

The mechanics of causal discourse expectations

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Overview

- 1 Implicit Causality basics
- 2 Semantic theory of implicit causality
- 3 Discourse continuation experiments

Implicit Causality: Our story in a nutshell

- Implicit Causality: Lexically triggered preference for specific types of explanations.
 - IC bias: Epi-phenomenon of explanatory strategies.
 - Association of explanation with one of the participants.
- (1)
- a. **Bias-congruent**
John congratulated **Sarah** because . . . **she** won the race.
 - b. **Bias-incongruent**
John congratulated Sarah because . . . **he** was very impressed by her performance.
- Rooted in verb semantics, our theory allows for systematic manipulation of the IC bias.

Implicit Causality bias basics

- Implicit Causality verbs: verbs with two animate arguments
- Discourse continuation studies

(2) **prompt:** *NP1 verb-ed NP2 because ...*

- Preference for pronominal reference
- Bias: proportion of continuations mentioning NP1 or NP2 first

(3) Peter frightened Mary because ... he started yelling for no reason.
↪ *frighten*: NP1 bias

(4) John congratulated Sarah because ... she won the race.
↪ *congratulate*: NP2 bias

- Kehler et al: Truly implicit
 - we expect an explanation after a full stop.

Previous verb-based accounts of Implicit Causality

- Other ‘verb semantic’ accounts have focused on argument structure classes
- Stimuli and ‘evocators’ are strong bias attractors
 - **stimuli:**
 - NP1 bias:* **STIM** amused EXP
 - NP2 bias:* EXP admired **STIM**
 - **evocators:**
 - NP2 bias:* AGENT congratulated **EVOCATOR**
- Agents and patients do not attract the bias in a systematic way
- No *explanation* of patterns, mere correlation between bias and verb classes as defined by argument structure
- Which semantic properties of stimuli and evocator arguments trigger the bias?

Questions to be answered in a theory of Implicit Causality

- What determines the bias?
- Why do some verbs have a clear bias and others not?
- How does the expectation of an explanation come about?
- Why does there exist a correspondence between explanation patterns and coreference?
- How can we provide a unified account of discourse expectations (explanations) and verb semantics?

Implicit Causality ingredients

Main claim

Implicit Causality verbs trigger specific kinds of explanations associated with one of the two participants

- (5)
- a. John disturbed Mary because ... he sang loudly.
 - b. John congratulated Mary because ... she won the race.
- IC bias may be observed when a *because* clause can specify a semantic entity associated with (only) one of the participants
 - IC bias is dependent on
 - Causal elaboration possibilities in *NP1 verb-ed NP2*
 - Semantic properties of *because* (clauses)
 - Consequently, we need a suitable theory of verb semantics and a typology of explanations (as introduced by *because*)

because: causes and reasons

- **Simple causes** are causes of (attitudinal) states or events

(6) **Simple (direct) cause:**

John disturbed *Mary* because *he* sang loudly.

- **Reasons** are causes of attitudinal states involving intentionality

(7) **Externally anchored reason:**

John disturbed *Mary* because *she* had stolen his textbook.

(8) **Internally anchored reason:**

John disturbed *Mary* because *he* was angry at her.

- **Backgrounds** are necessary, but not sufficient causes

(9) **Background:**

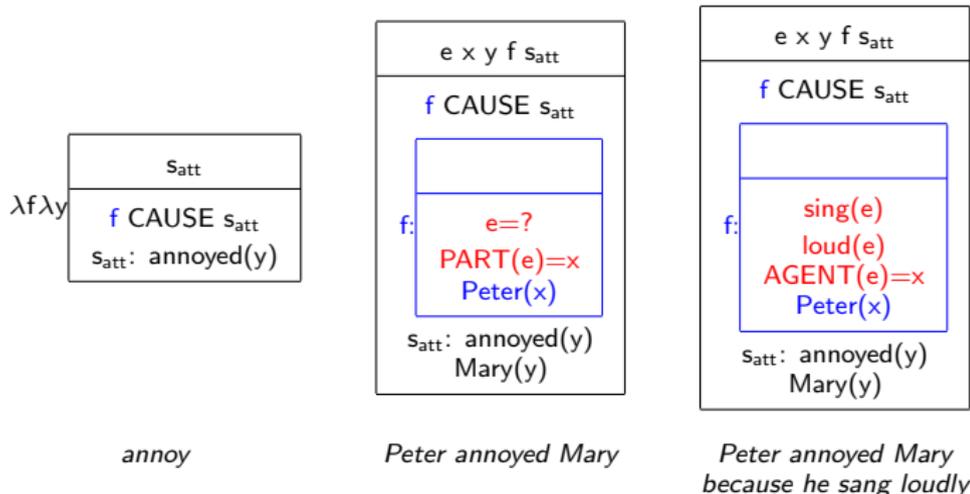
John disturbed *Mary* because she needed silence to concentrate.

