Causation in Semantics and Grammatical Structure

Week 7: Internal and external causation

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The causative alternation: review

Certain verbs, like *break, open,* and *melt* appear either transitively or intransitively

(1) a. The door opened.
    b. Miren opened the door.

(2) a. The lamp broke.
    b. Miren broke the lamp.

- alternating verbs often describe a change of state (sometimes a change of position)
- the transitive variant can be (roughly) paraphrased by using *cause* + the intransitive variant
The causative alternation: review

Not all intransitive or change-of-state verbs participate:

(3)  a. The audience laughed. [intransitive]
    b. *The comedian laughed the audience.

(4)  a. The flowers bloomed. [change of state]
    b. ??The gardener bloomed the flowers.

Alternation-specific questions:

- How can we characterize the verbs that participate?
- Which form is basic, and what does this tell us about the way we conceptualize change of state events?

More generally:

- What can we learn about the conceptualization of causation?
  - are all changes of state caused?
  - if not, which ones do we think of as caused, and why?
The causative alternation: review

Last week, we looked at one analysis of the causative alternation, from Levin & Rappaport Hovav (1994):

- **important note:** this is NOT the only available analysis
- We focused on this analysis because it explains the alternation well, and introduces a distinction in causal conceptualization that is of interest in examining the linguistic representation of causation

Levin & Rappaport Hovav’s proposal (for change of state verbs):

- the crucial distinction for alternation is the distinction between **internal** and **external** causation
- the distinction has to do with the extent to which the changed/changing object’s properties are involved in bringing about the change of state
- **Upshot:** the transitive variant of alternating verbs is the basic form (exceptions can be predicted)
Internal- and externally-caused changes of state

Internally-caused changes of state:
“...states that come about naturally in an entity. These states are conceptualized as having their source internal to the entity that changes state.” (L&RH 1995)

A change of state is **internally** caused if something (some property, etc) internal to the changed object is responsible for the change:

- e.g., *bloom* describes an internally-caused change of state, because – while it might be supported and enabled by external factors, it’s initiated by some internal measure or force

- according to L&RH, these verbs appear only intransitively because the ‘causer’ slot in argument structure is occupied by the thing that also undergoes the change
Internal- and externally-caused changes of state

Externally-caused changes of state:
“...by their very nature imply the existence of an ‘external cause’ with immediate control over bringing about the eventuality.” (L&RH 1995)

A change of state is externally caused if it’s fundamental to our knowledge of the event that something external to the changed object precipitates/initiates/controls the change:

- *cut*, *shoot* are externally caused because they involve instruments
- *break*, *open* are externally caused because, while relying on certain properties, breaking and opening aren’t spontaneous
Internal- and externally-caused changes of state

For externally-caused changes of state:

▸ the possibility of apparently spontaneous occurrence permits intransitive uses (L&RH)

(5) The door opened (and two men came in).

▸ doors don’t ‘just open’, but without direct evidence of the cause, it can appear spontaneous
  ▸ intransitive use doesn’t imply absence of external cause, but might convey that we don’t have information about the cause (cf. McCawley 1978)

▸ events that cannot even appear to be spontaneous don’t allow intransitive uses:

(6) *The cake cut.

▸ things can only be cut with scissors or a knife; any observation of a cutting event necessarily involves an observation of the instrument (and the cause) as well
Internal- and externally-caused changes of state

L&RH are making a broader claim about the conceptualization of changes of state:

- if their explanation of the causative alternation is correct, then linguistic representation is sensitive to a concept of internal vs. external causation
- they are represented as different kinds of events:
  
  \[
  \text{break}_{\text{trans}} := [x \ \text{CAUSE} \ [y \ \text{BECOME} \ \text{BROKEN}]]
  \]

  \[
  \text{laugh} := [x \ \text{LAUGH}]
  \]

- externally caused events have a more complex representation
  - including some component of meaning represented in (7) by \text{CAUSE}
  - \text{laugh} might also describe a caused event, but on this representation the causal information here is only encoded in the semantic role assigned to the sole argument
Internal- and externally-caused changes of state

\[ \text{break}_{\text{trans}} := [x \ \text{CAUSE} \ [y \ \text{BECOME BROKEN}]] \]

\[ \text{laugh} := [x \ \text{LAUGH }] \]

Today: We’d like to test for these distinctions

- indirectly a way of testing L&RH’s hypothesis
- find evidence of the cognitive reality of a distinction between internal and external causation

McKoon & MacFarland (2000):

- **big idea:** differences in lexical semantic structure should correspond to differences in processing effort
- **specific hypothesis:** if the structures proposed by L&RH are correct, externally caused change of state verbs should require more effort than internally-caused verbs
Important assumption: Sentences involving changes of state are produced and understood through processes that make use of their underlying lexical semantic templates.

