

# Semantic Templates and Transitivity Alternations in the Lexicon

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## Abstract

A systematic and principled account of verb subcategorization is important for large-scale lexicon construction. A given verb may have several subcategorization frames in which its arguments appear. Starting from a lexical-semantic description of event structure, we describe a mechanism for generating subcategorization properties for a large variety of verb classes. In this paper, we motivate this mechanism by proposing a distinction between two kinds of resultative as well as the unaccusative and middle constructions.

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## 1. Background

We represent verb meanings in terms of event templates (Pustejovsky, 1995), in particular those inspired by (Rappaport Hovav & Levin, 1998), also (1991; 1995; 1999). An event template consists of a constant, the verb-specific core meaning that supplies spell-out, and an event structure, common to all verbs of a class, containing a small number of primitive elements that combine in a finite number of ways. The basic semantic templates (STs) are as follows:

Activity	[ x ACT <sub>&lt;manner&gt;</sub> ]	Achievement	[ BECOME [ x <state> ] ]
State	[ x <state> ]	Accomplishment	[ x CAUSE [ BECOME [ y <state> ] ] ]

Canonical realization rules pair constants (verbs) with STs:

manner	→ [ ACT <sub>&lt;manner&gt;</sub> ]	jog, run, creak, whistle
internally caused state	→ [ x <state> ]	bloom, blossom, decay, flower, rot, rust, sprout
externally caused state	→ [[ x ACT ] CAUSE [ BECOME [ y <state> ] ] ]	break, dry, harden, melt

STs may be simple or complex, i.e. augmented by the addition of subevent templates. The following examples are taken from (Rappaport Hovav & Levin, 1998):

Phil swept (the floor)	[ x ACT <sub>&lt;sweep&gt;</sub> y ]
Phil swept the floor clean	[[ x ACT <sub>&lt;sweep&gt;</sub> y ] CAUSE [ BECOME [ y <state> ] ] ]

Furthermore, template augmentation is constrained by rules prohibiting the elimination of elements and non-compositionality. For example:

- \*Achievement → Activity (*<state>* can't be eliminated)
- \*Activity → Achievement (\*[ BECOME [ x ACT<sub><manner></sub> ] ] non-compositional)

In the following sections, we propose a new semantic template theory for dealing with resultatives expressing change of state and transformation into new entities. In contrast to (Rappaport Hovav & Levin, 1998), who adopt a single template theory that grows monotonically as sub-events are added, we introduce the notion of a primary template expressing the core meaning of the verb in conjunction with a secondary template expressing secondary predication. A secondary template will be constrained in two ways: (1) via a general requirement that its elements must be checked-off, or licensed, against corresponding elements in the primary template, and (2) semantic admissibility conditions (to be described below). We also show how these admissibility conditions operate on primary templates in the case of both middle and achievement formation.

## 2. Two Types of Resultatives

We draw a semantic distinction between Adjective Phrase (AP) and Prepositional Phrase (PP) resultatives. Both refer to a state brought about by the event denoted by the verb. The following examples illustrate how different verb types select for resultatives:

- (1) (a) I danced/ran \*tired/\*into an athlete (neither AP nor PP)
- (b) I broke/bent the bracelet into pieces/a U/\*ruined (PP only)
- (c) I wiped/swept/rubbed the floor clean/\*into a shiny surface (AP only)
- (d) I cleaned the floor \*sparkling/\*into a shiny surface (neither AP nor PP)
- (e) I wrote/conceptualized the book \*interesting/\*into a bestseller (*same as above*)
- (f) John pounded/crushed/hammered the metal flat/into a thin sheet (AP and PP)

## 3. Resultatives and Semantic Templates

Our analysis rests crucially on the distinction between *change of state* and *transformation into a new entity* for AP and PP resultatives, respectively.

