Projection variability of clausal complements across different operators

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Projection inferences

(1) Rachel: *"Does Cole know that Julian dances salsa?"*

Yes, Julie is committed! ("CC projects out of the question")

Do you, the interpreter, infer that Rachel is committed to the truth of the content of the complement (CC), that Julian dances salsa?

(2) Rachel: *"Does Cole think that Julian dances salsa?"*

No, Julie is not committed! ("CC does not project")

Frege 1892, Strawson 1950, Kiparsky & Kiparsky 1970, Karttunen 1971, Karttunen & Peters 1979, …, Coppock & Champollion 2022, and many more

Entailment-cancelling operators

Family-of-sentences-test:

e.g. Chierchia & McConnell-Ginet (1990), Coppock & Champollion (2022)…

Polar Question:

Does *Cole know that Julian dances salsa?*

Negation:

Cole ***doesn't*** *know that Julian dances salsa.*

Epistemic modal:

Perhaps *Cole knows that Julian dances salsa.*

Conditional antecedents:

If *Cole knows that Julian dances salsa, Logan will be joyful.*

Hints at by-operator variation

Factive vs. semi-factive predicates (Karttunen, 1971)

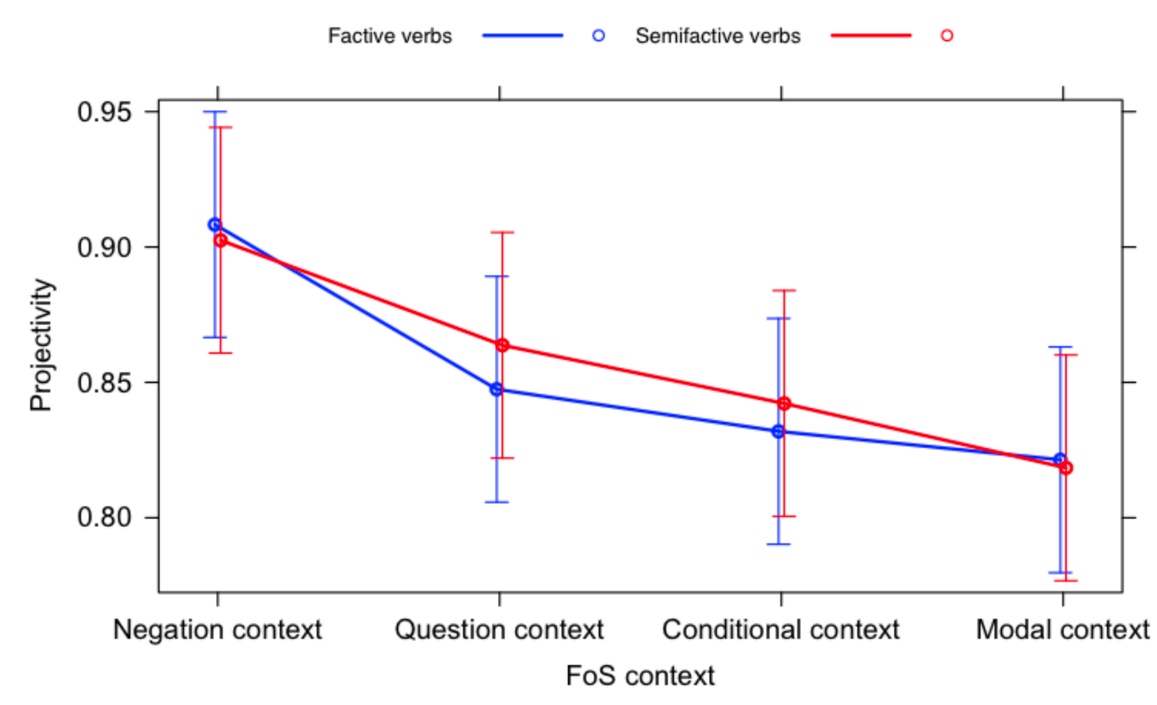
- Factives (*be annoyed, regret, …*):
  CC projects across all four operators
- Semi-factives (*discover, realize, see, notice, …*):
  CC projects across negation, but not always for the other operators

Experiment with English projective contents (Smith & Hall, 2014)

- Projective content of epithets (e.g. *"idiot"*) and the CC of *"know"*: more projective under negation than conditionals
- Opposite pattern for appositive relative clauses and *"win"*

Experiment with German clause-embedding predicates
(Sieker & Solstad, 2022)

- Higher projection ratings with negation than other three operators
- No by-predicate variation, no evidence for factive/semi-factive distinction



Sieker & Solstad (2022), p. 286
Projection-ratings by embedding operator, for purported factive and semi-factive predicates

Does the projection of content differ across entailment-canceling environments?

- We tested this for CC of English clause-embedding predicates
- Using the ***"certain that"*-task** from Tonhauser (2016), Tonhauser et al. (2018)

Rachel: *"Cole doesn't know that Julian dances salsa."*

- Task: Assess whether "Rachel" is certain about the truth of the complement
- Get at speaker's commitment that the CC is true

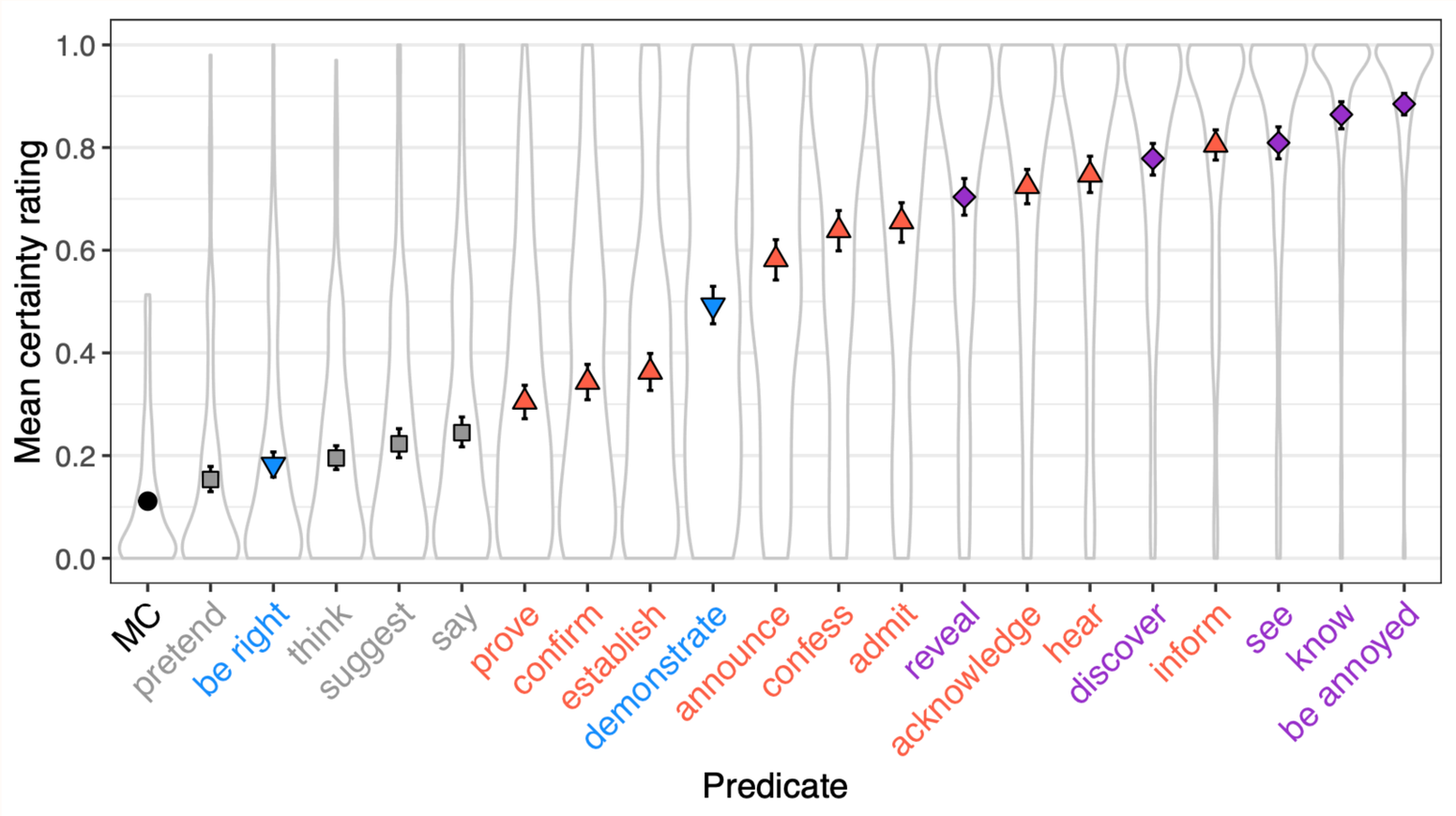
…also used in e.g. Djärv & Bacovcin (2017), de Marneffe et al. (2019), Mahler (2020) Degen & Tonhauser (2022), Sieker & Solstad (2022)