- Lexical semantic representations like (7) and (8) are codes for syntactic structure (via linking rules):

  (7) \( \text{break}_{\text{trans}} := [x \ \text{CAUSE} \ [y \ \text{BECOME} \ \text{BROKEN}]] \)

  (8) \( \text{laugh} := [x \ \text{LAUGH}] \)

- Optional information about the event can be associated with the content level of representation:

  (9) John broke the window (with a hammer)

- The oblique argument provides additional information but doesn’t fundamentally change the nature/construction of a breaking event in mental representation.
McKoon & MacFarland: Four production tests
Does the internal/external difference . . .

1. . . . correspond to differences in production of transitive sentences?
   ▶ preliminary expectation: internally-caused verbs will not appear frequently in transitive constructions

2. . . . affect the types of entity that can appear as the subject in intransitive sentences?
   ▶ expectation: since internal causation involves inherent properties, subjects of internal verbs will be more restricted

3. . . . affect what appears as the object in transitive sentences?

4. . . . affect what appears as the subject of transitive sentences?
   ▶ subjects of transitive uses of internally-caused change of state verbs are content arguments, and don’t change the conception of the event – thus, they should be tightly tied to the process described by the verb
Question: How often do internally-caused verbs occur in transitive constructions?

Expectation/hypothesis:
- L&RH argue that the possibility of alternation (of having both transitive and intransitive variants) depends on an external-causation construal
- internally-caused events have the same argument as the causer and the affected object, so...
- we should expect to see internally-caused events occurring in transitive constructions infrequently (these are exceptional cases)
Study 1: frequency of transitive uses of internally-caused verbs

Design:

- used prior classification of internally-caused verbs (Levin & Rappaport Hovav 1995)
  - blister, bloom, blossom, corrode, decay, deteriorate, erode, ferment, flower, germinate, rot, rust, sprout, stagnate, swell, tarnish, wilk, wither
- calculated transitive use frequency:
  
  \[
  \frac{\text{# of times used transitively}}{\text{# of times used transitively} + \text{# of times used intransitively}}
  \]

Result: No clear pattern amongst internally-caused verbs
Study 1: frequency of transitive uses of internally-caused verbs

Data:

<table>
<thead>
<tr>
<th>VERB</th>
<th>PROBABILITY</th>
<th>VERB</th>
<th>PROBABILITY</th>
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<tbody>
<tr>
<td>blister</td>
<td>.22</td>
<td>germinate</td>
<td>.06</td>
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<td>bloom</td>
<td>.00</td>
<td>rot</td>
<td>.08</td>
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<td>blossom</td>
<td>.00</td>
<td>rust</td>
<td>.14</td>
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<td>corrode</td>
<td>.63</td>
<td>sprout</td>
<td>.26</td>
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<tr>
<td>decay</td>
<td>.00</td>
<td>stagnate</td>
<td>.02</td>
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<td>deteriorate</td>
<td>.01</td>
<td>swell</td>
<td>.37</td>
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<tr>
<td>erode</td>
<td>.67</td>
<td>tarnish</td>
<td>.98</td>
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<td>ferment</td>
<td>.54</td>
<td>wilt</td>
<td>.06</td>
</tr>
<tr>
<td>flower</td>
<td>.00</td>
<td>wither</td>
<td>.12</td>
</tr>
</tbody>
</table>

Note: There were two transitive sentences with bloom; rounding makes the entry .00.

Table 1. Probability of transitive construction.