- A. An AP resultative, expressing the result of a change of state, comes with its own distinct template:

(2) y be *<state>*

- B. Elements in a secondary template must be identified or checked off against elements in the main template. For example, the y in “y be *<state>*” must be identified with a corresponding y in the main template:

- (3) (a) John wiped the table clean
- (b) John wiped the table & the table clean
- (c) x act<sub><manner></sub> on y & y be *<state>*

(d) *John act<sub><wip(ing)></sub> on the table & the table be clean*

If *y* is not present in the main template, the derivation fails:

- (4) (a) \*John jogged dizzy  
(b) *x act<sub><manner></sub> & y be <dizzy>* (y unchecked)

C. A PP resultative expresses a *transformation*; it comes with its own distinct template:

(5) *y become y'*

*y'* represents the new entity that *y* has transformed into as a result of an event:

- (6) (a) He spun wool into gold  
(b) He spun wool & wool into gold  
(c) *x caus y xform<sub><manner></sub> (y') & y becomes y'*

In (6c), *y'* in the secondary template checks off against implicit *y'* (shown in parentheses) in the primary template.

## 4. Conditions on Resultatives

Both the AP and PP resultatives select for a primary ST with the following conditions:

- D. (i) *y* must be present (cf. (B) above)  
This condition merely states the requirement for a direct object, on which the resultant state or transformation is predicated.
- (ii) \*...<state>...  
Statehood, including (non-)existence, expressed as a constant cannot appear in the primary ST.
- (iii) “*y* will be *y'*” (no transformation of *y*)  
This condition holds only for AP resultatives, where *y* does not get transformed into a new entity as a result of the event.

## 5. Consequences

Let us re-examine the data from section 2 given these conditions.

First, unergative verbs, such as *dance*, *jog*, *laugh*, *run* and *sleep*, are intransitives whose subject is an underlying external argument (semantically, an AGENT or ACTOR), (Perlmutter, 1978). These verbs cannot select for a resultative:

- (7) (a) John jogs/dances/sleeps  
(b) \*John jogs/dances/sleeps tired (resultative, not depictive reading)
- (8) (a) *x act<sub><manner></sub>*

(b) x act<manner> & y be <state> (violates Di)

(7a) and (7b) have STs (8a) and (8b), respectively. (8b) violates condition (Di) since y in the secondary template remains unchecked against a y in the primary template.

Unergatives can have an AP resultative if a fake reflexive is introduced (Simpson, 1983). Contrast (9a) with (9b):

- (9) (a) \*I danced/ran tired  
(b) I danced/ran myself tired/\*into an athlete

The fake reflexive introduces a y into the primary template for these otherwise intransitive verbs, and thus secondary y can be correctly checked off.

Next, many activity verbs, e.g. *mop*, *paint*, *shoot*, *sweep* or *wipe*, take either an optional or an obligatory direct object. As (10) shows, only AP resultatives are possible:

- (10) (a) John wiped/mopped/swept the floor clean  
(b) \*John wiped/mopped/swept the floor into a shiny surface

These verbs have has ST (11a):

- (11) (a) x act<manner> on y  
(b) x act<manner> on y & y be <state>  
(c) x act<manner> on y & y become y' (violates B)

Here (10b) is ruled out since y' (the new entity) remains unchecked in (11c).

Third, verbs like *break*, and *tear* express a resulting change of state in the direct object. These verbs are compatible with PP resultatives only:

- (12) (a) John broke/tore the painting  
(b) John broke/tore the painting into pieces  
(c) \*John broke/tore the painting ruined/worthless
- (13) (a) x caus y xform<manner> (y')  
(b) x caus y xform<manner> (y') & y become y'  
(c) x caus y xform<manner> (y') & y be <state> (violates Diii)

In the transform template, y' is the (implicit) new entity that y transforms into. y' need not be expressed in syntax.<sup>1</sup>

(12c) is ruled out because an AP resultative indicates the state of y after the event, but verbs like *break* and *tear* imply a transformation of y into a new entity y', i.e. y is changed as a result of the event. Rule (Diii) encodes this intuition.

Fourth, verbs that are derived from adjectives, either by zero-affix morphology e.g. *clean*, or by an affix, resist resultatives of any kind:

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<sup>1</sup>It will be expressed when it is checked off by a secondary template as in (12b).

