Causation in Semantics and Grammatical Structure

# Week 7: Internal and external causation

Prerna Nadathur

November 21, 2019

# 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 precipites/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:

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

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

- ▶ externally caused events have a more complex representation
    - ▶ including some component of meaning represented in (7) by CAUSE
    - ▶ *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

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

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

**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

# McKoon & MacFarland

**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) $break_{trans} := [x \text{ CAUSE } [y \text{ BECOME BROKEN}]]$

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

- ▶ 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

# McKoon & MacFarland: Production tests

**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 infreqently (these are exceptional cases)

# McKoon & MacFarland: Production tests

**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

# McKoon & MacFarland: Production tests

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

**Data:**

| VERB | PROBABILITY | VERB | PROBABILITY |
|------|-------------|------|-------------|
| blister | .22 | germinate | .06 |
| bloom | .00 | rot | .08 |
| blossom | .00 | rust | .14 |
| corrode | .63 | sprout | .26 |
| decay | .00 | stagnate | .02 |
| deteriorate | .01 | swell | .37 |
| erode | .67 | tarnish | .98 |
| ferment | .54 | wilt | .06 |
| flower | .00 | wither | .12 |

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)

| | EXTERNAL CAUSATION VERBS | | | INTERNAL CAUSATION VERBS | | | |
|---|---|---|---|---|---|---|---|
| | LOW PROB. | | HIGHER PROB. | | LOW PROB. | | HIGHER PROB. |
| VERB | TRANS. | VERB | TRANS. | VERB | TRANS. | VERB | TRANS. |
| abate | .10 | dissipate | .41 | bloom | .00 | blister | .22 |
| atrophy | .03 | fossilize | .60 | deteriorate | .01 | corrode | .63 |
| awake | .05 | fray | .52 | germinate | .06 | erode | .67 |
| crumble | .05 | redden | .24 | rot | .08 | ferment | .54 |
| explode | .07 | splinter | .49 | rust | .14 | sprout | .26 |
| fade | .01 | thaw | .61 | stagnate | .02 | swell | .37 |
| shrivel | .11 | | | wilt | .06 | | |
| vibrate | .03 | | | wither | .12 | | |
| MEAN | .06 | MEAN | .48 | MEAN | .06 | MEAN | .45 |

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 instransitive 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)

# McKoon & MacFarland: Production tests

**Study 2:** subjects of intransitive sentences

**Design:**

- ▶ experiment 1 verbs (both internal and external), matched for frequency of overall occcurence
- ▶ 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

# McKoon & MacFarland: Production tests

**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

# McKoon & MacFarland: Production tests

**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.

# McKoon & MacFarland: Production tests

**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

# McKoon & MacFarland: Production tests

**Study 4:** subjects of transitive sentences

**Expectation/hypothesis, continued:**

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

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

- based on (7), the subject of external verbs is only constrained by the CAUSE subevent – so we don't expect restrictions

- based on (8), a transitive use of internal verbs involves introducing a 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 *burp* examples this way?

  (11) The nurse burped the baby.

# McKoon & MacFarland: Production tests

**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

# McKoon & MacFarland: Comprehension studies

**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

# McKoon & MacFarland: Comprehension studies

**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

# McKoon & MacFarland: Comprehension studies

**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

**Result˜˙**

| | EXTERNAL CAUSE | | INTERNAL CAUSE | |
|---|---|---|---|---|
| | JUDGMENT TIME (MS) | PROBABILITY 'YES' | JUDGMENT TIME (MS) | PROBABILITY 'YES' |
| All sentences | 1551 | .91 | 1400 | .96 |
| Low probability transitive | 1561 | .92 | 1392 | .96 |
| Higher probability transitive | 1538 | .90 | 1413 | .96 |

TABLE 7. Results for experiment 1.

- 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

# McKoon & MacFarland: Comprehension studies

**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

# McKoon & MacFarland: Comprehension studies

**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

# McKoon & MacFarland: Comprehension studies

**Experiment 2:** Response times to transitive sentences

**Results:**

| | EXTERNAL CAUSE | | INTERNAL CAUSE | |
|---|---|---|---|---|
| | JUDGMENT TIME (MS) | PROBABILITY 'YES' | JUDGMENT TIME (MS) | PROBABILITY 'YES' |
| All sentences | 2220 | .86 | 2069 | .96 |
| Low probability transitive | 2230 | .81 | 2131 | .96 |
| Higher probability transitive | 2210 | .93 | 1963 | .96 |

TABLE 8. Results of experiment 2.

- ▶ 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

# McKoon & MacFarland: Conclusions

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

# Wright 2002

**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

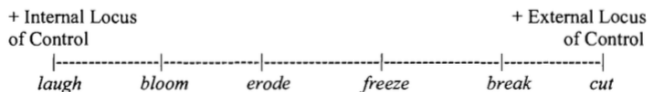   **Figure 1  Transitivity and Agentivity with Change of State Events**

   

   -Transitive
   -Agent
   +Transitive
   +Agent

   bloom     germinate     freeze   .   break

# Wright 2002
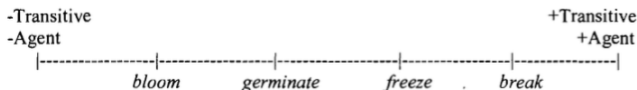
**Factors under consideration, continued:**

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

+ External Locus
of Control

|---------------|---------------|---------------|---------------|---------------|

laugh     bloom     erode     freeze     break     cut

**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
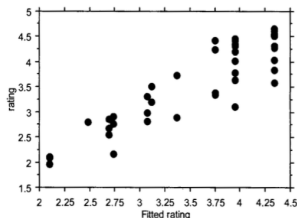
# Wright 2002

**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:**



Figure 3  Acceptability Ratings: Internally Caused Change of State Verbs

- ▶ 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
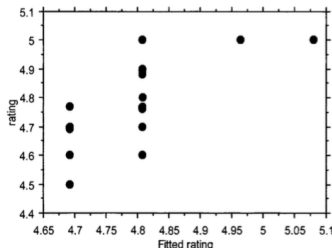    acceptability

# 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, continued:**

Figure 4 Acceptability Ratings: Externally Caused Change of State Verbs



- ▶ 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