- The bias patterns depend on the availability of these explanation types

Explanatory slots I: Stimulus arguments

- $annoy \rightsquigarrow f \text{ CAUSE } s_{att}$
Some fact brings about the attitudinal state of y being annoyed
- Default explanations are **simple causes**

(10) Peter annoyed Mary because he sang loudly.



- Evidence: Stimuli may also be realized by *that* clauses

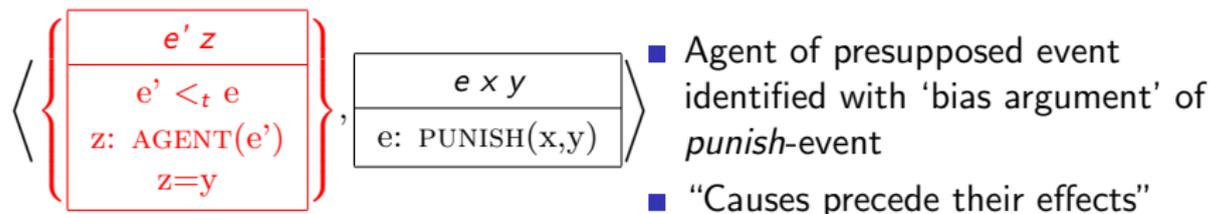
(11) It annoyed Mary *that Peter sang loudly*.

Explanatory slots II: Presuppositions

- *because* clauses may elaborate a presupposed preceding event

(12) NP2 bias:

Lars punished **Melanie**, *because she stole the money*.



- Explanations are **external reasons**
- ▷ With both stimuli and presuppositions, **AvoidAccommodation** triggers the specification of an explanation

AP verbs: external vs. internal reasons

- With agent-patient verbs, any distribution of verb biases is possible

(15) *Judith* *bashed* *Richard*, because ...

- a. **External reason:**
he *tormented* *her* *brother*.
- b. **Internal reason:**
she *was* *very* *upset*.

- **However: IC bias should follow from the ratio of external to internal reasons**
 - External reasons \rightsquigarrow NP2 bias
 - Internal reasons \rightsquigarrow NP1 bias

Manipulating expectations: Basic intuitions

- How can we test these assumptions?
- Missing information triggers systematic specification
- If we specify the missing information in the prompt, we should be able to influence the preferences for explanation
- Consequently, the bias should also change.

- (16) **presupposition verb** *congratulate*:
Sebastian congratulated Linda because ...
she won the 1st price.
- (17) Sebastian congratulated Linda **on winning the first price** because ...
he was very impressed.

Modifying SE and AP verbs

- In German, stimulus-Experiencer verbs allow *durch* phrases to specify the stimulus
- Similar to *by+ing* or *with* phrases

- (18) a. **Bias-congruent:**
Hannah ängstigte Leo, weil ... **sie** ihm eine Gruselgeschichte erzählte.
'Hannah scared Leo because ... she told him a horror story.'
- b. **Bias-incongruent:**
Hannah ängstigte **Leo** **durch die Erzählung einer Gruselgeschichte** weil ... **er** ein Hasenfuß war.
'Hannah scared Leo with a horror story because ... he was a coward.'

- *durch*: Specification of **simple cause**
- Pre-emption of specification strategy
- Shift away from simple cause

Modifying SE and AP verbs

- Interestingly, causative agent-patient verbs also allow *durch* phrases specifying a simple cause.
- e CAUSE s
- However, given that *durch* and *weil* ('because') are in 'complimentary distribution' with these predicates, the *durch* phrase shouldn't affect the explanation pattern

- (19) a. #Sarah killed Jacob because she shot him.
b. Sarah killed Jacob by shooting him.
- (20) a. Sarah tötete Jacob, weil . . . sie wütend auf ihn war.
'Sarah killed Jacob because she was angry at him.'
b. Sarah tötete Jacob **durch einen Schuss**, weil . . . sie wütend auf ihn war.
'Sarah killed Jacob with a shot because she was angry at him.'