- (14) (a) I cleaned the floor  
 (b) \*I cleaned the floor sparkling/into a shiny surface
- (15) (a) x caus y become <state>  
 (b) x caus y become <state> & y be <state> (violates Dii: <state> in primary ST)  
 (c) x caus y become <state> & y become y' (violates Di and Dii)

Finally, verbs expressing the creation or destruction of an entity such as *write*, *paint* and *eat* are incompatible with a resultative:

- (16) (a) I wrote the book  
 (b) \*I wrote the book interesting/into a bestseller<sup>2</sup>
- (17) (a) x caus y become<manner> exist(+)  
 (b) x caus y become<manner> exist(+) & y be <state> (violates Dii)  
 (c) x caus y become<manner> exist(+) & y become y' (violates Dii)

The *end state* for the entity expressed by the direct object of a creation/destruction verb will be exist(±). End states preclude AP and PP resultatives (Dii).

In summary, we saw that unergatives and activities take only AP resultatives, verbs of transformation or change take only a PP resultative, and verbs encoding a final state and verbs of creation/destruction take neither resultative.

## 6. Achievements

According to (Rappaport Hovav & Levin, 1998), achievements are events referring to changes of state, as shown in 6 (adopting our terminology):

- (18) y become <state>

We propose the following conditions for deriving achievement templates from a given primary template:

- F. (i) y must be present  
 (ii) x[-sentient]

(Fii) states that the causing entity must be non-sentient, i.e. inanimate. Here are some examples of non-sentient causers:

wind, rain, storm, cold	anger, greed	acid, drugs, mold
(natural force)	(emotion, psychological motive)	(substances)

We adopt the following notation:

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<sup>2</sup>Contrast (16b) with: *I rewrote the book \*interesting/into a bestseller*. *Rewrite* is not a creation verb. *re-* affixation turns some creation verbs into verbs of transformation.

- G. (i) x                            underspecified, i.e. x[sentient] ∨ x[-sentient]  
 (ii) x[sentient]            (agent)  
 (iii) x[-sentient]        (causer)

(Fi) requires an object, namely y. It excludes all unergatives like *run*, which have templates with x only.

Verbs of transformation like *break*, *melt* and *tear* have ST (13). The lexicon specifies the nature of x with respect to sentience. *Melt* and *break* have an underspecified x (Gi) and thus allow both sentient and non-sentient causers:

- (19) (a) The sun/John melted/broke the ice  
 (b) The ice melted/broke

*Spin* can only have an agent (sentient) causer, see (20a), and has ST (20b); this precludes achievement formation:

- (20) (a) The magician/\*momentum spun the wool  
 (b) x[sentient] caus y xform<manner> (y')  
 (c) \*Wool spun (violates Fii)

Activity verbs such as *wipe* in (21a) tend to have sentient causers only: hence ST (21b):

- (21) (a) \*The wind/John wiped the table  
 (b) x[sentient] act<manner> on y  
 (c) \*The table wiped

(21c) is out for same reason as (20c); the requirement for a sentient causer in the verb's lexical specification precludes achievement formation.

Third, de-adjectival verbs like *clean* have sentient causers; others like *empty* may admit ±sentient causers:

- (22) (a) I/\*the mop cleaned the floor  
 (b) \*The floor cleaned
- (23) (a) The sale/customers emptied the store  
 (b) The store emptied

*Clean* and *empty* have STs (24a) and (24b), respectively:

- (24) (a) x[sentient] caus y become <state>            (blocks Achievement formation)  
 (b) x caus y become <state>

## 7. Intrinsic Achievements

Some verbs denote events that are always internally caused; consequently, these verbs do not have a transitive/causative alternation. For example, (25a) could have the ST (25b):

- (25) (a) The flowers blossomed/bloomed  
(b) y become <state>

With a resultative, the composite ST (26) would be inadmissible (violating (Dii); the constraint that AP resultatives are incompatible with <state> in the primary template):

- (26) y become <state> & y be <state> (violates Dii)

Apparent counterexamples are (27):

- (27) The flowers blossomed/bloomed red

But note that *blossom* and *bloom* have an additional, stative reading (28b) with a corresponding template (28a). The stativity is shown by the presence of the *for* phrase (Vendler, 1967):

- (28) (a) y be <state>  
(b) The flowers blossomed/bloomed (for days)

The adjuncts in (29) show that (27) is a stative and thus incompatible with a resultative, rather, *red* in (27) is a depictive.

- (29) The flowers blossomed/bloomed red for days/\*in a day

### Achievements and Resultatives

We saw earlier that some verbs like *melt* in (19a) form achievements. Unaccusative *melt* as in (30a) may take a PP resultative (30c), but not an AP resultative (30b):

- (30) (a) The ice melted  
(b) \*The ice melted liquid  
(c) The ice melted into a liquid

*Melt* has ST (31a). Therefore, (30b) and (30c) have STs (31b) and (31c), respectively.

