Constraint-based projection

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Based on joint work with Judith Degen, Stanford University

Ruhr-Universität Bochum
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Goal

motivate a constraint-based projection analysis

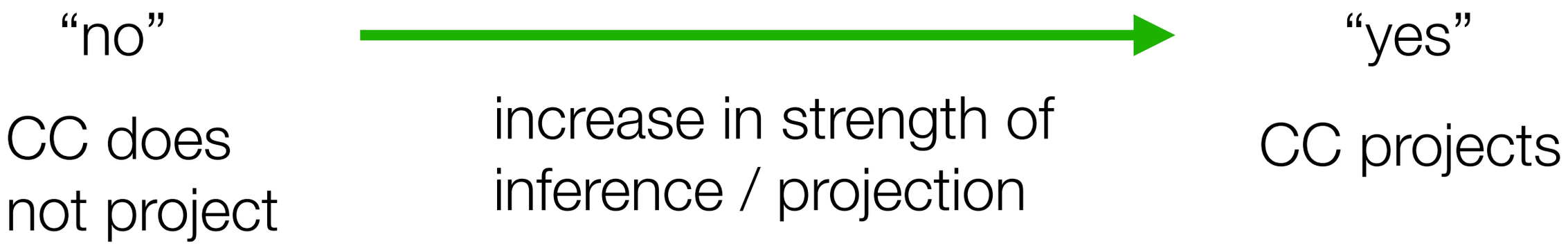
Outline

1. Projection
2. The constraint-based approach to projection
3. Exp 1: Lexical meaning matters, but not as expected
4. Exp 2: Listener belief influence projection
5. Conclusions and outlook

Projection

Taylor: *“Did Kim discover that Sandy’s work is plagiarized?”*

Do you (the listener) infer that Taylor is committed to the content of the complement (CC), that Sandy’s work is plagiarized?



Frege 1892, Strawson 1950, Kiparsky & Kiparsky 1970, Karttunen 1971, Prince 1978, Karttunen & Peters 1979, Atlas & Levinson 1981, and many more

Projection

Projective content is ubiquitous in natural language: appositives, deictic and definite expressions, tense, verbs, adverbs…
(e.g., Levinson 1983, Potts 2005, Tonhauser et al 2013, Tonhauser 2020)

<u>Empirical domain in today's talk:</u>

The content of the complement (CC) of clause-embedding predicates

Taylor: "Did Kim discover that <u>Sandy's work is plagiarized</u>?"

know, be annoyed, announce, believe, pretend,…

English: over 1,000 such predicates (White & Rawlins 2016)

Many information sources influence projection

1. Common ground (e.g., Stalnaker 1972, Karttunen 1974; Gazdar 1979; Heim 1982, 1983)

Taylor: *"Did Kim discover that Sandy's work is plagiarized?"*

<u>Context 1:</u>
Taylor is a professor. Her TA Kim called a student, Sandy, in for a meeting. Taylor asks another TA:

<u>Context 2:</u>
Taylor, Cam and Sandy are collaborating students. Sandy was called in for a meeting by Kim, their TA. Taylor asks Cam:

Inference to CC is stronger, i.e., CC is more projective, in Context 2 than Context 1.

Many information sources influence projection

2. Predicate (e.g., Kiparsky & Kiparsky 1970; Xue & Onea 2011, Tonhauser, Beaver & Degen 2018)

discover

Taylor: *"Does Kim _____ that Sandy's work is plagiarized?"*

think

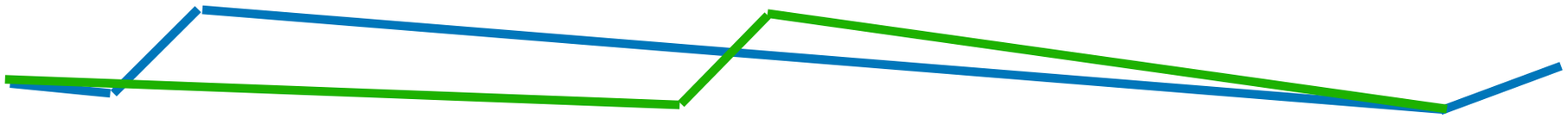
Inference to CC is stronger, i.e., CC is more projective, with *discover* than with *think*.

Many information sources influence projection

3. Information structure (e.g., Beaver 2010, Tonhauser 2016, Djärv & Bacovcin 2017)

Prosody 1
(focus: *Kim)*

Prosody 2
(focus: *Sandy*)



Taylor: *“Did Kim discover that Sandy’s work is plagiarized?”*

Inference to CC is stronger, i.e., CC is more projective, with Prosody 1 than Prosody 2.

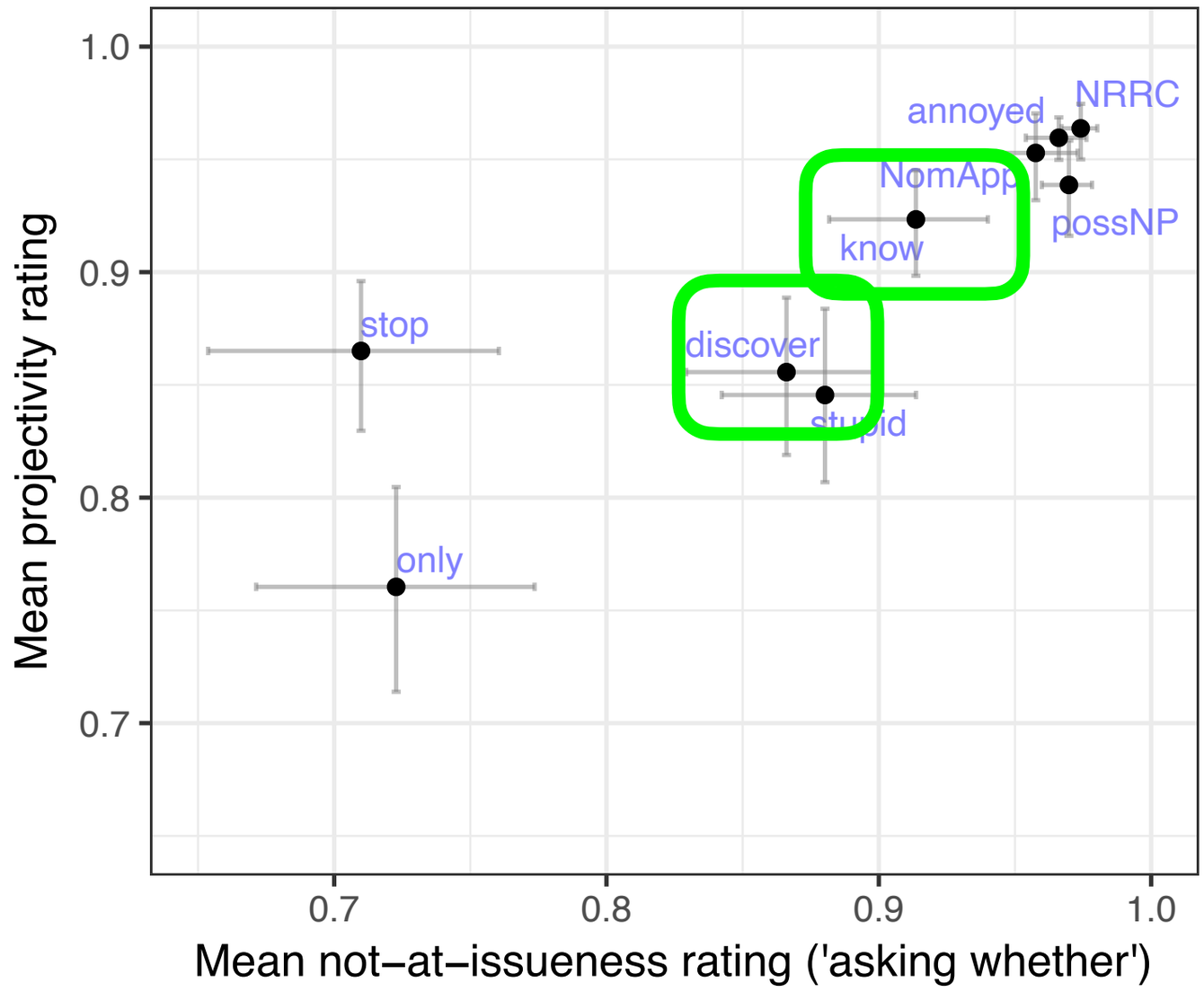
Many information sources influence projection

4. Question Under Discussion / At-issueness

(e.g., Simons et al 2010, 2017; Xue & Onea 2011; Cummins & Rohde 2015)

Taylor: *"Did Kim discover / Does Kim know that Sandy's work is plagiarized?"*

The more the CC is not-at-issue, the more projective it is.



Tonhauser, Beaver & Degen 2018 (*Journal of Semantics*)

Many information sources influence projection

5. Information about the subject of the attitude or the speaker (e.g., reliability, credibility, political affiliation)

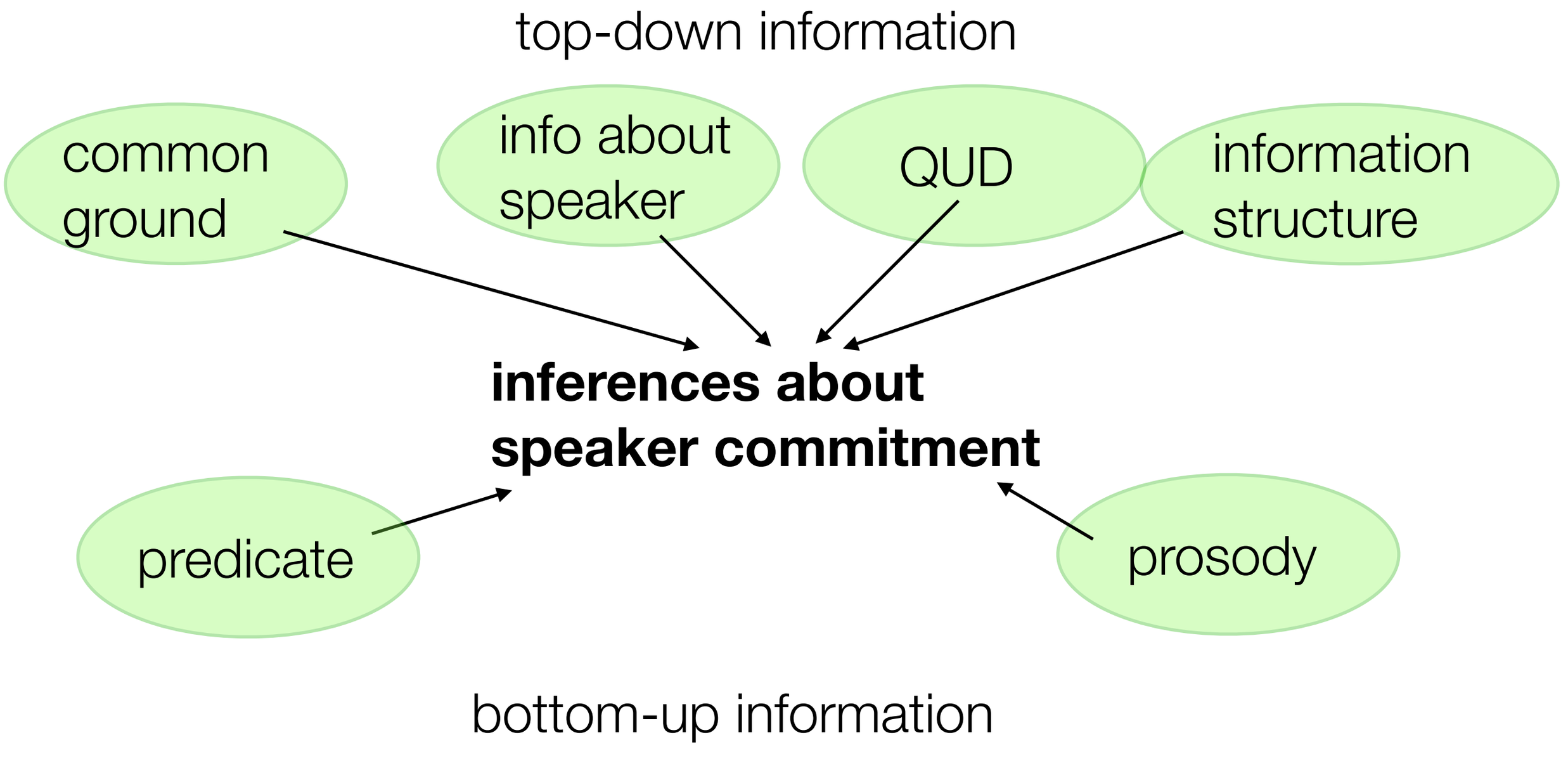
Schlenker 2010; de Marneffe et al 2012; Mahler 2020

Mahler 2020 manipulated the political affiliation of the speaker

Cindy: *"Ben doesn't know that Obama improved the American economy."*

Listeners' inferences that Cindy is committed to the CC are stronger when Cindy is a Democrat than a Republican.