- No pre-emption
- No change in explanatory strategy

Modifying presupposition verbs

- Similarly, the presupposition of an IC presupposition verb can be specified by means of a *für* phrase
- Comparable to *for* phrases in English

- (21)
- a. **Bias-congruent:**
Maria dankte Peter, weil ... er ihr beim Umzug geholfen hat.
'Mary thanked Peter because he helped her with the move.'
- b. **Bias-congruent:**
Maria dankte Peter **für die Hilfe beim Umzug**, weil ... sie es ohne ihn nie geschafft hätte.
'Mary thanked Peter for helping her with the move because she couldn't have made it otherwise.'

- Verification/Specification of presupposition
- Pre-emption of explanatory strategy
- Shift away from external reasons

Discourse expectations

- Given a discourse segment, which relation may be expected to be established between this segment and the following discourse segment?

(22) John disturbed Mary. ...
He sang loudly.

- Shift towards forward-looking perspective on unmarked discourse relations.
- If the non-marked continuations follow from the 'slot filling' strategy we propose, the modifiers should also influence this behaviour.

(23) John disturbed Mary **by singing late at night** ...
Consequently, she left the room.

Interim summary

- Implicit Causality is triggered by underspecified content
- AvoidAccommodation
 - 1 Stimulus: unspecified property
 - Causal explanation: Simple causes
 - Bias: Stimulus (NP1)
 - 2 Presupposition
 - Causal explanation: Externally anchored reasons
 - Bias: Argument associated with presupposition (NP2)
- Pronominal reference is an epi-phenomenon of explanatory strategy
- Expectations at the type level

Experimental study

Overall predictions

- Verbs with underspecified entities should trigger more explanations than verbs without slots
 - More explanations: Stimulus-experiencer and presupposition verbs
 - Less explanations: Agent-patient verbs
- Verbs where the slot is filled in the prompt should trigger significantly less explanations than in unmodified prompts.
 - Less explanations with modified stimulus-experiencer and presupposition verbs
 - No change with modified agent-patient verbs
- Correspondingly, the bias should change where a slot is filled
 - Bias change with stimulus-experiencer and presupposition verbs
 - No bias change with agent-patient verbs

Experiments 1A and 1B
Comparing Stimulus-Experiencer and Agent-Patient verbs

Methods: Exp. 1A/B

- Between items/within participants:
 - Exp. 1A: 20 SE-verbs
 - SE) Ben amused Mia (by telling a funny story)
a) full stop ... b) because ...
 - Exp. 1B: 20 causative AP-verbs
 - AP) Jasmin killed Henry (by a shot)
a) full stop ... b) because ...
- Within items/participants: 2×2 design (*connective* \times *modification*)
- Counterbalanced between NP1/2 = masc./fem.
- 40 items + 40 fillers, latin square design
- Instructions: “continue the discourse in the most natural way” (or skip it if you can’t come up with a continuation)
- Two blocks:
 - 1st block: Full stop conditions
 - 2nd block: *because* conditions

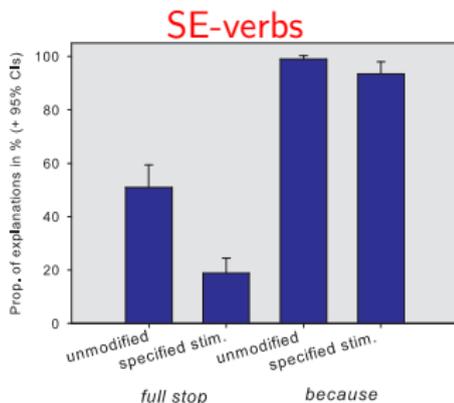
Discourse annotation

The resulting corpus of continuations was annotated wrt. the following categories:

