Strategic pronoun use

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special thanks to Oliver Bott and Torgrim Solstad
The Iterated Best Response (IBR) model of pragmatics
<table>
<thead>
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<th>some</th>
<th>all</th>
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**Literal Meaning**

<table>
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<tr>
<th>S₀</th>
<th>S₁</th>
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<tr>
<td>some</td>
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<table>
<thead>
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<th>R₀</th>
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<tr>
<td>some</td>
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Remention biases: Implicit Causality
• What kind of **discourse relation** is most likely to come next?
• Which **referent(s)** are most likely to be mentioned next?
• Which **form of expression** is used to communicate this reference?

(1)  
   a. Peter impressed Mary. **He** is very clever.  **(explanation)**
   b. Peter impressed Mary **because** **he** is so clever.
   c. Talking of Mary, she is entirely impressed by Linda **because** she/Linda is so clever.
Implicit causality bias (IC bias)

(2)  a. Peter impressed Mary because he sang beautifully.
Implicit causality bias (IC bias)

(2) a. **Peter** impressed Mary because **he** sang beautifully.
b. Peter admired **Mary** because **she** sang beautifully.
Implicit causality bias (IC bias)

(2)  

a. **Peter** impressed Mary because **he** sang beautifully.  
b. Peter admired **Mary** because **she** sang beautifully.  
c. Peter impressed **Mary**. That’s why **she** started to write romantic poems.  
d. **Peter** admired Mary. That’s why **he** started to write romantic poems.

A large number of psycholinguistic experiments show:

Depending on the verb, participants prefer to produce/perceive an explanation associated with NP1 or NP2. This preference is affected by the discourse relation: result/consequence relation shifts the bias.
Implicit causality bias (IC bias)

(2)  

a. **Peter impressed** Mary because **he** sang beautifully.  
b. Peter **admired** Mary because **she** sang beautifully.  
c. Peter **impressed** Mary. That’s why **she** started to write romantic poems.  
d. **Peter admired** Mary. That’s why **he** started to write romantic poems.

A large number of psycholinguistic experiments show:

- Depending on the *verb*, participants prefer to produce/perceive an *explanation* associated with NP1 or NP2  
- This preference is affected by the *discourse relation*: *result/consequence* relation shifts the bias
Implicit causality: The role of coherence relations

Kehler et al. (2008), see also Bott/Solstad (2014):

- IC verbs: explanation is the default

- coreference: explicitly marked = implicit explanations (continuations after a full stop without *because*)

- coreference varies with discourse relation
A growing number of online studies show early ‘focussing’ effects:

- Eyetracking during reading and self-paced reading (Koornneef/van Berkum 2006, Featherstone/Sturt 2010): IC congruency effect right at the pronoun
- Eyetracking in the visual world paradigm (Pykkönen/Järvikivi 2010, Cozijn et al. 2011): Referential expectation even before *because*
- Event-related potentials (Otten et al. 2008): P600 effect right at IC-bias incongruent pronouns
- Implicit learning paradigm (Rohde/Horton 2014): IC verbs raise expectations for explanation relations

▷ IC bias sentences give rise to expectations about an upcoming explanation re-mentioning a particular referent
• Sexus ambiguity, no forced referent conditions

(3)   a. John infuriated Bill.
    b. John scolded Bill.
    c. John chatted with Bill.

• Only effects of position/grammatical function

Figure 2. Rate of pronominalisation, by verb bias and referent position (subject vs. non-subject).
Implicit causality: Dissociation between reference and anaphoric form?

Forced referent continuation paradigm, Fukumura/van Gompel (2010):

(4)  

a. [John] impressed Mary because. . .


c. [John] admired [Mary] because. . .

d. John admired [Mary] because. . .