- (31) (a) x caus y xform<manner> (y')  
(b) y xform<melt> (y') & y be <state>  
(c) y xform<melt> (y') & y become y'

(31b) (but not (31c)) violates the “y will be y” condition, namely (Diii).

Finally, some verbs, such as *decompose*, *decay*, *deteriorate*, *rot* and *wither*, denote events that cannot be caused by a sentient AGENT but only by a natural cause or phenomenon:

- (32) (a) Humidity/\*John deteriorated/rotted the body  
(b) x[-sentient] caus y xform<manner> (y')  
(c) The body deteriorated/rotted  
(d) \*The body deteriorated/rotted dry (violates Diii)  
(e) The body deteriorated/rotted into slime

The ST for (32a) is (32b). Here, x[-sentient] permits (32c) to be formed. (32b) also blocks the AP resultative (32d) but allows the PP. Compare this with the ST for *melt* in (31a), where the cause is unspecified with respect to sentience.

To summarize, some verbs take only sentient causers, some only non-sentient, and others both. This distinction is used to facilitate or block Achievement formation, and is also relevant for another alternation: the Middle construction.

## 8. The Middle

The middle construction is characterized by the following central properties: (A) a transitive verb, (B) whose Patient or Affected Argument (normally appearing in direct object position) is the subject, (C) has a “generic” interpretation, not specific to (a) particular agent(s), and (D) paraphrases with tough-movement or *-able* affixation on the verb. See (Fellbaum, 1985) for more detail, also (Fellbaum & Zribi-Hertz, 1989) and (Keyser & Roeper, 1984).

- (33) (a) These drawers open/install easily (It is easy to open/install these drawers)  
(b) John opened/installed these drawers

The middle often seems indistinguishable from the unaccusative, but a careful analysis reveals differences between these constructions that affect their distribution:

- (34) (a) Spy novels read easily (middle)  
(b) It is easy (for someone) to read spy novels  
(c) John reads spy novels  
(d) \*Spy novels read (unaccusative)
- (35) (a) These flowers wilted last night (unaccusative)  
(b) \*It is easy (for someone) to wilt these flowers  
(c) \*John wilted these flowers



To undergo middle formation, a verb must select for an agent (a necessary but not sufficient condition). A wilting event cannot be directly caused by an Agent, hence (35a) is not a middle and both (35c) and the paraphrase (35b) are ungrammatical.

In general:

- All middles will have accomplishment-style counterparts, e.g. (33b) for (33a).
- Not all middles will have achievement counterparts, e.g. (34d) for (34a).
- Middle verbs undergo *-able* affixation: *driveable*, *steerable*, *openable*. Contrast with *\*wilttable* and *\*deterioratable*.

## 9. Conditions on Middle Formation

To allow middle formation, verb templates must satisfy the following conditions:

- H. (i) y must be present  
 (ii) x[sentient] agent (sentient)  
 (iii) \*exist(±) \*creation/destruction verbs

Let us examine how these conditions apply to the verb classes and STs we have discussed. We saw earlier that *melt* and *break* have ST (13) with a causer unspecified with respect to sentience. Hence, both (36a) and (36b) can be formed:

- (36) (a) Ice melts/breaks easily (middle)  
 (b) Ice melts/breaks (unaccusative)

Contrast this with *saw*, which has a sentient causer in its ST (37c). Hence, achievement but not middle formation is blocked:

- (37) (a) I/\*corrosion sawed the pipes  
 (b) \*The pipe sawed (violates Fii: achievement formation blocked)  
 (c) x[sentient] y xform (y')  
 (d) Plastic pipes saws easily

Thus, not all middles (37d) have achievement counterparts (37b). Although all middles have transitive counterparts, the reverse does not hold:

- (38) (a) Nero built/destroyed/ruined the temple  
 (b) \*Temples build/destroy/ruin easily  
 (c) x caus y become<manner> exist(±)

Verbs of creation/destruction are generally incompatible with middles (Fellbaum, 1985). *Build*, *destroy* and *ruin* have the ST (38c), which violates (Hiii).

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