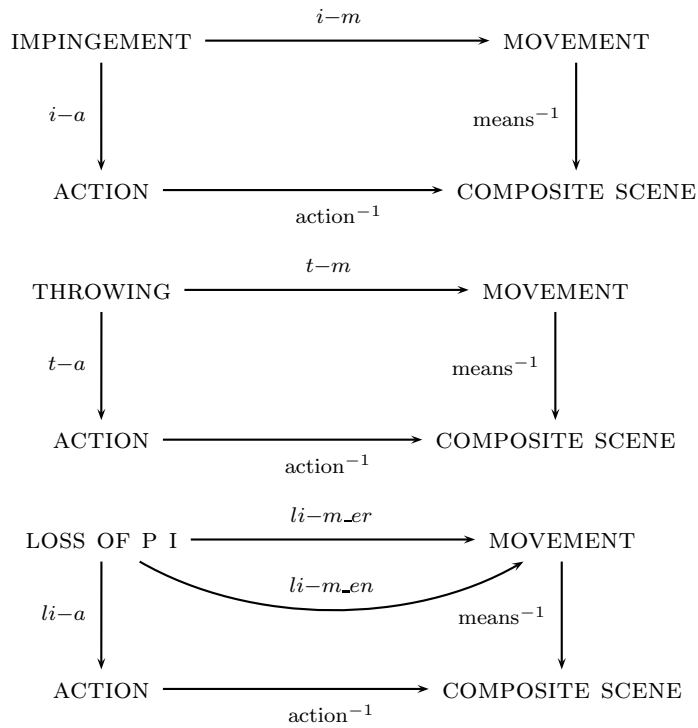


- (54) John₁ broke the hammer₂ against the vase₃.

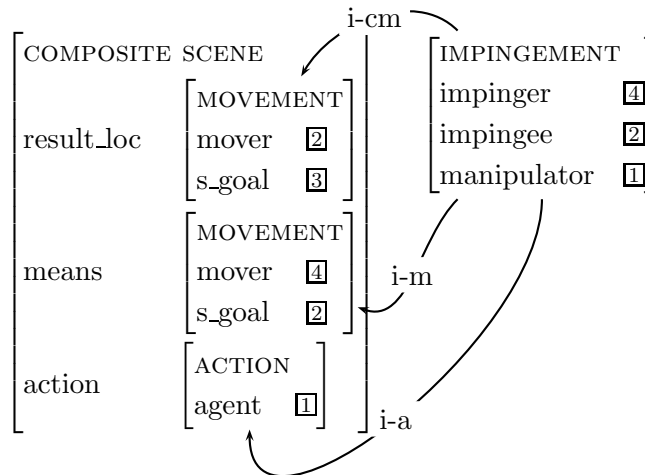


- (55) John₁ broke the vase₃ with the hammer₂.

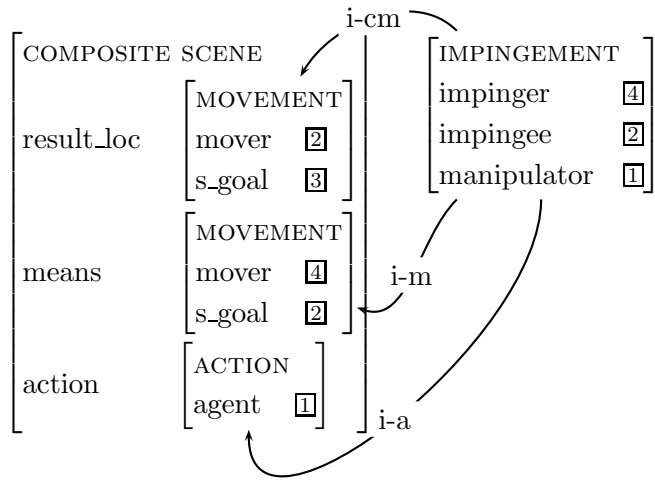




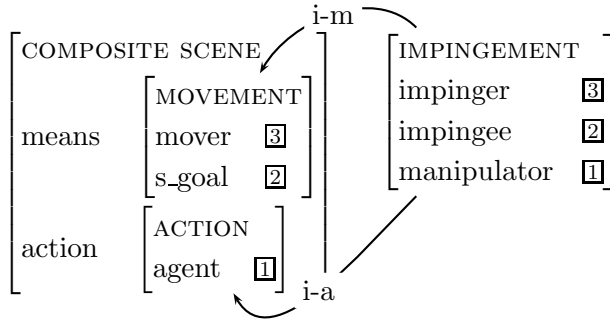
- (56) a. John₁ hit the ball₂ over the wall₃.
 b. impinger must show up in arg structure (obligatory start of causal chain).