Materials

- 20 clause-embedding predicates that have shown projection variability in question contexts (Degen & Tonhauser, 2022)
  - Crossed w/ 20 CCs: 20 x 20 = 400 combinations

One experiment per operator:

1. Polar questions
2. Negation
3. Modal *"perhaps"*
4. Conditional antecedents



Degen & Tonhauser (2022), p. 562
Mean certainty ratings by predicate

Materials

Assess the effect of **operator** and **predicate** on **projection**

- 4 experiments (operator: question, negation, modal, conditional):
  ~750 participants each
- Participants saw:
  - 20 clause-embedding predicates
  - (6 controls for exclusion)

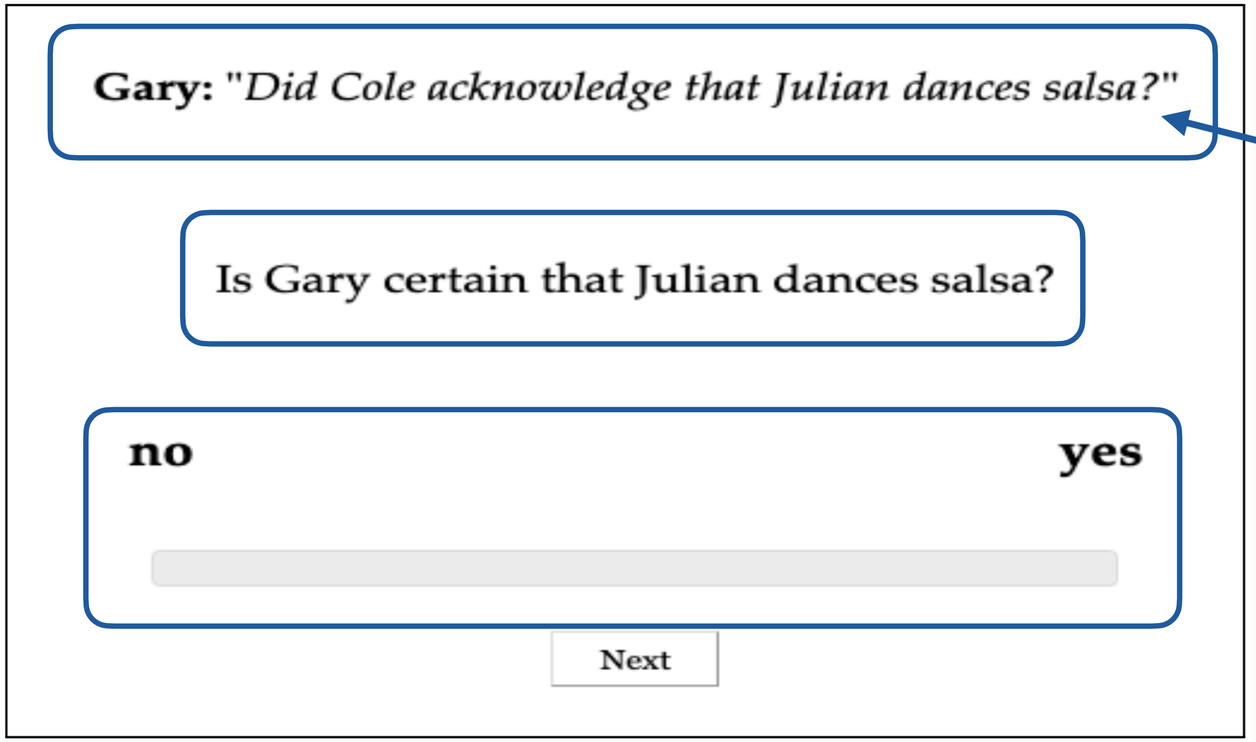
(Experiments also used different at-issueness measures in separate block, not analyzed here)