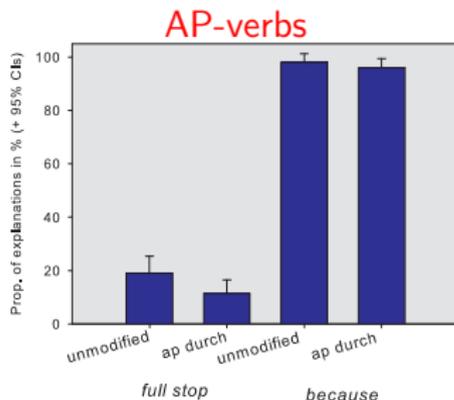
- Discourse relation (agreement: Cohen's $\kappa = .80$)
 - sensible continuation (skips and nonsense \triangleright mis. values)
 - temporal order (event_{continuation} after event_{prompt}?)
 - explanation? (*because* test)
- Causal annotation: *simple cause* vs. *ext. reason* vs. *int. reason* vs. *background* (agreement: Cohen's $\kappa = .74$)
- Bias annotation (agreement: Cohen's $\kappa = .86$)
 - NP1 vs. NP2 vs. no anaphor
 - unequivocal vs. ambiguous (*he loved her*)
 - kind of anaphor (pronoun, DP, proper name)

SE and AP verbs: Proportions of explanations

- (24) Mia amused Ben because ...
(25) Mia amused Ben with a funny story because ...



- (26) Mia killed Ben because ...
(27) Mia killed Ben with a shot because ...



- For SE verbs, *durch* phrases reduce explanations from 51% to 19%
- For AP verbs without underspecified content, less explanations overall (19% vs. 11%)
- Stronger decrease in SE than in AP conditions (interaction: $LRC_{S1}(1) = 6.9; p < .01$)

Explanation types: Predictions for SE verbs and AP verbs

SE verbs

- **Drop in Simple causes**
- Increase in Internal reasons
- Increase in Backgrounds

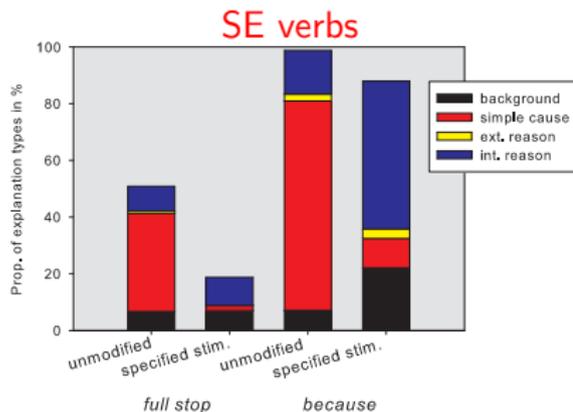
AP verbs

- no significant changes in explanation profile

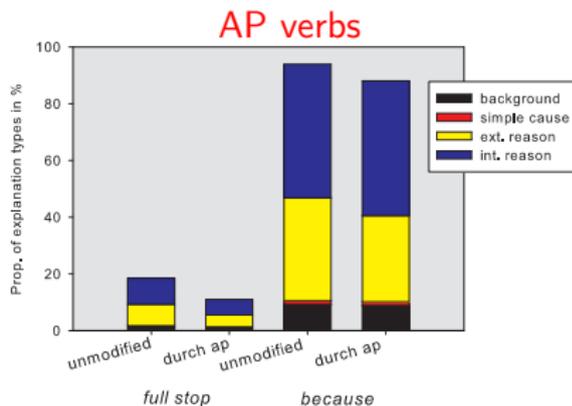
- (28) a. *Stimulus-Experiencer:*
Hannah scared Leo because ... she told him a horror story.
- b. *Stimulus-Experiencer modified:*
Hannah scared Leo **by telling a horror story** because ... he was a coward.
- (29) a. *Agent-Patient:*
Mia killed Ben because ... she was angry at him.
- b. *Agent-Patient modified:*
Mia killed Ben **with a shot** because ... she was angry at him.

SE and AP verbs: Explanation types

- (30) Mia amused Ben (because) ...
(31) Mia amused Ben with a funny story (because) ...



- (32) Mia killed Ben (because) ...
(33) Mia killed Ben with a shot (because) ...