- Dependent variable: Anaphoric form (pronoun, proper name, definite description)
- Forced corefence: 1) subject vs. object, 2) IC-bias congruent vs. incongruent
- Influence of grammatical function, more pronouns for subject than object coreference
- No effect of IC bias
Kehler/Rohde (2013, 2014) propose Bayesian analysis assuming a fundamental dissociation between production and comprehension:

\[
p(\text{referent}|\text{pronoun}) = \frac{p(\text{pronoun}|\text{referent}) \times p(\text{referent})}{p(\text{pronoun})}
\]

- \(p(\text{pronoun}|\text{referent})\) relates to a production problem: *Should I – the speaker – choose a pronoun to refer to this referent?*
- The prior \(p(\text{referent})\) relates to a comprehension problem: *How likely is it that a certain referent is re-mentioned?*
- Dissociation
  - IC-bias is among the factors influencing \(p(\text{referent})\)
  - IC-bias is not among the factors influencing \(p(\text{pronoun}|\text{referent})\), but subjecthood, or rather topichood are

▷ No “cascading” from higher levels to anaphoric form?
Implicit causality and anticipatory processing

- Early focussing effects provide evidence for anticipation at the discourse level
- However, the exact form of these effects seems to be at odds with the generative models assumed in the prediction literature
  - ✔ Discourse expectation of an explanation
  - ✔ Referential expectation
  - ✗ Predicted anaphoric form – bias-congruent pronoun
Implicit causality accounts

- Observations: For a number of verbs, IC bias is strongly correlated with verb class
- IC bias is related to argument structure
  - **Stimulus-Experiencer** (e.g. *impress*), **Experiencer-Stimulus** (e.g. *admire*)
  - **Agent-Evocator** (e.g. *thank*)
Main claim (Bott/Solstad 2014; under review)

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

(5) a. Bias-congruent
     John admired Sarah because . . . she sang beautifully.

b. Bias-incongruent
     John admired Sarah because . . . he was very impressed by her performance.

- IC bias may be observed when a because clause/an explanation can specify a semantic entity associated with (only) one of the participants
- Bias: Epi-phenomenon of explanation preferences
- We need to look beyond pronouns
Implicit Causality ingredients

- IC bias is dependent on
  - “Slots” providing 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 $because$)
- Upshot: Rooted in verb semantics, our theory allows for systematic manipulation of the IC bias.

✔ Discourse expectation of an explanation
✔ Referential expectation
❌ Predicted anaphoric form – bias-congruent pronoun
Other verb classes display remention biases.

Transfer-of-possession predicates

Anna gave Angie a bouquet. Then . . . she threw it away.

Anna got a bouquet from Angie. Then . . . she put it away.

For transfer-of-possession predicates, the recipient/goal argument is referred to preferably. \(\Rightarrow\) in particular for result relations

(6)  

a. Michael handed a cookbook to Mary/John.

b. Michael handed a cookbook to Mary/John.

c. Michael took a cookbook from Mary/John.

d. Michael took a cookbook from Mary/John.

<table>
<thead>
<tr>
<th>Table 7</th>
<th>Experiment 3 results: Rate of pronoun production by condition.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Goal (%)</td>
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<table>
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<th>Exp. 3: Renamed sentence completion</th>
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</thead>
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<td>% pronouns</td>
</tr>
<tr>
<td>goal</td>
</tr>
<tr>
<td>source</td>
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</table>
Experimental study, part I – Pretest
60 Implicit Causality verbs:
- 20 stimulus-experiencer verbs (impress)
- 20 experiencer-stimulus verbs (admire)
- 20 agent-evocator verbs (praise)

48 Transfer-of-possession verbs → subject-goal, 24 object-goal
same gender (“ambiguous”) vs. different gender (“unambiguous”)
participants: 24 native speakers of German

(18)
a. Janina/Paul faszinierte Sonja/Peter ganz und gar, weil...
   ‘Janina/Paul fascinated Sonja/Peter altogether, because...’
b. Adele/Felix achtete Katrin/Mark in hohem Maß, weil...
   ‘Adele/Felix respected Katrin/Mark to high degree, because...’
c. Käthe/Franz verkaufte Lisa/Max einen Fernseher. Danach...
   ‘Käthe/Franz sold Lisa/Max a TV set. Then...’
d. Käthe/Franz kaufte von Lisa/Max einen Fernseher. Danach...
   ‘Käthe/Franz bought from Lisa/Max a TV set. Then...’
e. Jule/Ansgar lobte Lea/Justus ganz besonders, weil...
   ‘Jule/Ansgar praised Lea/Justus extraordinarily, because...’
The chart shows the relative frequency of different syntactic roles as antecedents in various sentence structures. The roles include 'experiencer-stimulus', 'stimulus-experiencer', 'transfer of possession/object goal', and 'transfer of possession/subject goal'.