Procedure: Experiment 1

utterance

projection question

response



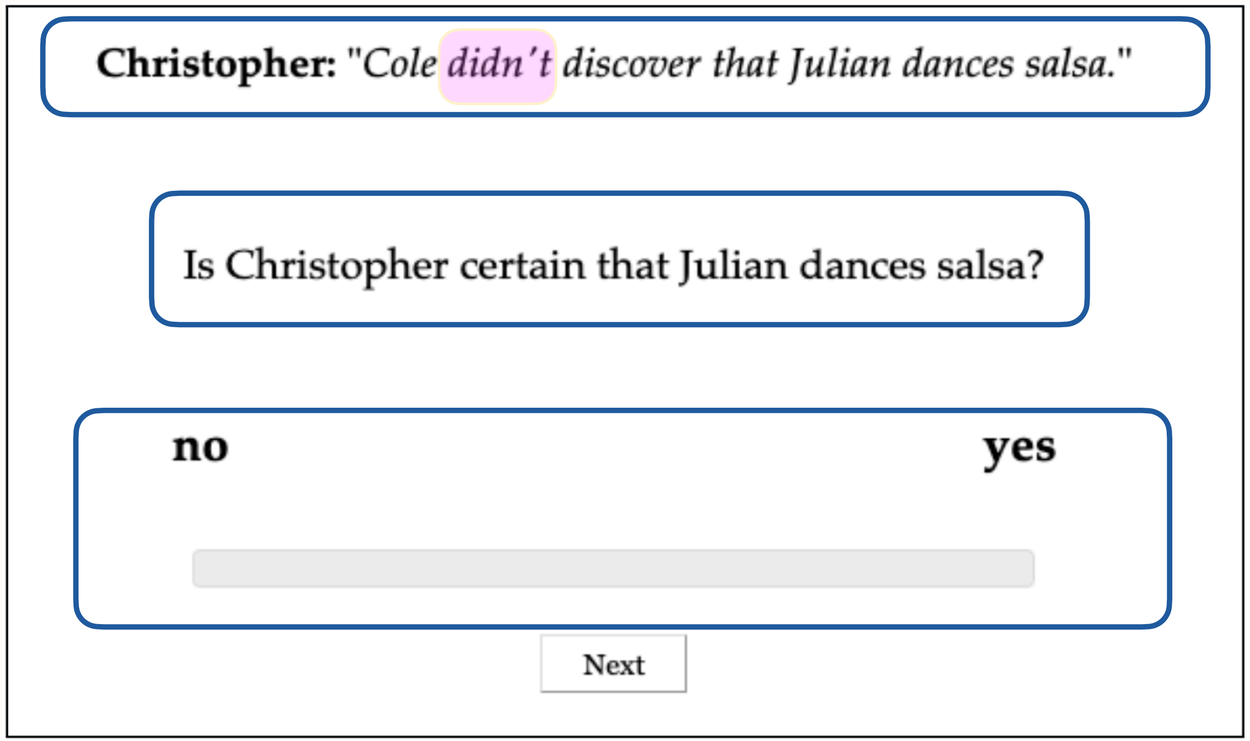
complement

Experiment 2 – Negation

utterance

projection question

response

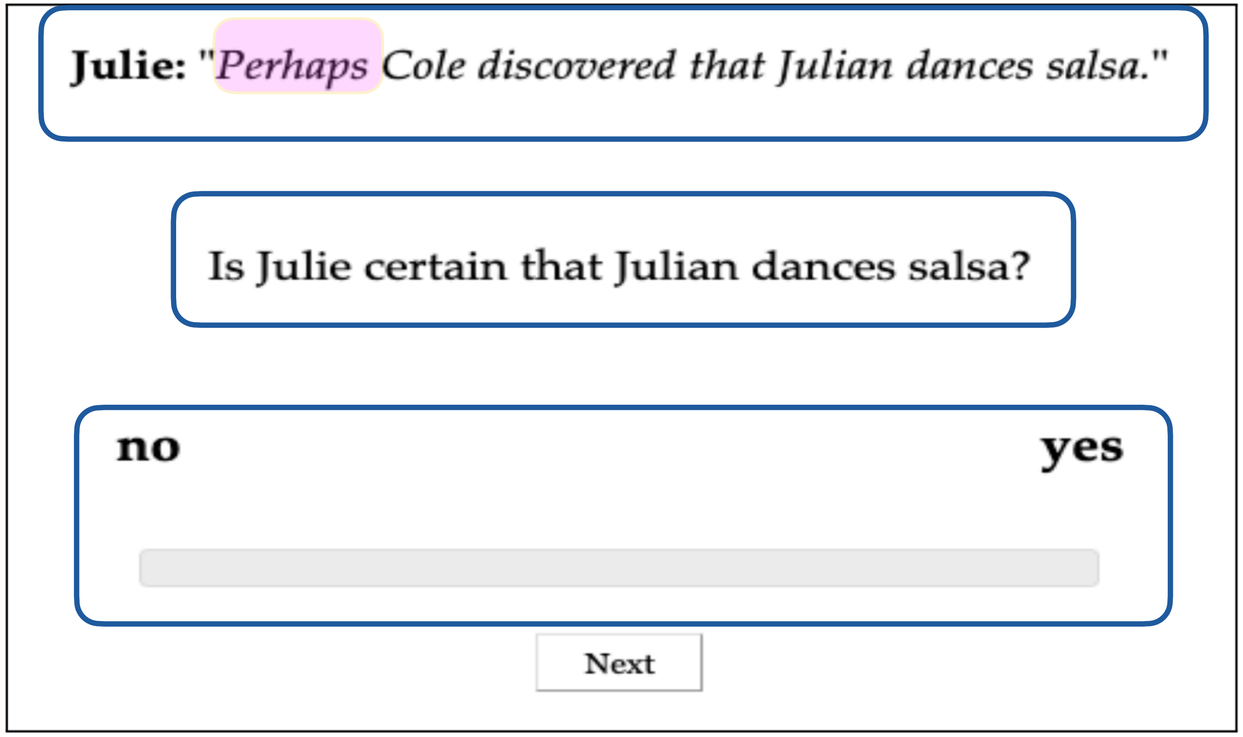


Experiment 3 – *perhaps*

utterance

projection question

response

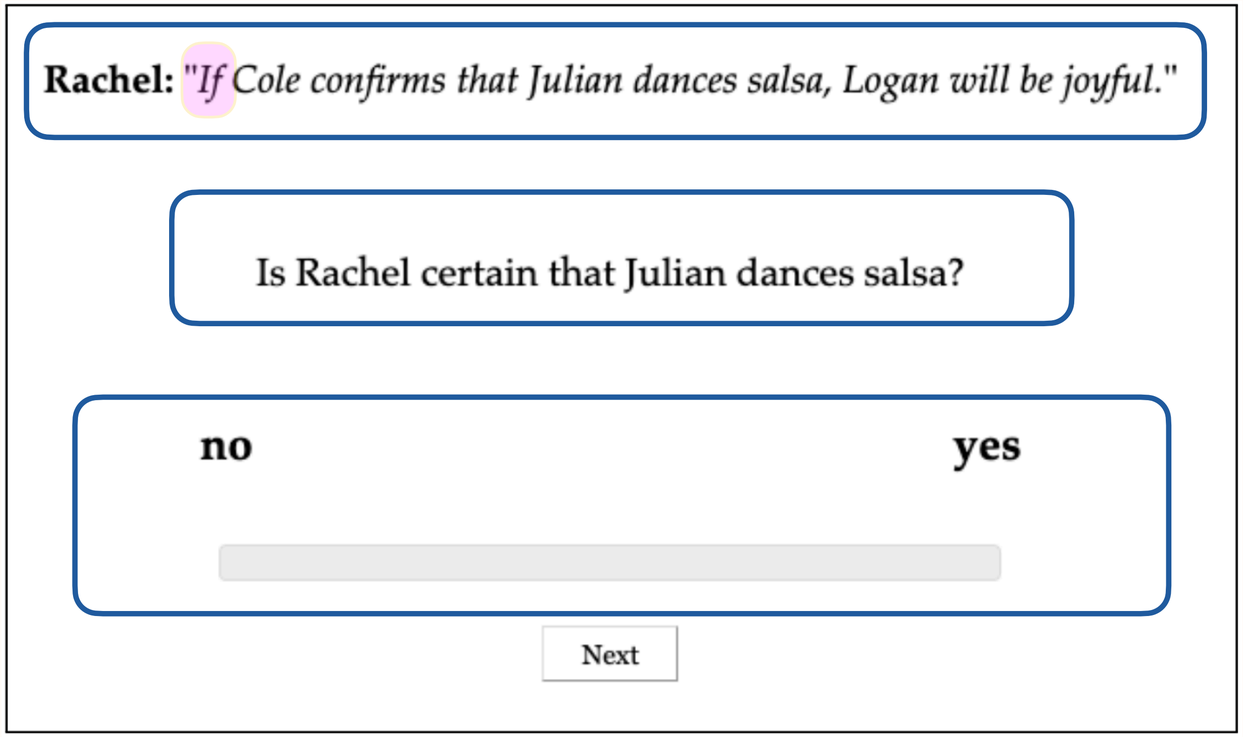


Experiment 4 – Conditionals