Interim summary: Listeners rely on multiple sources of information in inferring speaker commitment to the CC, i.e., in inferring projection of the CC.



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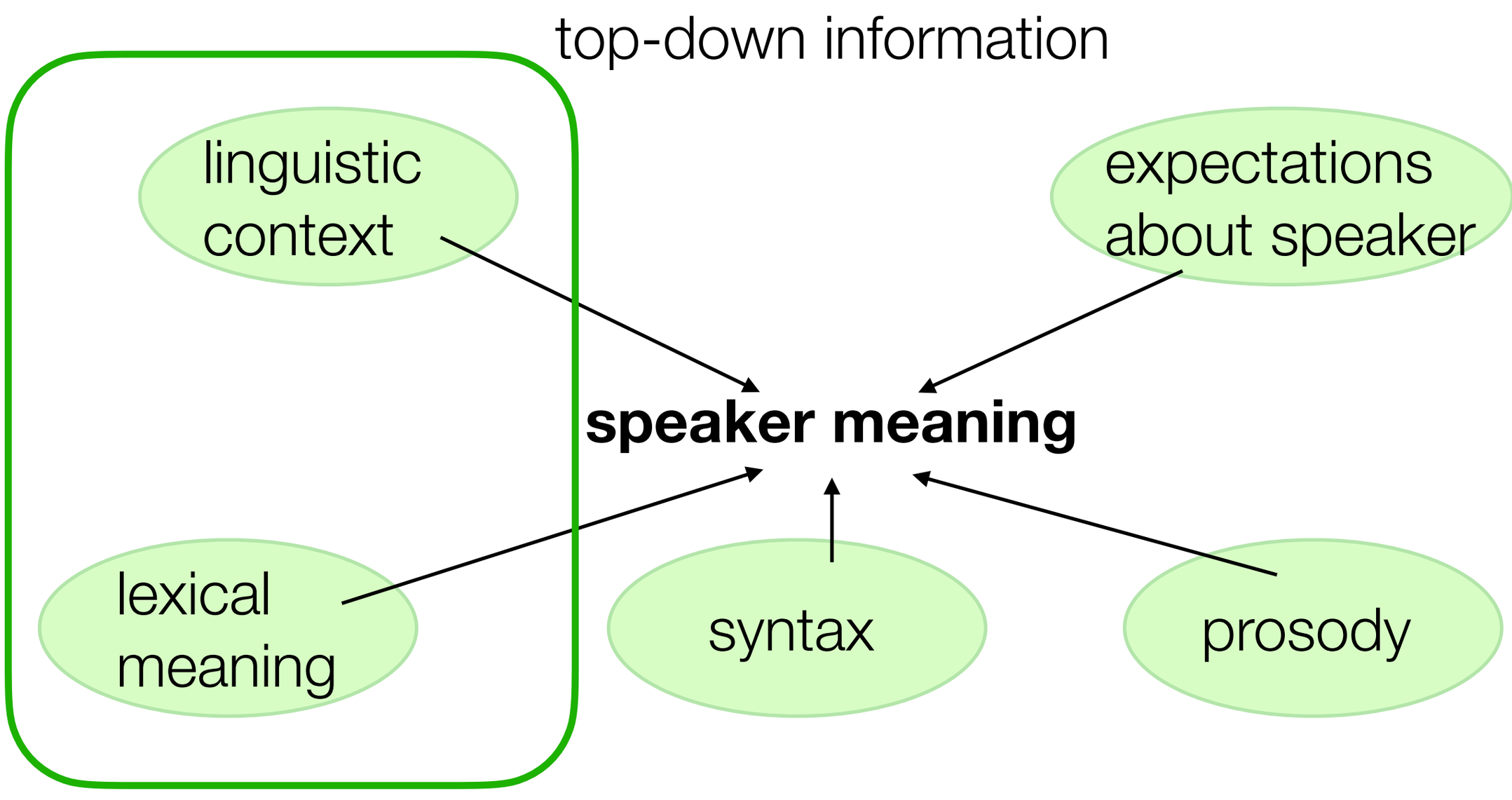
Constraint-based approaches to pragmatics

(e.g., Degen & Tanenhaus 2015, 2019)

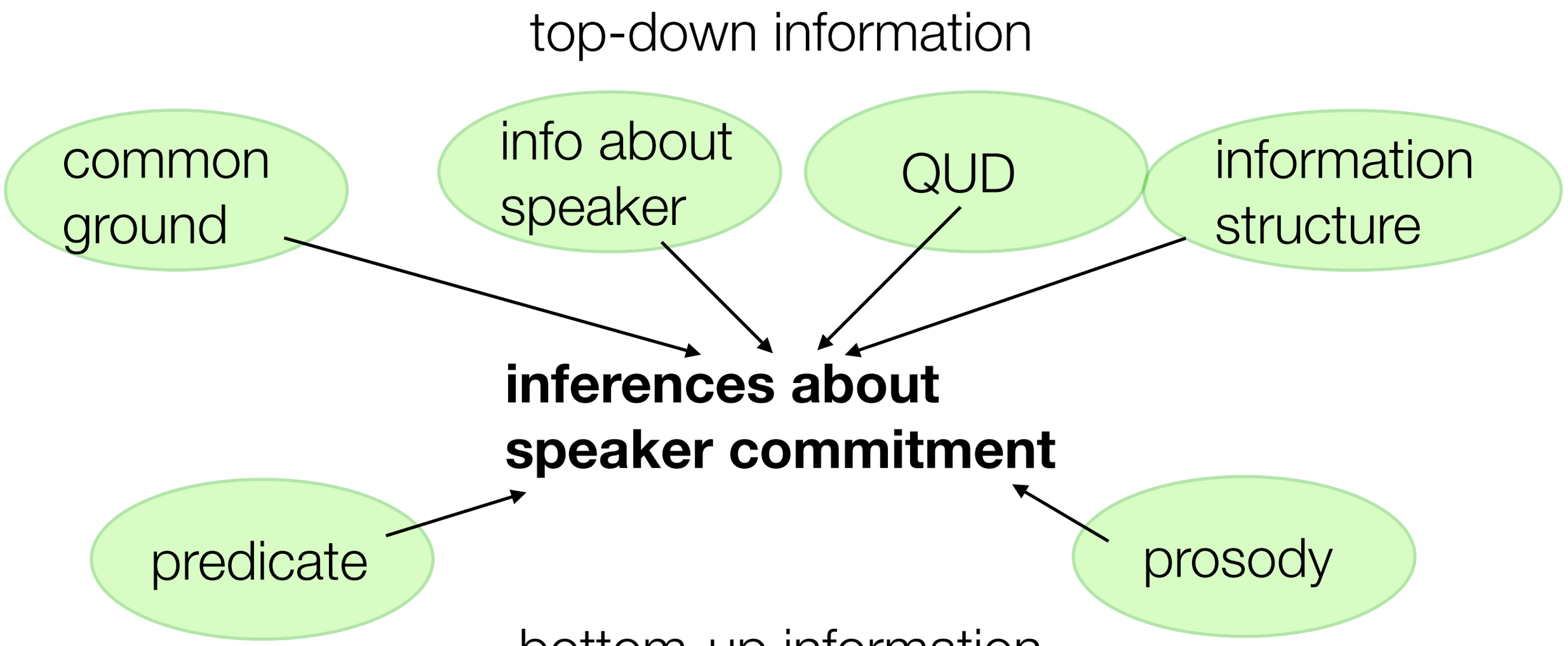
To identify speaker meaning, listeners integrate probabilistic information from multiple sources.



Constraint-based approach to projection

To draw inferences about speaker commitment, listeners integrate probabilistic information from multiple sources.

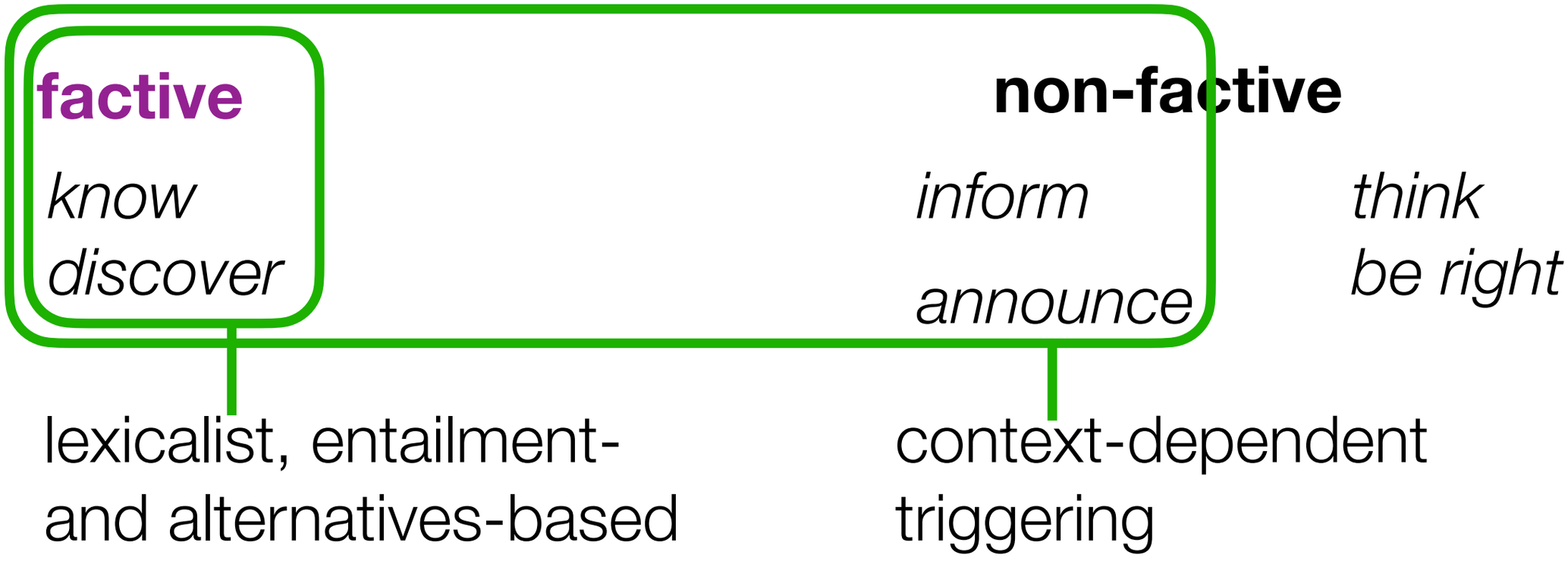
Big question: What are the relevant information sources in the empirical domain and how are they integrated?