- some verbs (bloom, decay, stagnate) are infrequently transitive
- others (corrode, erode, ferment) have a fairly high frequency

Conclusion: the internal/external distinction may be real, but transitive use frequency does not correlate with this strongly
McKoon & MacFarland: Production tests

Study 1: frequency of transitive uses of internally-caused verbs

Sanity check: transitive frequency of externally-caused verbs (per L&RH95)

<table>
<thead>
<tr>
<th>EXTERNAL CAUSATION VERBS</th>
<th>INTERNAL CAUSATION VERBS</th>
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<tbody>
<tr>
<td></td>
<td>LOW PROB.</td>
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<tr>
<td>abate</td>
<td>.10</td>
</tr>
<tr>
<td>atrophy</td>
<td>.03</td>
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<tr>
<td>awake</td>
<td>.05</td>
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<td>crumble</td>
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<td>explode</td>
<td>.07</td>
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<td>fade</td>
<td>.01</td>
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<td>shrivel</td>
<td>.11</td>
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<tr>
<td>vibrate</td>
<td>.03</td>
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<tr>
<td>MEAN</td>
<td>.06</td>
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</tbody>
</table>

Note: There were two transitive sentences with *bloom*; rounding makes the entry .00.

TABLE 2. Probability of transitive construction.

- no clear difference between the classes, conclusion supported
McKoon & MacFarland: Production tests

**Study 2:** subjects of intransitive sentences

**Question:** Is the range and variation in intransitive subjects of internal verbs restricted relative to the range of intransitive subjects of external verbs?

**Expectation/hypothesis:**
- since internal changes are inherent in the object undergoing change, the subject of an intransitive has to have the ‘right sort’ of properties to precipitate the change
- internal intransitive subjects should be more restricted
- NB: according to L&RH, externally-caused verbs can alternate because the events they describe can at least seem to be spontaneous
  - alternating verbs rely on the properties of the changed object
  - so, we might expect that subjects of intransitive external verbs are limited to things with the right kinds of properties (though the relevant properties will be different)
Study 2: subjects of intransitive sentences

Design:
- experiment 1 verbs (both internal and external), matched for frequency of overall occurrence
- 100 randomly chosen intransitive uses
- sorted the subjects into 5 categories:
  - Artifacts (man-made things), Nature (incl. natural forces), Animate (volitionality), Body Parts, and Abstract (intangibles)
- calculated distribution across subject categories

Results: No clear difference between internal vs. external causation
- some verbs in each category (e.g. internal: erode; external: dissipate) are restricted, but others (int: sprout, wither; ext: crumble, vibrate) are well-distributed across the subject categories
Study 3: objects of transitive sentences

Question: Is the range and variation in transitive objects of internal verbs restricted relative to the range of transitive objects of external verbs?

▶ since Study 1 showed that internal verbs occur transitively, it’s reasonable to ask this question

▶ it amounts to the same thing as Study 2, since the transitive object of an alternating verb is the intransitive subject

Expectation/hypothesis:

▶ we expect to see the same pattern as in Study 2
Study 3: objects of transitive sentences

Design:
- same verbs, examined transitive uses instead
- objects divided into same 5 categories

Results:
- no significant internal-external difference with respect to objects
- **BUT**: the distribution is not the same as for intransitive subjects
  - # abstract trans objects > # abstract intr subjects
  - *suggestion*: abstract objects represent metaphorical extensions of change of state verbs, so the causer needs to be made explicit

(10) a. The river bank eroded.  [water, usually]
    b. Politicians’ behaviour is eroding public morals.
Study 4: subjects of transitive sentences

Question: Is there a difference in the types of entities that appear as transitive subjects of internal and external verbs?

Expectation/hypothesis:
- externally-caused verbs should show a wider variety of subject types
- this has to do with how McKoon & MacFarland think the subject argument is licensed in each case
  - not exactly the same as L&RH
Study 4: subjects of transitive sentences

Expectation/hypothesis, continued:

(7) \( \text{break}_{\text{trans}} := [x \ \text{cause} [y \ \text{become BROKEN}]] \)
(8) \( \text{laugh} := [x \ \text{LAUGH}] \)

- based on (7), the subject of external verbs is only constrained by the \text{cause} subevent – so we don’t expect restrictions
- based on (8), a transitive use of internal verbs involves introducing a \text{CONTENT} argument (M&M, p.842):
  “Because it is licensed by the content part of meaning and ... part of the same subevent as the change of state, the participant should be ... intrinsically involved in the change of state. If something is said to erode a beach, this cannot be just any something ... it must be something that participates intrinsically in erosion, like wind or water.”

- one issue: can we make sense of the \text{burp} examples this way?