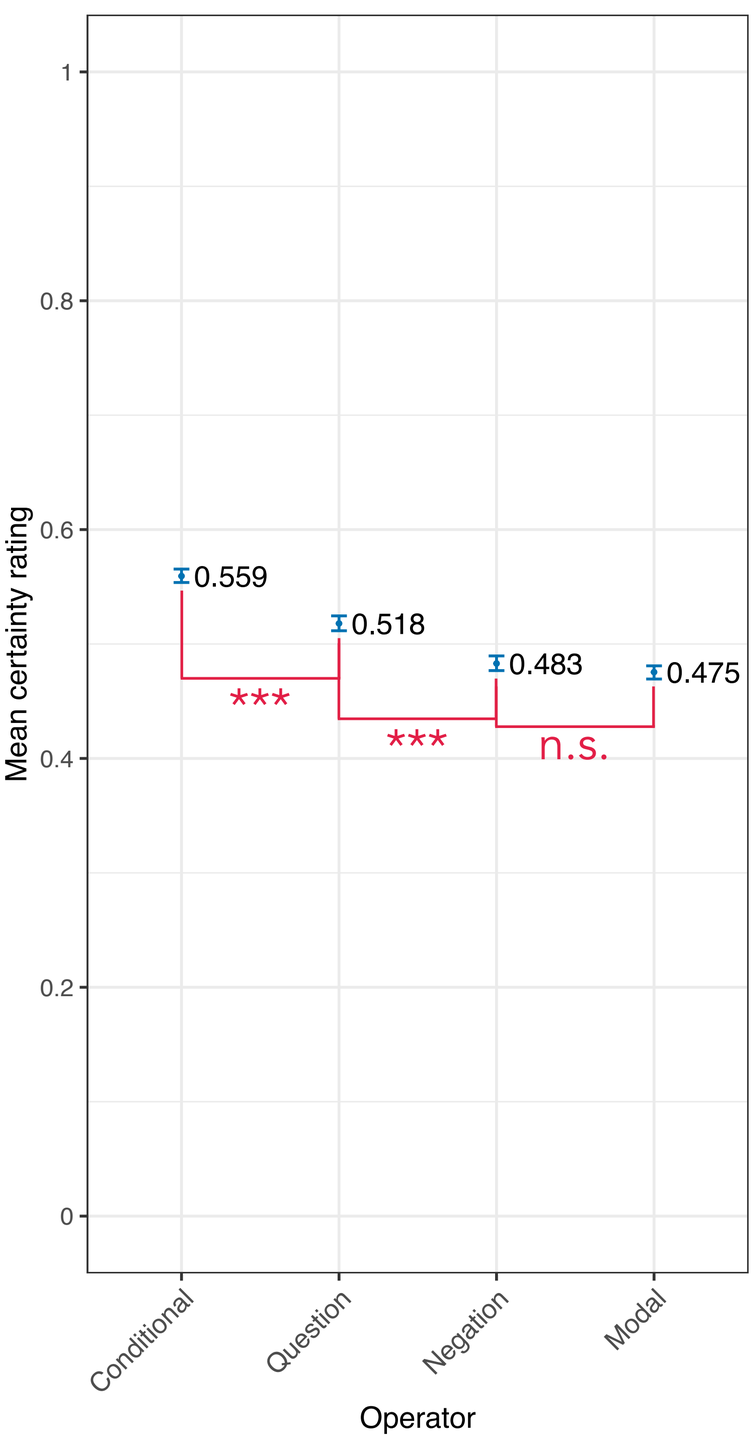
utterance

projection question

response

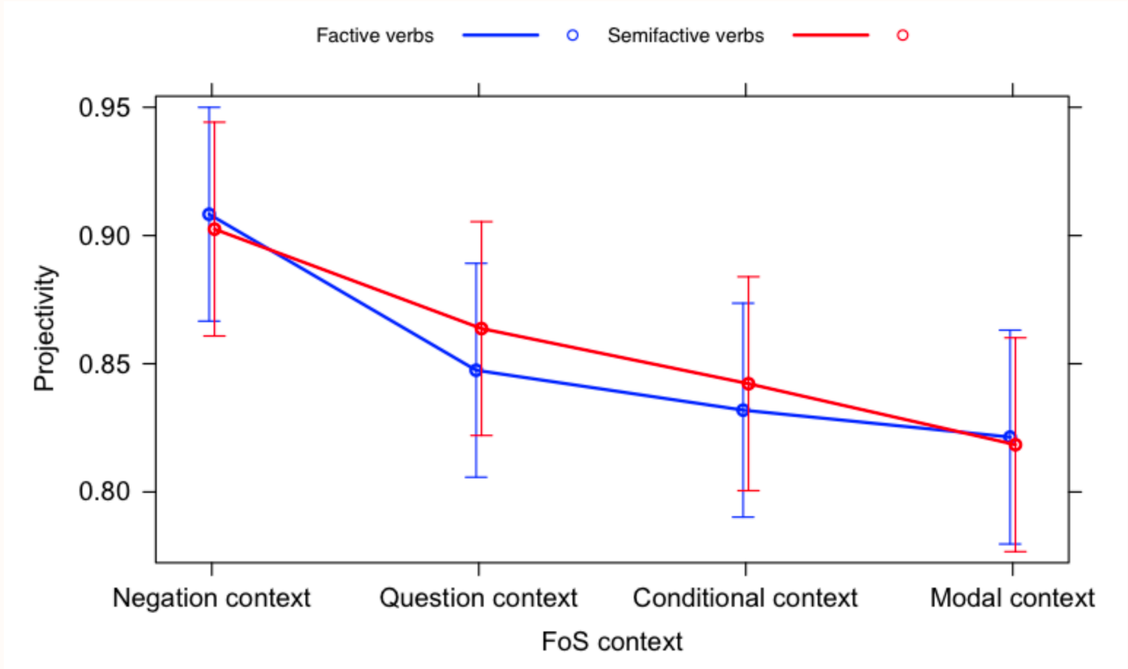


Main effect of embedding operator



By-operator variation aggregating across predicates

- Conditional > Question > Negation, Modal
- But small differences, as in Sieker & Solstad's (2022) study
- Sieker & Solstad's results for German: Negation > Question, Conditional, Modal