Contemporary projection analyses

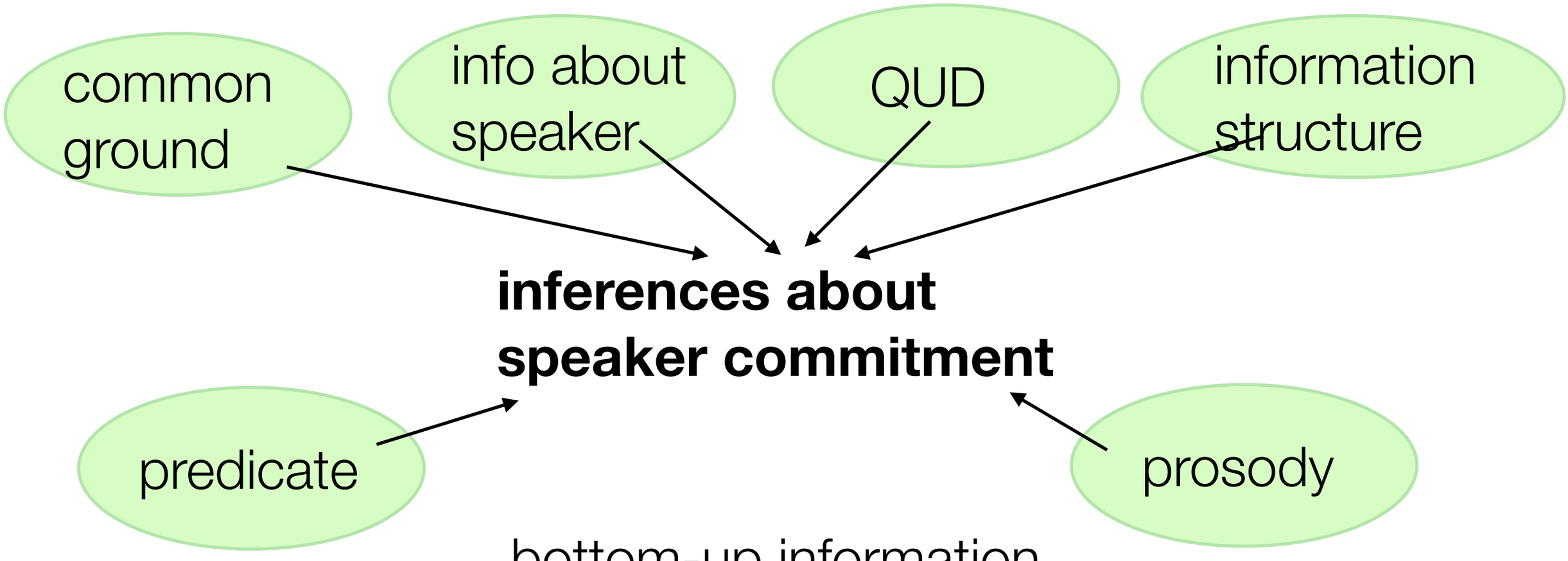
- Lexicalist (e.g., Heim 1983, van der Sandt 1992)
- Entailment-based (e.g., Abrusán 2011, 2016; Simons, Beaver, Roberts & Tonhauser 2017)
- Alternatives-based (e.g., Chemla 2009; Abusch 2002, 2010; Romoli 2015)
- Context-dependent triggering (Schlenker ms/2019)

Common theme: Analyses only apply to "presupposed" CCs, i.e., predicates or utterances for which the inference that the speaker is committed to the CC is "sufficiently strong".



Recasting contemporary projection analyses in the constraint-based framework

Is this empirically adequate?



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Experiment 1: Lexical meaning

(Tonhauser & Degen under revision; see LingBuzz)

How does lexical meaning contribute to projection?

Is it empirically adequate for projection analyses to disregard the CCs of particular classes of predicates (e.g., non-factive)?

Experiment 1: Materials

20 clause-embedding predicates

- **Factive:** *know, be annoyed, discover, reveal, see* (5)
- **Non-factive:**
  - **Non-veridical non-factive:** *pretend, think, say, suggest* (4)
  - **Veridical non-factive:** *be right, demonstrate* (2)
  - **Optionally factive:** *prove, confirm, establish, announce, confess, admit, ackowledge, hear, inform* (9)

(Kiparsky & Kiparsky 1970)

Lexicalist, entailment- and alternatives-based analyses predict that the CC of factive predicates is projective but they make no predictions about the CC of most non-factive predicates.

Each predicate was combined with one of 20 complement clauses, for 400 predicate/clause combinations.

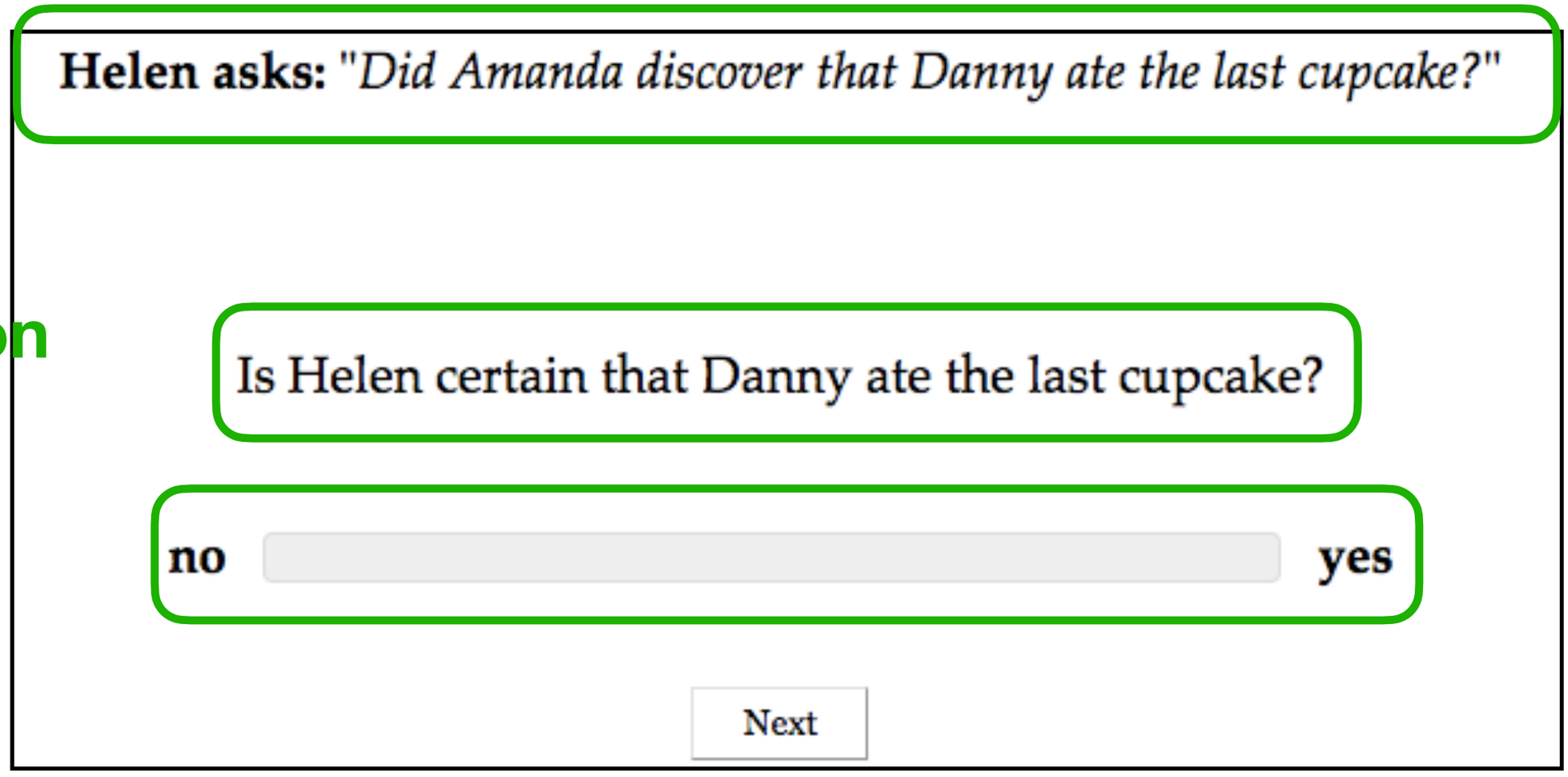
‘certain that’ diagnostic for projection

(e.g., Tonhauser 2016, Djärv & Bacovcin 2017, Tonhauser, Beaver & Degen 2018)

utterance

projection question

response



Each participant rated the projectivity of the CC for each of the 20 clause-embedding predicates and 6 non-projecting controls.

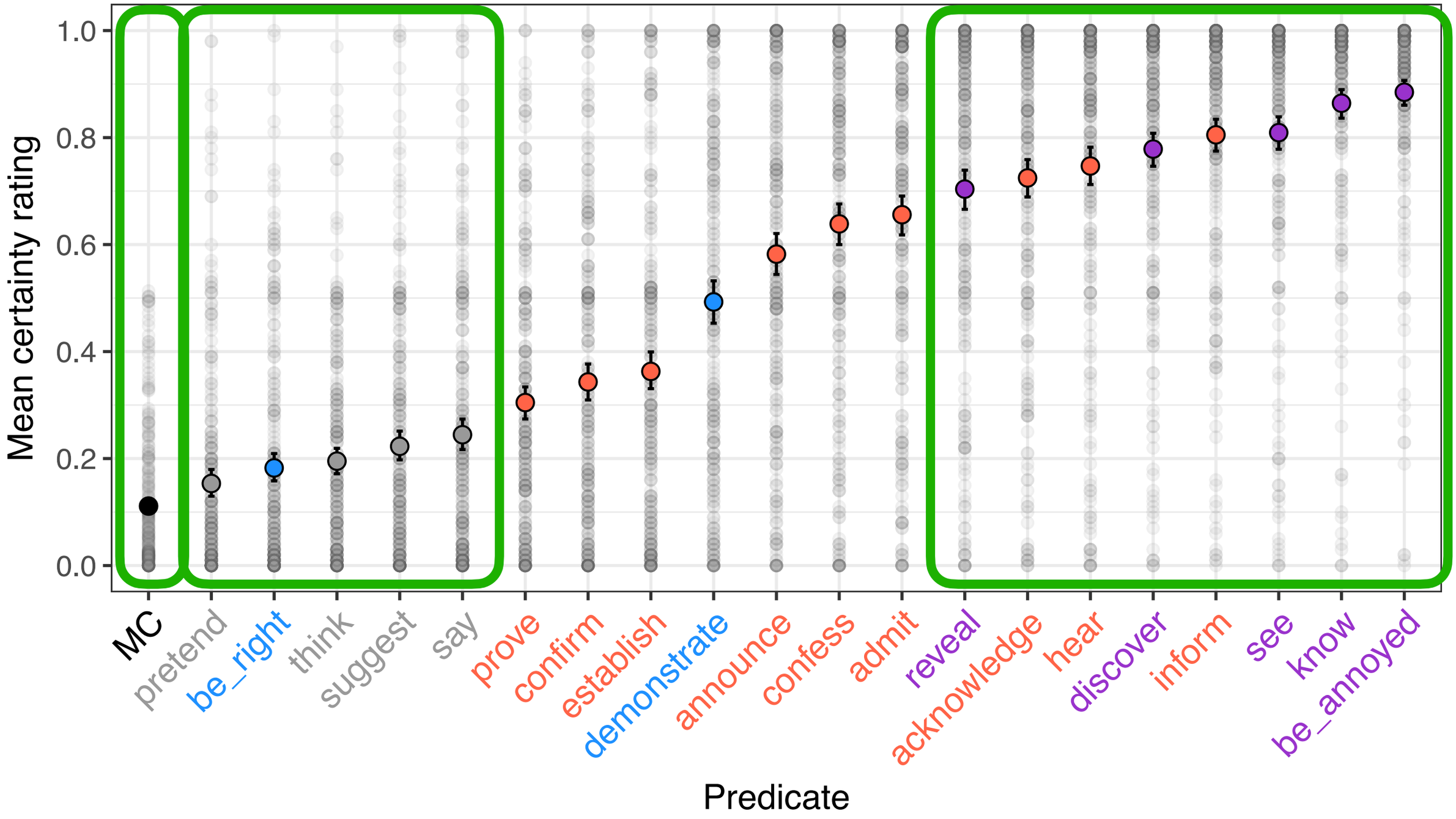
6 non-projecting main clause controls

Sandy: *“Is Zack coming to the meeting tomorrow?”*

Is Sandy certain that Zack is coming to the meeting tomorrow?