(11) The nurse burped the baby.
Study 4: subjects of transitive sentences

Design:

- matched occurrences of external/internal verbs in transitive constructions
- frequency of 5 types of subject noun against concrete and abstract objects

Results:

- when direct objects are concrete, internally caused verbs (mostly natural processes: *erode, germinate*) have natural forces as transitive subjects
  - i.e., things that inherently participate despite externality
- no restrictions on external verbs with concrete objects
- difference is significant
- no real difference with abstract objects – mostly abstract subjects in each case
McKoon & MacFarland: Production tests

Conclusions from production studies:

- language use, metaphorical extension is relatively free, despite lexical structural templates
- but not entirely free: content-induced arguments can ‘break’ the lexical template pattern as long as they don’t disrupt the event construal
- **upshot:** while the transitive/intransitive (alternating/non-alternating) distinction doesn’t diagnose external vs. internal causation, restrictions on transitive subjects do

**Next:** If the lexical semantic templates are correct, externally-caused changes of state have a more complex event construal

- test this by testing comprehension of change of state verbs
Overall hypothesis: Since externally-caused changes of state have a more complex conceptual representation, involving both a cause and a become subevent, they should have additional processing costs

- it should take longer to parse and comprehend descriptions of externally caused changes of state than internally caused changes
- measure this with response times in a yes/no acceptability judgement task

Acceptability judgements:

- you’re shown a word or phrase and the task is to decide if it’s a real word or a grammatical utterance
- usually, we’re interested in response times to actual words
- the longer the response, the more time/effort it took the participant to process and comprehend the stimulus
- use nonwords or unacceptable sentences to figure out a baseline for response time, then measure differences from that baseline
Experiment 1: Response times to intransitive change of state sentences

Question: Is it more effortful/time consuming to process change of state descriptions with external verbs than to process descriptions with internal verbs?

Expectation/hypothesis:

- since the lexical semantic template (involving 2 subevents) is supposed to be active regardless of the transitive/intransitive nature of a stimulus sentence . . .
- a more complex representation will take longer to process
- and acceptable externally-caused intransitive descriptions will have slower response times than acceptable internally-caused intransitive descriptions
**Experiment 1:** Response times to intransitive change of state sentences

**Design:**
- 1 acceptable three-word intransitive with each of 14 internally-caused verbs and 14 externally-caused verbs
  
  (12) a. The wind abated.
  
  b. The flowers bloomed.

- Matched verbs with similar occurrence frequencies (to test the idea that comprehension time just reflects familiarity)

- Pre-experiment lexical decision task with relevant verbs, to ensure that participants were familiar with the verbs

- Fillers to balance acceptable/unacceptable sentences, and gage baseline response time
McKoon & MacFarland: Comprehension studies

**Experiment 1:** Response times to intransitive sentences

**Results:**

- **significant differences for internal vs. external verbs:** on average, externally-caused verbs take 150 ms/10% longer
  - accuracy rates, etc were similar (slightly lower for externally-caused verbs, but not significant)
- **supports the prediction that externally caused verbs are more complex**
- **no statistical differences observed using verb frequency instead of internal/external difference**
- **no priming effects of noun-verb pairs**

<table>
<thead>
<tr>
<th></th>
<th><strong>EXTERNAL CAUSE</strong></th>
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<th><strong>INTERNAL CAUSE</strong></th>
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</thead>
<tbody>
<tr>
<td></td>
<td><strong>JUDGMENT</strong></td>
<td><strong>PROBABILITY</strong></td>
<td><strong>JUDGMENT</strong></td>
</tr>
<tr>
<td></td>
<td><strong>TIME (MS)</strong></td>
<td><strong>‘YES’</strong></td>
<td><strong>TIME (MS)</strong></td>
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<tr>
<td>All sentences</td>
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<td>.91</td>
<td>1400</td>
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<tr>
<td>Low probability transitive</td>
<td>1561</td>
<td>.92</td>
<td>1392</td>
</tr>
<tr>
<td>Higher probability transitive</td>
<td>1538</td>
<td>.90</td>
<td>1413</td>
</tr>
</tbody>
</table>

**Table 7. Results for experiment 1.**
Experiment 2: Response times to transitive sentences

Question: Is it more effortful/time consuming to process change of state descriptions with external verbs than to process descriptions with internal verbs?