- Experiencer-stimulus: 0.95 (object) and 0.05 (subject)
- Stimulus-experiencer: 0.78 (object) and 0.22 (subject)
- Transfer of possession/object goal: 0.59 (object) and 0.41 (subject)
- Transfer of possession/subject goal: 0.04 (object) and 0.96 (subject)

The chart indicates a higher frequency of subjects as antecedents compared to objects across these roles.
Consequences for IBR
• experimental paradigm allows to manipulate the prior probability of different meanings while everything else remains constant
• German has rich system of expressions for anaphoric relations

(19)

   ‘I could not sleep. This dog / Fido / *PROX-DEM / *DIST-DEM / *D-PRO / *he kept me awake.’

b. Ich grüßte meinen neuen Nachbarn. Dieser / jener / der / er / war gestern eingezogen.
   ‘I welcomed my new neighbor. PROX-DEM/ DIST-DEM / D-PRO / he had moved in yesterday.’

stimulus-experiencer verbs/ambiguous

Mary impressed Julia.

Pixel representation:

S0

S1

S2

R0

R1

R2
experiencer-stimulus verbs/ambiguous

Literal meaning

S0

R0

S1

R1

S2

R2
Mary liked Paul.

Literal meaning

<table>
<thead>
<tr>
<th></th>
<th>sie</th>
<th>er</th>
<th>diesen</th>
<th>Mary</th>
<th>Paul</th>
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<tr>
<td>R0</td>
<td>Mary liked Paul.</td>
<td>0</td>
<td>0</td>
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<td>Mary liked Paul.</td>
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<table>
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<th>Paul</th>
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<td>Mary liked Paul.</td>
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<td>0</td>
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<td>R1</td>
<td>Mary liked Paul.</td>
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<tr>
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<td>Mary liked Paul.</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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</table>
• unambiguous: only personal pronouns
• stimulus-experiencer, ambiguous:
  • subject reference $\Rightarrow$ personal pronoun
  • object reference $\Rightarrow$ demonstrative
• experiencer-stimulus, ambiguous:
  • object reference $\Rightarrow$ demonstrative
  • subject reference:
    • $S_1, S_3, \ldots$: personal pronoun
    • $S_2, S_4, \ldots$: proper noun
Experimental study, part II
• similar setup as before but **forced referent continuation**
• one name in the context sentence is highlighted and participants are instructed to refer back to that person
• in total, 1,280 continuations were elicited

(20)  
\( a. \) Jonas entzückte Rüdiger ganz außergewöhnlich, weil...  
‘Jonas enchanted *Rüdiger* extraordinarily because...’

\( b. \) ... jener etwas Nettes gesagt hatte.  
‘DIST-DEM had said something nice’

(21)  
\( a. \) Carla verabscheute Marlene schon seit Wochen, weil...  
‘Carla despised *Marlene* since weeks because...’

\( b. \) ... jene nur Lügen über ihre Mitmenschen verbreitete.  
‘DIST-DEM only spread lies about her fellow humans.’

(22)  
\( a. \) Anke hasste Madeleine bis aufs Blut, weil...  
‘*Anke* hated Madeleine fiercely because...’