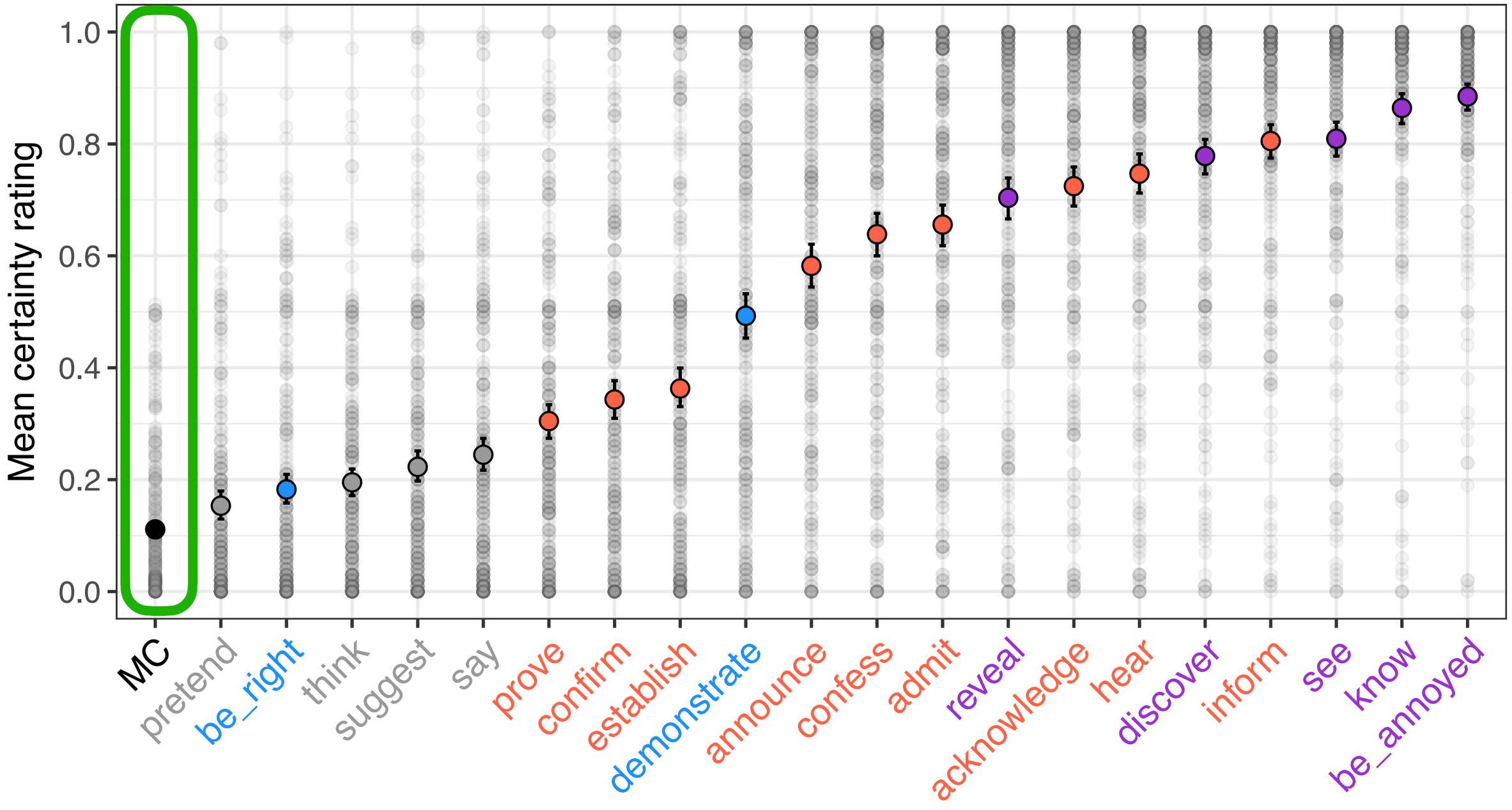
Factive predicates are not categorically different from non-factive predicates.

266 self-declared native speakers of American English



The CC of all predicates is at least mildly projective; there is no non-arbitrary cutoff for “presupposed CCs”

266 self-declared native speakers of American English



(Bayesian ME Beta regression predicting certainty ratings from predicate (treatment coding, MC as reference level); random by-participant and -item intercepts)

Discussion

Predicate meaning influences projection — as long recognized!

It is not empirically adequate to

- privilege particular classes of predicates, like ‘factives’, or CCs, like ‘entailed CCs’ or
- assume a projection threshold to identify “presuppositions”.

Four pieces of converging evidence: (Tonhauser & Degen under revision)

1. Experiment with categorical response options (‘yes’, ‘no’)
2. CommitmentBank (de Marneffe et al 2018, SuB)
3. VerbVeridicality (Ross & Pavlick 2019, EMNLP)
4. MegaVeridicality (White & Rawlins 2018, NELS)

datasets that differ in materials and projection diagnostic

Converging evidence: MegaVeridicality dataset

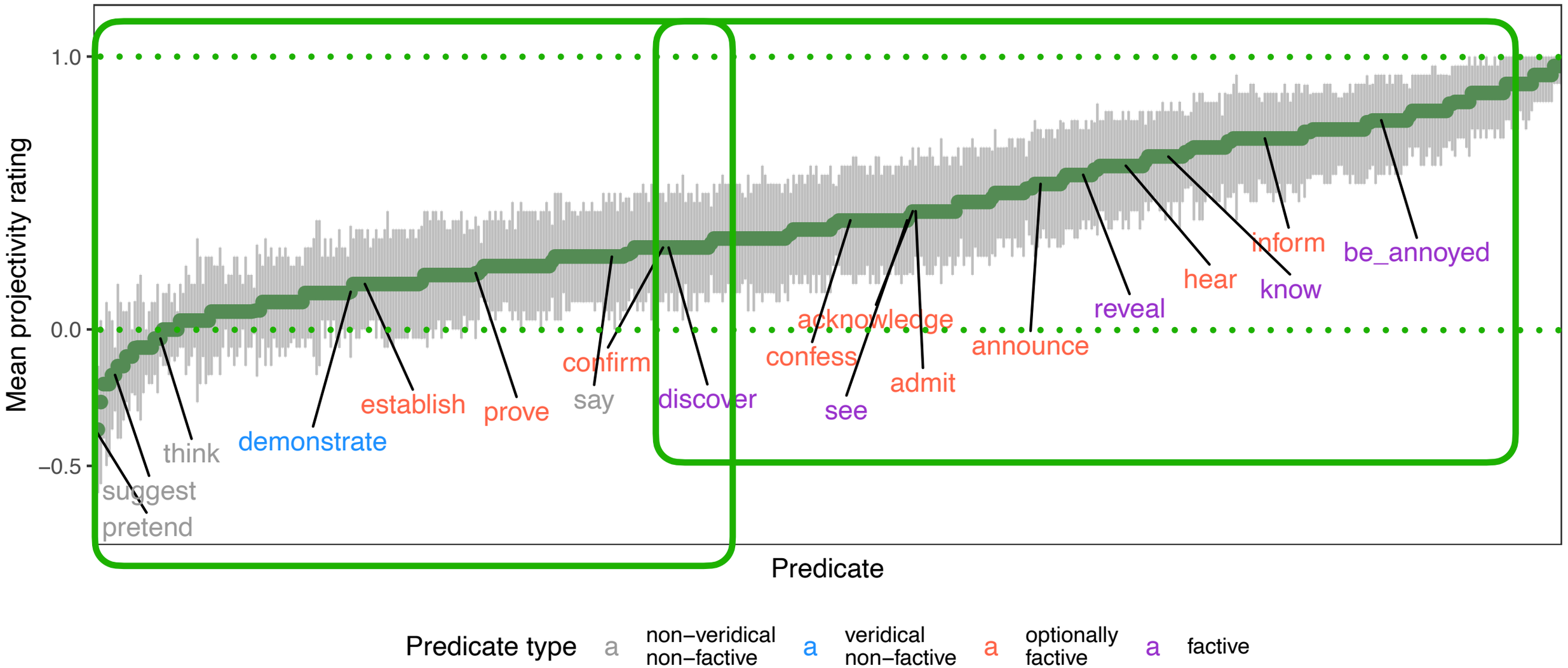
517 predicates

sentence (White & Rawlins 2018, NELS)

Somebody didn't [PRED] that a particular thing happened.

Did that thing happen? **projection diagnostic**

No empirical evidence that some class of predicates is extremely privileged:



Interim summary

How does lexical meaning contribute to projection?

The lexical meaning of clause-embedding predicates influences the projection of the CC; lexical meaning is a relatively stable predictor across multiple experiments and datasets.

Is it empirically adequate for projection analyses to disregard the CCs of particular classes of predicates (e.g., non-factive)?

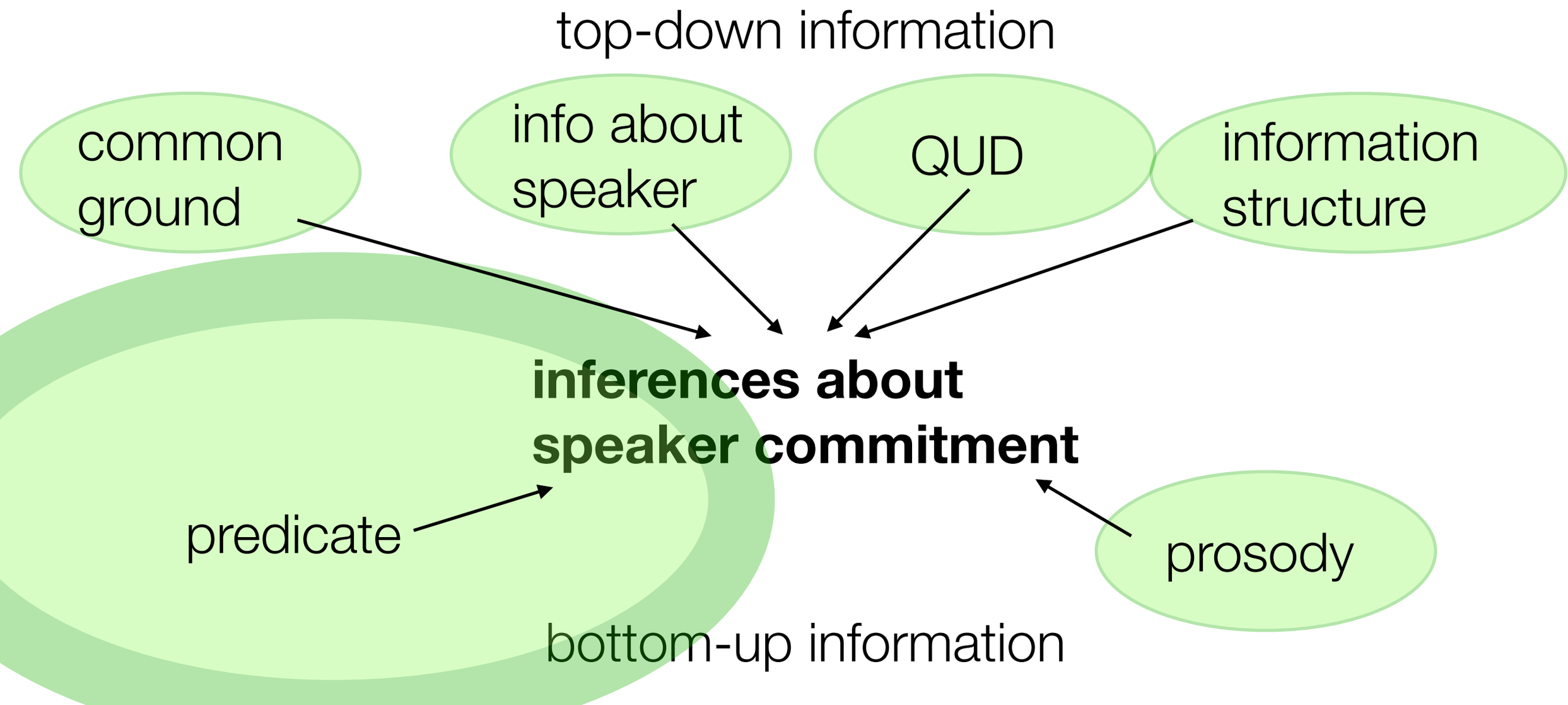
No. The CCs of other predicates are projective, too, sometimes even more so!