Expectation/hypothesis:

▶ if the differences in Experiment 1 are due to differences in underlying lexical semantic templates, we expect the same results

▶ internally-caused changes of state only need to represent change of state subevent, a transitive subject is part of this subevent

▶ as suggested by the production data from corpus study 4
Experiment 2: Response times to transitive sentences

Design:
- changed verb lists slightly for matching purposes
- 2 acceptable sentences for each verb, balanced in trials with fillers
- lexical decision and priming tests also conducted
- frequency balanced internal/external verbs to cross-check frequency hypothesis
Experiment 2: Response times to transitive sentences

Results:

- Results replicated Experiment 1 data, supporting complexity hypothesis
- Externally-caused verbs take about 10% longer for responses
- Frequency effects were not statistically significant
- No evidence of priming
Both comprehension and production studies reflect a real difference between internally- and externally-caused change of state events

- production: difference in trans. subject types, NOT trans. availability
- comprehension: RTs show that externally-caused change of state events are more complex

The conceptual distinction has consequences for representation:

- internally-caused change of state events are represented more simply than externally-caused change of state events, at the lexical template level
  - internal verbs are construed primarily as change of state events, without subevents
  - external verbs are construed as directed changes, with causing and changing subevents
- the data is consistent with a single lexical semantic template for verbs, regardless of surface realization
- show evidence for the reality of proposed lexical semantic decompositions
Refining the distinction

Wright (2002):

- there is more variation in how internal and external change of state verbs can be (syntactically) realized than we might expect from L&RH’s original proposal
  - *bloom, rust, wilt* are all internal changes:
    
    (13)  
    a. *Sarah/the gardener bloomed the roses.*
    b. Salt air rusted the metal pipes.
    c. Early summer heat wilted the petunias.

- what other factors are relevant in the distinction, and can be used to account for the variation?

- **ultimately:** Wright points out some additional parameters that affect the encoding of causation
  - purely semantic (and pragmatic) considerations explain the difference between (13)a and (13)b-c
  - for McKoon & MacFarland, this amounts to identifying CONTENT factors that affect surface realization
Factors under consideration:

1. causer type
   - humans, natural forces, non-volitional entities
   - internally-caused changes of state usually not associated with agentivity, a ‘prototypical’ feature of transitive/causative constructions
   - idea: agentive causation is more likely to be represented transitively
Factors under consideration, continued:

2. controllability (cf. Smith 1970)
   ▶ degree of manipulability by outside source
   ▶ internal changes can only be manipulated to a certain degree: facilitators rather than controllers

Figure 2  Locus of Control with Verbal Events

+ Internal Locus of Control
  [---------] [---------] [---------] [---------] [---------]
  laugh     bloom   erode    freeze   break      cut

+ External Locus of Control
Factors under consideration, continued:

3. subject modification

- causer/causer type is inherent for internal verbs
- it's relevant to mention causers in this case only if they are unusual/unexpected in some way (related to the problem of causal selection/CCFs)

(14) a. ?Last July, sunlight wilted the begonias.
    b. Last July, intense sunlight wilted the begonias.

Survey task:

- subjects listed similar causers for internal verbs, but a wider variety for external (cf. M&M)
- modified causers improved transitive uses of internal verbs (significantly), but no such difference arises with external verbs
Wright 2002

Regression model:

- graded acceptability ratings (1 to 5)
- three coded variables as potential factors:
  - agentivity (causer type), subject modification: 0 or 1;
  - controllability: graded, 5-point scale (3 raters)

Findings:

- all three factors were predictive of acceptability ratings for internal verbs ($y$ -actual, $x$ -model)
  - controllability mattered the most, supporting Smith 1970, L&RH
  - agentivity, subject-modification corresponded positively with acceptability
Regression model:

- graded acceptability ratings (1 to 5)
- three coded variables as potential factors:
  - agentivity (causer type), subject modification: 0 or 1;
  - controllability: graded, 5-point scale (3 raters)

Findings, continued:

- agentivity and controllability mattered for external verbs, with agentivity the strongest predictor
Conclusions and overview

- both McKoon & MacFarland and Wright support the idea that the internal and external causation distinction makes a difference in linguistic encoding:
  - M&M: externally-caused events have a more complex representation
  - Wright: the factors that determine whether or not an internal verb can appear transitively are different than those that matter for an external verb
- but both also suggest that a variety of other aspects of causation/causal events play a role in determining surface realizations
  - Wright’s ‘subject modification’ criterion suggests that causers, if overtly represented, should be significant or unpredictable in some way
  - this correlates with agentivity, which also affects the surface forms of change of state descriptions
- next, we’ll explore the impact of agentivity