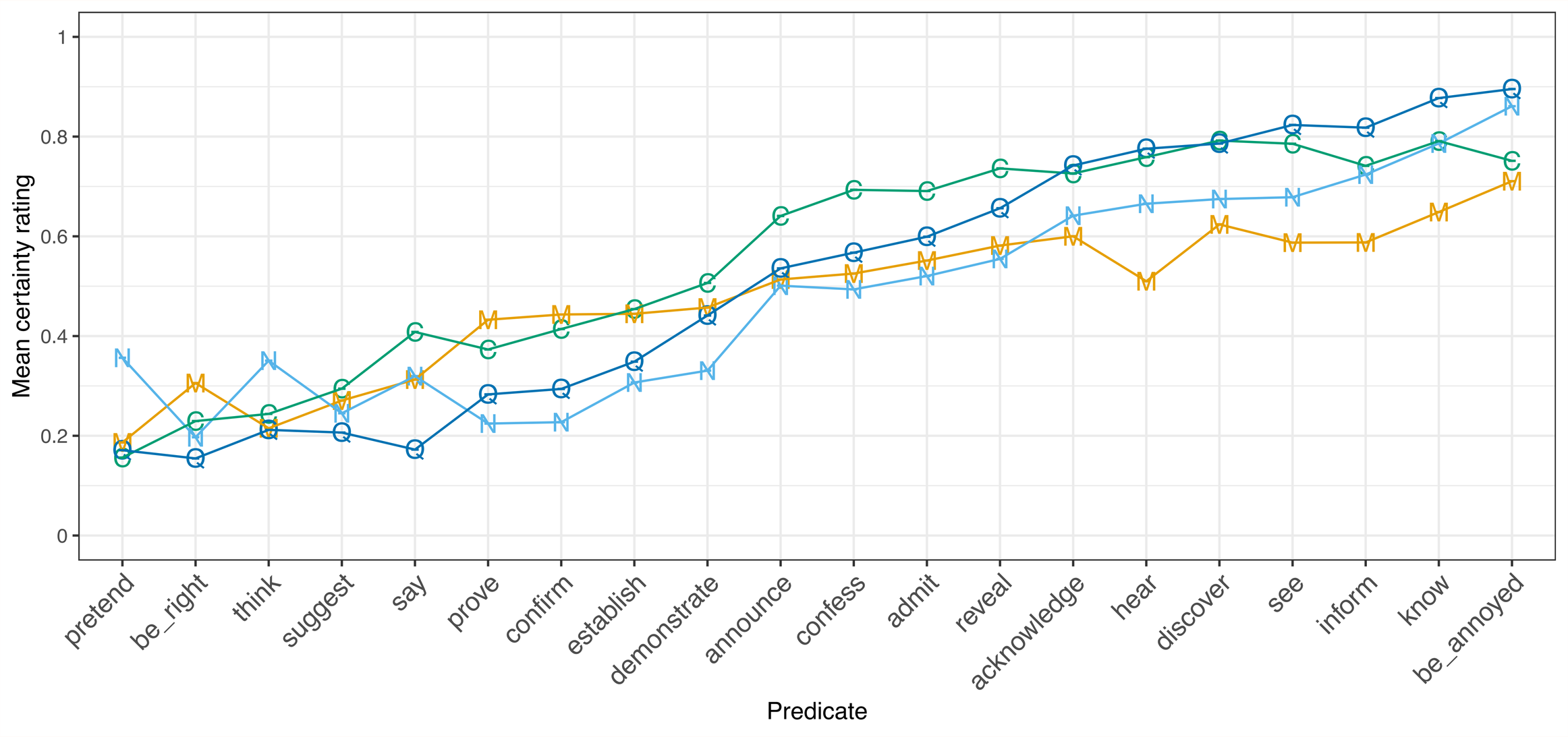


Model #1: Linear mixed effect regression

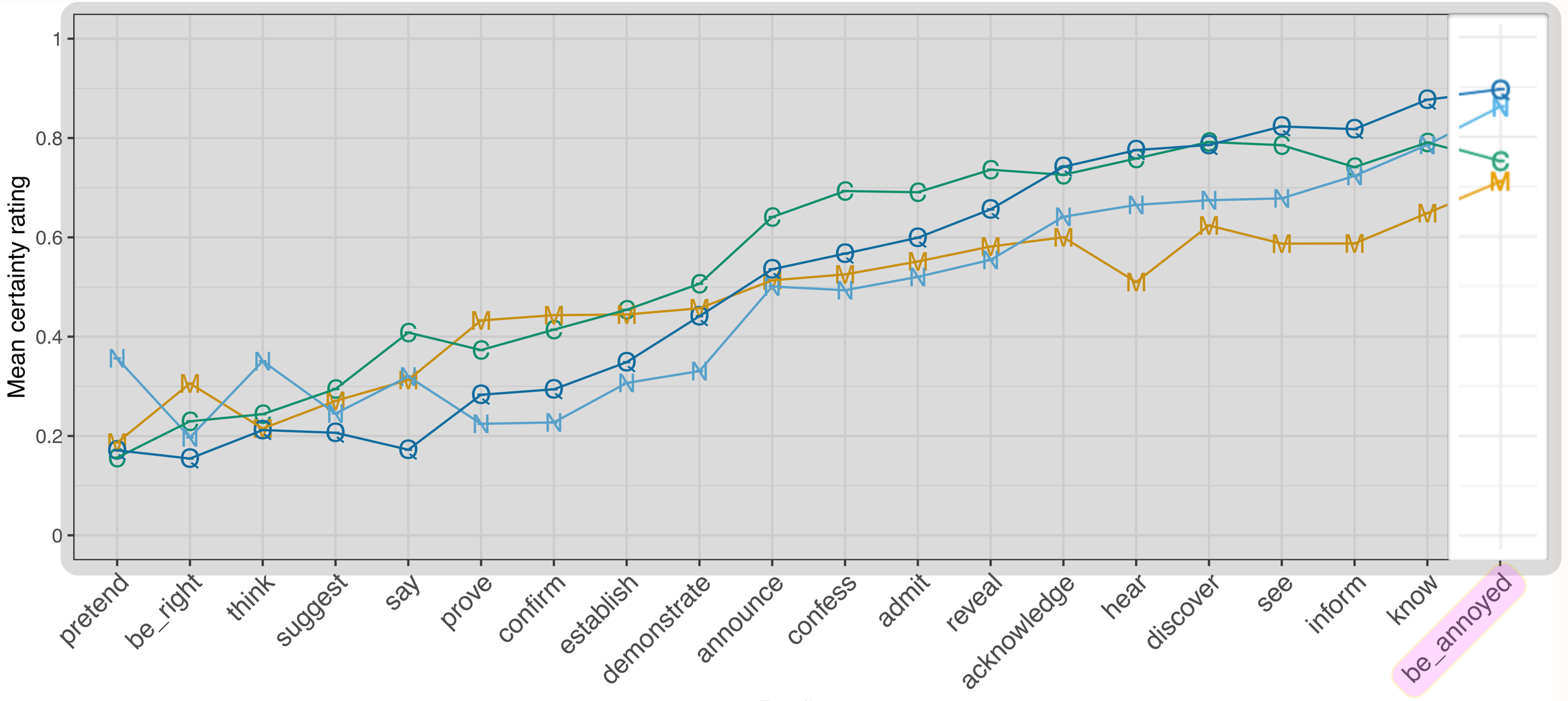
response: **certainty ratings**, fixed effect: **operator** (base level: Question)**,** random intercepts: participants, items

MLEs: question (intercept) 0.51, conditional +0.05, modal -0.04, negation -0.03; with $p < 0.001$

By-predicate variation in the effect of operator



By-predicate variation in the effect of operator

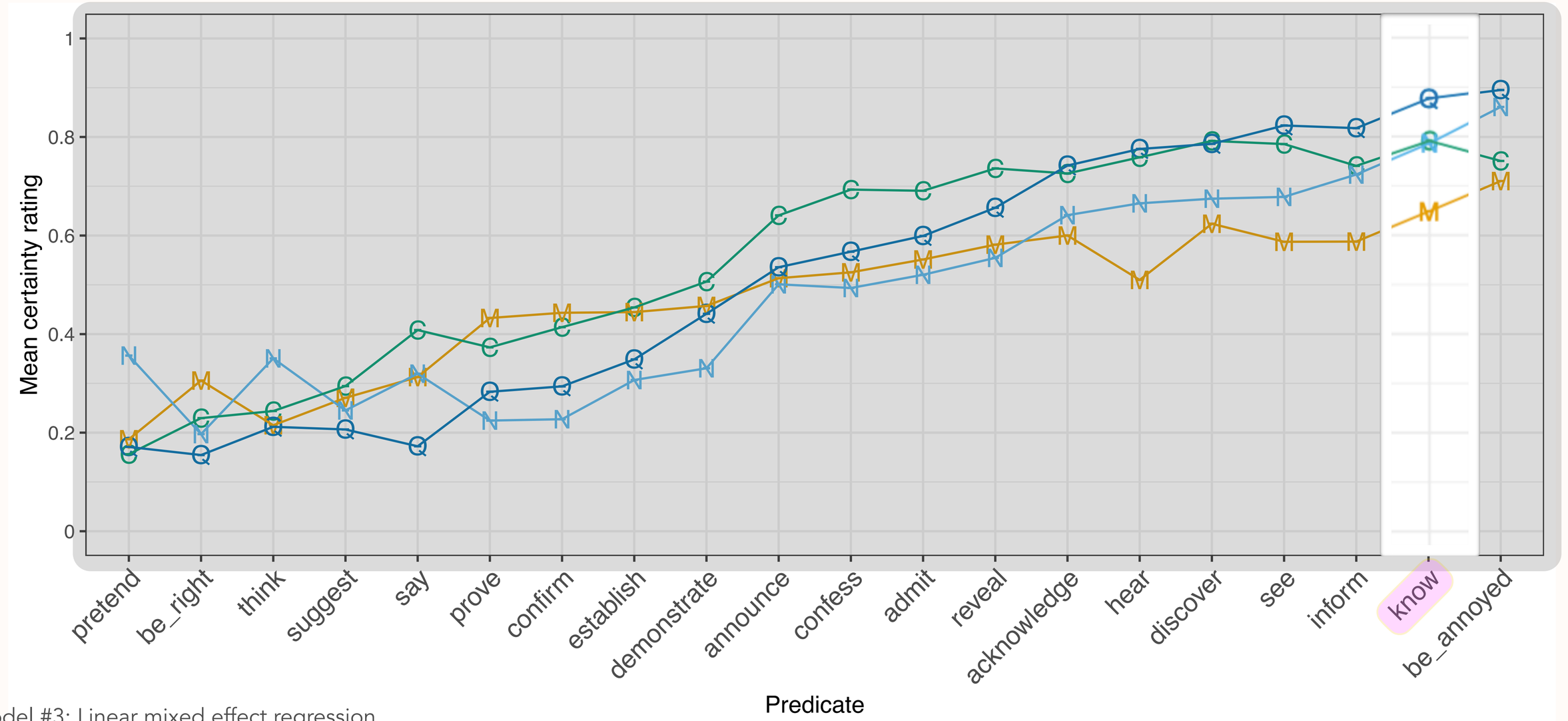


Model #2: Linear mixed effect regression

response: **certainty ratings**, fixed effects: **operator, predicate, and interaction** (base level: **be annoyed** / negation)**,** random intercepts: participant

MLEs: negation (intercept) 0.87, conditional -0.12, modal -0.16; with $p < 0.001$; question +0.02 (n.s.)