Thus: An empirically adequate projection analysis must consider the influence on projection by the lexical meaning of all predicates.

Constraint-based approach to projection

To draw inferences about speaker commitment, listeners integrate probabilistic information from multiple sources.

Big question: What are the relevant information sources in the empirical domain and how are they integrated?



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Experiment 2: Listener belief

(Degen & Tonhauser in prep)

How does listener belief influence projection?

Listener beliefs influence interpretation

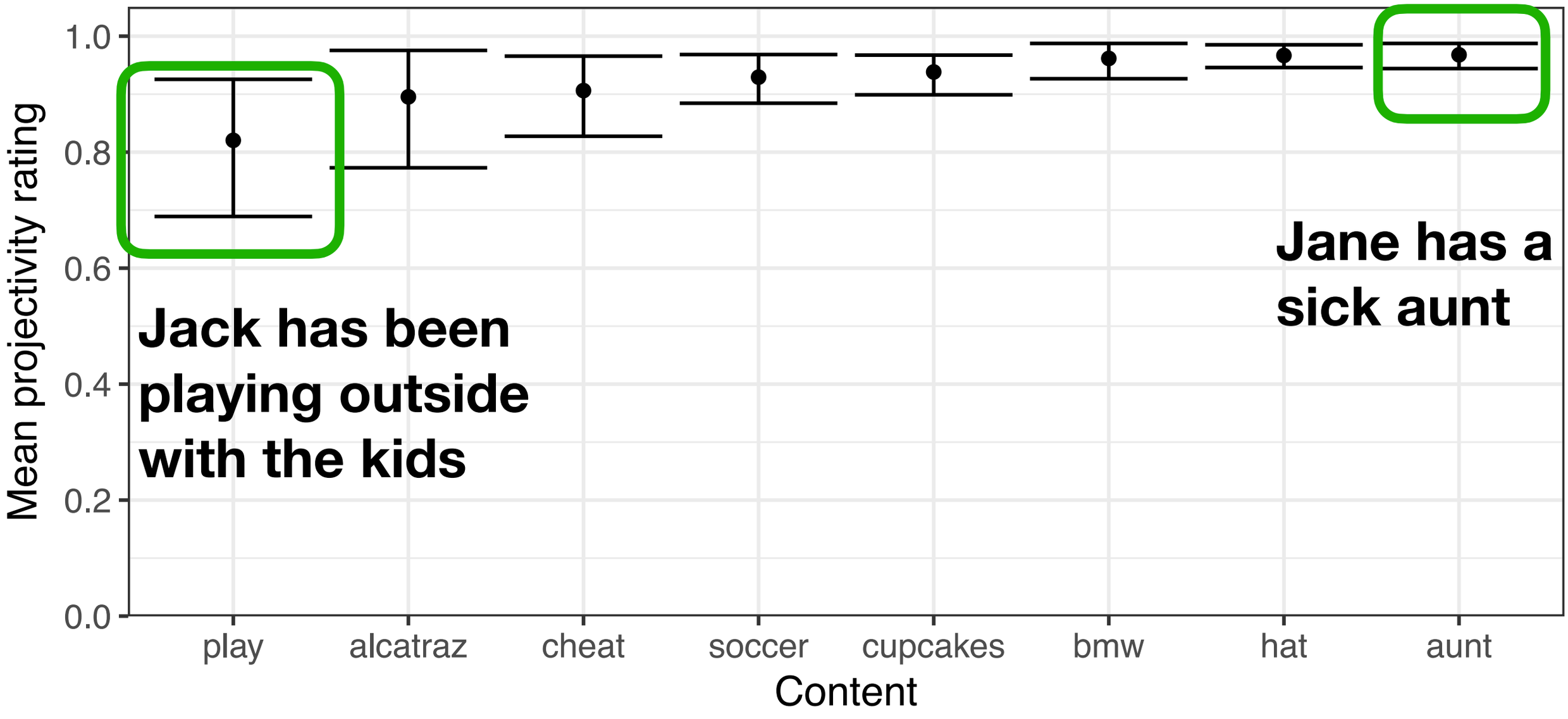
Listeners bring their beliefs about the world, including their beliefs about the speaker's epistemic state (≈ world knowledge), to bear on utterance interpretation:

- Pronoun resolution
- Ambiguity resolution
- Scalar implicatures
- Genericity
- Projection

e.g., Winograd 1972; Altmann & Kamide 1999; Chambers et al 2002, 2004; Hagoort et al 2004; Bicknell & Rohde 2009; Degen et al 2015; Kravtchenko & Demberg 2015; Tessler & Goodman 2019; Mahler 2020

Some lexical content is more projective than other

Sally: "*Does Kim know that…?*"



Tonhauser, Beaver & Degen 2018 (*Journal of Semantics*) Exp 1a

Hypothesis from Tonhauser, Beaver & Degen 2018: 500

Content is more projective the higher its prior probability, i.e., the stronger listeners' prior belief in the content.

Experiment 2: Materials

20 clause-embedding predicates (same as Exp 1)

- **Factive:** *know, be annoyed, discover, reveal, see* (5)
- **Non-factive:**
  - **Non-veridical non-factive:** *pretend, think, say, suggest* (4)
  - **Veridical non-factive:** *be right, demonstrate* (2)
  - **Optionally factive:** *prove, confirm, establish, announce, confess, admit, ackowledge, hear, inform* (9)

(Kiparsky & Kiparsky 1970)

Each predicate was combined with one of 20 complement clauses, for 400 predicate/clause combinations, as in Exp 1.

Additional manipulation: Prior probability of the CC

Experiment 2: Materials and procedure

400 polar questions

Sally: *"Did Kim discover that Julian dances salsa?"*

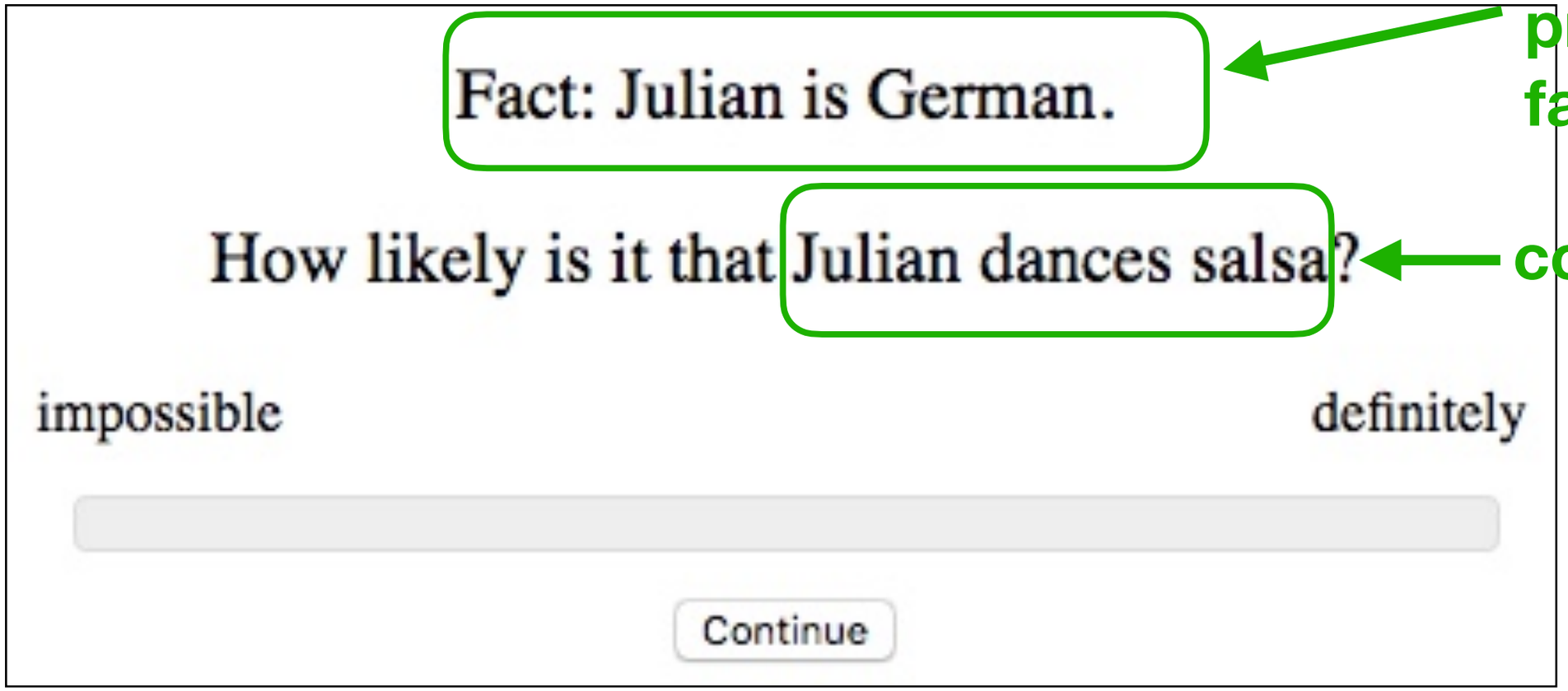
Manipulation of prior probability of the CC

1. Higher prior probability fact: Julian is Cuban
2. Lower prior probability fact: Julian is German

800 combinations of a polar question and a fact

286 participants (AMT)
Block 1: Prior probability of the CC, given the fact
Block 2: Projection of the CC, given the fact and the predicate
(block order randomized)