- *durch*-PPs reduce simple causes ($LRCS_{1/2}(1) \leq 266; p_{1/2} < .01$)
- After *weil*, simple causes are substituted by int. reasons and backgrounds

- No sign. effects of *modification*
- ▷ Same explanation profiles across conditions

Bias: predictions for SE and AP verbs

SE verbs

- Explanations in unmodified conditions
 - Mainly simple causes
 - ▷ Strong NP1 bias
- Explanations after *durch*
 - no simple causes, internal reasons and backgrounds, instead
 - ▷ Bias shifts towards NP2

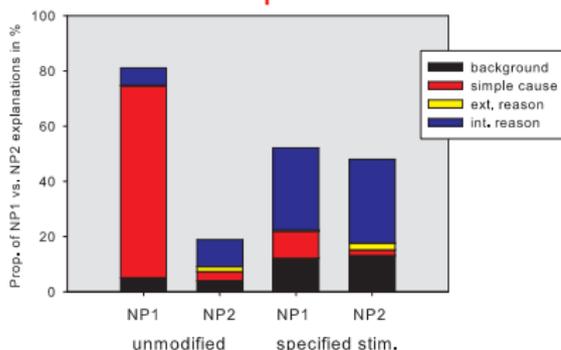
AP verbs

- Explanations in unmodified conditions
 - External and internal reasons
 - ▷ Balanced bias
- Explanations after *durch*
 - Unchanged explanation profile
 - ▷ Same bias

SE and AP verbs: Bias

- (34) Mia amused Ben (because) ...
 (35) Mia amused Ben with a funny story (because) ...

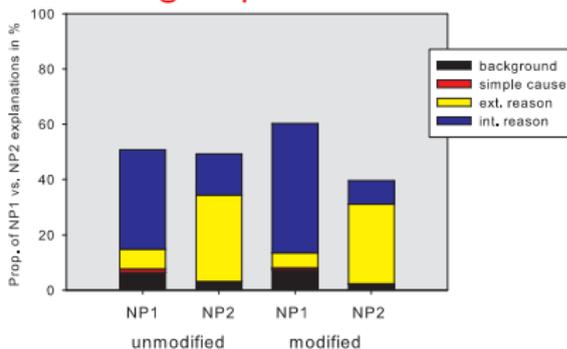
Stimulus-experiencer verbs



- *durch* phrases decrease the likelihood of rementioning NP1! ($LRCS_{1/2}(1) \geq 72$; $p_{1/2} < .01$)

- (36) Mia killed Ben (because) ...
 (37) Mia killed Ben with a shot (because) ...

Agent-patient verbs



- *durch* phrases **increase** the likelihood of rementioning NP1! ($LRCS_{1/2}(1) \geq 3.9$; $p_{1/2} < .05$)
- Why?

Experiment 1A/B – Discussion

- In contrast to ordinary AP verbs, SE verbs in *NP1 verb-ed NP2* sentences attract explanations
- Stimulus-Experiencer verbs trigger simple causes that specify a property of the stimulus argument
- *durch* modification affects explanation types and bias in a fully predictable way
- But why should *durch* lead to a bias effect in AP verbs?
 - (1) John killed Mary by a shot. (= John's shot)
 - (2) John amused Mary by telling a joke. (= John's joke)
- Across verb types, *durch*-phrases should enhance salience of NP1
- This influenced the specific form of the explanation sentence, but not its type!

Experiment 2
Presupposition verbs

Methods: Exp. 2

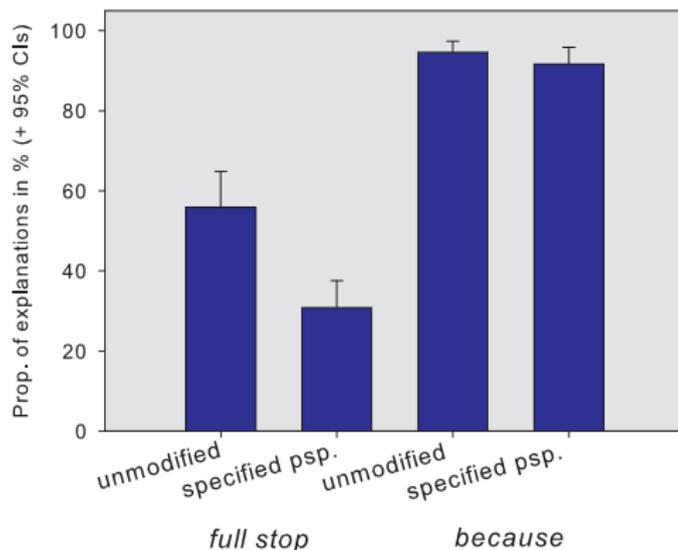
- AP-verbs with a presupposition
 - PSP) Sebastian congratulated Jaqueline (on winning the first prize in the dancing competition)
 - a)** full stop ... **b)** because ...
- Within items/participants: 2×2 design (*connective* \times *modification*)
- Counterbalanced between NP1/2 = masc./fem.
- Run together with Exp. 1A/B, same methods
- Annotation as in Exp. 1A/B