By-predicate variation in the effect of operator

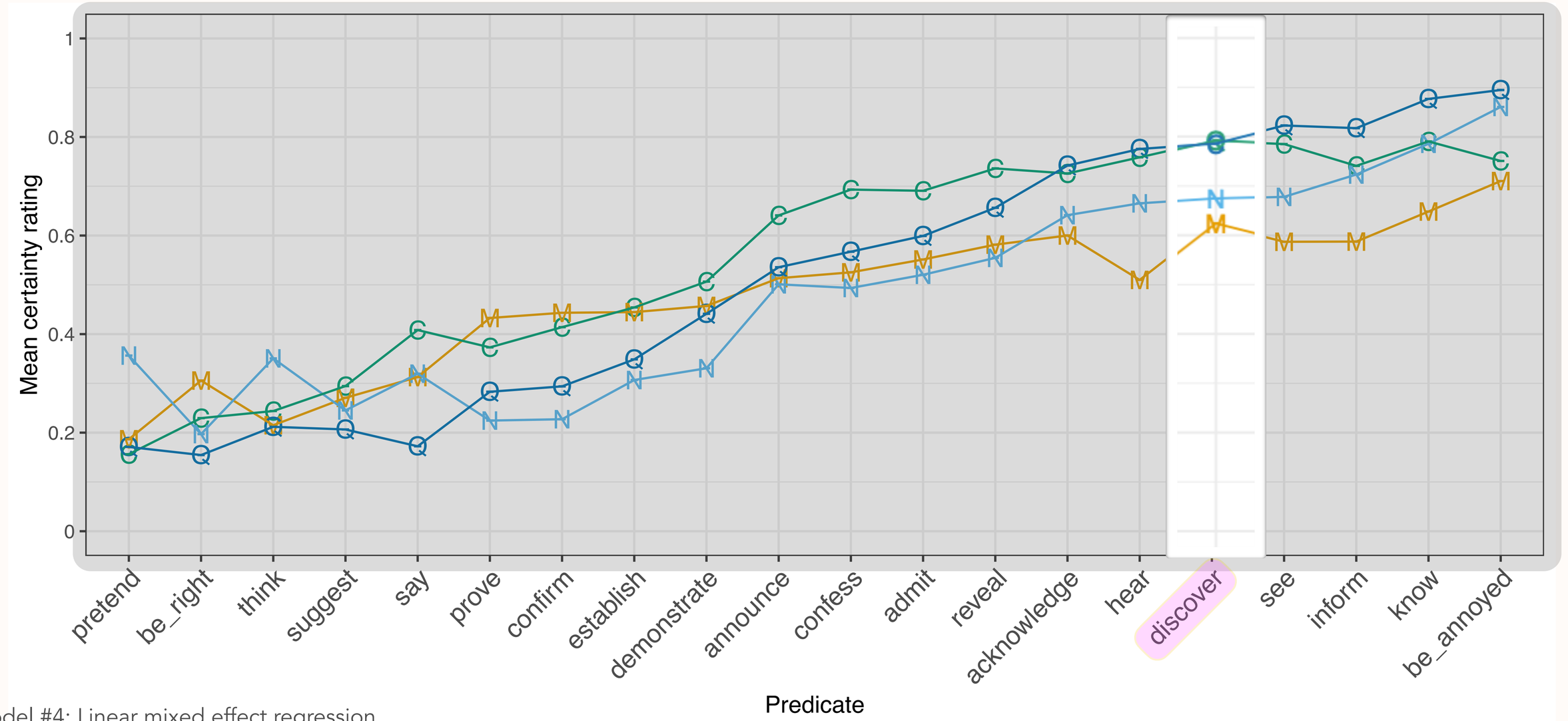


Model #3: Linear mixed effect regression

response: **certainty ratings**, fixed effects: **operator, predicate, and interaction** (base level: **know** / negation)**,** random intercepts: participant

MLEs: negation (intercept) 0.79, modal -0.14, question +0.08; with $p < 0.001$; , conditional +/- 0, (n.s.)

By-predicate variation in the effect of operator



Model #4: Linear mixed effect regression

response: **certainty ratings**, fixed effects: **operator, predicate, and interaction** (base level: **discover** / negation)**,** random intercepts: participant

MLEs: negation (intercept) 0,68, conditional +0.11, modal -0.06, question +0.10; with $p < 0.001$

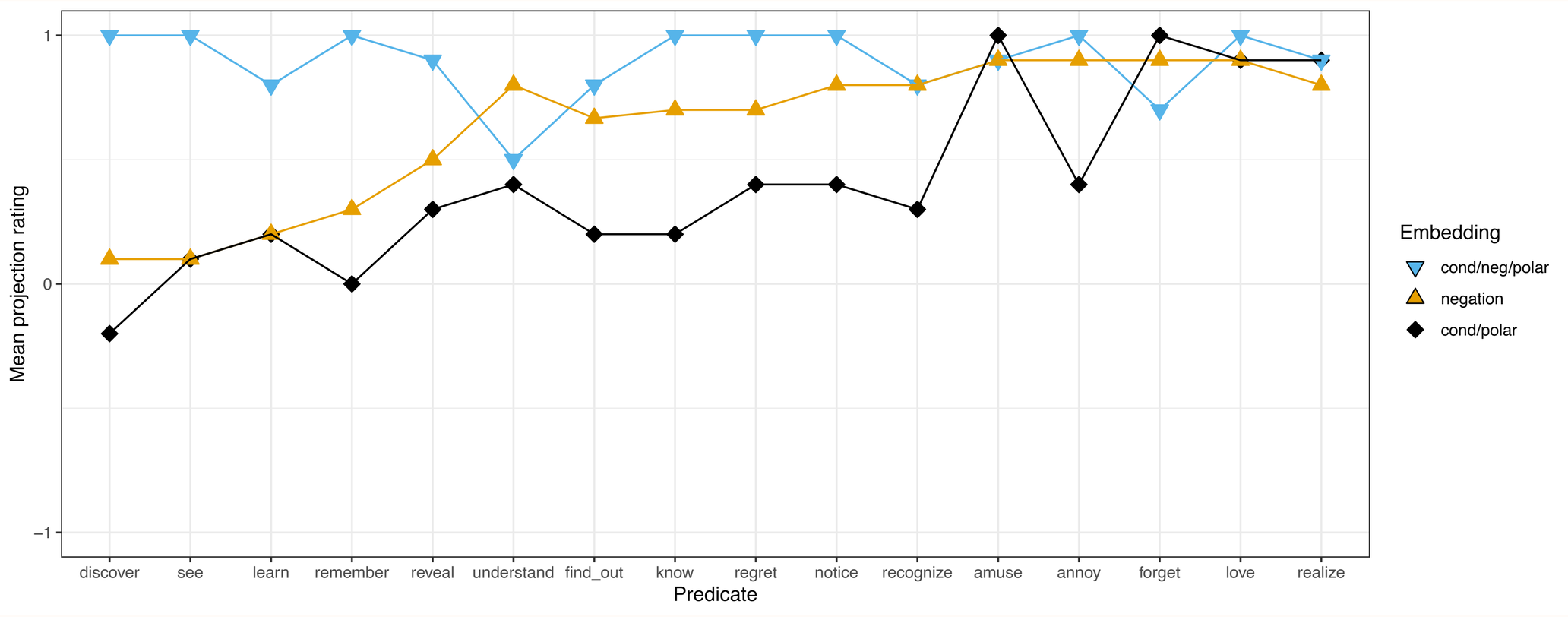
Converging evidence: By-operator by-predicate variation

MegaVeridicality dataset (White & Rawlins, 2018): 517 predicates in three sentence types

(1) *Somebody **didn't know** that a particular thing happened.* (Did that thing happen?)