Block 1: Prior probability of the CC, given the fact

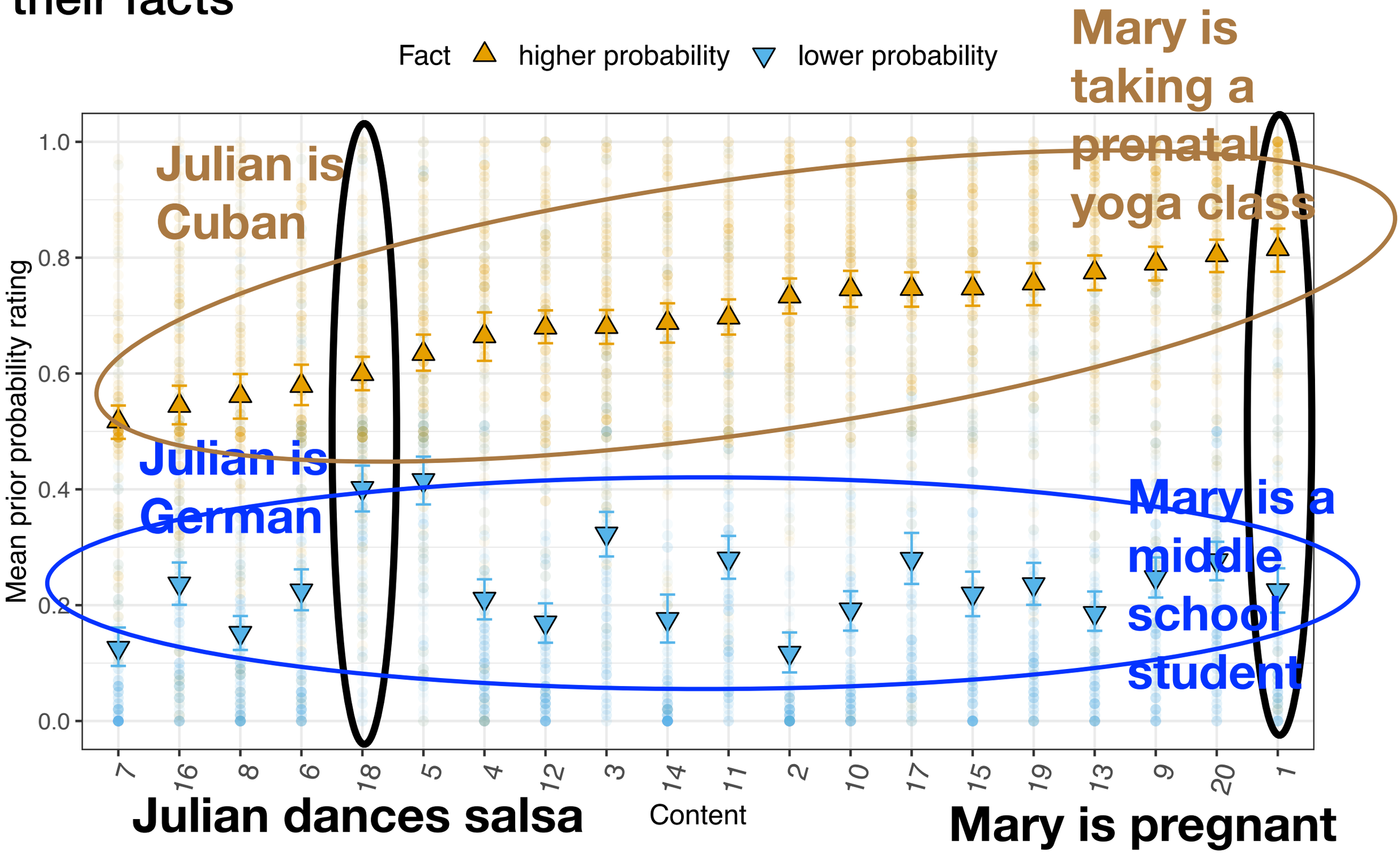


lower probability fact

complement

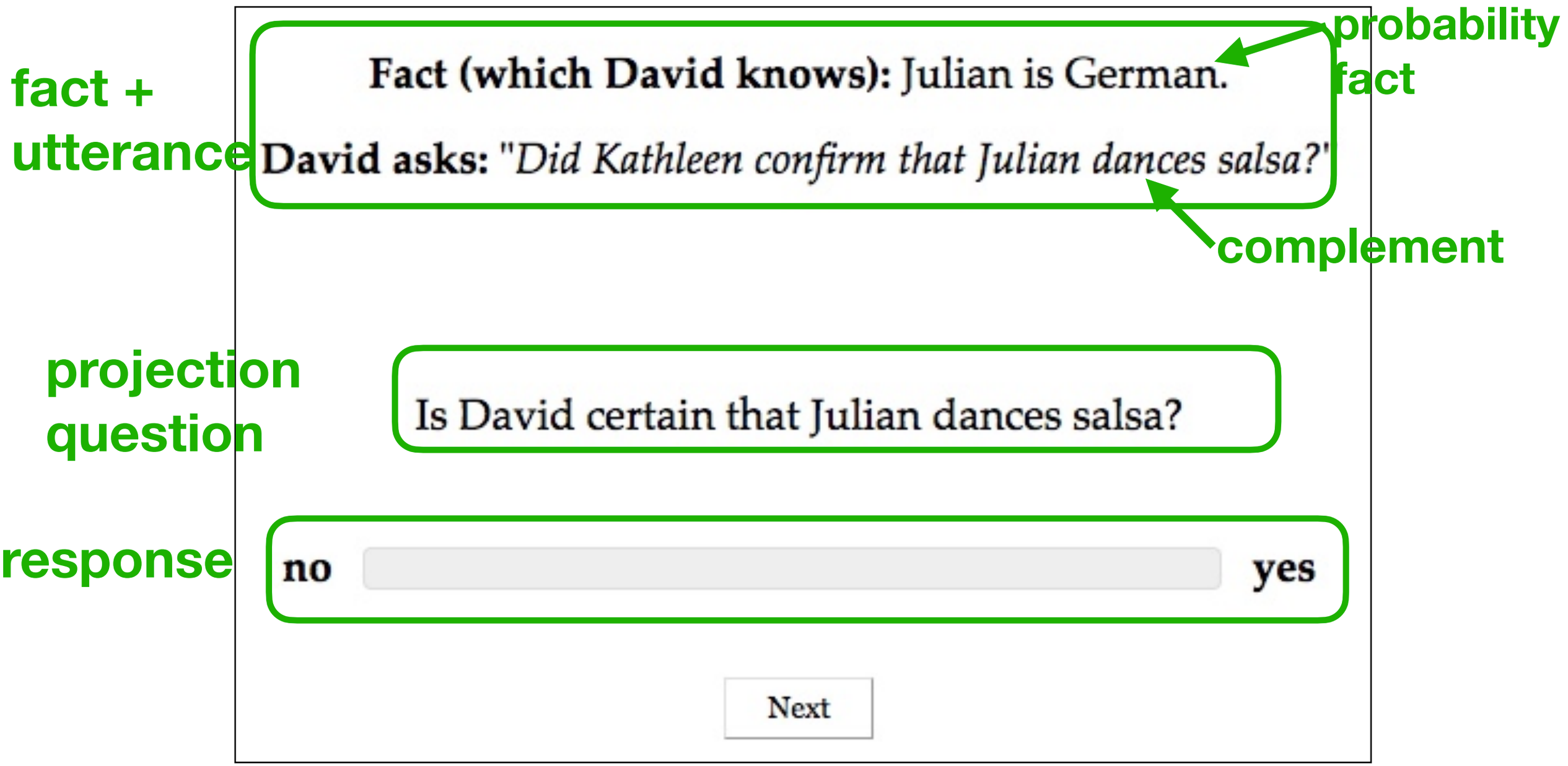
Every participant rated the prior probability of 20 CCs: 10 with higher and 10 with lower probability facts

Prior probability of the 20 CCs is influenced by their facts



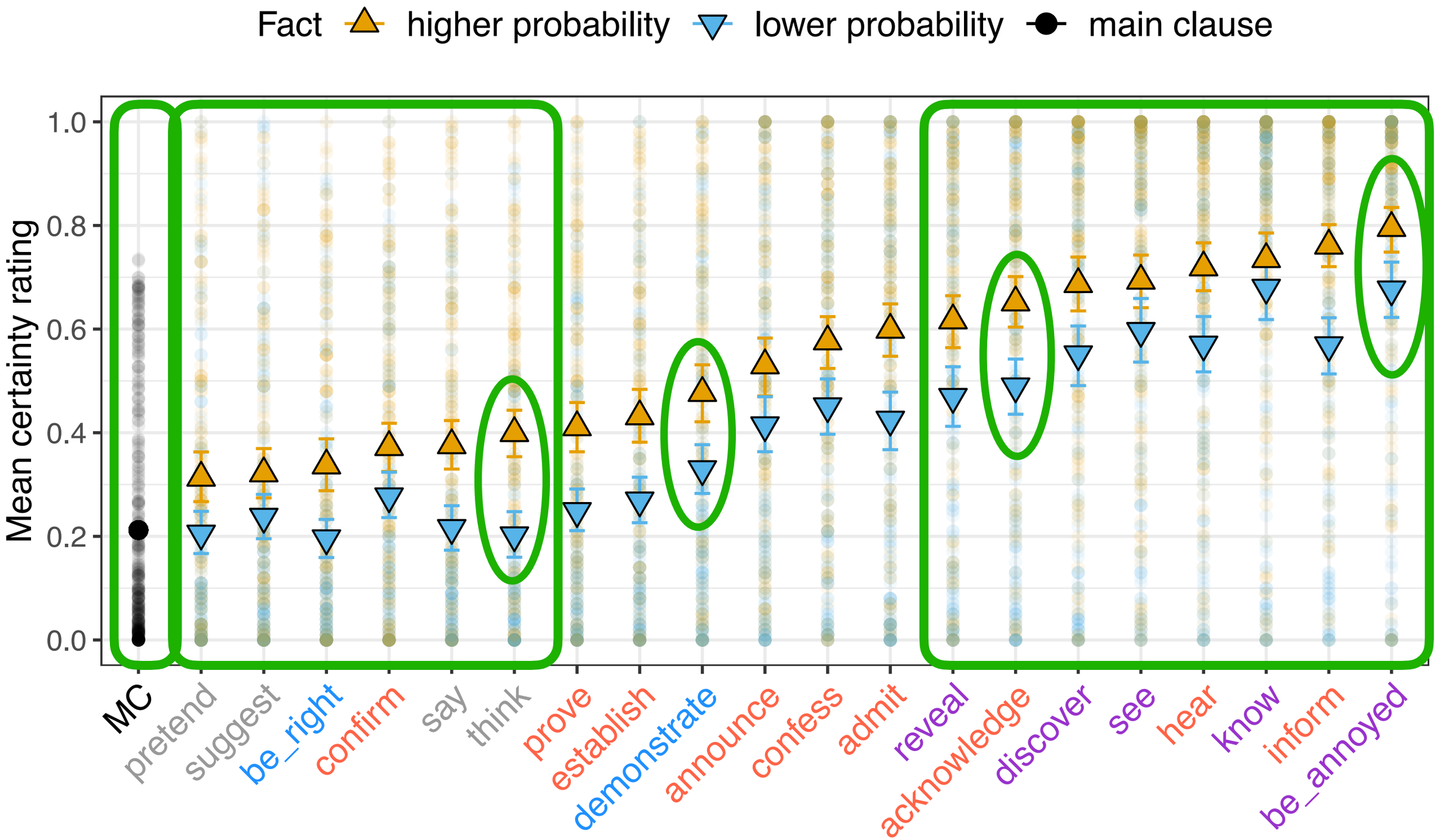
286 self-reported speakers of American English

Block 2: Projection of the CC, given fact and predicate



Each participant rated the projectivity of 20 CCs given a fact and a unique predicate and 6 main clause controls