Predictions for PSP verbs

- 1 Specifying missing content explicitly in the prompt should lead to a drop in the number of explanations
- 2
 - Unmodified conditions should trigger ext. reasons
 - modified conditions should trigger internal reasons (or backgrounds)
- 3 This should alter IC bias from NP2 towards NP1

PSP verbs: proportions of explanations

- (38) Sebastian congratulated Jacqueline (because) ...
(39) Sebastian congratulated Jacqueline on winning the race (because) ...



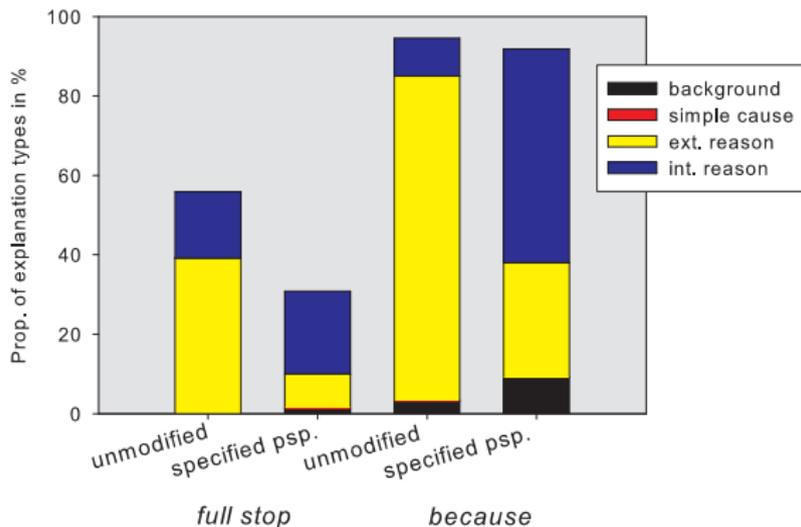
- After a full stop, explanations dropped from 56% to 31%

($LRCS_{1/2}(1) \geq 31$; $p < .01$)

PSP verbs: Explanation types

(40) Sebastian congratulated Jacqueline (because) ...

(41) Sebastian congratulated Jacqueline on winning the first price (because) ...

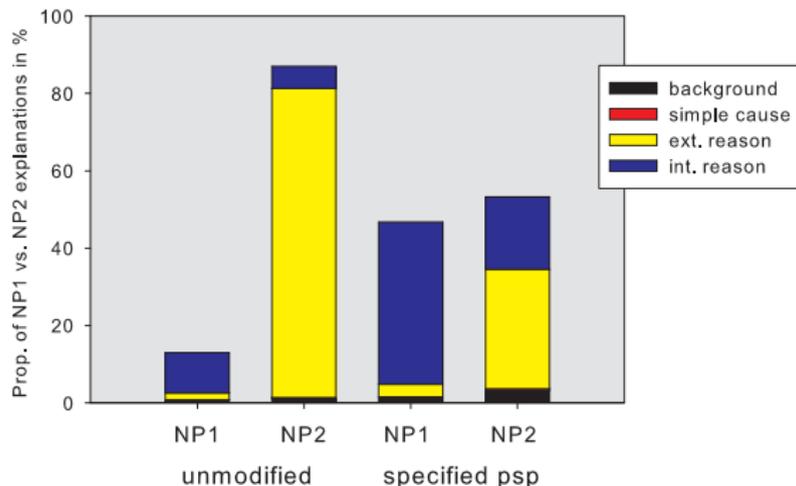


- Unmodified conditions trigger ext. reasons
- Modification leads to a shift towards int. reasons

($LRCS_{1/2}(1) \geq 193; p < .01$)

PSP verbs: Bias

- (42) Sebastian congratulated Jacqueline (because) ...
- (43) Sebastian congratulated Jacqueline on winning the race (because) ...