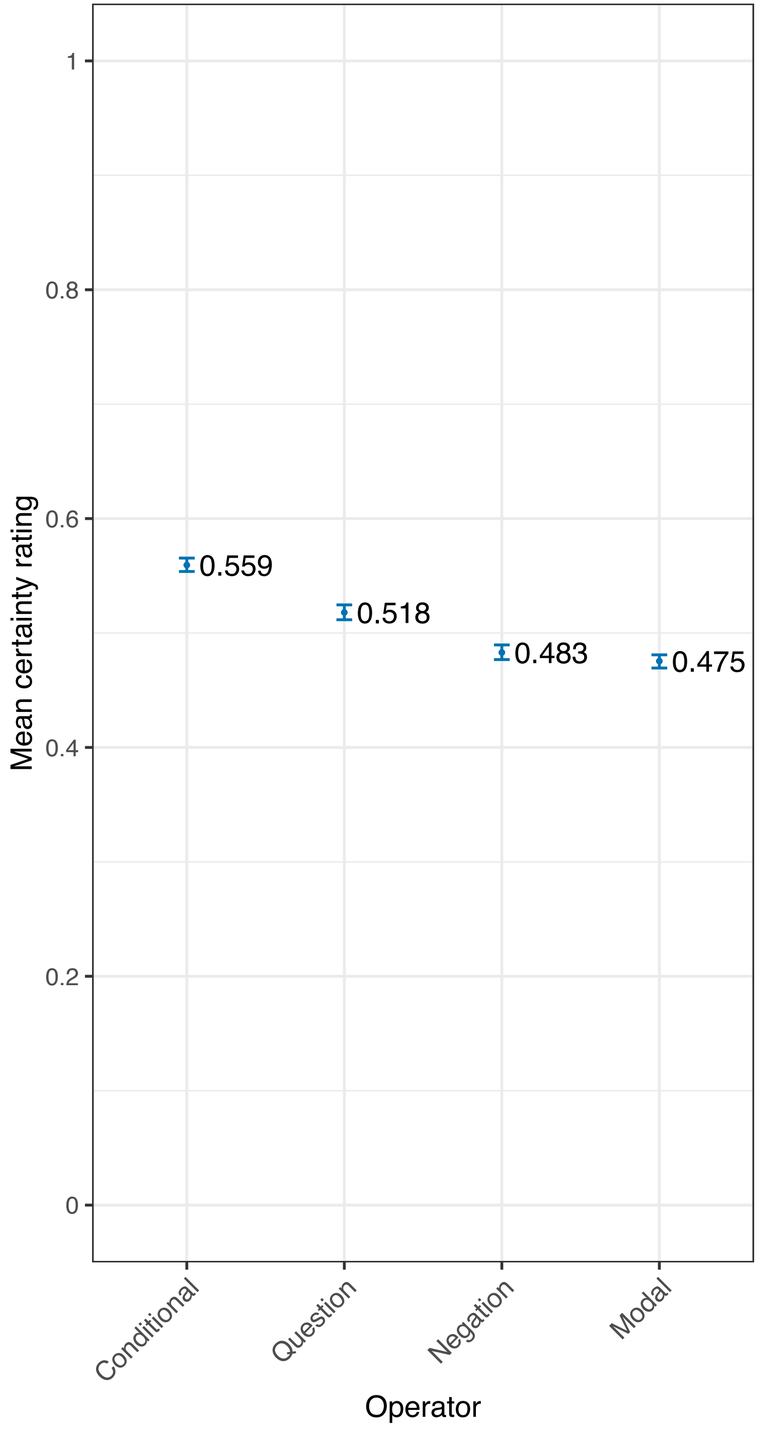
(2) ***If** somebody **knows** that a particular thing happened, did that thing happen?*

(3) ***If** somebody **didn't know** that a particular thing happened, did that thing happen?*

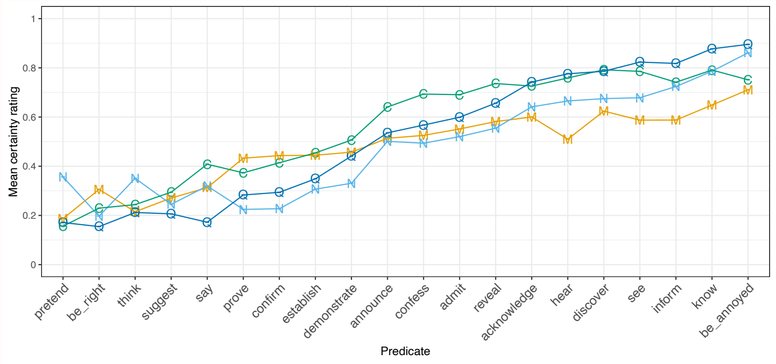


Summary

- Main effect of operator:
  Conditional > Question > Negation, Modal
- Small differences - family-of-sentences diagnostic can be applied
- But for some contents there are differences, so have to consider that results can be different for other operators



By-predicate variation in the effect of operator



- Concurs with Smith and Hall (2014), who found content/operator interactions for English projective contents
- Differs from Sieker and Solstad (2022), who found no predicate/operator interaction for CCs of German clause-embedding predicates

No evidence for factive vs. semi-factive distinction (Karttunen, 1971)

- CC of purported factive *"be annoyed"* does not invariably project across operators
- CC of purported semi-factives (*"discover, see"*) do not project more across negation than other operators

Provide support (from negation, modals, conditionals) for Degen & Tonhauser's (2022) result:

- Projection does not categorically differentiate between (semi-)factive/ non-factive predicates

Do theories predict our results?

Main results to capture

1. (Degen & Tonhauser 2022 challenge a well-defined class of factive predicates)
2. Effect of entailment-cancelling operators differs by predicate

- **Dynamic accounts of projection (Heim, 1983; v. d. Sandt, 1992):**
  - Lexical factivity + dynamic operators
- **Entailment & discourse structure (Abrusán, 2011; Simons et al. 2017):**
  - Lexical entailments + aboutness / at-issueness
- **Schlenker (2021):**
  - Contextual entailment + epistemic preconditions

— None of the existent accounts can predict our results —

Heim (1983) / van der Sandt (1992)

Distinguish factive and non-factive predicates:

- factive predicates (*be annoyed, regret, …*): CC conventionally required to be contextually entailed in common ground
- non-factive predicates (*believe, say, …*): no such requirement

Factive content projects globally, unless not admitted by common ground

These analyses do not predict our results:

Predictions	Our results
"Out-of-the-blue" contexts used in experiment: predict consistent projection of factive CCs	Projection variation among factive predicates
No predictions for non-factive predicates	CCs of some non-factive predicates projects just as much as that of some factive predicates
Meaning of each entailment-canceling operator (invariably) encodes how it interacts with the conventional content of embedded factive predicates	Effect of entailment-cancelling operators varies among predicates

Abrusán (2011) / Simons, Beaver, Roberts & Tonhauser (2017)

Distinguish veridical predicates (CC is entailed) from non-veridical ones:

- veridical predicates (*be right, demonstrate, …*): entailed CC projects if not at-issue
- non-veridical predicates (*believe, say, …*): no predictions / CC projects if required by discourse coherence

These analyses do not predict our results:

Predictions	Our results
Veridical predicates: analyses may be extended by assuming that the CCs of veridical predicates differ in at-issueness in out-of-the-blue contexts	Projection variation among veridical predicates
But analyses do not incorporate the gradient contribution of at-issueness	
No systematic predictions for non-veridical predicates	CCs of some non-veridical predicates projects just as much as that of some veridical predicates
No systematic predictions for how veridicality or at-issueness interact with the meaning of entailment-canceling operators	Effect of entailment-cancelling operators varies among predicates

Schlenker (2021)

Potential of projection for contents that are *contextually* entailed (given a context and the utterance):

- Lexically veridical predicates
- "Distributed veridicality" context (Roberts 2019)
- Other sources of contextual inference

Cole {was not wrong, can't believe} that Julian dances salsa.

(Cole is Julian's best friend.) Cole said that Julian dances salsa.