Higher-probability CCs are more projective than lower-probability CCs

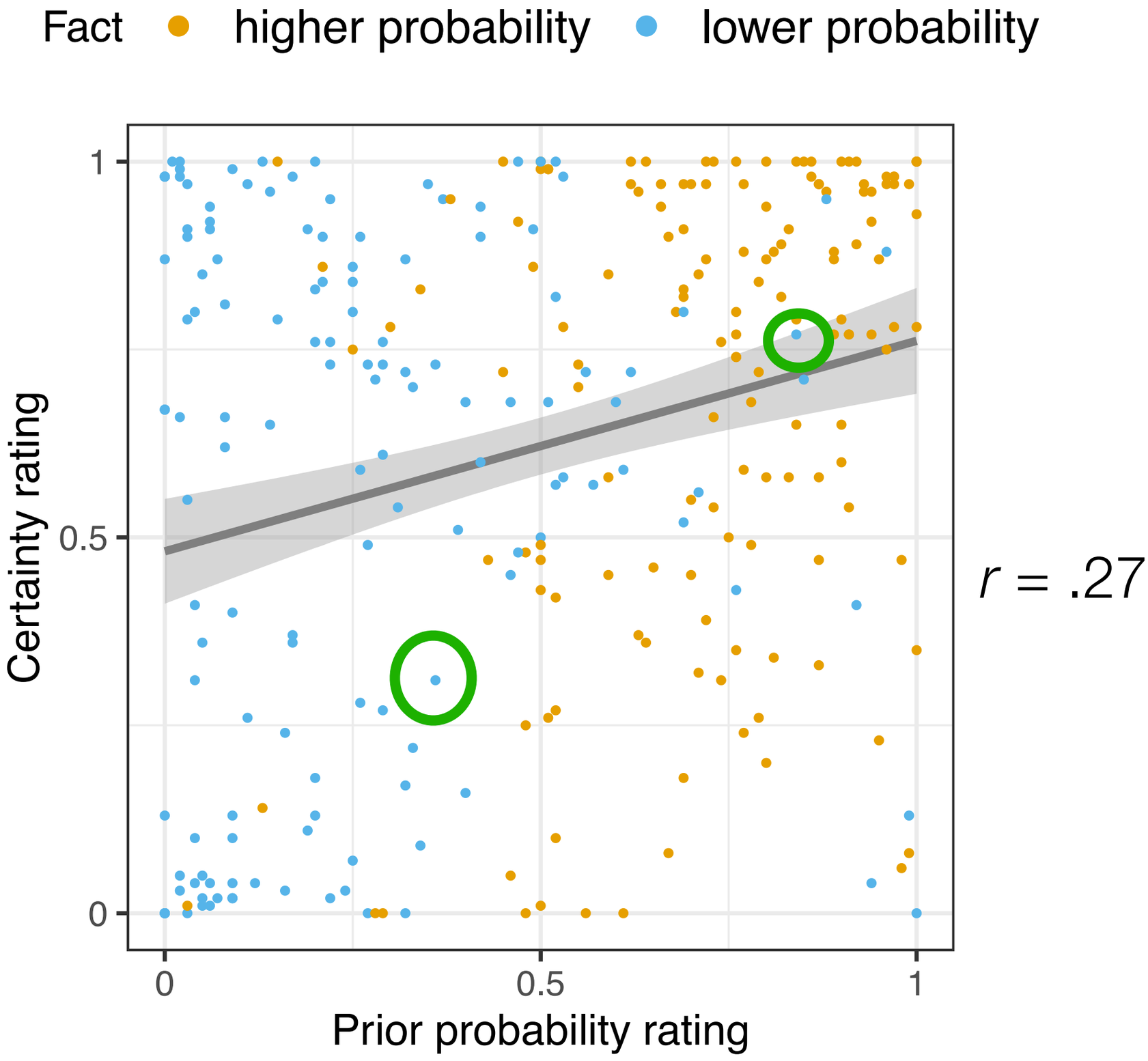


LMEM predicting certainty rating from prior probability rating; random effects for participant, predicate, CC; by-participant slope for prior probability (β = .27, SE = .02, t = 12.8, $p < .0001$)

Listener prior belief predicts projection

discover

286 participants' projection and prior ratings



Experiment 2: Summary of findings

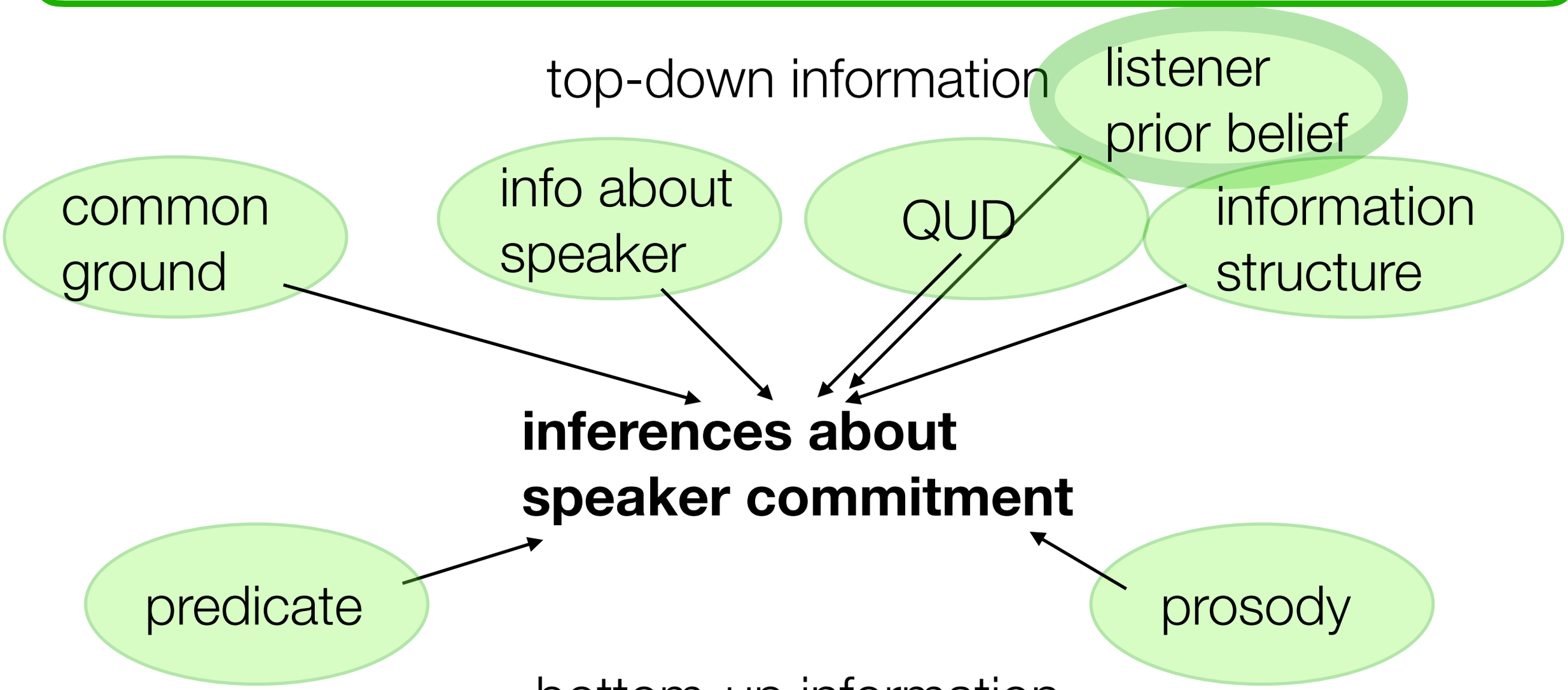
1. The CC of all 20 predicates, including non-factive ones, is at least mildly projective (as in Exp 1).

2. The higher a **listeners' prior belief**, the stronger their inference that the speaker is committed to the CC, i.e., the more projective is the CC (see Tonhauser, Beaver & Degen's 2018 hypothesis).

Constraint-based approach to projection

To draw inferences about speaker commitment, listeners integrate probabilistic information from multiple sources.

Big question: What are the relevant information sources in the empirical domain and how are they integrated?



Discussion

Do contemporary projection analyses lead us to expect this influence of listeners' prior beliefs on projection?

- Lexicalist (e.g., Heim 1983, van der Sandt 1992)
- Entailment-based (e.g., Abrusán 2011, 2016; Simons, Beaver, Roberts & Tonhauser 2017)
- Alternatives-based (e.g., Chemla 2009; Abusch 2002, 2010; Romoli 2015)
- Context-dependent triggering (Schlenker ms/2019)

Context-dependent triggering (Schlenker ms/2019)

Fact: Julian is German.

Taylor: *"Did Kim discover that Julian dances salsa?"*

<u>Simplified characterization:</u>

The CC is presupposed (i.e., a commitment of the speaker) if

1. the CC is contextually entailed

   Context: Julian is German.

   Sentence: Kim discovered that Julian dances salsa.

   Does it definitely follow that Julian dances salsa?

2.

Context-dependent triggering (Schlenker ms/2019)

Fact: Julian is German.

Taylor: *"Did Kim discover that Julian dances salsa?"*

<u>Simplified characterization:</u>

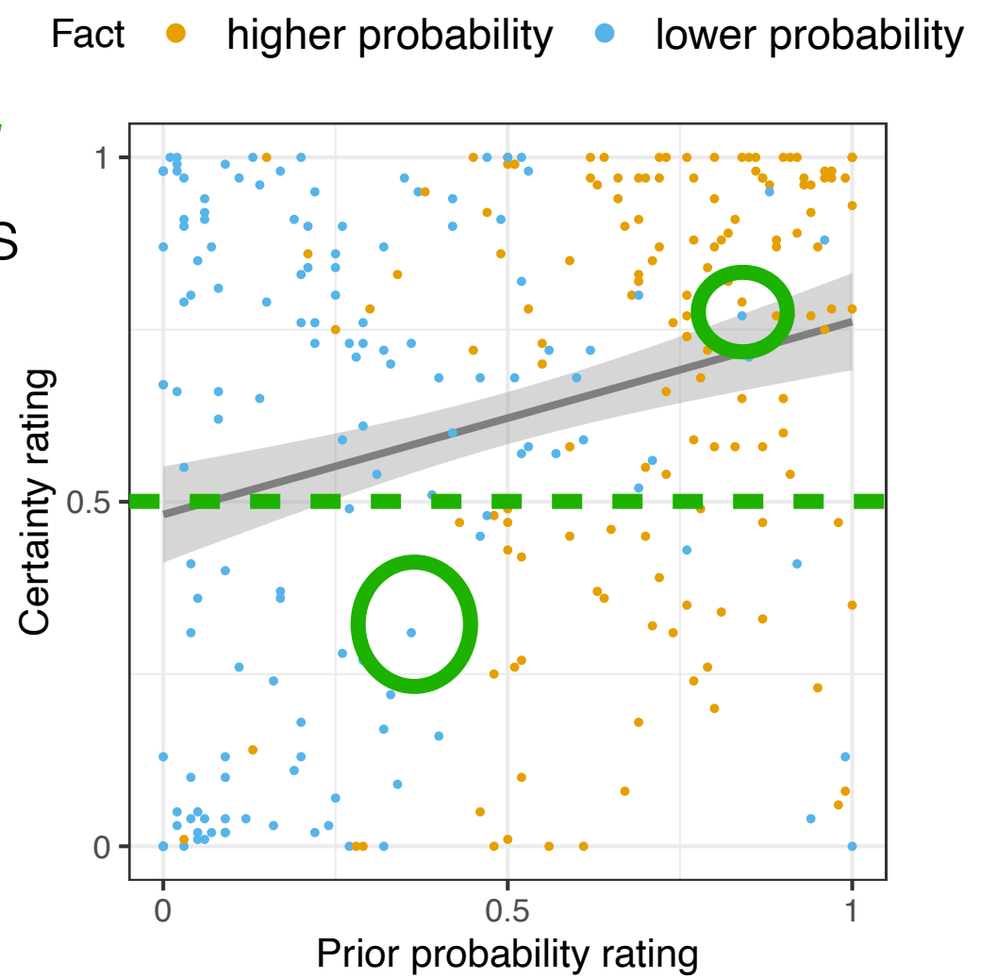
The CC is presupposed (i.e., a commitment of the speaker) if

1. the CC is contextually entailed

2. the probability that a generic agent believes the CC given that they believe the content of the utterance in that context is at least as high as threshold *a*.

discover

286 participants' ratings



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- Entailment-based (e.g., Abrusán 2011, 2016; Simons, Beaver, Roberts & Tonhauser 2017)
- Alternatives-based (e.g., Chemla 2009; Abusch 2002, 2010; Romoli 2015)
- Context-dependent triggering (Schlenker ms/2019)
  - Yes, insofar as listeners' prior beliefs influence their posterior beliefs.
  - But how strong does the inference about speaker commitment need to be to count as a presupposition?

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To draw inferences about speaker commitment, listeners integrate probabilistic information from multiple sources.