\( b. \) ... Anke eifersüchtig war.  
‘... *Anke was jealous.*’
• only testing the object focus condition
• within-participant comparison
• 42 participants
• 1,393 continuations analyzed
<table>
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<th>se</th>
<th>Wald's z</th>
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<td>**foc<em>amb</em>verb+(1</td>
<td>p</td>
<td>)+(1</td>
<td>i)**</td>
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<td>VERB</td>
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<td>.33</td>
<td>-.150</td>
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<td>FOC × AMB</td>
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<td>.95</td>
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<td>FOC × VERB</td>
<td>1.71</td>
<td>.82</td>
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<td>FOC × AMB × VERB</td>
<td>-1.47</td>
<td>1.57</td>
<td>-0.93</td>
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<td>)+(1</td>
<td>i)**</td>
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<tr>
<td>intercept</td>
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<td>1.22</td>
<td>4.07</td>
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<td>0.86</td>
<td>1.51</td>
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<td>1.53</td>
<td>-0.16</td>
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<td>)+(1</td>
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<td>5.08</td>
<td>***</td>
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<tr>
<td>VERB</td>
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<td>.34</td>
<td>-1.54</td>
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<td>AMB × VERB</td>
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<td>.58</td>
<td>2.34</td>
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<td>VERB</td>
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<td>**object foc., amb.: verb+(1</td>
<td>p</td>
<td>)+(1</td>
<td>i)**</td>
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<td>VERB</td>
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Table 2: Logit mixed-effects model analyses on the rate of personal pronouns computed for Exp. 1 with model equations in R-syntax. The global analysis was computed on the complete data set, the other analyses analyzed the specified subsets of the data. Abbreviations: * = 'p < .05', ** = 'p < .01', *** = 'p < .001'; AMB = ambiguity, FOC = focus, VERB = verb type, p = participant, i = item.
Experiment 3

- transfer-of-possession verbs, subject-goal vs. object-goal (cf. Kehler, 2008; Rosa and Arnold, 2017)
- run together with previous experiments; same participants and procedure
- 1,008 continuations elicited
- only 21% chose explanation continuation and were used for further analysis
(a) Subject focus conditions

(b) Object focus conditions
<table>
<thead>
<tr>
<th>Model Term</th>
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<th>Wald’s ( z )</th>
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<td>AMB ( \times ) VERB</td>
<td>-0.18</td>
<td>0.61</td>
<td>-0.30</td>
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Table 4: Logit mixed-effects model analysis on the rate of personal pronouns computed for the object focus conditions in Exp. 3. Please note that models with a more elaborate random effects structure failed to converge. Abbreviations: * = ‘\( p < .05 \)’, ** = ‘\( p < .01 \)’, *** = ‘\( p < .001 \)’; AMB = ambiguity, VERB = verb type, p = participant, i = item.
• only testing the object focus condition
• 60 new participants, 3,600 continuations
Evaluation:
Bayesian mixed-effects multinomial logistic regression with interaction
personal pronouns

ambiguous

stim-exp

psp

exp-stim

not ambiguous

0 2 4
prox-demonstrative pronouns

ambiguous

not ambiguous

stim-exp

psp

exp-stim
prox-demonstrative pronouns

ambiguous

stim-exp

psp

exp-stim

not ambiguous
proper nouns

ambiguous

not ambiguous

stim-exp

psp

exp-stim

-2 0 2 4

-2 0 2

42 / 48
Evaluation:
Frequentist mixed-effects logistic regression with interaction
| amb*verb+(1+p)+(1|i) | \( \beta \) | se  | Wald’s z | \( p \) |
|---------------------|---------|------|----------|-------|
| INTERCEPT           | 0.28    | 0.33 | 0.86     |       |
| AMB                 | 1.82    | 0.19 | 9.4      | ***   |
| VERB (contrast: SE vs. ES) | 0.04    | 0.19 | 0.19     |       |
| VERB (contrast: SE vs. PSP) | -0.12   | 0.20 | -0.59    |       |
| AMB \times VERB (contrast: SE vs. ES) | 0.044   | 0.25 | 0.17     |       |
| AMB \times VERB (contrast: SE vs. PSP) | -0.10   | 0.25 | -0.39    |       |
Conclusion
Important aspects for experimental design

- Forced referent (vs. Rohde & Kehler)
- Sexus ambiguity/Audience design (vs. Fukumura & van Gompel)
- Experiment 2: Implicit causality and transfer-of-possession verbs in a within subjects design (vs. everybody)
- Tested for German: Richer inventory of anaphoric form
• unexpectedly weak effect of continuation bias on choice of referring expression
• clear effect of ambiguity: personal pronouns are preferred unless they lead to (local) ambiguity
• consistent with IBR-prediction $R_0 \leftarrow S_1 \leftarrow R_2 \leftarrow S_3 \cdots$
• inconsistent with IBR-prediction $S_0 \leftarrow R_1 \leftarrow S_2 \leftarrow R_3 \cdots$
• future work: quantitative modeling via RSA model