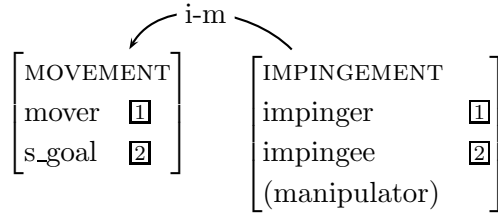
- (57) John₁ hit the ball₂ over the wall₃ with the bat₄.



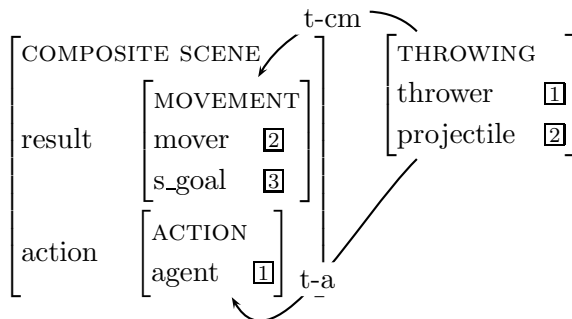
(58) John₁ hit the ball₂.



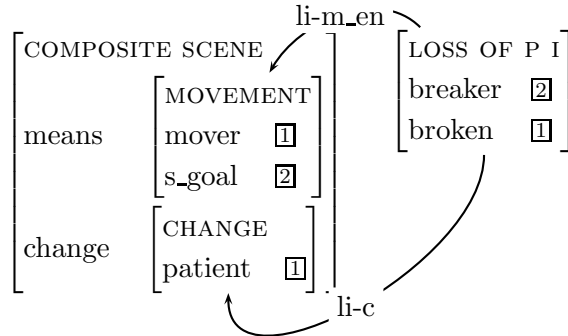
(59) The bat₁ hit the ball₂.



(60) John₁ flung the towel₂ against the wall₃



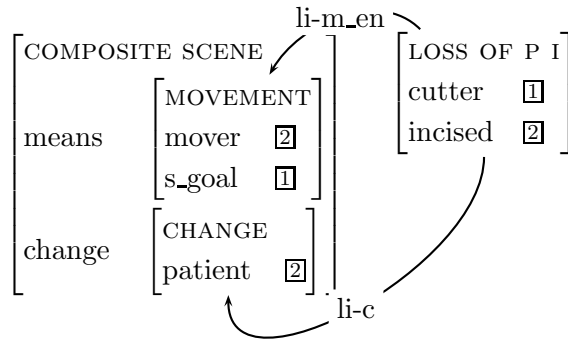
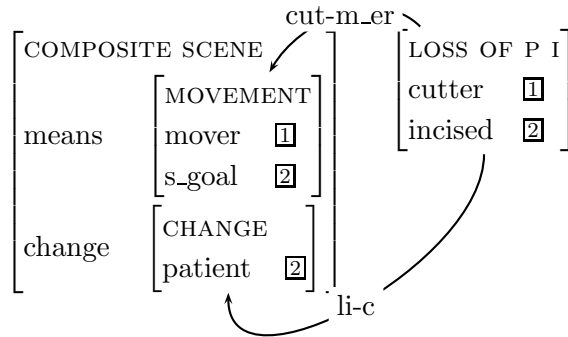
- (61) a. The hammer₁ broke against the vase₂.
 b. * The hammer₁ broke the vase₂ (on a reading which is paraphrase of (a), because a patient hasn't become object)



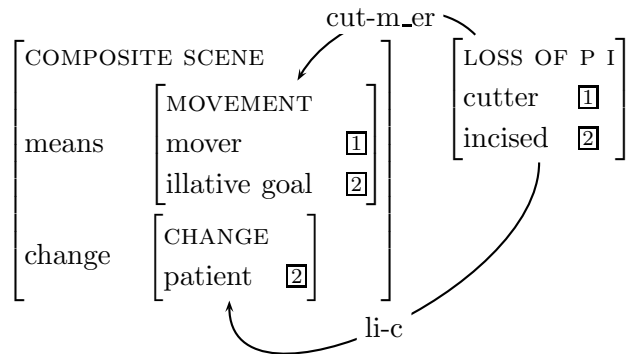
Q&A

- (62) a. Why is the CHANGE subscene necessary in (54), (55), and (61)?
 b. Because, when used by a circumstance frame, a CHANGE scene or subscene must always show up in arg structure (50c).
- (63) a. Why is the MEANS subscene necessary in (54), (55), and (61)?
 b. To license the oblique participant.