These analyses do not predict our results:

Predictions	Our results
Makes predictions about CCs of all clause-embedding predicates	Projection for all clause-embedding predicates
May be extended to address our data by making explicit how combinations of operator + predicate can be associated with contextual inferences	Operator / predicate interaction effects
No differential predictions for the interaction between the content of clause-embedding predicates, context, and entailment-canceling operators	
"Out-of-the-blue" contexts do not warrant assumption of contextual entailment: No projection is predicted	Some amount of projection for all predicates

Implications

Theoretical implications

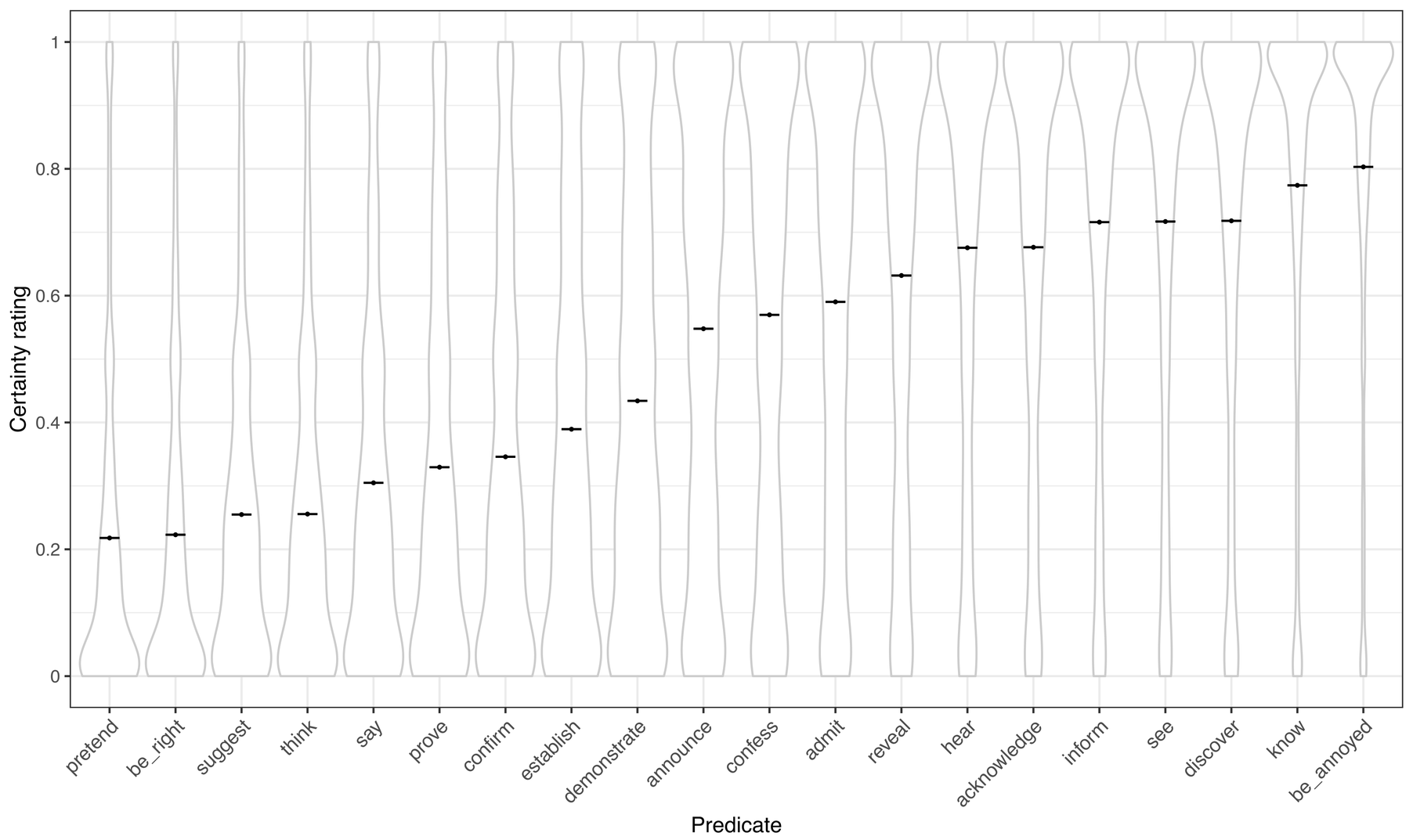
- From previous work, we know that projection analyses must be able to take into consideration the effect of **lexical meaning** (e.g. Kiparsky & Kiparsky 1970, Karttunen 1971, et seq.), **world knowledge** (de Marneffe et al., 2012; Degen & Tonhauser, 2021), and **discourse structure** (e.g. Simons et al., 2017, Tonhauser, Beaver & Degen, 2018)
- Add to that the effect of various **entailment-cancelling operators**
- An analysis of projection should be able to address operator / content interaction effects on projection. None of the extant projection analyses capture our data.

Methodological implications:

- We can keep introducing the family-of-sentences test for projection to our students without immediately pointing to by-operator variation.
- But for individual projective contents, there is by-operator variation, which should be taken into consideration in experimental investigations and our teaching

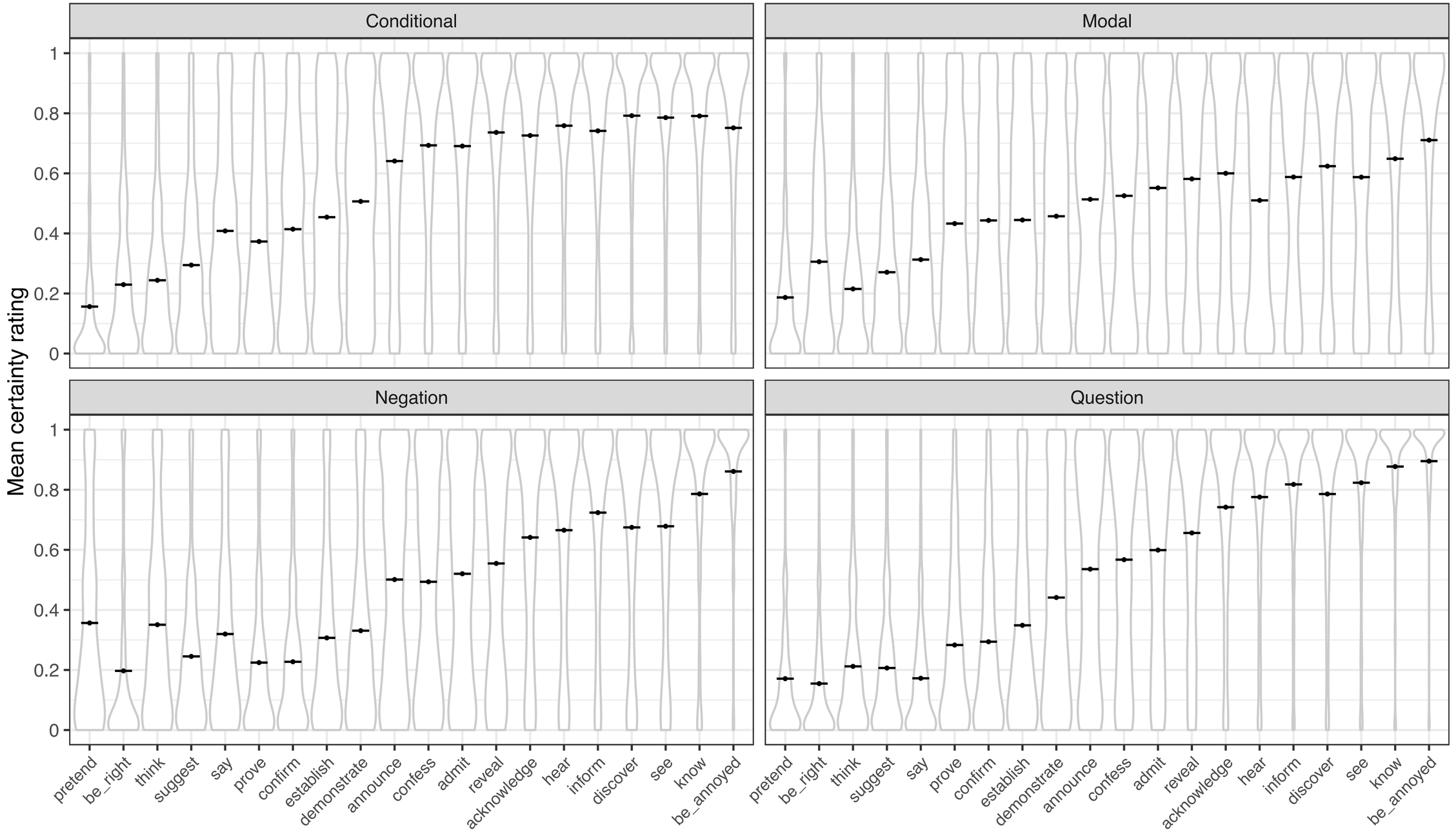
Extra slides

Projectivity by predicate



Certainty ratings by predicate with means, 95% bootstrapped confidence intervals, and distributions of observations

Distributions of ratings by predicate and operator



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