Big question: What are the relevant information sources in the empirical domain and how are they integrated?

top-down information

common ground

info about speaker

QUD

listener

1. Principled incorporation of information sources
2. Integration of information sources

Exp 2

inferences about speaker commitment

Exp 1

predicate

(Djärv & Bacovcin 2017, Mahler et al 2019)

bottom-up information

information structure

3. Research on languages other than English

prosody

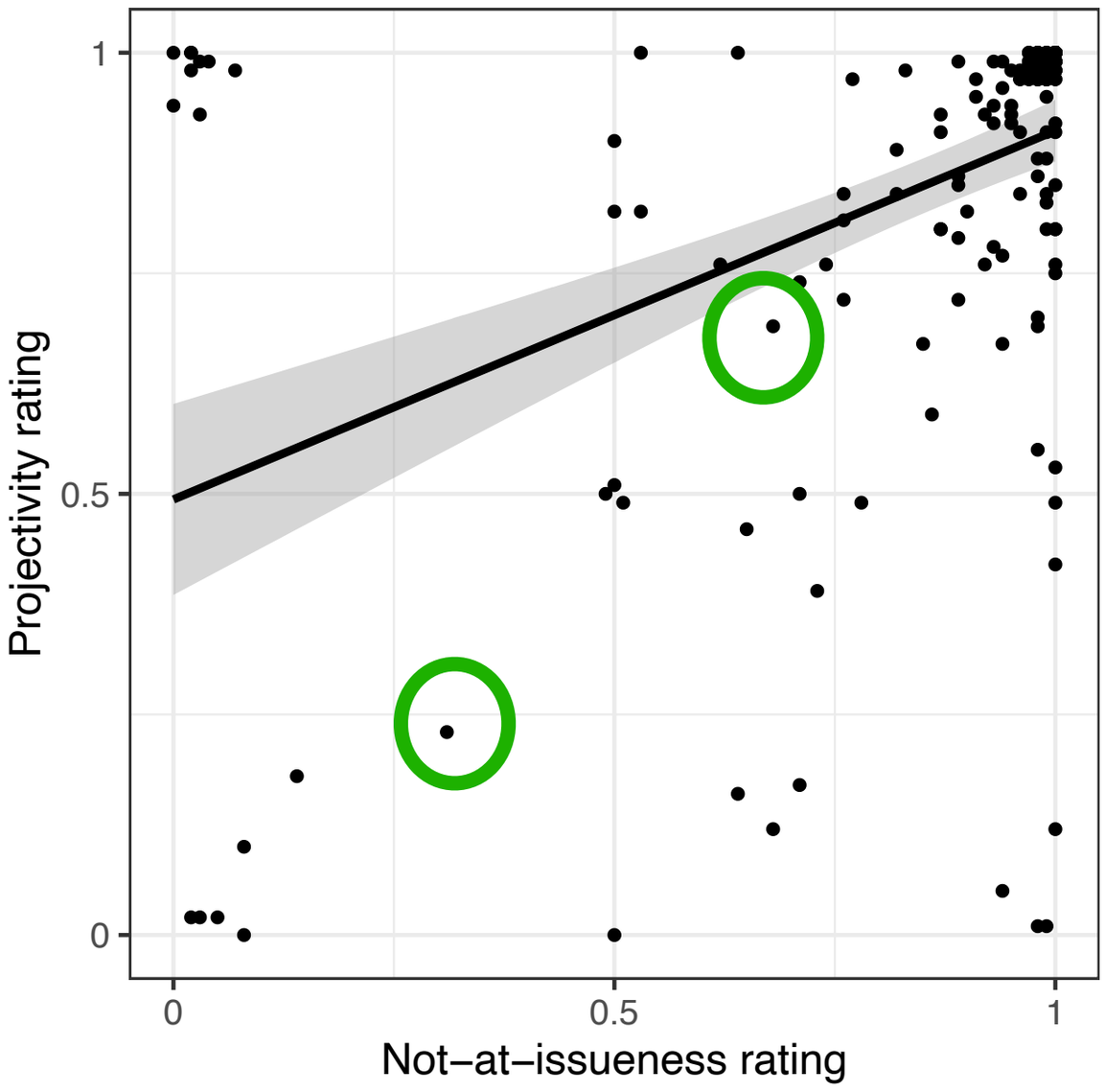
SUPPLEMENTARY SLIDES

Many information sources influence projection

4. Question Under Discussion / At-issueness (e.g., Simons et al 2010, 2017; Cummins & Rohde 2015)

discover

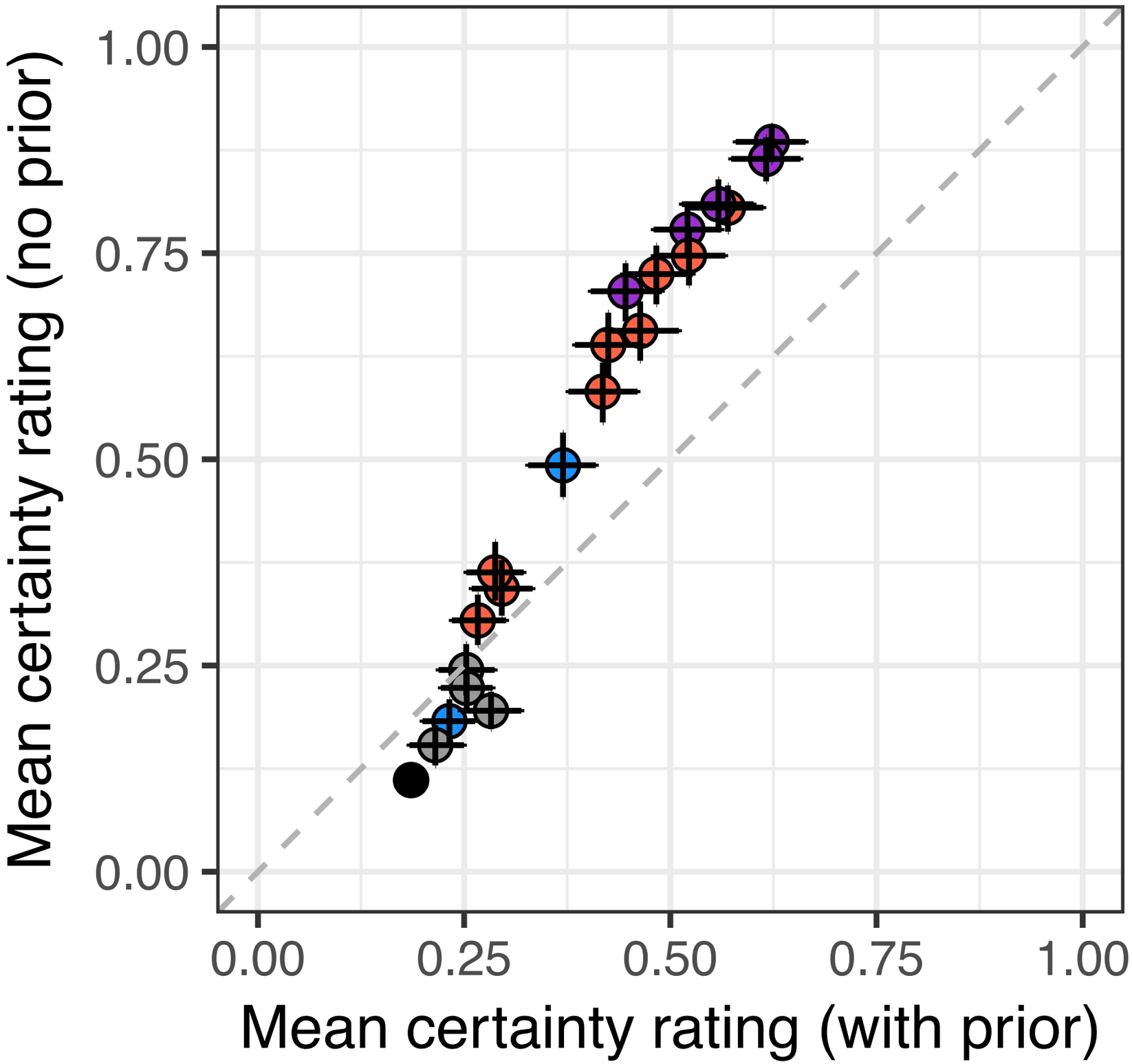
210 participants' projection and at-issueness ratings



$r = .43$

Tonhauser, Beaver & Degen 2018 (*Journal of Semantics*)

Comparing projectivity ratings

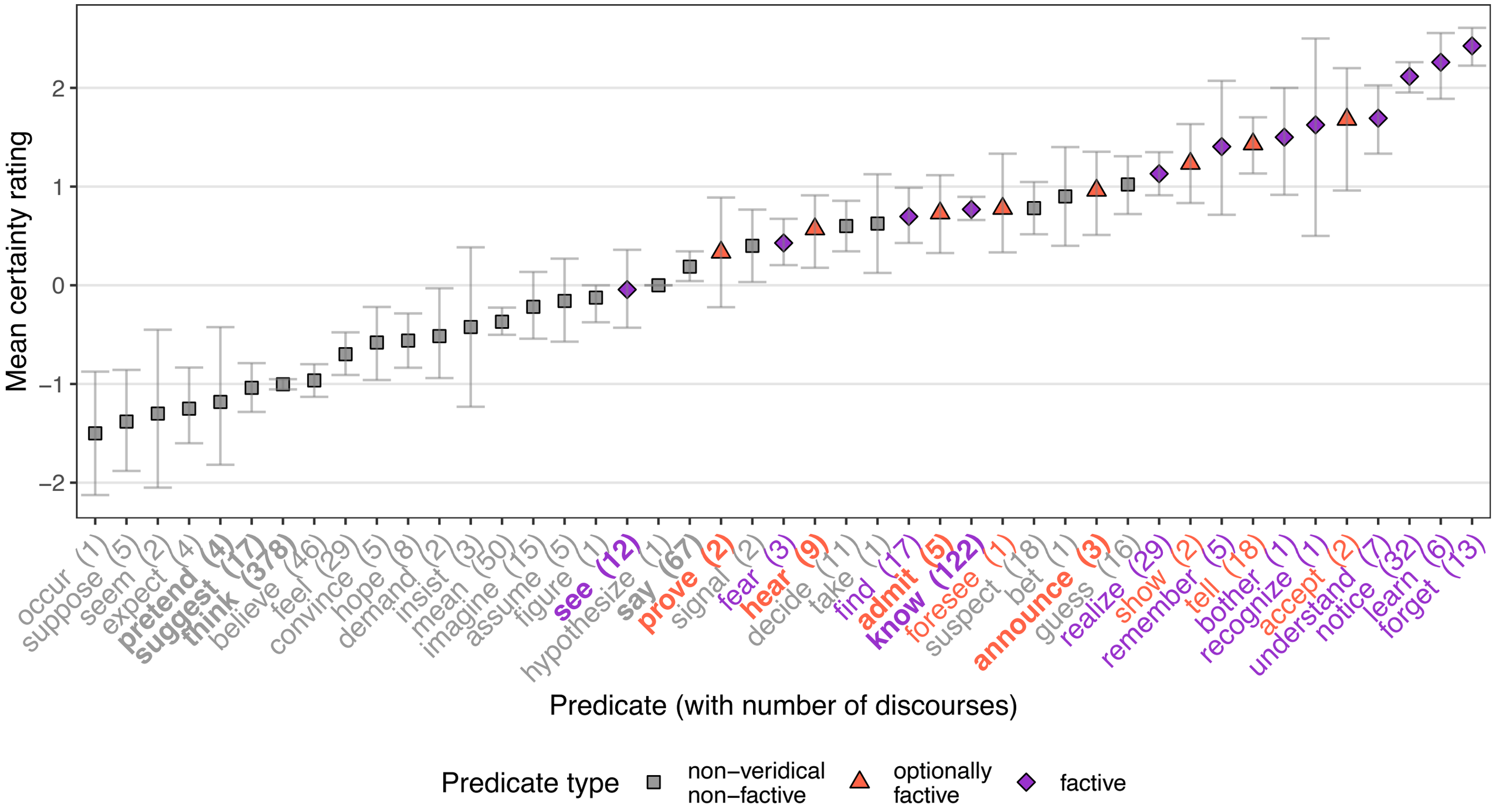


Spearman's rank correlation

n = 20

r_S = .983

Converging evidence: CommitmentBank



Converging evidence: VerbVeridicality