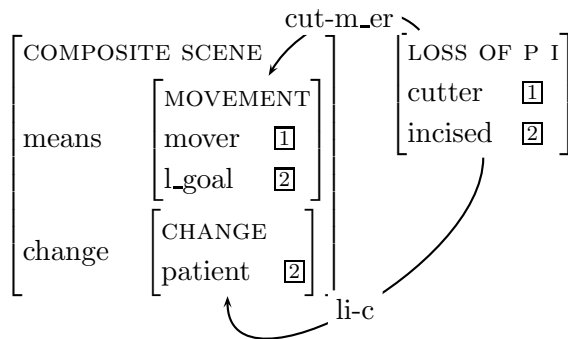
- (64) The rock₁ cut my foot₂.



- (65) The rock₁ cut into my foot₂.



(66) The rock₁ cut at my foot₂.



5 Conclusion

(67) In search of a theory of lexical semantics that ...

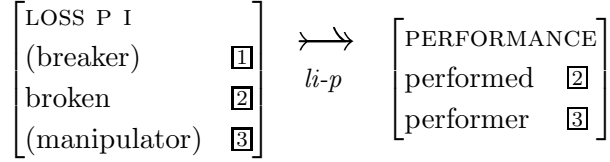
- a. ... can represent both hard and soft constraints, in some cases, at least, as different points on a continuum.
- b. ... can accommodate semantic classes that bear only a statistical relation to certain valence choices (Bresnan et al. 2005).
- c. ... can accommodate a 2-way interaction between distributional and semantic facts. [use determines meaning and meaning determines use]
- d. ... is liberated from reducing an open class of concepts to a “language of thought”.

(68) Translation (not decomposition)

- a. *break* is primitive, a (prototypically) dyadic telic event predicate (not BE-COME(*broken*))
- b. *throw* is primitive, a dyadic event predicate entailing the projectile’s motion and an animate, instigating thrower (not [x DO-TO/throw z] CAUSE [z GO TO y])
- c. But one has to map onto argument structures enforcing some specific “decompositional” scheme, which means there will be splits, merger, and mismatches.

(69) Partial mappings

- a. Analysis of *cut*, *break* relies crucially on partial mapping (what moves can change)
- b. Joanne broke the glass with $\left\{ \begin{array}{l} \text{a pillow.} \\ \text{a single high note.} \\ \text{a nod.} \end{array} \right.$
- c. Adjunct instrumentals



- d. $\llbracket \text{with} \rrbracket \ni \text{means } \circ \text{ performed}$

The basic picture

Partial mappings (roles/participants or circ-arg frame mappings) are soft constraints on circumstance frames and argument structure or on the relation between circumstances and argument structure. These greatly overgenerate, unless we assume that something like frequency effects constrain the actually realized possibilities.

Putting the mappings center stage

- a. Let \vec{r} be the syntactically argument frame roles realized.
- b. Let \vec{p} be the circumstance participant roles realized.
- c. Let c be the circ frame.
- d. $\Pr(\vec{p}, \vec{r} | c)$
is the probability of a valence given a circ frame

(70) Some parameters of variation

- a. Optionality/obligatoriness of roles (syntactic)
- b. Optionality/obligatoriness of participants (circumstantial)
- c. Optionality/prototypicality/obligatoriness of mapping
- d. Cooccurrence possibilities of mappings. How often does \vec{r} entail a co-occurrence of i_{cm} with i_m (*John hit the ball over the fence with the bat.*)? A co-occurrence of i_a with i_{cm} ? * *The bat hit the ball over the fence.*)
- e. Possibility of a certain preposition/role marking a certain mapped participant (*dote on, hanker after, hankering for, death by hanging*)