- Unmodified conditions are strongly biased towards NP2
- Modification eliminates the bias

($LRCS_{1/2}(1) \geq 93; p < .01$)

Ordinary Agent-Patient Verbs

Experiment 3: Methods

- Discourse continuation study with 100 participants
- Same methods and annotation as in Exp. 1A/B & Exp. 2
- 101 verbs: 16 SE; 18 ES; 10 AP/+PSP; **57 AP/-PSP**
 - 1. block *full stop*: *NP1 verbed NP2. ...*
 - 2. block *because*: *NP1 verbed NP2, because ...*
- 10,100 productions

AP/–PSP verbs: external vs. internal reasons

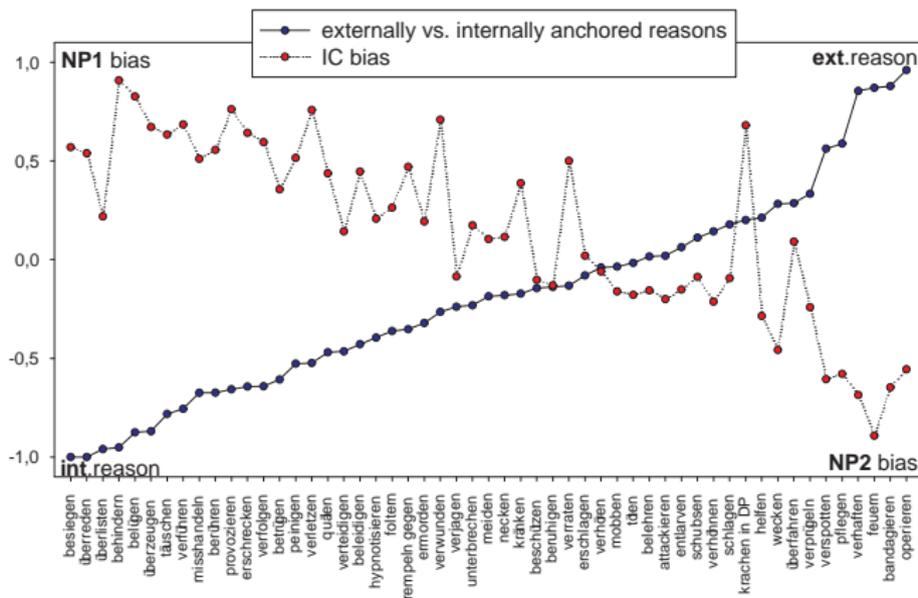
- Recall: With agent-patient verbs, any distribution of verb biases is possible

(44) *Judith* *bashed* *Richard*, because . . .

- a. **External reason:**
he *tormented* *her* *brother*.
- b. **Internal reason:**
she *was* *very* *upset*.

- **We claimed: The IC bias of an AP/–PSP verb should follow from the ratio of external to internal reasons**
 - External reasons contribute to NP2 bias
 - Internal reasons contribute to NP1 bias

AP Verbs with no underspecified content



- The ratio internal-to-external reasons is a good predictor for IC-bias
(accounted variance: $R^2 = .75$)

Conclusions

- Our account: IC bias is due to specific discourse expectations triggered by missing causal content
- Evidence: Providing the missing information in the matrix clause fills the explanatory gap and leads to predictable shifts wrt. coherence relation, explanation types and IC bias
- Underlying processing constraint: **AvoidAccommodation** (van der Sandt 1992, Zeevat 2000)
 - Well-established for syntactic processing (e.g. Altmann & Steedman 1988, van Berkum et al. 1999)

The (quantum) mechanics of causal discourse expectations

deterministic expectations in a probabilistic world

- 1 *NP1 IC-verb NP2* presupposes causal content
- 2 Expectation of a particular explanation type
- 3 Explanation type associated with particular referent

- Notion of ‘mechanics’ is too strong.
- The shift away from an explanation type is not deterministic.
 - Several explanation types available
- A particular explanation type can be realized in several ways.
 - (1) Peter bewunderte Maria, weil . . .
‘Peter admired Mary because . . .’
 - a. sie **seiner Meinung nach** einfach großartig war.
‘she, **in his opinion**, was just great’
 - b. **er fand, dass** sie einfach großartig war.
‘**he thought that** she was just great’

We thank you ... for your attention
... and Aleks Dimitrov for helping us with the annotation!