A natural simplification. Let \mathcal{M} be the set of circumstance-argument frame mappings involved in \vec{r} , \vec{p}

$$\begin{aligned} \Pr(\vec{p}, \vec{r} | c) &= \Pr(A, \mathcal{M} | c) \\ &\approx \Pr(A | c) \cdot \prod_{i=0}^n \Pr(f_i | c, A) \end{aligned}$$

where

$$\begin{aligned} \mathcal{M} &= \{f_i | 0 \leq i \leq n\} \\ A &= \{r | r \text{ is a realized role of the argument frame}\} \end{aligned}$$

Each mapping f is a set of role-participant alignments (cf. IBM model I Brown et al. 1993)

$$\Pr(\vec{r}_i | \vec{p}_i)$$

See appendix II

Appendix I: fact pattern

Note: in all of the following examples, judgments are given for what ought to be the pragmatically sensible reading (foot = incised; rock = cutter)

- (71) a. *My foot cut the rock. [Hierarchy violation: mover is not subject, patient is not object]
b. *My foot cut with the rock./* The rock cut with my foot. [Hierarchy violation: mover is not subject, ok only when agent present.]
c. The rock cut at/into my foot. [Hierarchy OK because mover is subject, object hierarchy can't be violated in intransitive clause, default path overruled with *at* (l_goal), default path compatible with *into* (illative goal).]
d. I cut at my foot with the rock. [Hierarchy OK: object hierarchy cant be violated in intransitive clause, default path overruled.]
e. I cut my foot *at/*into/on/against the rock. [Hierarchy OK: *at* and *into* out because when cutter is goal, it must be an s_goal.]
f. *I cut the rock against/at/on my foot. [Hierarchy violation: All out because there is an object and it's not the patient]
g. *I cut at my foot against the rock. [no such mapping, can't have two goals.]
h. *I cut with my foot against the rock. [Unacceptability unexplained. Uncaptured constraint on *with*: marked NP can't be at the end of the force-dynamic chain (Croft 1998). In general, only a restricted set of prepositions get to make that patient oblique to give us a conative construction. *with* is definitely NOT one of them.]
i#My foot cut on/against the rock. (Unaccounted for. Incised subject disfavored. But compare parallel sentences with *break*. Maybe better to say *cutter* must be subj in absence of agent. Related to the fact that **My foot cut* is out and *The knife cut deep* is in?).

Appendix II: Categorical judgments and probability models

Categorical judgments: Pr(Form | Content, Verb)

1. Assuming broad sense of “content” including, for example, pronomality, definiteness, animacy, weight, and, crucially, semantic info.
2. Not directly capturable by the binary logistic regression model of Bresnan et al. (2005), but only because it is binary. Such a model can select only among two form variants competing for the same meaning.

- (72) a. ?Mary gave the creeps to John.
b. This story is designed to give the creeps to people who hate spiders, but its not true.

3. Slightly expanded form

$$\hat{F} = \operatorname{argmax}_{F \in \mu(c)} \Pr(F \mid c, d, k, e, \text{Verb}) \quad (1)$$

<i>c</i>	event type	circumstances, including arg types?
<i>d</i>	speech situation type	
<i>k</i>	kontext	given, new, ...
<i>e</i>	encoding	heavyness, pronominality, definiteness, dots

Such a model might be expressed/estimated by a multinomial logistic model.

4. Can plausibly account even for exceptional gaps in a productive pattern (exceptions in *spray-load* alternation, *pace* Pinker (1989))

- (73) a. John hung drapes on the wall.
b.?John hung the wall with drapes.

5. But the following types are different

- (74) a.*John fell the apple (off the table).
b.*The ball threw.

Caused motion (following Goldberg 1995) vs. nonfinite clause)

- (75) a. John locked Mary into/in/out of/?under the house.
b.*John unlocked Mary out of/out from the house.
c.*John opened Mary out of/out from the house.
d. John followed Mary out of the room.
e. John looked Mary out of the room.

because there are no obvious competing forms. This leaves several possibilities:

1. Such judgments are categorical. That's actually what my model for *throw* says for (75b). But we need agents to be introducable for dyadic circs like LOFF OF PI by partial mappings, so why doesn't *fall* undergo such a partial mapping? Pushing on down this road: such alternations must be handled by lex rule/construction, creating new circs, and perhaps a second probabilistic mechanism accounts for exceptions (*fall* vs. *drop*).
2. Adopt some kind of relativized threshold model. Somehow we define a minimum probability below which a mapping just fades away. I have no idea how to do this. Problem: Distinguishing rare from non-occurring (but licensed by some productive process).
3. Use a probability model of a different form.

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